DPF 2011

Monday 8 August 2011 - Saturday 13 August 2011

Rhode Island Convention Center

Book of Abstracts

Contents

Poster Session / 1

Possible Existence of Overlapping Universe and Antiuniverse

Author: Mohamed Assad Abdel-Raouf[1]

[1] *United Arab Emirates Un iversity, College of Science*

Corresponding Author: assad@uaeu.ac.ae

The creation of antihydrogens at CERN (1995) and Fermilab (1997) and the very recent synthesizing of antiheliums at CERN (2011) have invigorated the fascinating idea about the existence of separate universe and antiuniverse as a resultant of the big bang. Particularly, the production of exotic atoms composed of particles and antiparticles (e.g. positroniums, Ps, protoniums, Pn, true muoniums, Mu, and pioniums, A2π) as well as the experimental formation of positronium molecules, Ps2, and theoretical predictions of exotic four-body systems composed of matter and antimatter (e.g. Heterohydrogens, PsPn, Ps Mu, PsA2π) open the gate in front of new research activities aiming to investigate the possible existence of overlapping universe and antiuniverse. The main goal of the present work is to discuss this possibility and show that it provides us with satisfactory explanations of the dilemma connected with the rare existence of antimatter in our universe and the mysterious astrophysical observation of highly energetic gamma-rays occurring at the edge of our universe.

Summary:

This work is addressing two problems, namely the rare existence of anti matter in our universe and the existence of high energetic gamma- rays at its edge.

Perturbative and non-Perturbative QCD / 2

A New Formulation of Analytic, Non-Perturbative, Gauge-and Lorentz-Invariant QCD

Author: Herbert Fried[1]

Co-authors: Ming Sheu [2]; Thierry Grandou [3]; Yves Gabellini [3]

[1] *Brown University*

[2] *BEA Systems*

[3] *Universite de Nice*

Corresponding Author: fried@het.brown.edu

A simple and previously overlooked choice of one parameter allows the Schwinger/Symanzik Generating Functional of QCD to be re-written in a manifestly gauge-invariant fashion, without the need of Fadeev-Popov insertions. When combined with Fradkin functional representations for the Green's function, G[A], of a quark in an effective color potential A, and the vacuum loop functional L[A], all QCD correlation functions can be represented as Gaussian, functional-linkage operations connecting relevant combinations of G[A] and L[A]. And because the Fradkin representations for those functionals are Gaussian in their dependence on A, the functional-linkage operation can be done exactly, and one then sees that gauge invariance here is achieved by gauge-independence, as the gauge-dependent gluon propagators exactly cancel out everywhere. In this way, the non-perturbative sums over Feynman graphs reduce to an explicit, gauge-independent functional expression.

That new, final functional expression now displays a new property we call ``Effective Locality'' (EL), in

It should be noted that such progress is possible because the Fradkin representations are Potential Theor

This work, by myself (HMF), French colleagues Grandou and Gabellini (of the Universite de Nice), a

Summary:

This presentation describes a new, non-perturbative, gauge-invariant, analytic formulation of QCD. When the non-perturbative sums over all relevant Feynman graphs are performed (functionally), a new property called "Effective Locality" appears, which greatly simplifies all calculations, reducing a Halpern-type functional integral, as well as other functional integrals associated with color dependence, into a few sets of ordinary integrals, depending on the nature of the amplitude under consideration. A fundamental shift of viewpoint, requiring the original Lagrangian to contain "transverse imprecision" of the subsequently bound quarks, is then required, and is simple to initiate. Using this approach it is a simple matter to calculate quark binding potentials which produce pions and nucleons; and, for the first time ever, to generate nucleon-nucleon scattering and binding potentials, in effect obtaining Nuclear Physics from basic QCD.

CP-Violation / **4**

Search for CP violation in the Bs - Bsbar system with LHCb

Author: Daan Van Eijk[1]

[1] *NIKHEF*

Corresponding Author: dveijk@nikhef.nl

The determination of the mixing induced CP-violating asymmetry in decays such as $B_s^0 \to J/\psi\phi$ is one of the key goals of the LHCb experiment. Its value is predicted to be very small in the Standard Model but can be significantly enhanced in many models of New Physics. The steps towards a precise determination of this phase with a flavour-tagged, time-dependent, angular analysis of the decay $B_s^0 \to J/\psi\phi$ will be presented, and first results shown from this measurement programme, using data collected in 2010 and the early months of the 2011 run. Results will also be shown, and prospects discussed, from related measurements.

Heavy Flavor Physics / **5**

Studies of b-hadron decays to charmless final states at LHCb

Author: Paul Douglas Sail[1]

[1] *Department of Physics and Astronomy-University of Glasgow*

Corresponding Author: 0903886s@student.gla.ac.uk

Studies of charmless hadronic decays of B mesons have high sensitivity to possible contributions from New Physics. Precision measurements involving these decays with charged hadrons in the final state are being performed at LHCb, notably those of CP-violating asymmetries. These measurements benefit from a trigger system which is very efficient for hadronic final states and excellent particle identification capabilities. Results will be presented based on the 2010 data, and from the first months of the 2011 run. Future prospects will be reviewed.

Heavy Flavor Physics / 6

Studies of b-hadron decays to charming final states at LHCb

Author: Stefania Ricciardi[1]

[1] *Particle Physics-Rutherford Appleton Laboratory-STFC - Science*

Corresponding Author: stefania.ricciardi@stfc.ac.uk

We present studies from the LHCb experiment of decays of the type $h_b \to h_c X$, where h_b represents a beauty hadron ($B^{\pm}$, B^0 or Λ_b) and h_c a charmed hadron (D^0, $D(*)^+$, D_s or Λ_c). Such decays are important for the determination of the CKM angle γ, a key goal of the LHCb physics programme. We exploit the data accumulated in 2010, and in the early months of the 2011 run. We report on the observation of new decay modes, and first measurements on the road to a precise determination of γ.

Heavy Flavor Physics / 7

Search for Bs -> mu+mu- at LHCb

Author: Marc-Olivier Bettler[1]

[1] *Universita e INFN*

Corresponding Author: marc-olivier.bettler@cern.ch

With the ~ 1ˆfb^{-1} of data expected in the 2011-12 run, LHCb will achieve the world's best sensitivity to the very rare decay $B_sto\mu^+\mu^-$, exploring a regime where many models of New Physics predict a signal, and reaching down towards the Standard Model value for the branching ratio. Results will be presented from data collected in 2010, and from the early months of the 2011 run.

Heavy Flavor Physics / 8

Electroweak Penguin decays at LHCb

Author: Thomas Blake[1]

[1] *Imperial College Sci., Tech. & Med.*

Corresponding Author: thomas.blake00@imperial.ac.uk

Promising ways to search for New Physics effects in radiative penguin decays are in the angular analysis of $B^0 \to K^*\mu^+\mu^-$, in the measurement of direct CP violation in $B^0 \to K^*\gamma$ and a time dependent analysis of $B_s^0 \to \phi\gamma$. All of these studies are being pursued at LHCb. First results will be shown from the 2010 and early 2011 data, with particular emphasis on $B^0 \to K^*\mu^+\mu^-$.

Heavy Flavor Physics / **9**

Results and prospects for Charm Physics at LHCb

Author: Silvia Borghi[1]

[1] *University of Glasgow*

Corresponding Author: silvia.borghi@cern.ch

Precision measurements in charm physics offer a window into a unique sector of potential New Physics interactions.
LHCb is well equipped to take advantage of the enormous production cross-section of charm mesons in pp collisions at $\sqrt{s} = 7$˜TeV.
The measurement of the $D^0 - \bar{D^0}$ mixing parameters and the search for CP-violation in the charm sector are key physics goals of the LHCb programme. Results will be shown, based on the data collected in 2010, and the first few months of the 2011 run.

Heavy Flavor Physics / **10**

Studies with onia at LHCb

Author: Luigi Li Gioi[1]

[1] *Lab. de Physique Corpusculaire (LPC)-Inst. Nat. Phys. Nucl. et*

Corresponding Author: luigi.li.gioi@cern.ch

LHCb results will be presented of studies made of the production of $c\bar{c}$ and $b\bar{b}$ states in pp collisions at $\sqrt{s} = 7$˜TeV.
The range and precision of these measurements will be invaluable in discriminating between theoretical models. Results and prospects will also be shown for so-called exotics, such as the X(3872).

Perturbative and non-Perturbative QCD / **11**

Soft QCD measurements in the forward direction with the LHCb experiment

Author: Alessandro Camboni[1]

[1] *Universitat de Barcelona*

Corresponding Author: acamboni@ecm.ub.es

LHCb presents studies of particle production in minimum bias events in pp collisions at $\sqrt(s)$=7 TeV.
These studies include measurements of strangeness production, particle ratios, baryon-antibaryon ratios and charged particle production. The forward coverage and low p_T acceptance of the experiment makes these measurements very complementary to those performed by the central detectors
at the LHC. Further benefits arise from the powerful particle identification capabilities provided by the LHCb RICH system. The measurements are compared with theoretical predictions.

Electroweak Physics / 12

W and Z production in the forward region with the LHCb experiment

Author: Jonathan Anderson[1]

[1] *Universitaet Zuerich*

Corresponding Author: jonathan.anderson@cern.ch

Results are presented of W and Z boson production in pp collisions at $\sqrt(s) = 7$ TeV
by the LHCb experiment.
These studies are of particular interest due to LHCb's unique forward acceptance in pseudo-rapidity (η) of $2 < \eta < 5$. The results may either be interpreted as a test of Standard Model predictions,
or may be used to constrain better parton density functions in this kinematical regime.

Top Quark Physics / 13

Top Quark Theoretical Cross Sections and pT and Rapidity Distributions

Author: Nikolaos Kidonakis[1]

[1] *Kennesaw State University*

Corresponding Author: nkidonak@kennesaw.edu

I present theoretical results for the top quark pair total cross section, and for the top quark transverse momentum and rapidity distributions at Tevatron and LHC energies. I also present results for single top quark production in the t- and s-channels and also via associated production with a W boson. The calculations include approximate NNLO corrections that are derived from NNLL soft-gluon resummation.

Neutrino Physics / 15

Neutrino Studies with the T2K P0D Detector

Author: Dmitriy Beznosko[1]

[1] *NN Group SUNYSB*

Corresponding Author: dima@dozory.us

The T2K experiment is an off-axis long baseline neutrino oscillation experiment. It utilizes the intense nu_mu beam generated at the J-PARC accelerator complex in Tokai, Japan. It has a near detector, ND280, at 280m from the proton target, and Super-Kamiokande as far detector at 295 km. The measurements of the neutral current pi0 and single charged current pi+ (as part of CC inclusive) cross-sections on water is necessary to understand the background for measurement of the theta13 mixing angle. However, these cross-sections are not known well in the energy region ˜0.6GeV that is the peak energy of the T2K neutrino beam. This work presents the description and operations of P0D detector, a part of the ND280, and the overview of analyses being carried out with this detector.

Field and String Theory / 16

Large Nc Gauge Theories on the Lattice

Author: Rajamani Narayanan[1]

[1] *Florida International University*

Corresponding Author: rajamani.narayanan@fiu.edu

We will present new results pertaining to large Nc gauge on the lattice.
Two main topics will be
(a) the phases of three dimensional large Nc gauge theories reduced to two dimensions;
(b) single site realization of large Nc gauge theories with adjoint fermions.

Accelerator Physics / 17

MICE step I: first measurement of emittance with particle physics detectors

Author: Ulisse Bravar[None]

Corresponding Author: ulisse.bravar@unh.edu

The muon ionization cooling experiment (MICE) is a strategic R&D project intending to demonstrate the only practical solution to prepare high brilliance beams necessary for a neutrino factory or muon colliders. MICE is under development at the Rutherford Appleton Laboratory (UK). It comprises a dedicated beam line to generate a range of input emittance and momentum, with time-of-flight and Cherenkov detectors to ensure a pure muon beam. The emittance of the incoming beam is measured in the upstream magnetic spectrometer with a sci-fiber tracker. A cooling cell will then follow, alternating energy loss in Li-H absorbers and RF acceleration. A second spectrometer identical to the first and a second muon identification system measure the outgoing emittance. In the 2010 run the beam and most detectors have been fully commissioned and a first measurement of the emittance of a beam with particle physics (time-of-flight) detectors has been performed. The analysis of these data should be completed by the time of the Conference. The next steps of more precise measurements, of emittance and emittance reduction (cooling), that will follow in 2011 and later, will also be outlined.

Low Energy Searches for Physics Beyond the Standard Model / 18

Searches for Light New Physics with BABAR

Author: Christopher Hearty[1]

[1] *University of British Columbia*

Corresponding Author: hearty@physics.ubc.ca

We present the results of direct searches for light new physics with BABAR. In particular, we describe studies of narrow Upsilon and B decays with sensitivity to possible light pseudoscalar Higgs bosons and invisibly decaying dark matter candidates. We also present results of searches for hidden sector gauge and Higgs bosons.

CP-Violation / **19**

Recent BABAR results on CP violation in B decays

Author: Romulus Godang[1]

[1] *University of Mississippi*

Corresponding Author: godang@slac.stanford.edu

We report on the study of the decay B+ ->D0(D0bar) K+ where the D0 or D0bar decaying to Kpipi0, with the Atwood Dunietz and Soni (ADS) method. We measure the ratios Rads, R+, and R- that, since the processes B+ -> D0barK+ and B+ -> D0K+ are proportional to Vcb and Vub, respectively, are sensitive to rB and to the weak phase gamma. We also report the results of CP violation studies of B->Dcp pi+pi- and B0->D*D*.

Heavy Flavor Physics / **20**

Recent BABAR measurements of hadronic B branching fractions

Author: David Norvil Brown[1]

[1] *Department of Physics-University of Louisville*

Corresponding Author: david.brown@louisville.edu

We report on recent results of measurements of hadronic B decay branching fractions from BABAR. These results include B0->D(*)0h0 (where h0 is a neutral hadron), B->D(*)D(*)K, B->D(*)ppbar and B->D(*)0Ks0.

Heavy Flavor Physics / **21**

Semileptonic B and Charm Decays with BABAR

Author: Brian Hamilton[1]

[1] *University Of Maryland*

Corresponding Author: brian.hamilton@cern.ch

We present recent results of studies of semileptonic B and charm
decays from BABAR. In particular, we describe a recent measurement of
the B-> D(*)tau nu branching fraction, and a study of Bs production and semileptonic decays using BABAR data collected above the Upsilon(4S).
We also discuss the determination of |Vub| from exclusive B->pi/rho l nu and and from fully inclusive measurements and present recent branching fraction measurements of B->Lamdba_c p X l nu, B -> Ds K l nu and D+->K-pi+ e nu.

Summary:

BABAR collaboration speaker TBD

Heavy Flavor Physics / **22**

Searches for Rare and Forbidden B and Charm Decays with BABAR

Author: Alessandro Rossi[1]

[1] *INFN Perugia*

Corresponding Author: alessandro.rossi@pg.infn.it

We present recent BABAR results of searches for rare decays with new physics sensitivity. In particular, we present the results of searches for B -> gammma gamma and the lepton and baryon number violating modes
B->Lambda(c)l and B->K/pi tau l. We also describe recent searches for the charm decays D-> Xl+l-, D0 -> gamma gamma and D0->l+l-.

Heavy Flavor Physics / **23**

BABAR Results on Leptonic and Radiative B and Charm Decays

Author: Brad Wray[1]

[1] *University of Texas at Austin*

Corresponding Author: bwray@slac.stanford.edu

We present present measurements of B and charm flavor changing neutral current processes, including inclusive and exclusive b->s gamma and B -> K nu nubar. We also present results of BABAR studies of leptonic decays of charged B and Ds mesons, in particular B -> tau nu and Ds->tau/mu nu.

Heavy Flavor Physics / **24**

Charmless Hadronic B Decays with BABAR

Author: Brian Edward Lindquist[1]

[1] *SLAC National Accelerator Laboratory*

Corresponding Author: brian.edward.lindquist@cern.ch

We present recent BABAR results on charmless hadronic B decays. In particular, we measure the branching fractions, longitudinal polarization fraction f_L and charge asymmetry in B -> rho(f_0) K* events, and report results of studies of B -> phi phi K and B0->K+pi-pi0. We also present the results of a recent study of the inclusive branching fractions of B-meson decays to charmless final states containing a charged or neutral kaon.

CP-Violation / **25**

Tau and charm CP violation studies with BABAR

Author: Ryan White[1]

[1] *University of South Carolina*

Corresponding Author: ryan.white@cern.ch

We report recent BABAR results of CP violation studies in D+->Ks0pi+, D+ ->Ks0 h+h+h- and tau -> Ks0pinu.

Hadron Spectroscopy / 26

Charmonium and Charmonium-like States with BABAR

Corresponding Author: hearty@physics.ubc.ca

We present a search for the X(3872) produced in B−>psi pi+pi- K and
B−>psi pi+pi-pi0 K (psi=J/psi or psi(2S)) using 427 fb-1 of BaBar data. We present updated mass and width measurements for the Y(4260)−> J/psi pi+pi- produced in Initial State Radiation events using 454 fb-1 of data. We report the study of the B meson decays B+−> J/psi phi K+ and B0−> J/psi phi K_S, and of charged and neutral B decays to chi_c1 K pi. We describe a detailed study of charmonium states produced in two-photon collisions and decaying to K_S K pi and K K pi pi pi0. We present a high statistics measurement of the mass and width of the etac(2S) state.

Hadron Spectroscopy / 27

Recent BABAR Studies of Bottomonium States

Author: Veronique Ziegler[1]

[1] *SLAC*

Corresponding Author: vziegler@slac.stanford.edu

We present a study of the radiative transitions from decays of the Y(2S)
and Y(3S) resonances using photons that have converted into an e+e- pair, obtaining precise measurements of the branching fractions for
chi_b1,2(1, 2P) −> gamma Y(1S) and chi_b1,2(2P) −>gamma Y(2S) transitions and search for radiative decay to the eta_b(1S) and eta_b(2S) states. We present a search for the spin-singlet partner of the chibJ(1P) triplet, the hb(1P) state of bottomonium in the transitions Y(3S)−>pi0 hb and Y(3S)−>pi+pi- hb using a data sample of 122 million Y(3S) events.

Hadron Spectroscopy / 28

BABAR results on meson-photon transition form factors and ISR production of hadrons

Author: Steven Robertson[1]

[1] *High Energy Physics Group-McGill University-Unknown*

Corresponding Authors: muller@slac.stanford.edu, steven.robertson@cern.ch

We report on latest results obtained at BABAR studying low energy e+e- annihilation, produced via initial state radiation. Hadronic cross sections are the experimental input for calculation of the muon anomalous magnetic moment, while the study of the final states and intermediate structures with unprecedented accuracy can reveal new states and their properties. In particular, an updated measurement, using the total data set taken by BABAR, of the cross sections for e+e- -> h+h-h'+h'- (where h,h'=pi,K), and of the study of the Y(2175) –> phi f_0(980) resonance, will be presented. In addition,
two-photon processes can be studied at e+e- colliders via the reaction e+ e- -> e+ e- gamma gamma*()* -> *e+ e- X, providing a suitable environment for hadron spectroscopy and tests of QCD predictions.*
We report recent measurements of the gamma gamma -> P transition form factors at large values of momentum transfer, where P is a pseudoscalar meson: pi0, eta, eta', and eta_c.

Top Quark Physics / **29**

A standard model explanation of a dijet excess in Wjj at CDF

Author: Zack Sullivan[1]

Co-author: Arjun Menon [1]

[1] *Illinois Institute of Technology*

Corresponding Author: zack.sullivan@iit.edu

The observation of a peak in the dijet invariant mass of the Wjj signal by the CDF Collaboration has caused great excitement. We demonstrate that this peak can be explained as the same upward fluctuations CDF observes in both t-channel and s-channel single-top-quark production. A peak in the dijet spectrum is expected, because CDF used a Monte Carlo simulation to subtract the single-top backgrounds instead of data. The D0 Collaboration has a small upward fluctuation in their published t-channel data; and, hence, we predict they would see a small peak in the dijet invariant mass spectrum of Wjj if they used Monte Carlo instead of data to subtract the single-top backgrounds.

Plenary Session / **30**

Electroweak Physics

Author: Michael Henry Schmitt[1]

[1] *Department of Physics and Astronomy-Northwesten University*

Corresponding Author: schmittm@lotus.phys.northwestern.edu

Plenary Session / **31**

QCD: Experiment

Author: Joey Huston[1]

[1] *Michigan State University*

Corresponding Author: huston@msu.edu

Plenary Session / **32**

QCD: Theory

Author: Christian Bauer[1]

[1] *UC Berkeley*

Corresponding Author: cwbauer@lbl.gov

Plenary Session / **33**

Neutrino Physics: theory

Author: Lisa Everett Everett[1]

[1] *University of Wisconsin*

Corresponding Author: leverett@wisc.edu

Plenary Session / **34**

Neutrino Physics: experiment

Author: Jennifer Raaf[1]

[1] *FNAL*

Corresponding Author: jlraaf@fnal.gov

Plenary Session / **35**

Searches for BSM Physics at Low Energy

Author: Krishna Kumar[1]

[1] *Physics Department University of Massachusetts Amherst*

Corresponding Author: kkumar@physics.umass.edu

Plenary Session / **36**

Field and String Theory

Author: Christopher Herzog[1]

[1] *Princeton University*

Corresponding Author: cpherzog@princeton.edu

Plenary Session / **37**

Beyond the Standard Model: theory

Author: Konstantin Matchev[1]

[1] *Department of Physics-University of Florida*

Corresponding Author: matchev@phys.ufl.edu

Plenary Session / **38**

Beyond the Standard Model: experiment

Author: George Redlinger[1]

[1] *Brookhaven National Laboratory (BNL)*

Corresponding Author: redlinger@bnl.gov

Plenary Session / **39**

Liquid Quark-Gluon Plasma: Opportunities and Challenges

Author: KRISHNA Rajagopal[1]

[1] *MIT*

Corresponding Author: krishna@ctp.mit.edu

Plenary Session / **40**

Heavy Ion Physics

Author: Barbara Jacak[1]

[1] *Stony Brook University*

Corresponding Author: jacak@skipper.physics.sunysb.edu

Plenary Session / **41**

Education & Outreach

Author: Michael Barnett[1]

[1] *Physics Division-Lawrence Berkeley National Lab. (LBNL)*

Corresponding Author: barnett@lbl.gov

Plenary Session / **42**

High Energy Gamma-Ray and Neutrino Astrophysics

Author: John Beacom[1]

[1] *Ohio State University*

Corresponding Author: beacom@mps.ohio-state.edu

Plenary Session / **43**

Early Universe and Cosmology

Author: Mark Trodden[1]

[1] *University of Pennsylvania*

Corresponding Author: trodden@physics.upenn.edu

Plenary Session / **44**

Dark Matter Searches

Author: Jonghee Yoo[1]

[1] *FNAL*

Corresponding Author: yoo@fnal.gov

Plenary Session / **45**

Hadron Spectroscopy

Author: Adam Szczepaniak[1]

[1] *Indiana University*

Corresponding Author: aszczepa@indiana.edu

Plenary Session / **46**

Heavy Flavor Physics

Author: Sheldon Stone[1]

[1] *Department of Physics-Syracuse University*

Corresponding Author: slstone@syr.edu

Plenary Session / **47**

CP Violation

Author: Hassan Jawahery[1]

[1] *Elementary Particles and High Energy Physics Groups*

Corresponding Author: jawahery@umdhep.umd.edu

Plenary Session / **48**

Top Quark Physics

Author: Kirsten Anne Tollefson[1]

[1] *Michigan State University*

Corresponding Author: tollefson@pa.msu.edu

Plenary Session / **49**

Higgs Searches

Author: Aurelio Juste Rozas[1]

[1] *IFAE - Institut de Física d'Altes Energies-Universitat Autònom*

Corresponding Author: aurelio.juste.rozas@cern.ch

Plenary Session / **50**

Celebrating the Tevatron: physics

Author: Paul Grannis[1]

[1] *High Energy Group (HEG)*

Corresponding Author: pgrannis@sunysb.edu

Neutrino Physics / 51

The DAQ Software System For NOvA Experiment

Author: Xinchun Tian[1]

[1] *Univesrity of South Carolina*

Corresponding Author: tianxc@fnal.gov

NOvA is an accelerator neutrino oscillation experiment which has a great potential to measure the last unknown mixing angle theta_{13}, the neutrino mass hierarchy, and the CP-violation phase in lepton sector with 1) 700 kW beam, 2) 14 mrad off the beam axis, 3) 810 km baseline.
The Near Detector on the Surface is fully functioning and taking both NuMI and Booster beam data. The far detector building achieves beneficial
occupancy on April 13. This talk will focus on the DAQ software system.

Perturbative and non-Perturbative QCD / 52

Second-Order Approximate Corrections for QCD Processes

Author: Nikolaos Kidonakis[1]

[1] *Kennesaw State University*

Corresponding Author: nkidonak@kennesaw.edu

I present generalized formulas for approximate corrections to QCD hard-scattering cross sections through second order in the
perturbative expansion. The approximate results are based on recent two-loop calculations for soft and collinear emission near threshold and are illustrated by several applications to strong-interaction processes in hadron colliders.

Poster Session / 53

On the Smallness of the Dark Energy Density in Split SUSY Models Inspired by Degenerate Vacua

Author: Roman Nevzorov[1]

Co-authors: Colin Froggatt [2]; Holger Nielsen [3]

[1] *University of Hawaii*

[2] *Glasgow University*

[3] *Niels Bohr Institute*

Corresponding Author: nevzorov@phys.hawaii.edu

It is well known that in no–scale supergravity global symmetries
protect local supersymmetry (SUSY) and a zero value for the cosmological constant. The breakdown of these symmetries that ensures the vanishing of the vacuum energy density near the physical vacuum leads to the natural realization of the multiple point principle (MPP) assumption, i.e. results in the set of degenerate vacua with broken and unbroken local supersymmetry. We present the minimal SUGRA model where the MPP assumption is realised naturally at the
tree–level. In this model vacua with broken and unbroken local supersymmetry in the hidden sector

(first and second phases) have the same energy density without any extra fine-tuning. Although hidden sector does not give rise to the breakdown of supersymmetry in the second phase SUSY may be broken there dynamically in the observable sector. Then a positive value of the energy density in the second vacuum is induced which can be assigned, by virtue of MPP, to all other phases including the one in which we live. The total vacuum energy density is naturally tiny or zero in this case. If gauge couplings in the physical and second vacua are the same then the dark energy density depends on the SUSY breaking scale in the physical vacuum only. Assuming Split SUSY type spectrum we argue that the observed value of the cosmological constant can be reproduced if the masses of squarks and sleptons are of order of 10ˆ{10} GeV.

CP-Violation / **54**

Probing CP violating anomalous top-quark couplings at Hadron Colliders

Author: Sudhir Gupta[1]

Co-authors: German Valencia [1]; Serhan Mete [1]

[1] *Iowa State University*

Corresponding Author: skgupta@iastate.edu

In this talk, I will discuss T-odd correlations induced by CP violating anomalous top-quark couplings at both production and decay level in the context of the Tevatron and the Large hadron collider. We will also show that by simply making use of four momenta of the top decay products it is possible to isolate such effects. With specific examples of top decay modes the experimental sensitivities for the aforementioned coupling will also be discussed.

Top Quark Physics / **55**

Top signals in flavor changing Z' models

Author: Sudhir Gupta[1]

Co-author: German Valencia [1]

[1] *Iowa State University*

Corresponding Author: skgupta@iastate.edu

Models with a non-universal Z' exhibit in general flavor changing neutral currents FCNC at tree-level. When the Z' couplings favor the third generation, flavor changing transitions of the form Z'tc and Z'tu could be large enough to be observable at the LHC. In this talk I will discuss some interesting LHC signatures of (a) associated production of a top with the Z', and, (b) the same sign tops when only one of the aforementioned flavor violating coupling is present. In case of later we will also discuss about the top quark reconstruction from the same sign dileptons using the recently invented variable MT2.

Particle Astrophysics and Cosmology / **56**

Cosmic Ray in the Northern Hemisphere: Results from the Telescope Array Experiment

Author: Charles Jui[1]

[1] *University of Utah*

Corresponding Author: fizprof@gmail.com

The Telescope Array (TA) is the largest ultrahigh energy (UHE) cosmic ray observatory in the northern hemisphere. TA is a hybrid experiment with a unique combination of fluorescence detectors and a stand-alone surface array of scintillation counters. We will present the spectrum measured by the surface array alone, along with those measured by the fluorescence detectors in monocular, hybrid, and in stereo mode. The composition results from stereo TA data will be discussed. Our report will also include results from the search for correlations between the pointing directions of cosmic rays, seen by the TA surface array, with AGN's.

Education and Outreach / **57**

Particle Physics Masterclasses

Author: Kenneth William Cecire[1]

[1] *University of Notre Dame*

Corresponding Author: kenneth.william.cecire@cern.ch

The IPPOG and U.S. particle physics masterclasses took place worldwide in March, 2011. For the first time, all masterclasses used real LHC data. Students in the U.S. masterclasses (that included participants in several countries outside the U.S.) analyzed both ATLAS and CMS data. QuarkNet has been evaluating the U.S. effort since 2008. The design of the LHC masterclasses and the results of this study will be discussed.

Summary:

This presentation is a discussion of LHC masterclasses and their evaluation in the U.S.

Particle Astrophysics and Cosmology / **58**

Probing Cosmology and Particle Physics with ACT

Author: Sudeep Das[1]

[1] *UC BERKELEY*

Corresponding Author: sudeep.das@berkeley.edu

Over the coming decade, tiny fluctuations in temperature and polarization of the Cosmic Microwave Background (CMB) will be mapped with unprecedented resolution. The Planck Surveyor, the Atacama Cosmology Telescope (ACT), and the South Pole Telescope (SPT) are already making great advances. In a few years, high resolution polarization experiments, such as PolarBear, ACTPol, and SPTPol will be in full swing. While these new arc-minute resolution observations will continue to help constrain the physics of the early universe, they will also be unique in a new way - they will allow us to measure the gravitational lensing of the CMB. This lensing is the deflection of CMB photons by intervening large scale structure. CMB lensing will probe the growth of structure over cosmic time, helping constrain the total mass of neutrinos and the behavior of dark energy. In the first part of the talk, I will review the recent progress made with ACT, especially in constraining the physics of Big Bang Nucleosynthesis and the neutrino sector. In the second part, I will discuss

the scientific potential of the CMB lensing signal, its first detection, a new way to constrain dark energy, and its prospects for cross-correlation with other datasets. Finally, I will discuss the upcoming polarized counterpart of ACT — the ACTPol project, which will have greater sensitivity than ACT, and will be a premier CMB lensing experiment. I will describe our plans to extract different flavors of science from the ACTPol data, including the cross-correlations with optical lensing and galaxy surveys, such as SDSS, BOSS, DES and LSST.

Perturbative and non-Perturbative QCD / 59

The Charge Radius of the Proton, a 5 Sigma Discrepancy?

Author: Gil Paz[1]

[1] *The University of Chicago*

Corresponding Author: gilpaz@wayne.edu

Recently, the charge radius of the proton was extracted, for the first time, from muonic hydrogen. The value was 5 sigma away from similar measurement of regular hydrogen. The extraction of the charge radius depends on a theoretical input. Together with Richard J. Hill, we are studying the hadronic uncertainty in the theoretical prediction, using the tool of an effective field theory, namely NRQED. In the talk I will report on the results of this study. I will also report on a previous study of the model-independent extraction of the charge radius from electron-proton scattering, which found that previous extractions have typically underestimated their errors.

CP-Violation / 60

Long-Distance Dominance of the CP Asymmetry in B->X_{s,d}+gamma Decays

Author: gil paz[1]

[1] *The University of Chicago*

Corresponding Author: gilpaz@wayne.edu

The CP asymmetry in inclusive b-> s gamma decays is an important probe of new physics. The theoretical prediction was thought to be of a perturbative origin. In the standard model the perturbative prediction for the asymmetry is about 0.5 percent. In a recent work with M. Benzke, S.J. Lee and M. Neubert , we have shown that the asymmetry is in fact dominated by non-perturbative effects. Since these are hard to estimate, it reduces the sensitivity to new physics effects. On the other hand, these new non-perturbative effects suggest a new test of new physics by looking at the difference of the CP asymmetries in charged versus neutral B-meson decays.

Poster Session / 61

Theory of EW interactions with dynamically generated scalars, gauge fixings, and masses of Z and W bosons

Author: Bing An Li[1]

[1] *University of Kentucky*

Corresponding Author: li@pa.uky.edu

A new theory of the EW interactions without spontaneous symmetry breaking, Higgs, and Fadeev-Popov procedure is presented
in this talk. It consists of three parts: $SU(2)_L \times U(1)$ gauge fields, massive fermion fields, and their interactions.
New mechanism of $SU(2)_L \times U(1)$ symmetry breaking caused by the fermion masses are found. Nonperturbative solutions are found.
The vacuum polarization of the Z field is expressed as
\[\Pi_{\mu\nu}(q^2)=\{F_1(q^2)(q_\mu q_\nu-q^2 g_{\mu\nu})+F_2(q^2)q_\mu q_\nu+{1\over2}\Delta m^2_Z g_{\mu\nu}\}.\]
Therefore, both the gauge fixing term(F_2) and the mass term of the field are dynamically generated from
the fermion masses. Top quark mass plays a dominant role.
No zero $\partial_\mu Z^\mu$ leads to a scalar field and a gauge fixing term for the Z field. The mass of the scalar field is determined to be
\[m_{\phi^0}=m_t e^{\frac{m^2_Z}{m^2_t}\frac{16\pi^2}{3\bar{g}^2}+1}=3.78\times10^{14}GeV.\]
The gauge fixing is determined to be
\[\xi_z=-1.18\times10^{-25}.\]
After renormalization it is determined
\[m_z={1\over2}\bar{g}^2 m^2_t\]
it agrees well with the data.
Similarly, the vacuum polarization of W boson is found. A charge scalar field is dynamically generated
\[m_{\phi^{\pm}}=m_t e^{\frac{m^2_W}{m^2_t}\frac{16\pi^2}{3g^2}}=9.31\times10^{13}GeV.\]
\[\xi_W=-3.73\times10^{-25}.\]
After renormalization the mass of the W boson is determined as
\[m^2_W={1\over2}g^2 m^2_t.\]
It agrees well with the data. It also obtain
\[\frac{m^2_W}{m^2_Z}=\frac{g^2}{\bar{g}^2}=cos^2\theta_W.\]
\[G_F=\frac{1}{2\sqrt{2}m^2_t}.\]
The Fermi coupling constant in good agreement with data.
The propergators of Z- and W- fields are derived as
\[\Delta_{\mu\nu}^Z=
\frac{1}{q^2-m^2_Z}\{-g_{\mu\nu}+(1+\frac{1}{2\xi_Z})\frac{q_\mu q_\nu}{
q^2-m^2_{\phi^0}}\}\]
\[\Delta^W_{\mu\nu}=
\frac{1}{q^2-m^2_W}\{-g_{\mu\nu}+(1+\frac{1}{2\xi_W})\frac{q_\mu q_\nu}{
q^2-m^2_{\phi_W}}\}\]
This theory can be tested by LHC experiments.

Hadron Spectroscopy / **62**

Chiral field theory of 0-+ glueball

Author: Bing An Li[1]

[1] *University of Kentucky*

Corresponding Author: li@pa.uky.edu

A chiral field theory of 0^{-+} glueball is presented. The Lagrangian of this theory is constructed by adding a 0^{-+} glueball field to a
successful Lagrangian of chiral field theory of pseudoscalar, vector, and axial-vector mesons.
The couplings between the pseodoscalar glueball field and
the mesons are via U(1) anomaly revealed.
Quantitative study of the physical processes of the 0^{-+} glueball of $m = 1.405$GeV is presented.
In this talk following topics are presented:
a new chiral field theory of 0^{-+} glueball;
mass mixing between $\eta, \eta',\ and\ 0^{-+}(\eta(1405))$ glueball;

kinetic mixing;
$J/\psi \to \gamma\eta(1405)$ decay;
$\eta(1405) \to \gamma\gamma, \gamma\rho, \gamma\omega, \gamma\phi, \gamma\pi\pi, \gamma KK$ decays;
$\eta(1405) \to \rho\pi\pi$ and strong decays of $\eta(1405)$.

The theoretical predictions can be used to identify the 0^{-+} glueball.

Neutrino Physics / **63**

Data Quality and Performance of the NOνA Prototype Detector

Author: Susan Lein[1]

[1] *University of Minnesota*

Corresponding Author: lein@physics.umn.edu

The NuMI Off-Axis ν_e Appearance (NOνA) project is a long-baseline neutrino experiment. It utilizes the NuMI neutrino beam at Fermilab and consists of two functionally-identical plastic, scintillator-filled detectors placed 14 milliradians off-axis from the beam and 810 km apart. A 209 ton prototype detector, the Near Detector On the Surface(NDOS), was built and began taking initial neutrino data in December 2010. NDOS is 110 milliradians off-axis from the NuMI beam and also receives neutrinos from the Booster Neutrino Beam. As NDOS is in the commissioning phase, metrics are being developed to improve understanding of the detector as well as monitor the quality of data. Performance of the prototype detector will be presented.

Education and Outreach / **64**

CMS Data for High School Teachers and Students

Author: Kenneth William Cecire[1]

[1] *University of Notre Dame*

Corresponding Author: kenneth.william.cecire@cern.ch

The CMS Collaboration has released more than a quarter of a million 7 TeV proton-proton events that contain pairs of muons, electrons or jets with 2-body invariant masses in the range 0 to 100 GeV for student and teacher investigations. QuarkNet and I2U2 have developed software to exploit these data in a manner similar to that of the front-line physicists: a 3-D web-based event display to understand particle interactions in the detector and a histogramming package to create and examine mass plots after making cuts on the data. An additional package allows the students to produce on-line posters featuring their results. The data include large numbers of events corresponding to the presence of J/psi, W and Z particles, allowing students to make "discoveries". We describe the released data and three initiatives that allow exploration: a student masterclass, a more in-depth web-based "e-Lab" and a summer 2011 teacher workshop to be held at Fermilab.

Summary:

CMS data is available for education purposes from the 7 TeV run of 2010. QuarkNet and I2U2 have developed packages for making this data accessible to high school students and teachers.

Poster Session / 65

Are Leptons and Quarks Highly Relativistic Bound States?

Author: G. Bruce Mainland[1]

[1] *The Ohio State University at Newark*

Corresponding Author: mainland.1@osu.edu

Because the existence of families of elements and hadrons was ultimately understood by the realization that atoms and hadrons are composite, in the 1970's many physicists thought that the existence of the four families of leptons and quarks could be understood if leptons and quarks were composite. By the early 1980's, however, the physics community had given up on the idea because it had not been possible to determine the force that binds constituents into leptons and quarks. The development of supercomputers now makes it feasible to study such highly relativistic bound states. Here the possibility is discussed that leptons and quarks are highly relativistic bound states of a scalar and spin-1/2 fermion bound by minimal electrodynamics. These bound states are described by the Bethe-Salpeter equation and have the following three properties, all of which are essential if quarks and leptons are composite: (1) The boundary conditions allow strongly bound solutions when the coupling constant has a magnitude on the order of the fine structure constant. Typically the coupling constant for strongly bound solutions is on the order of or greater than unity. (2) All strongly bound, normalizable solutions must have spin-1/2 if the coupling constant has a magnitude on the order of the fine structure constant. It is remarkable that higher spin, strongly bound solutions are forbidden. (3) Some strongly bound solutions possess a property that suppresses the unobserved decay of a muon into an electron and a photon.

Low Energy Searches for Physics Beyond the Standard Model / 66

The Mu2e Experiment at Fermilab

Author: Craig Group[1]

[1] *University of Virginia*

Corresponding Author: rcg6p@virginia.edu

The goal of the Mu2e experiment is to improve on the existing experimental limits for the neutrinoless conversion of a muon into an electron by four orders of magnitude. Such sensitivity means that if low-energy supersymmetry is discovered at the LHC, Mu2e will provide complimentary information. Even in the absence of new physics at the TeV scale, Mu2e could still find evidence for new physics at mass scales up to 10^4 TeV. In this talk I will give a brief account of the theoretical motivation for the experiment, the current status of the design, planned methods to detect the conversion electron and to suppress backgrounds, and the expected sensitivity of the Mu2e experiment.

Education and Outreach / 67

Classroom Cosmic Rays: Detectors and Analysis

Author: Thomas Jordan[1]

[1] *University of Florida/Fermilab*

Corresponding Author: jordant@fnal.gov

Since 1998, QuarkNet has provided over 500 cosmic ray muon detectors to teachers in the project and collaborators on similar projects. The detector relies on GPS accuracy for time-stamping PMT pulses

from four scintillation counters. The DAQ is now in its third revision. Students and teachers use the detector to carry out small experiments to measure properties of cosmic ray muons. Other groups, most international, have purchased the detector for similar uses. We will describe the detector, its installation base and our web-based data-sharing and analysis portal.

Education and Outreach / 68

Celebrating 30 Years of K-12 Educational Programming at Fermilab

Author: Marjorie Bardeen[1]

[1] *Fermilab*

Corresponding Author: mbardeen@fnal.gov

In 1980 Leon Lederman started Saturday Morning Physics with a handful of volunteer physicists, around 300 students and all the physics teachers who tagged along. Today Fermilab offers over 30 programs annually with help from 250 staff volunteers and 50 educators, and serves around 40,000 students and 2,500 teachers. Find out why we bother. Over the years we have learned to take advantage of opportunities and confront challenges to offer effective programs for teachers and students alike. We offer research experiences for secondary school teachers and high school students. We collaborate with educators to design and run programs that meet their needs and interests. Popular school programs include classroom presentations, experience-based field trips, and high school tours. Through our work in QuarkNet and I2U2, we make real particle physics data available to high school students in data-driven activities as well as masterclasses and e-Labs. Our professional development activities include a Teacher Resource Center and workshops where teachers participate in authentic learning experiences as their students would. We offer informal classes for kids and host events where children and adults enjoy the world of science. Our website hosts a wealth of online resources. Funded by the U.S. Department of Energy, the National Science Foundation and Fermilab Friends for Science Education, our programs reach out across Illinois, throughout the United States and even around the world. We will review the program portfolio and share comments from the volunteers and participants.

Particle Astrophysics and Cosmology / 69

Status of CoGeNT

Author: Juan Collar Colmenero[1]

[1] *University of Chicago*

Corresponding Author: collar@uchicago.edu

Recent results from CoGeNT and future directions will be discussed.

Perturbative and non-Perturbative QCD / 70

A QCD and N = 4 SYM Motivated Model for Soft Interactions and LHC Data

Author: Errol Gotsman[1]

Co-authors: Eugene Levin [1]; Uri Maor [1]

[1] *Tel Aviv University*

Corresponding Author: gotsman@post.tau.ac.il

Monte Carlo generators (Pythia and Phojet) which were tuned for energies up to that of the Tevatron, appear to be found wanting when extended
to LHC energies.
We have constructed a model that satisfies the theoretical
requisites of high energy soft interactions, based on two conjectures:
(i) the results of N =4 SYM, which at present is a unique theory
that allows one to deal with a large coupling constant: and
(ii) the requirement of matching with high energy QCD.
In accord with these postulates we assume that the soft Pomeron
intercept is relatively large, and the slope of the Pomeron trajectory is equal to zero. We derive analytical formulae that sum both enhanced
and semi-enhanced diagrams for elastic and diffractive amplitudes.
We fit the available experimental data, up to and including the
Tevatron energies, and predict the values of cross sections at all energies accessible at the LHC and beyond.
The values we obtained are in agreement with the measured value of the
inelastic cross section at 7 TeV published by the ATLAS collaboration,
and the inclusive cross sections measured by CMS, ATLAS and ALICE.
We compare our results with experimental data and competing models.

Summary:

The material summarizes the contents of :
(1) Eur.Phys.J. (2011)71:1553
(2) arXiv:1103.4509

Top Quark Physics / **71**

Top quark pairs in association with a photon and the top quark electric charge

Author: Markus Schulze[1]

Co-authors: Andreas Scharf [2]; Kirill Melnikov [1]

[1] *Johns Hopkins University*

[2] *Universtity at Buffalo*

I would like to present results for hadronic top quark pair production in association with a photon at next-to-leading order accuracy.This process allows a direct measurement of the top quark electromagnetic couplings that, at the moment, are only loosely constraint. Top quark decays are treated in the narrow width approximation and spin correlations of all final state particles are accounted for. We include photon radiation off top quark decay products which yields a significant contribution to the cross section. At the Tevatron, the Standard Model production rate is relatively small. However, thanks to the large data sample, the CDF collaboration started looking for anomalous effects in this rare process. I will present results at next-to-leading order accuracy that match the CDF selection cuts. I will also discuss results for the LHC where hundreds of high energetic photons events will be observed within the next two years. In particular, a direct and more precise measurement of the top quark electric charge seems possible.

Beyond the Standard Model / **72**

Searches for Supersymmetry in Hadronic Final States with the CMS Detector at the LHC

Author: Sudarshan Paramesvaran[1]

[1] *University of California Riverside*

Corresponding Author: sudarshan.paramesvaran@cern.ch

We present the results of searches for Supersymmetry in all-hadronic final states with jets and missing transverse energy, including the cases of jets identified as b-jets, the decay products of top quarks and hadronically decaying tau leptons. The searches are performed using data collected by the CMS experiment at the LHC in pp-collisions at a center-of-mass energy of 7 TeV. Various data-driven techniques used to measure the Standard Model backgrounds are discussed. The results are interpreted in a range of Supersymmetric scenarios.

Summary:

Submission is on behalf of CMS, CMS speaker will be named once the abstract has been accepted.

Beyond the Standard Model / **73**

Searches for Supersymmetry in Final States with Leptons with the CMS detector at the LHC

Author: Benjamin Henry Hooberman[1]

[1] *Fermi National Accelerator Lab. (Fermilab)*

Corresponding Author: benjamin.henry.hooberman@cern.ch

We present the results of searches for Supersymmetry in various topologies that lead to one or more isolated leptons, jets, and missing transverse energy in the final state. The searches are performed using data collected by the CMS experiment at the LHC in pp-collisions at a center-of-mass energy of 7 TeV. Various data-driven techniques used to measure the Standard Model backgrounds are discussed. The results are interpreted in a range of Supersymmetric scenarios.

Beyond the Standard Model / **74**

Searches for Supersymmetry in Events with Photons and Missing Transverse Energy with the CMS Detector at the LHC

Author: Duong Hai Nguyen[1]

[1] *Department of Physics-Brown University*

Corresponding Author: nhduongvn1@gmail.com

We present the results of searches for Supersymmetry in various topologies that lead to final states with jets, missing transverse momentum and one or two photons or a photon and a lepton. These searches are performed using data collected by the CMS experiment at the LHC in pp-collisions at a center-of-mass energy of 7 TeV. Various data-driven techniques used to measure the Standard Model

backgrounds are discussed. The results are interpreted in General Gauge Mediated Supersymmetry breaking models.

Heavy Flavor Physics / **75**

Efficiency measurement of b-tagging algorithms developed by the CMS experiment

Author: Saptaparna Bhattacharya[1]

[1] *Brown University*

Corresponding Author: saptaparna.bhattacharya@cern.ch

Identification of jets originating from b quarks (b-tagging) is a key element of many physics analyses at the LHC. Various algorithms for b-tagging have been developed by the CMS experiment to identify b-tagged jets with a typical efficiency between 40% and 70% while keeping the rate of mis-identified light quark jets between 0.1% and 10%. An important step, in order to be able to use these tools in physics analysis, is the determination of the efficiency for tagging b-jets. Several methods to measure the efficiencies of the life-time based b-tagging algorithms are presented. Events that have jets with muons are used to enrich a jet sample in heavy flavor content. The efficiency measurement relies on the transverse momentum of the muon relative to the jet axis or on solving a system of equations which incorporate two uncorrected taggers. Another approach uses the number of b-tagged jets in top pair events to estimate the efficiency. The results obtained in 2010 data and the uncertainties obtained with the different techniques are reported.

Heavy Flavor Physics / **77**

b-tagging Algorithms in the CMS experiment

Author: Gavril Giurgiu[1]

[1] *Rowland Dept. of Phys. and Astron.-Johns Hopkins University (JH*

Corresponding Author: gavril.giurgiu@cern.ch

The identification of b-jets is an important ingredient in characterizing top quark events and many new physics scenarios. The b-tagging algorithms developed within the CMS experiment are mainly based on the large lifetime of b-hadrons. The discriminators and variables defined by the various algorithms which characterize b-jets (e.g. track impact parameter, vertex properties) have been studied using data and compared to expectations from Monte Carlo simulations. In addition detailed studies to optimize track selection and assignment to the jet have been performed in different running conditions and compared with simulations. These studies have led to improvements and optimization of the software tools for the high event pileup scenarios during the 2011 LHC running.

Detector Technology and R&D / **78**

Performance of the b-tagging algorithms with an upgraded CMS detector

Author: Eric Charles Brownson[1]

[1] *Department of Physics and Astronomy-Vanderbilt University*

Corresponding Author: eric.charles.brownson@cern.ch

Identification of jets originating from b quarks (b-tagging) will likely continue to be a key element of many physics analyses at the upgraded HL-LHC where much higher pileup can significantly reduce the performance. An upgrade of the CMS pixel detector proposed for the Phase 1 HL-LHC should enable CMS to maintain the current level of b-tagging performance even in the presence of very high pileup. Results of Monte Carlo simulation studies with an upgrade CMS pixel detector will be presented for tracking and b-tagging performance and compared to that for the current CMS detector.

Electroweak Physics / **79**

Measurement of the differential production cross section of Z bosons at 7 TeV

Author: Joseph Anthony Gartner[1]

[1] *University of Florida*

Corresponding Author: joseph.anthony.gartner@cern.ch

In 2010 the CMS experiment collected about 35 pb-1 of data during the first physics run of the LHC accelerator. We present the first measurements of the differential cross section as a function of boson rapidity and transverse momentum for Z bosons produced at 7 TeV and decaying to pairs of electrons and muons. The data are unfolded and corrected for efficiencies, allowing a direct comparison to recent theoretical calculations.

Top Quark Physics / **80**

Measurements of the top quark pair production cross section at 7 TeV

Author: Sadia Khalil[1]

[1] *Kansas State University*

Corresponding Author: skhalil@cern.ch

We present several measurements of the top-pair production cross section in proton-proton collisions at the LHC at a centre-of-mass energy of 7 TeV. We use data collected with the CMS experiment during the year 2011. Measurements are presented in the lepton+jets final state, where events are selected by requiring exactly one isolated and highly energetic muon or electron, and at least four jets. In addition the di-lepton final state, consisting of two electrons or muons, at least two jets, and significant missing energy in the transverse plane, is used. We use b-jet identification in order to increase the purity of the selection. We present data-driven techniques to estimate the most important backgrounds, and discuss the systematic uncertainties on the measurements. The results, superseding previous measurements based on 2010 data, are combined and compared with the theory predictions.

Top Quark Physics / **82**

Measurement of the top pair invariant mass distribution at 7 TeV and search for New Physics

Author: Salvatore Rappoccio[1]

[1] *Department of Physics and Astronomy-Johns Hopkins University (J*

Corresponding Author: rappoccio@gmail.com

We present a measurement of the top-pair mass in tt events by using proton-proton collisions at the LHC at a centre-of-mass energy of 7 TeV. We use data collected with the CMS experiment during the year 2011. The analysis is performed in all possible final states originating from top-pair production, and the full event reconstruction is performed by using different reconstruction methods according to the final state under consideration. The measurement is then used for searching for production of a massive, narrow-width, neutral boson decaying into top-pairs. We observe no significant deviations from the QCD expectations, therefore we translate the measurement into an upper limit on the new physics production cross-section as a function of the particle mass.

Top Quark Physics / 84

Measurement of the charge asymmetry in top quark pair production at 7 TeV

Author: Michael Andrew Segala[1]

[1] *Department of Physics-Brown University*

Corresponding Author: michael.andrew.segala@cern.ch

We present a measurement of the charge asymmetry in top-pair production in proton-proton collisions at the LHC at a centre-of-mass energy of 7 TeV. We use data collected by the CMS experiment during the year 2011. The analysis uses events with one charged lepton and at least four jets. In order to measure the charge asymmetry in charge-symmetric initial state processes, the difference of absolute pseudo rapidities of top and anti-top is used. The asymmetry is measured inclusively, but also as a function of the top-pair invariant mass. The results are compared with various theory predictions, and discussed in the context of forward-backard asymmetry measurements at Tevatron.

Top Quark Physics / 85

Measurements of the top quark mass and the top-antitop mass difference at 7 TeV

Author: Aram Avetisyan[1]

[1] *Department of Physics-Brown University*

Corresponding Author: aram.avetisyan@cern.ch

The mass of the top quark is a fundamental parameter of the Standard Model. We present a measurements of the top quark mass in proton-proton collisions at the LHC at a centre-of-mass energy of 7 TeV using data collected by the CMS experiment during the year 2011. Measurements are presented in all possible final states originating from top-pair production, and the different reconstruction methods to extract the top quark mass are discussed. Particular emphasis will be given to the contribution of systematic uncertainties. The results of the various channels are combined and compared to the world average. The top mass is also extracted from the top pair cross section measured at CMS, including a determination of mtop in the msbar scheme. Finally, a measurement of the top-antitop quark mass difference is presented.

Top Quark Physics / 87

Measurement of t-channel single top quark production at 7 TeV

Author: Thomas Speer[1]

[1] *Department of Physics-Brown University*

Corresponding Author: thomas.speer@cern.ch

We present a measurement of the inclusive single top production cross section in proton-proton collisions at the LHC at a centre-of-mass energy of 7 TeV, using data collected with the CMS experiment during the year 2011. The analysis considers decay channels where the W from the top decays into electron-neutrino or muon-neutrino, and makes use of kinematic characteristics of electroweak single top production for the separation of signal from backgrounds using multivariate methods. The result, which supersedes an earlier measurement based on 2010 data, is compared with the most precise standard model theory predictions. In addition, we present measurements of various differential single top quark production cross sections.

Top Quark Physics / 89

Top quark physics results using CMS data at 7 TeV

Author: Karl Ecklund[1]

[1] *Rice University*

Corresponding Author: karl.ecklund@cern.ch

We give an overview of the most recent results on top quark properties and interactions, obtained using data collected with the CMS experiment during the years 2010-2011 at 7 TeV center-of-mass energy. Measurements are presented for both the inclusive top pair production cross section, using the dilepton, lepton+jets, hadronic and tau channels, as well as for various differential cross sections. The results are compared with standard model predictions and allow to search for possible presence of new physics. In particular, measurements of the top pair invariant mass distribution are used to search for new particles decaying to top pairs. We extract the mass of the top quark using various methods, including indirect constraints from the measured cross section. We measure total and differential cross sections for the electroweak production of single top quarks in both t- and tW-channels, also useful for constraining the CKM matrix element Vtb. Further results include measurements of the W helicity in top decays and the top pair charge asymmetry.

Electroweak Physics / 91

Measurement of the Drell-Yan differential cross section at 7 TeV

Author: Stoyan Emilov Stoynev[1]

[1] *Department of Physics and Astronomy-Northwesten University*

Corresponding Author: stoyan.stoynev@cern.ch

We present a measurement of the Drell-Yan differential cross section in pp collisions as a function of the dilepton invariant mass (dsigma/dm). The data sample was collected by the CMS detector at the

LHC operating at a center-of-mass energy of 7 TeV during 2010 and 2011. The results are compared to predictions of the Standard Model.

Heavy Ion Physics/Hot and Dense QCD / 94

Hydrodynamic flow in Pb+Pb collisions observed via azimuthal angle correlations of charged hadrons

Author: Charles Felix Maguire[1]

[1] *Department of Physics and Astronomy-Vanderbilt University*

Corresponding Author: charles.felix.maguire@cern.ch

Azimuthal angle correlations of charged hadrons were measured in $\sqrt{s}_{NN}$ = 2.76 TeV Pb+Pb collisions by the CMS experiment. The distributions exhibit anisotropies that are correlated with the event-by-event orientation of the reaction plane. Several methods were employed to extract the strength of the signal: the event-plane, cumulant and Lee-Yang Zeros methods. These methods have different sensitivity to correlations that are not caused by the collective motion in the system (non-flow correlations due to jets, resonance decays, and quantum correlations). The second Fourier coefficient of the charged hadron azimuthal distributions was measured as a function of transverse momentum, pseudorapidity and centrality in a broad kinematic range: $0.3 < p_T < 12.0$ GeV/c, $|\eta| < 2.4$), as a function of collision centrality. In addition, first results on odd Fourier components will be presented and their connection to the hydrodynamic medium will be discussed.

Heavy Ion Physics/Hot and Dense QCD / 95

Studies of Jet Quenching in PbPb Collisions at CMS

Author: Monika Grothe[1]

[1] *U Wisconsin*

Corresponding Authors: george.stephans@cern.ch, monika.grothe@cern.ch

Jets are an important tool to probe the hot, dense medium which is produced in ultra-relativistic heavy ion collisions. Copious production of hard processes, well above the heavy ion background, occurs at the Large Hadron Collider due to the large increase in collision energy. The multipurpose Compact Muon Solenoid (CMS) detector is well designed to measure the hard scattering processes with its high quality calorimeters and high precision silicon tracker. Jet quenching has been studied in CMS in PbPb collisions at $\sqrt{s_{NN}}$ =\,2.76~TeV. As a function of centrality, dijet events with a high pT leading jet were found to have an increasing momentum imbalance that was significantly larger than those predicted by simulations. The angular distribution of jet fragmentation products has been explored by associating charged tracks with the dijets observed in the calorimeters. The calorimeter-based momentum imbalance is reflected in the associated track distributions, which show a softening and widening of the subleading jet fragmentation pattern. Studies of the missing transverse momentum projected on the jet axis have shown that the overall momentum balance can be recovered if tracks at low pT are included. In the PbPb data, but not in the simulations, a large fraction of the balancing momentum is carried by soft particles radiated at large angle relative to the jets.

Electroweak Physics / 98

Study of diboson production at CMS

Author: Kalanand Mishra[1]

[1] *Fermi National Accelerator Lab. (Fermilab)*

Corresponding Author: kalanand.mishra@cern.ch

We report on the study the diboson production (WW, WZ, ZZ) at CMS based on the data collected during the 2010+2011 running of the LHC.

Electroweak Physics / **99**

Measurement of W and Z boson production rate and asymmetry at CMS

Author: Ji Yeon Han[1]

[1] *University of Rochester*

Corresponding Author: ji.yeon.han@cern.ch

We report the measurements of the rates and asymmetries of inclusive and differential production of W and Z vector bosons in pp collisions at 7 TeV c.m. energy at the CMS detector.

Neutrino Physics / **100**

NOvA: Present and Future

Author: Gavin Davies[1]

[1] *Iowa State University*

Corresponding Author: gsdavies@iastate.edu

NOvA is a next generation neutrino oscillation experiment designed to search for muon neutrino to electron neutrino oscillations by comparing electron neutrino event rates in a Near Detector at Fermilab with the rates observed in a large Far Detector at Ash River, Minnesota, 810 km from Fermilab. The detectors are totally active, segmented, liquid scintillator and the Near Detector is located 14 mrad o the NuMI beam axis. The Far Detector has begun construction and will begin taking data in early 2013. The experiment aims to measure the neutrino mixing angle theta_13 and will push the search for electron neutrino appearance beyond the current limits by more than an order of magnitude. For non-zero theta_13, it is possible for NOvA to observe CP violation in neutrinos and establish the neutrino mass hierarchy. The NOvA prototype near detector on the surface (NDOS) began running at Fermilab in November and registered its first neutrinos from the NuMI beam in December 2010. An overview and
current status of the experiment will be presented.

Computing in HEP / **102**

Persistent Data Layout and Infrastructure for Efficient Selective Retrieval of Event Data in ATLAS

Authors: David Malon[1]; Peter Van Gemmeren[1]

[1] *Argonne National Laboratory*

Corresponding Author: peter.van.gemmeren@cern.ch

The ATLAS detector [1] at CERN has completed its first full year of recording collisions at 7 TeV, resulting in billions of events and petabytes of data. At these scales, physicists must have the capability to read only the data of interest to their analyses, with the importance of efficient selective access increasing as data taking continues.

ATLAS has developed a sophisticated event-level metadata infrastructure (TAG [2]) and supporting I/O framework [3] allowing event selections by explicit specification, by back navigation, and by selection queries to a TAG database via an integrated web interface (iELSSI). These systems and their performance have been reported on elsewhere.

The ultimate success of such a system, however, depends significantly upon the efficiency of selective event retrieval. Supporting such retrieval can be challenging, as ATLAS stores its event data in column-wise orientation using ROOT TTrees [4] for a number of reasons, including compression considerations, histogramming use cases, and more.

For 2011 data, ATLAS will utilize new capabilities in ROOT to tune the persistent storage layout of event data, and to significantly speed up selective event reading.
The new persistent layout strategy and its implications for I/O performance will be presented in this paper.

[1] ATLAS Collaboration, ATLAS Detector and Physics Performance Technical Design Report, CERN-LHCC-1999-14 and CERN-LHCC-1999-15.
[2] J. Cranshaw et al, "Event selection services in ATLAS", in J. Phys.: Conf. Ser., vol. 219, 042007, 2010
[3] P. van Gemmeren, D. Malon, "The event data store and I/O framework for the ATLAS experiment at the Large Hadron Collider", in IEEE International Conference on Cluster Computing and Workshops, 2009, pp.1-8.
[4] R. Brun and F. Rademakers, "ROOT –An Object Oriented Data Analysis Framework", Nucl. Inst. & Meth. in Phys. Rev. A 389 (1997) 81-86. See also http://root.cern.ch

Beyond the Standard Model / 103

Charged X Production in Simplest Higgs via Gauge Boson Fusion

Author: Matthew Bishara[1]

[1] *University of Rochester*

Corresponding Author: mbishara@pas.rochester.edu

The Simplest Higgs model is one of several Little Higgs extensions that attempt to address the hierchy problem through expansion of the Standard Model weak sector.
New charged and neutral weak gauge bosons can cancel out the quadratic Higgs divergences in the Higg's potential through loop diagrams. Production of charged X gauge bosons is studied through gauge boson fusion in pp collisions at 7 through 14 TeV. The pp > qqW±Y>qQX± production method of X± gauge bosons is shown to produce cross-sections that could be large enough to be detectable at the LHC. Here Q represents new heavy quarks that come out of the Simplest Higgs model, and Y is a massive neutral boson. Possible decay products of these gauge bosons are also discussed.

Summary:

This is a study of possible signature charged gauge boson production in the simplest Higgs model. It focuses on gauge boson fusion production of a heavy X particle.

Detector Technology and R&D / 104

Frequency Scanned Interferometry for ILC Tracker Alignment

Author: Haijun Yang[1]

Co-authors: Keith Riles [1]; Tianxiang Chen [1]

[1] *University of Michigan*

Corresponding Author: haijun.yang@cern.ch

In order to exploit fully the physics potential of future lepton colliders, highly precise tracking systems will be needed, for which systematic alignment uncertainties must be small. We describe ongoing R&D in frequency scanned interferometry (FSI) to be applied to alignment monitoring of a detector's charged particle tracking system, in addition to its beam pipe and final-focus quadrupole magnets. In FSI alignment, one measures hundreds of absolute point-to-point distances of detector elements in 3 dimensions by using an array of beams split from a central laser. We report here on progress using a dual-laser FSI single-channel prototype. Dual lasers with oppositely scanned frequency directions permit cancellation of many systematic errors, making the alignment robust against vibrations and environmental disturbances. Under realistic environmental conditions, a precision of about 0.2 microns was achieved for a distance of about 40 cm for the prototype. Work is now under way to demonstrate a multi-channel system on the bench. Recent progress will be summarized.

Top Quark Physics / 105

The Tevatron Top Quark Forward-Backward Asymmetry and Same Sign Top Quark Pair Production at the LHC

Author: Edmond Berger[1]

[1] *ANL*

Corresponding Author: berger@anl.gov

The forward-backward asymmetry for top quarks measured in proton-antiproton collisions at the Tevatron shows a large deviation from standard model expectations. Among possible interpretations, the exchange of a non-universal Z' is of some interest as it naturally predicts a top quark in the forward region of large rapidity. To reproduce the size of the Tevatron asymmetry, the couplings of the Z' to standard model quarks must be large, inevitably leading to copious production of same-sign top quark pairs at the Tevatron and at the Large Hadron Collider (LHC). We discuss the constraints on this model from (a) the Tevatron top-antitop cross section, (b) the Tevatron top-antitop invariant mass distribution, and the same sign top pair cross section limits at the Tevatron. We explore the discovery potential for tt and ttj production in early LHC experiments at 7 TeV and conclude that if {\it no} tt signal is observed with $1\^{}\mathrm{fb}^{-1}$ of integrated luminosity, then a non-universal Z' alone cannot explain the Tevatron forward-backward asymmetry.

Neutrino Physics / 106

Early Neutrino Data in the NOvA Near Detector

Author: Minerba Betancourt[1]

[1] *University of Minnesota*

Corresponding Author: betancourt@physics.umn.edu

NOvA is a long baseline neutrino experiment using an off-axis neutrino
beam produced by the NuMI neutrino beam at Fermilab. The NOVA experiment will study neutrino oscillations from ν_μ flavor to ν_e flavor. A short term goal for the NOvA experiment is to develop a good understanding of the response of the detector. These studies are being carried out with the full Near Detector installed on the surface at Fermilab (NDOS). This detector is currently running and will acquire neutrino data for a year. Using beam muon neutrino data, quasi-elastic charge-current interactions will be studied. Status of the NDOS running and early data will be shown.

Higgs Physics / 109

Search For The Standard Model Higgs Boson In The WH->lnubb And H->WW->lnulnu Decay Modes

Author: G Carrillo Montoya[1]

[1] *Department of Physics-University of Wisconsin*

Corresponding Author: g.carrillo.montoya@cern.ch

Results for a Higgs boson search by the ATLAS experiment in the WH->lnubb and H->WW->lnulnu decay modes using a multivariate approach are presented. The results are based on data taken in 2011 at 7 TeV center-of-mass energy. No evidence is found for a Standard Model-like Higgs boson in either decay mode. Exclusion limits in terms of the ratio to expected SM rate are reported in Higgs mass ranges of 115-130 GeV and 120-600 GeV respectively in the two modes.

Beyond the Standard Model / 112

Search for dark matter from prompt lepton-jets in the electron channel

Author: Mahsana Ahsan[1]

[1] *Department of Physics-University of Texas at Dallas-Unknown*

Corresponding Author: mahsana.ahsan@cern.ch

We will present a search on dark matter particles of nearly GeV scale that decay into highly boosted set of electrons. \ These collimated set of leptons produced in the final state are called lepton-jets. \ The search is motivated by recent observations from astrophysical experiments on the anomalous excess of cosmic ray leptons. \ The analysis is performed using the data collected by the ATLAS detector from proton-proton collisions at $\sqrt{s} = 7$ TeV at the Large Hadron Collider. \ The dominant source of background are events containing energetic jets from QCD productions which mimic the signal events. \ We utilize multivariate analysis techniques to discriminate the signal against the background and perform a cut-based analysis for cross-checks.

Top Quark Physics / 113

Measurement of the top-pair production cross-section at ATLAS

Author: M Saleem[1]

[1] *University of Oklahoma, USA*

Corresponding Author: muhammad.saleem@cern.ch

We present measurements of the top-quark pair-production cross section
in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS detector
at the Large Hadron Collider. The cross sections are measured in the lepton+jets channels.

Higgs Physics / 114

Nonstandard Higgs Decays and Dark Matter in the E6SSM

Author: Roman Nevzorov[1]

Co-authors: Jonathan Hall [2]; Marc Sher [3]; Sandip Pakvasa [1]; Steve King [2]

[1] *University of Hawaii*

[2] *University of Southampton*

[3] *College of William and Mary*

Corresponding Author: nevzorov@phys.hawaii.edu

We study the decays of the lightest Higgs boson within the exceptional
supersymmetric (SUSY) standard model (E6SSM). The E6SSM is based on the SM gauge group together with an extra U(1)*{N} gauge symmetry under which right-handed neutrinos have zero charge. The low energy matter content of the E6SSM involves three 27 representations of E_6 and a pair of SU(2) doublets from additional 27 and \bar{27}.Thus E6SSM predicts three families of Higgs-like doublets plus three SM singlets that carry U(1)*{N} charges. One family of Higgs-like doublets and one SM singlet develop vacuum expectation values. The fermionic partners of other Higgs-like fields and SM singlets form Inert neutralino and chargino states. Two lightest Inert neutralinos tend to be the lightest and next-to-lightest SUSY particles (LSP and NLSP). The considered model can account for the dark matter relic abundance if the lightest Inert neutralino has mass close to half the Z mass. In this case the usual SM-like Higgs boson decays more than 95% of the time into either LSPs or NLSPs. As a result the decays of the lightest Higgs boson into
l^{+} l^{-} + X might play an essential role in the Higgs searches. This scenario also predicts other light Inert chargino and neutralino states below 200 GeV, and large LSP direct detection cross-sections which is on the edge of observability of XENON100.

Beyond the Standard Model / 115

Search for supersymmetry in final state containing isolated electrons and muons, jets, and missing transverse momentum from sqrt(s)=7 TeV proton-proton collisions at the LHC

Author: Tapas Sarangi[1]

[1] *University of Wisconsin*

Corresponding Author: tapas.sarangi@cern.ch

We report on searches for supersymmetry in events with one, two or multi-lepton final states with the 2011 data from the ATLAS experiment. In case of no excess observed a 95% CL upper limit is set for squark and gluino masses for different signal models. A 95% CL limit on the cross section times branching ratios times efficiency is set for
different final states under study.

Detector Technology and R&D / 116

CMS pixel detector upgrade

Author: Neeti Parashar[1]

[1] *Purdue University Calumet*

Corresponding Author: neeti.parashar@cern.ch

The present Compact Muon Solenoid silicon pixel tracking system has been designed for a peak luminosity of 10^{34} $cm^{-2}s^{-1}$ and total dose corresponding to two years of the Large Hadron Collider (LHC) operation. With the steady increase of the luminosity expected at the LHC, a new pixel detector with four barrel layers and three endcap disks is being designed. We will present the key points of the design: the new geometry, which minimizes the material budget and increases the tracking points, and the development of a fast digital readout architecture, which ensures readout efficiency even at high rate. The expected performances for tracking and vertexing of the new pixel detector are also addressed.

Detector Technology and R&D / 117

Study of the readout chip and silicon sensor degradation for the CMS pixel upgrade

Author: gemma Tinti[1]

[1] *Department of Physics and Astronomy-University of Kansas*

Corresponding Author: gemma.maria.tinti@cern.ch

Hybrid silicon pixel detectors are currently used in the innermost tracking system of the Compact Muon Solenoid (CMS) experiment. Radiation tolerance up to fluences expected for a few years of running of Large Hadron Collider (LHC) has already been proved, although some degradation of the part of the silicon detector closer to the interaction point is expected. During the LHC upgrade phases, the level of dose foreseen for the silicon pixel detector will be much higher. To face this aspect, dedicated irradiation tests with fluences above $\mathcal{O}(\infty\prime^{\infty\bigtriangledown})\tilde{}n_{eq}/cm^2$ have been performed on the silicon sensor and readout chip. Changes in the operation of the sensor and readout chip as a function of the fluence are presented. The charge collection efficiency has been studied: partial recovery of the detector efficiency can be achieved by operating the detectors in a controlled environment and at higher bias voltage.

Detector Technology and R&D / 118

Performance of the CMS Electromagnetic Calorimeter at the LHC

Author: Marco Grassi[1]

[1] *Universita di Roma I 'La Sapienza'-Universita e INFN, Roma I*

Corresponding Author: marco.grassi@cern.ch

The CMS Electromagnetic Calorimeter (ECAL) is a high resolution, fine grained calorimeter devised to measure photons and electrons at the LHC. Built of lead tungstate crystals, it plays a crucial role in the search for new physics as well as in precision measurements of the Standard Model. A pre-shower detector composed of sandwiches of lead and silicon strips improves pi-0/gamma separation in the forward region. The operation and performance of the ECAL during the 2010 run at the LHC, with pp collisions at $\sqrt{s}$ = 7 TeV will be reviewed, and to some extent for the 2011 running as well. Pure samples of electrons and photons from decays of known resonances have been exploited to improve and verify the trigger efficiency, the reconstruction algorithms, the detector calibration and stability, and the particle identification efficiency. A review of these aspects will be given.

Computing in HEP / **119**

CMS Computing: Performance and Outlook

Author: Kenneth Bloom[1]

[1] *Department of Physics and Astronomy-University of Nebraska*

Corresponding Author: kenbloom@unl.edu

After years of development, the CMS distributed computing system is now in full operation. The LHC continues to set records for instantaneous luminosity, recording data at 300 Hz. Because of the intensity of the beams, there are multiple proton-proton interactions per beam crossing, leading to larger and larger event sizes and processing times. The CMS computing system has responded admirably to these challenges. We will present the present status of the system, describe the recent performance, and discuss the challenges ahead and how we intend to meet them.

Electroweak Physics / **120**

Rates of Jets Produced in Association with W and Z Bosons

Author: Kira Suzanne Grogg[1]

[1] *Department of Physics-University of Wisconsin*

Corresponding Author: kira.suzanne.grogg@cern.ch

We present a study of jets produced in association with vector bosons production in pp collisions at center-of-mass energy of 7 TeV using the full CMS 2010 data set, corresponding to 36 pb−1. The transverse energy distribution of the reconstructed leading jets is measured and compared to theoretical expectations. The jet multiplicity distributions are efficiency corrected and unfolded . The ratios of multiplicities, sigma(V+n+1)/sigma(V+n) and sigma(W +n)/sigma(Z +n) where n stands for n jets, are also presented.

Perturbative and non-Perturbative QCD / **124**

First Measurement of the isolated prompt diphoton production cross-section in CMS at sqrt(s)=7 TeV

Author: Laurent Millischer[1]

[1] *IRFU-CEA - Centre d'Etudes de Saclay (CEA)*

Corresponding Author: laurent.millischer@cern.ch

Events with two isolated photons are a useful probe of hard-scattering QCD. Also, uncertainty in sigma(diphoton + X) is a major source of systematic error for Higgs and exotic diphoton searches. We present the first measurement of the isolated differential diphoton cross-section from proton-proton collisions at a center-of-mass energy of 7 TeV with the Compact Muon Solenoid detector at CERN. We compare the results with next-to-leading-order perturbative QCD calculations.

Perturbative and non-Perturbative QCD / 125

Measurements of the forward energy flow and forward jet production with CMS.

Author: Hans Jozef H Van Haevermaet[1]

[1] *Universiteit Antwerpen Physics Department*

Corresponding Author: hans.van.haevermaet@cern.ch

We present measurements of the forward (3 < |eta| < 5) energy flow in minimum bias events and in events with either hard jets or W and Z bosons produced at central rapidities. Results are compared to MC models with different parameter tunes for the description of the underlying event.

Beyond the Standard Model / 132

Search for new physics with same-sign isolated dilepton events with jets and missing transverse energy at CMS

Author: Marc Gabriel Weinberg[1]

[1] *Department of Physics-University of Wisconsin*

Corresponding Author: marc.gabriel.weinberg@cern.ch

The results of searches for Supersymmetry in events with two same-sign isolated leptons, hadronic jets, and missing transverse energy in the final state are presented. The searches use pp collisions at 7 TeV collected in 2011 by the CMS experiment.

Beyond the Standard Model / 133

Search for Physics Beyond the Standard Model in Opposite-Sign Dilepton Events at CMS

Author: Derek Michael Barge[1]

[1] *Physics Department-Univ. of California Santa Barbara*

Corresponding Author: derek.michael.barge@cern.ch

The results of searches for Supersymmetry in events with two opposite-sign isolated leptons, hadronic jets, and missing transverse energy in the final state are presented. The searches use pp collisions at 7 TeV collected in 2011 by the CMS experiment.

Beyond the Standard Model / **134**

Search for Supersymmetry at CMS in events with three or more leptons

Author: Sho Maruyama[1]

[1] *Department of Physics-University of California Davis (UCD)*

Corresponding Author: sho.maruyama@cern.ch

A search for physics beyond the Standard Model (SM) is performed using events with at least three leptons and any number of jets. The search is performed in data collected in 2011 by the CMS experiment at the LHC in pp-collisions at a center of mass energy of 7 TeV. Numerous leptonic channels have been investigated in an exclusive manner and data-driven techniques are used to quantify the SM backgrounds. The results are used to constrain hitherto unexplored regions of supersymmetry that have significant multilepton yield at 7 TeV pp-collisions.

Perturbative and non-Perturbative QCD / **136**

Soft QCD results from CMS

Author: Monika Grothe[1]

[1] *U Wisconsin*

Corresponding Authors: dayong.wang@cern.ch, monika.grothe@cern.ch

Studies of hadron production in pp collisions, including charged particle transverse momentum, pseudorapidity and event-by-event multiplicity distributions at sqrt(s) = 0.9, 2.36 and 7 TeV are shown. Measured spectra of identified strange hadrons, reconstructed based on their decay topology, are also presented. Comparisons to several QCD Monte Carlo models and tunes are discussed. Results on two-particle angular correlations over a broad range of pseudorapidity and azimuthal angle in pp collisions are presented at sqrt(s) = 0.9 and 7 TeV. In high multiplicity events, a pronounced structure emerges in the two-dimensional correlation function for particle pairs with intermediate transverse momentum of 1-3 GeV/c. Furthermore, Bose-Einstein correlations between identical particles are measured in samples of proton-proton collisions at sqrt(s) = 0.9 and 7 TeV. Finally, a measurement of the underlying activity in scattering processes with a pT scale in the several GeV region is also presented.

Heavy Flavor Physics / **138**

Measurements of inclusive B-quark production at 7 TeV with the CMS experiment

Author: gemma Tinti[1]

[1] *Department of Physics and Astronomy-University of Kansas*

Corresponding Author: gemma.maria.tinti@cern.ch

Measurements performed by the CMS experiment of the cross section for inclusive b-quark production in proton-proton collisions at sqrt(s) = 7 TeV are presented. The measurements are based on different methods, such as inclusive jet measurements with secondary vertex tagging or selecting a sample of events containing jets and at least one muon, where the transverse momentum of the muon with respect to the closest jet axis discriminates b events from the background. The results are compared with predictions based on perturbative QCD calculations at leading and next-to-leading order.

Heavy Flavor Physics / **140**

Search for B_(s,d)->mumu in CMS

Author: Jose Lazo-Flores[1]

[1] *University of Nebraska*

Corresponding Author: jose.lazo-flores@cern.ch

The rare decays B_(s,d) ->mumu provide an excellent test of the flavor sector of the Standard Model and provide sensitivity to models of new physics with extended Higgs boson sectors. We report on a search for these decays with the CMS experiment using data taken until Summer 2011.

Heavy Flavor Physics / **141**

Measurement of Quarkonia production at 7 TeV with the CMS experiment

Author: Yu Zheng[1]

[1] *Purdue University*

Corresponding Author: yu.zheng@cern.ch

The measurement of J/psi and Y production cross section in proton-proton collisions at $\sqrt{s}$ = 7 TeV is presented using a data sample collected with the CMS detector at the LHC. We also report the measurement of the ratio of X(3872) and psi(2S) signal yields.

Higgs Physics / **142**

Search for Higgs Boson in Diphoton Final State with the ATLAS Detector

Author: Haichen Wang[1]

[1] *University of Wisconsin-Madison*

Corresponding Author: haichen.wang@cern.ch

Diphoton final state is one of the most sensitive channels to a Higgs search in the low mass region (115GeV-140GeV). The analysis is optimized to search for a Standard Model (SM) Higgs and dominates the SM Higgs combination in the mass range lower than 120GeV. Nevertheless, an inclusive search strategy adopted is also sensitive to find a low mass diphoton resonance that could be predicted by some new physics models.

Electroweak Physics / 143

Measurement of the Transverse Momentum Distribution of Z/gamma* Bosons in 7TeV Proton-Proton Collisions with the ATLAS Detector

Author: Jianbei Liu[1]

[1] *University of Michigan*

Corresponding Author: jianbei.liu@cern.ch

I present a measurement of the Z/gamma*transverse momentum (pTZ) distribution in proton-proton collisions at √s=7TeV using Z/gamma*->e+e− and Z/gamma*->μ+μ− decays in data samples corresponding to integrated luminosities of 35 pbˆ−1 and 40 pbˆ−1 respectively, taken in 2010 with the ATLAS detector. The normalized pTZ distributions are measured separately for electron and muon decay channels as well as for their combination up to pTZ of 350 GeV. The combined measurement is compared to predictions of perturbative QCD and various event generators.

Particle Astrophysics and Cosmology / 144

The MiniCLEAN Dark Matter Experiment

Author: Andrew Hime[1]

[1] *Los Alamos National Laboratory*

Corresponding Author: ahime@lanl.gov

The MiniCLEAN dark matter experiment exploits a single-phase liquid argon (LAr) detector, instrumented with photomultiplier tubes submerged in the cryogen with nearly 4pi coverage of a 500 kg (150 kg) target (fiducial) mass. The high light yield and unique properties of the scintillation time-profile in LAr provide effective defense against radioactive backgrounds through pulse-shape discrimination and event position-reconstruction. The detector is also designed for a liquid neon target which, in the event of a positive signal in LAr, will enable an independent verification of backgrounds and provide a unique test of the expected Aˆ2 dependence of the WIMP interaction rate. The conceptually simple design can be scaled to target masses in excess of 10 tons in a relatively straightforward and economic manner. The experimental technique and current status of MiniCLEAN will be summarized.

Electroweak Physics / 145

WW Cross Section Measurement and Limits on Anomalous TGCs with the ATLAS Detector

Author: Haijun Yang[1]

[1] *University of Michigan*

Corresponding Author: haijun.yang@cern.ch

I will report on measurement of the WW production cross section and associated limits on anomalous couplings using LHC proton-proton collision data collected by the ATLAS Detector at 7 TeV center-of-mass energy. The production cross section was measured in the WW leptonic decay channels. Precise measurement of the triple-gauge-boson couplings is a stringent test of the Standard Model and also a sensitive probe to new physics in the bosonic sector that could provide complementary information to direct searches for new physics at LHC. Results about the WWgamma and WWZ triple-gauge-boson coupling limits will be presented.

Beyond the Standard Model / 146

Search for Chargino-Neutralino Associated Production in Dilepton Final States with Tau Leptons

Author: Robert Forrest[1]

Co-author: Maxwell Chertok [1]

[1] *UC Davis*

Corresponding Author: rforrest@physics.ucdavis.edu

We present a search for chargino and neutralino supersymmetric particles yielding same signed dilepton final states including one hadronically decaying tau lepton using 6.0 fbˆ-1 of data collected by the the CDF II detector. This signature is important in SUSY models where, at high \tan{\beta}, the branching ratio of charginos and neutralinos to tau leptons becomes dominant. We study event acceptance, lepton identification cuts, and efficiencies. We set limits on the production cross section as a function of SUSY particle mass for certain generic models.

Neutrino Physics / 147

The Majorana Demonstrator Project

Author: Frank Avignone[1]

[1] *University of South Carolina*

Corresponding Author: avignone@sc.edu

The Demonstrator will comprise two cryostats containing a total of 70,p-type point-contact Ge detectors. The Collaboration is acquiring
45 -kg of Ge enriched to more than 86% in Ge-76. The goal is to have at least 20-kg of enriched germanium in detectors. The remaining space in the cryostats will be occupied by at least 20-kg of natural abundance Ge detectors. The two detector arrays will be operated in a common bulk passive and active shield in the Sanford Laboratory in Lead, South Dakota, with 4000 meters water equivalent overburden. The operation of a prototype cryostat with only natural detectors is scheduled to operate in early 2013. It will be followed by the first ultra-clean module, which will begin operation later in 2013. The second module is scheduled to begin operation in 2014. An overview and status report of the project will be given.

Accelerator Physics / 148

High Power, High Energy Cyclotrons for Decay-At-Rest Neutrino Sources: The DAEdALUS Project

Author: Jose Alonso[1]

Co-authors: Janet Conrad [1]; Luciano Calabretta [2]; Michael Shaevitz [3]; William Barletta [1]

[1] *MIT-LNS*

[2] *INFN-LNS, Catania*

[3] *Columbia University*

Corresponding Author: jose.alonso@cern.ch

Neutrino physics from muon decay is very much at the forefront of today's physics research. Large detectors installed in deep underground locations perform neutrino mass, CP violation, and oscillation studies using long- and short-baseline beams of neutrinos from muons decaying in flight. DAEdALUS looks at neutrinos from stopped muons, "Decay At Rest (DAR)"neutrinos. The DAR neutrino spectrum has no electron antineutrinos (nu-e-bar) (pi-minus are absorbed to level of 10ˆ-4), so a detector with much hydrogen (water-Cherenkov or liquid scintillator) is sensitive to appearance of nu-e-bar's oscillating from nu-mu-bar via inverse-beta-decay. Oscillations are studied using shorter baselines, less than 20 km reaching the same L/E range as the current and planned neutrino experiments originating at Fermilab. As the neutrino flux is not variable, nor is the energy, the baseline is varied: plans call for 3 accelerator-based neutrino sources at 1.5, 8 and 20 km with staggered beam-on cycles. Key is cost-effectively generating megawatt beams of 800 MeV protons. A superconducting ring cyclotron, accelerating H2+ ions is being designed by L. Calabretta and his group at INFN-LNS-Catania. Having a design peak power of 8 MW, the 5 emA circulating beam is extracted via a stripping foil, avoiding beam-loss problems that would be encountered in classical cyclotron extraction. The molecular hydrogen beam also reduces the severity of space charge effects at the low-energy central region for the injected beam. The system consists of two cascaded cyclotrons, and an axial injection line from an external microwave source. >20 emA of H2+ ions, CW, are seen with an available source. The injector cyclotron will bring beam to 50 MeV/a, and a short transfer line will take beam to the main ˜15 meter diameter Ring cyclotron. This will consist of 8 sectors of superconducting magnets, with maximum field of 6 T. Isochronicity is maintained by field design and suitable trim coils. RF cavities between the magnet sectors accelerate the beam. An extraction channel of the lower-rigidity protons exiting the stripper foil is plotted through the highly-variable magnetic field, and exits cleanly from the machine. A large water-cooled graphite target provides the source of neutrinos from pi-mu decays. For DAEdALUS applications, each of the three machines will be run at ˜20% duty factor, so events in the detector can be tagged unambiguously with a source. Timing is arbitrary, beam on time for each machine can range from seconds to days. Average power from each source still exceeds 1 MW, providing adequate neutrino flux at the detector for very fine sensitivity to the measurements desired. It should be noted that the original, and even revolutionary design of these accelerators can facilitate many other "ADS" (Accelerator-Driven Systems) applications, such as driving subcritical reactors, waste transmutation, etc.

Summary:

The DAEdALUS experiment studies CP violation in the neutrino sector, and other neutrino properties using 800 MeV, megawatt beams of protons as sources of Decay-At-Rest neutrinos that are devoid of electron anti-neutrinos, and looking for appearance of these neutrinos in large detectors with high proton content (water Cherenkov or liquid scintillator). Basis for experiment is a new technology for superconducting cyclotrons accelerating H2+ ions. Using molecular hydrogen, and stripping extraction, avoids several of the problems of high-power beams in cyclotrons. The cyclotrons will be described.

Neutrino Physics / 149

Constraints on non-standard neutrino-matter interactions from MINOS

Author: Zeynep Isvan[1]

[1] *University of Pittsburgh*

Corresponding Author: zisvan@fnal.gov

MINOS searches for neutrino oscillations using the disappearance of muon neutrinos between two detectors, over a baseline of 735 km. We recently reported the most precise measurement of neutrino oscillations in the atmospheric sector and the first tagged measurement of antineutrino oscillations. The neutrino mass splitting and mixing angle are measured to be $|\Delta m^2| = 2.32^{+0.12}_{-0.08} \times 10^{-3}\, eV^2$ and $\sin^2 2\theta > 0.90$ (90\% C.L.) for an exposure of 7.25×10^{20} protons-on-target (PoT). Antineutrino oscillation parameters are measured as $\Delta\overline{m}^2 = (3.36^{+0.46}_{-0.40}\text{(stat.)} \pm 0.06\text{(syst.)}) \times 10^{-3}\, eV^2$ and $\sin^2(2\bar{\theta}) = 0.86^{+0.11}_{-0.12}\text{(stat.)} \pm 0.01\text{(syst.)}$ with an exposure of 1.7×10^{20} PoT in NuMI antineutrino running mode. We use the apparent difference in neutrino and antineutrino oscillation parameters to constrain non-standard matter interactions which could occur during propagation through the Earth's crust to the far detector.

Field and String Theory / 150

Manifest SO(N) invariance and S-matrices of three-dimensional N=2,4,8 SYM

Authors: Abhishek Agarwal[1]; Donovan Young[2]

[1] *American Physical Society*

[2] *Neils Bohr Institute*

Corresponding Author: avishek.agarwal@gmail.com

An on-shell formalism for the computation of S-matrices of SYM theories in three spacetime dimensions will be presented. The framework is a generalization of the spinor-helicity formalism in four dimensions. The formalism will be applied to establish the manifest SO(N) covariance of the on-shell superalgebra relevant to N =2,4 and 8 SYM theories in d=3. The results will be used to argue for the SO(N) invariance of the S-matrices of these theories: a claim which will be proved explicitly for the four-particle scattering amplitudes. Recursion relations relating tree amplitudes of three-dimensional SYM theories will be shown to follow from their four-dimensional counterparts. The results for the four-particle amplitudes will be shown to be verified by tree-level perturbative computations and a unitarity based construction of the integrand corresponding to the leading perturbative correction will also be presented for the N=8 theory. For N=8 SYM, the manifest SO(8) symmetry will be used to develop a map between the color-ordered amplitudes of the SYM and superconformal Chern-Simons theories, providing a direct connection between on-shell observables of D2 and M2-brane theories.

Beyond the Standard Model / 151

Supersymmetric multiple Higgs doublet models

Author: Sherwin Love[1]

[1] *purdue university*

Corresponding Author: loves@purdue.edu

The minimal supersymmetric standard model (MSSM) is extended by the inclusion of an addition pair of constrained Higgs doublet superfields through which the electroweak symmetry breaking is nonlinearly realized. The superpotential coupling to the MSSM Higgs doublet then generates

its vacuum expectation value. The resultant Higgs scalars and Higgsino-gaugino mass spectrum is presented for several choices of SUSY breaking and Higgs superpotential mass parameters and the results are contrasted with those of the MSSM.

Neutrino Physics / 152

Electron Antineutrino Appearance in MINOS

Author: Adam Schreckenberger[1]

[1] *University of Minnesota*

Corresponding Author: adams@physics.umn.edu

The Main Injector Neutrino Oscillation Search (MINOS) is a long-baseline neutrino experiment that utilizes Fermilab's NuMI beam and two steel-scintillator calorimeters. Designed to search for νμ disappearance, MINOS provides an opportunity to study νe appearance as well. Analysis methods developed by the MINOS νe group have facilitated the placement of limits upon the mixing angle associated with νμ to νe oscillations. In addition, the experiment is capable of repeating its analyses using an antineutrino beam. Recent observations of anti-νμ disappearance have motivated supplementary data collection with the antineutrino beam configuration. The benefits of an anti-νe appearance study and MINOS's anti-νe sensitivity will be presented.

Neutrino Physics / 153

Charged Current Quasi-Elastic Scattering of Muon Neutrinos at the T2K Near Detector

Author: Brian Kirby[1]

[1] *University of British Columbia*

Corresponding Author: kirbybri@phas.ubc.ca

T2K (Tokai-to-Kamioka) is a long-baseline neutrino oscillation experiment designed to search for electron neutrino appearance. An intense off-axis muon neutrino beam produced at the JPARC facility in Tokai is analyzed at two locations, the first a set of detectors 280 m from the production point (ND280) and the second the Super-Kamiokande detector (SK) 295 km away. The ND280 detectors can identify a variety of neutrino interaction processes including the charged current quasi-elastic (CCQE) interactions used in conjunction with the neutrino beam simulation to predict the neutrino flux and energy spectrum at SK. This "golden mode" provides precise measurements of the flux and spectrum and can also be used to measure the neutrino beam's flavor content. This talk will describe the results of the first inclusive charged current rate measurement made at ND280, the ability of the detector to identify exclusive channels, and the latest status of the CCQE measurement at ND280.

Electroweak Physics / 154

Two-loop corrections to W and Z boson production at high pT

Author: Nikolaos Kidonakis[1]

[1] *Kennesaw State University*

Corresponding Author: nkidonak@kennesaw.edu

I present new results for the complete two-loop corrections in the soft approximation for W and Z boson production at large transverse momentum. Analytical expressions for the NNLO approximate transverse momentum distributions are derived. Results for W boson production at Tevatron and LHC energies are presented.

Neutrino Physics / **155**

Daya Bay Neutrino Experiment: Goal, Progress and Schedule

Author: Zhe Wang[1]

[1] *Brookhaven National Laboratory*

Corresponding Author: wangzhe@bnl.gov

The discovery of neutrino oscillation, as a breakthrough in particle physics, motivated the Daya Bay Neutrino Experiment, which is designed to make a precise measurement of the last unknown neutrino mixing angle theta13, with a sensitivity 0.01 for sinˆ2(2*theta13), using reactor anti-neutrino from 17.4GW Daya Bay Nuclear Power Plant located in Shenzhen, China. This talk will introduce the goal of this experiment including an overall introduction of site and baseline selection, detector optimization, current construction progress and schedule for expected data taking.

Beyond the Standard Model / **156**

Search for New Physics in pp Collisions at √s = 7 TeV in Final States with Missing Transverse Energy and Heavy Flavor

Author: Bart Butler[1]

[1] *SLAC*

Corresponding Author: bart.butler@cern.ch

Results are presented of a search for new physics in events with large missing transverse energy and heavy flavor jet candidates in √s=7 TeV proton-proton collisions with the ATLAS detector at the Large Hadron Collider. Several signal regions corresponding to different regions of phase space are examined. The results are interpreted in the context of phenomenological simplified new physics models as well as universal new physics models such as mSUGRA.

Computing in HEP / **157**

ATLAS Petascale Data Processing on the Grid: Facilitating Physics Discoveries at the LHC

Authors: Alexandre Vaniachine[1]; Alexei Klimentov[2]; Jonas Strandberg[3]; Junji Tojo[4]; Pavel Nevski[2]; Rodney Walker[5]; Wensheng Deng[2]

[1] *Argonne*

[2] *BNL*

[3] *KTH*

[4] *KEK*

[5] *LMU*

Corresponding Author: vaniachine@anl.gov

ATLAS detector is in the second year of the LHC long run. A starting point for ATLAS physics analysis is data reconstruction. Following the prompt reconstruction, the ATLAS data is reprocessed. The reprocessing allows reconstruction of the data with improved software and updated calibrations, which provides the coherence and improves physics quality of the reconstructed data.

The large-scale data reprocessing campaigns are conducted on the Grid. Computing centers around the world participate in reprocessing providing tens of thousands of CPU-cores for a faster throughput. Reprocessing relies upon underlying ATLAS tools and technologies assuring reproducibility of results, scalable database access, orchestrated workflow and performance monitoring, dynamic workload sharing, and petascale data integrity control. Same tools empower ATLAS physics groups in further data processing steps on the Grid. These tools were adopted for the trigger reprocessing required to validate new trigger menus or other trigger changes critical during 2011 LHC operations.

To facilitate physics discoveries we must minimize unrecoverable event losses. This is assured by automated resubmission of the failed data processing jobs, which excludes transient failures. The events that were not possible to reconstruct during the reprocessing campaign are recovered shortly in a dedicated post-processing step using an updated software release and/or conditions.

We describe ATLAS technologies developed to eliminate the event losses in Petascale data processing and present the experience of large-scale data reprocessing campaigns and group data processing on the Grid.

Summary:

We present the experience of large-scale ATLAS data reprocessing campaigns and group data processing on the Grid.

Neutrino Physics / **158**

Confronting Recent Neutrino Oscillation Data with Sterile Neutrinos

Author: Georgia KARAGIORGI[1]

[1] *Columbia University*

Corresponding Author: georgia@nevis.columbia.edu

Recent neutrino oscillation results have provoked renewed interest in sterile neutrino models. This talk will review the data from MiniBooNE, MINOS and reactor neutrinos. We incorporate these results as well as new electron neutrino disappearance data into our fits, and expand the model to address matter effects. We discuss how future experiments will resolve the questions that have been raised.

Electroweak Physics / **159**

Search for WW/WZ in Lepton plus Neutrino plus Heavy Flavor Dijet Final States at CDF

Author: Federico Sforza[1]

[1] *INFN Pisa*

Corresponding Author: sforza@fnal.gov

We present a search for WW/WZ diboson production in the lepton plus neutrino plus heavy flavor dijet channel at the CDFII experiment. After successful observation of WW/WZ in the inclusive lepton plus neutrino plus dijet channel, we now focus on the identification of this process in cases where either a W or Z boson decays into one or more heavy flavor quarks. The search uses events with a single reconstructed electron or muon, large missing transverse energy and two reconstructed jets, which are collected using a number of orthogonal trigger paths. In comparison with the previous analysis we have improved the rejection of the QCD multijet background using a Support Vector Machine algorithm, which considerably improves background rejection.

Education and Outreach / **160**

Education and Public Outreach Activities of the Laser Interferometer Gravitational-Wave Observatory

Author: Marco Cavaglia[1]

Co-author: William Katzman [2]

[1] *University of Mississippi*

[2] *California Institute of Technology*

Gravitational waves are produced by some of the most energetic and dramatic phenomena in the Universe: Black holes, neutron stars and supernovae. As powerful as they are are at their sources, gravitational waves are incredibly elusive by the time they reach the Earth. Although gravitational waves were predicted almost a century ago (as a consequence of General Relativity), they still have not been directly detected. In the past few years, the Laser Interferometer Gravitational-wave Observatory (LIGO) and its international partners have been hunting for gravitational waves. The initial LIGO instruments were among the most sensitive scientific instruments on the planet. Their sensitivity will achieve further significant improvement with the current construction of Advanced LIGO. Direct detection of gravitational waves will allow scientists to explore the death throes of stars, the origin of dark energy and the nature of space-time in a way humans never have before. LIGO technology will push the frontiers of science and engineering in many areas, from lasers and materials science to high performance computing.

The nascent field of gravitational-wave astronomy and the LIGO project offer many opportunities for effective and inspirational astronomy and physics outreach, and provide a powerful showcase for the attractions and challenges of a career in science and engineering. In this talk we describe the extensive program of public outreach and education activities already undertaken by the LIGO Scientific Collaboration - from traveling exhibits, to student field trips, and more. We will also talk about a number of special events which are being planned for the next few years.

Hadron Spectroscopy / **161**

A new algorithm to estimate quark propagation in Lattice QCD

Author: Keisuke Juge[1]

Co-authors: Colin Morningstar [2]; David Lenkner [3]; John Bulava [4]; Justin Foley [5]; Michael Peardon [6]; Ricky Wong [3]

[1] *University of the Pacific*

[2] *Carnegie Mellon Univ.*

[3] *Carnegie Mellon Univ*

[4] *DESY Zeuthen*

[5] *University of Utah*

[6] *Trinity College Dublin*

Corresponding Author: kjuge@pacific.edu

A new algorithm ("stochastic LapH") for computing hadronic correlation functions in Lattice QCD will be presented. Lattice QCD is a framework in which the nonperturbative, first principles computation of hadronic correlation functions is possible. It requires a lattice regulation of QCD in a finite Euclidean space-time where correlation functions are evaluated numerically via Monte-Carlo integration methods. The asymptotic behaviour of correlation functions in Euclidan time is then used to extract the energies of the hadronic states of interest.

This approach of computing correlation functions becomes numerically very challenging as one attempts to evaluate multi-hadron correlators and disconnected diagrams due to the rapid increase in the number of quark propagators involved in the calculation. Each quark propagator is obtained from an inversion of the 4-dimensional Dirac matrix in a finite, but large volume. Disconnected diagrams (quark loop diagrams) are particularly problematic because they require quark propagators from every point on a timeslice to every other point on the same timeslice, for all timeslices of the lattice.

The cost of inverting the Dirac matrix, in terms of CPU cycles, increases as the quark mass being simulated approaches the physical values and the space-time volume is enlarged to reduce the finite size effects. It is not possible to compute these "all-to-all" quark propagators with the current resources available which limits the physics that can be addressed in Lattice QCD.

The standard solution is to stochastically estimate the all-to-all propagators with random noise sources. This method, however, introduces a lot of noise into the calculation which is reduced by performing more and more inversions. The stochastic LapH algorithm for inverting quark propagators solves this "using noise to cancel noise" approach by first reducing the space by cutting out the high frequencies (LapH) and then introducing noise sources in the LapH subspace.

The usual volume scaling problems of all-to-all algorithms are absent in this method and the judicious choice of noise-dilution schemes makes the algorithm practical for real simulations near physical values of the quark masses. The signal for selected correlation functions will be shown to demonstrate the efficacy of the algorithm.

Education and Outreach / **162**

Education and Public Outreach of the Pierre Auger Observatory

Author: Gregory Snow[1]

[1] *University of Nebraska*

Corresponding Author: gsnow@unlhep.unl.edu

The scale and scope of the physics studied at the Auger Observatory offer significant opportunities for original outreach work. Education, outreach and public relations of the Auger collaboration are coordinated in a separate task whose goals are to encourage and support a wide range of education and outreach efforts that link schools and the public with the Auger scientists and the science of cosmic rays, particle physics, and associated technologies. The presentation will focus on the impact

of the collaboration in Mendoza Province, Argentina, as: the Auger Visitor Center in Malargüe that has hosted over 60,000 visitors since 2001 and a third collaboration-sponsored science fair held on the Observatory campus in November 2010. The Rural Schools Program, which is run by Observatory staff and which brings cosmic-ray science and infrastructure improvements to remote schools, will be highlighted. Numerous online resources, video documentaries, and animations of extensive air showers have been created for wide public release. Increasingly, collaborators draw on these resources to develop Auger related displays and outreach events at their institutions and in public settings to disseminate the science and successes of the Observatory worldwide.

Detector Technology and R&D / 164

Chronopixel Detector Development for Vertex Detectors for future e+e- Colliders

Author: Charles Baltay[1]

Co-authors: David Rabinowitz [1]; David Strom [2]; James Brau [2]; Nicholas Sinev [2]

[1] *Yale University*

[2] *University of Oregon*

Corresponding Author: charles.baltay@yale.edu

Studies carried out in the U.S., Europe, and Asia, have demonstrated the power of a pixel vertex detector in physics investigations at a future high energy linear collider. At one time, silicon CCD' s (Charged Coupled Devices) seemed like the detector elements of choice for vertex detectors for future Linear e+ e- Colliders. However, with the decision for a cold TESLA-like superconducting technology for the future International Linear Collider (ILC), the usefulness of CCD's for vertex detection has become problematical. The time structure of this cold technology is such that it necessitates an extremely fast readout of the vertex detector elements and thus CCD's as we know them will not be useful. New CCD architectures are under development but have yet to achieve the required performance. For these reasons there is an increased importance on the development of Monolithic CMOS pixel detectors that allow extremely fast non sequential readout of only those pixels that have hits in them. This feature significantly decreases the readout time required. Recognizing the potential of a Monolithic CMOS detector, we initiated an R&D effort to develop such devices3. Another important feature of our present conceptual design for these CMOS detectors is the possibility of putting a time stamp on each hit with sufficient precision to assign each hit to a particular bunch crossing. This significantly reduces the effective backgrounds in that in the reconstruction of any particular event of interest we only need to consider those hits in the vertex detectors that come from the same bunch crossing.

The current Chronopixel design is for chips up to 12.5 cm x 2.0 cm in size with a single layer of 10 μ m x 10 μ m charge sensitive pixels. Each pixel has its own electronics under it, but both the sensitive layer and the electronics are made of one piece of silicon (monolithic CMOS) which can be thinned to a total thickness of 50 to 100 μ m, with no need for indium bump bonds. The electronics for each pixel will detect hits above an adjustable threshold. For each hit the time of the hit is stored in each pixel, up to a total of four different hit times per pixel, with sufficient precision to assign each hit to a particular beam crossing (thus the name "chronopixels"for this device). Hits will be accumulated for the 2820 beam crossing of a bunch train and the chip is read out during the 200 millisec gap between bunch trains. There is sufficient intelligence in each pixel so that only pixels with one or more hits are read out, with the x,y coordinates and the time t for each hit. With 10 micron size pixels we do not need analog information to reach a 3 to 4 micron precision so at the present we plan on digital read out, considerably simplifying the read out electronics.

We have developed a design, in collaboration with SARNOFF Research Labs of Princeton,N.J., of the Chronopixel devices that satisfy the requirements of the proposed ILC. The detailed design has been completed and SARNOFF has fabricated the first set of prototype devices. We have designed and built, with the help of SLAC, the electronics to test these prototypes. We have completed the test of the first prototypes. We found that they mostly work as designed but have some design flaws. In

consultation with SARNOFF we defined the parameters for the second set of prototypes, correcting the flaws of the first prototype and further improving the design,The detailed design of the second prototype is now in progress at SARNOFF and we expect the fabrication of the second prototype to be completed later this year.

The design of these Chronopixel detectors, the results of the tests of the first prototypes, and the design of the second prototype, will be presented.

Summary:

The University of Oregon and Yale University are carrying out an R&D program to develop the Chronopixel sensor, a CMOS pixel device, for Vertex Detectors for future high energy colliders. The unique feature of these sensors is the ability to record the time of each hit with sufficient precision to assign each hit to a specific bunch crossing of the collider (hence the name Chronopixel). This reduces the backgrounds due to integration over many beam crossings to a virtually negligible level at the linear collider.

Poster Session / 166

On a Singular Solution in Higgs Field (2) - A Representation of Certain f0 Mesons' Masses.

Author: Kazuyoshi Kitazawa[1]

[1] *Mitsui Chemicals*

Corresponding Author: risp.kitazawa@nifty.com

In preceding paper 1) the mass and the basic structure of SM Higgs boson (H0) were discussed by obtaining asymptotic solution for the Euler-Lagrange equation of nonlinear Klein-Gordon type, in Higgs field with newly developed mass triangle method.
In this paper we at first see that the ground state mass of glueball (GB) is calculated at 502.55 MeV/c2 which is expected as f0(600) meson's mass. The GBs will attract mutually with neighbors among original their components of gluons in different colors, so that they could gradually form cluster. And we show that our computed masses of f0(1370), f0(1500) and f0(1710) are within each f0 meson's mass from experiment while they will construct respective fullerene structure for ur-H0 as well as f0(600), provided that the mass of ur-H0 (120.611 GeV/c2) will consist of a number of masses of GB or f0 in which all (pure) GB fullerene may have an icosahedral (Ih) rotational symmetry. Finally we propose a representation by which f0 mesons masses above are reproduced respectively with masses of several light pseudoscalar mesons such as η0, K0, K0_bar, K±, π0, π± and GB, under the consideration of those junction networks. Where the mass of f0(1500) is described only by the mass of GB. And also ur-H0 will transform into H0 under mass invariance through, for instance, γf0 reaction to ηc as its component via radiative decay of J/ψ. Along with these discussions, a massive gluon propagator for virtual top quark-pair decay is calculated by Bethe-Salpeter equation.

1)Kazuyoshi Kitazawa, APS APRIL MEETING 2011, K1.00034.

Beyond the Standard Model / 167

Collider Phenomenology of the E6SSM

Author: Roman Nevzorov[1]

Co-authors: Jonathan Hall [2]; Marc Sher [3]; Sandip Pakvasa [1]; Steve King [2]

[1] *University of Hawaii*

[2] *University of Southampton*

[3] *College of William and Mary*

Corresponding Author: nevzorov@phys.hawaii.edu

We consider collider signatures of the exceptional supersymmetric standard model (E6SSM). This model is based on the SM gauge group together with an extra U(1)*{N} gauge symmetry under which right–handed neutrinos have zero charge. To ensure anomaly cancellation and gauge coupling unification the low energy matter*
content of the E6SSM involve three 27 representations of E_6 and a pair of SU(2) doublets from additional 27 and \bar{27}. Thus E6SSM predicts
Z' boson and extra matter beyond the MSSM. In particular, the low–energy spectrum of the E6SSM involves three families of Higgs–like doublets, three families of exotic quarks and three SM singlets that carry U(1){N} charges. The E6SSM Higgs sector contains one family of the Higgs–like doublets and one SM singlet that develop vacuum expectation values (VEVs) breaking gauge symmetry. The fermionic
and bosonic components of other Higgs–like and singlet superfields form Inert neutralino and chargino states and Inert Higgs states respectively. Two lightest Inert neutralinos tend to be the lightest and next-to-lightest SUSY particles (LSP and NLSP).We analyse the Higgs sector, examine the spectrum and couplings of the Inert neutralinos and charginos and study cosmological implications of the E6SSM. The SM-like Higgs boson can be significantly heavier in the E6SSM than in the MSSM
and NMSSM. The model can account for the dark matter relic abundance if the lightest Inert neutralino has mass close to half the Z mass. In this case the SM-like Higgs boson decays more than 95% of the time into either LSPs or NLSPs. This scenario also predicts other light Inert chargino and neutralino states below 200 GeV, and large LSP direct detection cross-sections which is on the edge of observability of XENON100. We also examine the production of the Z' and exotic
quarks at the LHC. Since exotic quarks in the E6SSM can be either diquarks or leptoquarks they may provide spectacular new physics signals at the LHC.

Particle Astrophysics and Cosmology / **168**

The Dark Energy Survey Data Management System

Author: Ignacio Sevilla[1]

[1] *CIEMAT*

Corresponding Author: ignacio.sevilla@ciemat.es

The Dark Energy Survey (DES) is a project with the goal of building, installing and exploiting a new 70 CCD-camera at the Blanco telescope, in order to study the nature of cosmic acceleration. It will cover 5000 square degrees of the southern hemisphere sky and will record the positions and shapes of 300 million galaxies up to redshift 1.4. The survey will be completed using 525 nights during a 5-year period starting in 2012. About O(1 TB) of raw data will be produced every night, including science and calibration images. The DES data management system has been developed for the processing, calibration and archiving of these data. It is being developed by collaborating DES institutions, led by NCSA. In this contribution, we detail how a high performance computing environment is the best choice for this task, what kind of scientific codes are involved and how the Data Challenge process works, to improve simultaneously the Data Management system algorithms and the Science Working Group analysis codes.

Higgs Physics / **169**

Searches For The Higgs Boson With The CMS Detector

Author: Marat Gataullin[1]

[1] *Charles C. Lauritsen Lab. of HEPhys-California Institute of Tec*

Corresponding Author: marat.gataullin@cern.ch

We report on the various SM and BSM Higgs Boson searches conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Higgs Physics / **170**

A Search For The Higgs Boson In H –> ZZ–> 4l Mode

Author: Mario Pelliccioni[1]

[1] *Universita degli Studi di Torino-Universita e INFN*

Corresponding Author: mario.pellic@gmail.com

We report on a search for SM Higgs Boson in the mode H –> ZZ–> 4l conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Higgs Physics / **171**

A Search For The Higgs Boson In H –> WW

Author: Kevin Kai Hong Sung[1]

[1] *Massachusetts Inst. of Technology (MIT)*

Corresponding Author: kevin.kai.hong.sung@cern.ch

We report on a search for the Higgs boson in the decay mode H –> WW based on data collected by the CMS experiment during the 2010+2011 running of the LHC.

Neutrino Physics / **172**

Neutrino interactions in the NOvA near detector prototype

Author: Jaroslaw Nowak[1]

[1] *University of Minnesota*

Corresponding Author: nowak@physics.umn.edu

The NuMI Off-Axis electron neutrino Appearance (NOvA) experiment has started taking data with the 209 ton liquid scintillator-filled prototype of the near detector in the end of November 2010. This detector collects data from two sources, the Main Injector complex and from the Booster Neutrino Beam. At the location of the prototype detector due to the off-axis effect the NuMI beam is narrow with maximum around 2GeV. On the other hand the detector is on axis of the BNB beam and sees its maximum around 1GeV. This configuration gives the NOvA experiment a unique opportunity of studying neutrino and anti-neutrino interactions with carbon target from two low energy beams.
I will present physics program for the NOvA experiment focusing on the cross section measurements and preliminary data obtained with the near detector prototype.

Higgs Physics / 173

A Search For The Higgs Boson In H –> ZZ–> 2l 2nu Mode

Author: Daniele Trocino[1]

[1] *Department of Physics-Northeastern University*

Corresponding Author: daniele.trocino@cern.ch

We report on a search for SM Higgs Boson in the mode H –> ZZ–> 2l 2nu conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Higgs Physics / 174

A Search For The Higgs Boson In H –> ZZ –> 2l 2jet Mode

Author: Ashish Kumar[1]

[1] *Department of Physics-Physics Faculty-State University of New Y*

Corresponding Author: ashish.kumar@cern.ch

We report on a search for SM Higgs Boson in the mode H –> ZZ–> 2l 2jet conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Higgs Physics / 175

A Search For An Exotic Higgs In The Decay Mode H++ –> l+l+

Author: Monika Grothe[1]

[1] *U Wisconsin*

Corresponding Authors: chertok@physics.ucdavis.edu, monika.grothe@cern.ch

We report on a search for a doubly charged Higgs H++ –> l+l+ conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Higgs Physics / 176

A Search For MSSM Higgs Boson in the Mode H –> Tau Tau

Author: Louis James Antonelli[1]

[1] *Department of Physics-College of Science-University of Notre Da*

Corresponding Author: lantonel@cern.ch

We report on a search for a BSM Higgs Boson in the mode H –> Tau Tau conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Higgs Physics / **178**

A Search For The Higgs Boson In H –>Gamma Gamma Mode

Author: Christopher Allan Palmer[1]

[1] *Department of Physics-Univ. of California San Diego (UCSD)*

Corresponding Author: christopher.allan.palmer@cern.ch

We report on a search for SM Higgs Boson in the mode H –> gamma gamma conducted by the CMS experiment with the data accumulated during the 2010 & 2011 running of the LHC at sqrt(s) = 7 TeV.

Detector Technology and R&D / **180**

RADIATION-HARD ASICS FOR OPTICAL DATA TRANSMISSION

Author: Richard Kass[1]

[1] *Ohio State University*

Corresponding Author: kass.1@osu.edu

RADIATION-HARD ASICS FOR OPTICAL DATA TRANSMISSION

K.K. GAN, *P. BUCHHOLZ, H.P. KAGAN*, R.D. KASS, *J.R. MOORE*,
D.S. SMITH, *A. WIESE, M. ZIOLKOWSKI**

- Department of Physics, The Ohio State University, Columbus, OH 43210, USA ** Fachbereich Physik, Universität Siegen, Siegen, Germany

The LHC at CERN has successfully reached energies and luminosities beyond previous hadron accelerators. To take advantage of this situation the ATLAS experiment plans to add a new pixel layer to the current pixel detector during the 2013 shutdown. The optical data transmission system will also be upgraded to handle the higher data transmission speed. Two ASICs have been prototyped for this new generation of optical links to incorporate the experience gained from the current system. The ASICs were designed using a 130 nm CMOS process. One ASIC contains a 4-channel VCSEL driver array and the other a 4-channel PIN receiver/decoder array with one channel of each array designated as a spare to bypass a malfunctioning VCSEL or PIN channel.
Each of the receiver/decoder circuits includes pre-amplification, a bi-phase mark (BPM) clock/data recovery circuit, and low voltage differential signal (LVDS) outputs for both the clock and data. In order to allow remote control of the chip, the ASIC includes command decoders that have been designed to be single event upset (SEU) tolerant. The command word for configuring the chip is formed by a majority vote of the command decoders. To further improve the SEU tolerance, all latches are based on a dual interlocked storage cell (DICE) latch.
The driver ASIC is designed to operate at 5 Gb/s. Each channel has an LVDS receiver, an 8-bit DAC, and a VCSEL driver. One channel is designated as the spare channel and contains a 16:1 multiplexer. The multiplexer allows routing of the received signal from any of the three channels to the spare channel output. The 8-bit DAC is used to set the VCSEL modulation current. To enable operation in

case of a failure in the communication link to the command decoder, we have included a power on reset circuit that will set the VCSEL modulation current to 10 mA upon power up.
We characterized the ASICs and then irradiated them to measure their radiation hardness and SEU tolerance. We will present results from this study. In addition, a new version of the ASIC has been submitted for production. Here the ASICs have been expanded to 12 channels with improvements based on the prototype results. We will briefly discuss this new design.

Education and Outreach / **181**

Early education activities at the Sanford Underground Laboratory/DUSEL

Author: Margaret Norris[1]

Co-author: Benedict Sayler [2]

[1] *Sanford Underground Laboratory*

[2] *BHSU*

Corresponding Author: pnorris@sanfordlab.org

The Deep Underground Science and Engineering Laboratory (DUSEL) –proposed for the site of the former Homestake Goldmine in Lead, SD –will provide the facility and infrastructure for scientists to study some of the most compelling questions about the history and fate of our universe through its major experiments searching for direct evidence of dark matter and exploring the nature of neutrinos. The Sanford Underground Laboratory at Homestake - operated by the South Dakota Science and Technology Authority - is currently preparing the site and hosting early science and education activities.
The Sanford Center for Science Education (SCSE) is in the planning stages as the education component of DUSEL. The mission of the SCSE is to draw upon the science and engineering of DUSEL, its human resources, its unique facility and its setting within the Black Hills to inspire and prepare future generations of scientists, engineers, and science educators. As work proceeds towards design of the building, institution, and the programs and exhibits therein, early work has progressed towards establishing programs that build capacity and partnerships and begin to prototype innovative educational programming and exhibits to meet its educational vision.
As the Sanford Lab/DUSEL education team explores innovative ways to convey the excitement of DUSEL physics to audiences of all ages, successes and challenges from the first two years of early educational programming will be highlighted in this talk. Examples include:
For Students:
• The Davis-Bahcall Scholars Program
• Development of a conceptual modern physics course for K-12
For educators
• Professional development workshops
For the public
• Deep science lecture series
• Neutrino Days
Cultural connections
• Finding intersections between American Indian ways of knowing and modern cosmology

Summary:

The Sanford Center for Science Education (SCSE) is in the planning stages as the education component of DUSEL. As the Sanford Lab/DUSEL education team explores innovative ways to convey the excitement of DUSEL physics to audiences of all ages, successes and challenges from the first two years of early educational programming will be highlighted in this talk.

Neutrino Physics / **182**

The MicroBooNE Experiment

Author: Christina Ignarra[1]

[1] *MIT*

Corresponding Author: ignarra@mit.edu

The MicroBooNE experiment is a 170 ton Liquid Argon Time Projection Chamber (LArTPC) which will begin running at Fermilab in 2013. It's primary physics goal is to explore the low energy excess of events seen by the MiniBooNE experiment and it is the next step in the R&D to make LAr a viable option for future large neutrino detectors. This talk will present an overview of the MicroBooNE experiment with an emphasis on the light collection system and recent technical advances.

Beyond the Standard Model / 183

Detecting Fourth Generation Heavy Quarks at the LHC

Author: David Atwood[1]

Co-authors: Amarjit Soni [2]; Sudhir Kumar Gupta [1]

[1] *Iowa State University*

[2] *Brookhaven National Labs*

Corresponding Author: atwood@iastate.edu

In this talk, I will discuss the production of fourth generation quarks at the LHC. In particular, if such a quark has a mass in the phenomenologically interesting range of 400GeV-600 GeV and decays to a light quark and a W-boson, I will consider a number of possible signals through which it might be detected.

In general, the signals I consider include missing momentum together with jets and either a single high-Pt lepton, an opposite sign pair of high-Pt leptons or a same sign pair of high-Pt leptons. In each case I will discuss methods for separating the signal from the three generation Standard Model background. I will show that these methods should allow the detection of heavy fourth generation quarks for a wide range of quark mass and mixing rates.

Summary:

I discuss the phenomenology and detection of fourth generation quarks at the LHC.

Top Quark Physics / 184

Search for ttbar Resonances in the Lepton plus Jets Channel in pp Collisions at Sqrt(s)=7 TeV using the ATLAS Detector

Author: Venkatesh Kaushik[1]

[1] *University Of Arizona*

Corresponding Author: venkat.kaushik@cern.ch

Several Beyond the Standard Model (BSM) theories predict the existence of new resonances that decay into ttbar pairs.

We describe a search for such resonances using lepton plus jet data collected by the ATLAS experiment in pp collisions at Sqrt(s)=7 TeV. The selection criteria and search method are presented. In the absence of signal, we produce 95% CL limits on the production cross section times branching ratio of resonances predicted by a few such BSM models.

Education and Outreach / 185

Bringing the LHC and ATLAS to a planetarium

Author: Reinhard Schwienhorst[1]

[1] *Michigan State University*

Corresponding Author: schwier@pa.msu.edu

An outreach effort has started at Michigan State University to bring the physics of the LHC and the ATLAS detector to the Abrams planetarium on the MSU campus. MSU graduate and undergraduate students from Physics as well as from the College of Communication Arts & Sciences are putting together planetarium content on the LHC and its connection to astronomy, the big bang, and dark matter. I will report on this effort and present a first short clip.

Poster Session / 187

The Value of the Newton Gravitation Constant Derived From a Combined Sakharov and Kaluza-Klein Model of Baryo-Genesis and Gravity EM Unification

Author: john brandenburg[1]

[1] *Orbital Technologies Corporation*

Corresponding Author: brandenburgj@orbitec.com

A model of Sakharov (1967) baryo-genesis where the 5th , compactified, dimension of Kaluza-Klein (1926) theory does 'double duty'as the creator of lepton-baryon numbers and creator of separate EM and gravity equations is proposed. The appearance of the compactified dimension breaks the symmetry of the Planckian vacuum, allowing the vacuum quantities hbar, G, and c to generate the particle quantities e, mp and me , which are the charges and masses of the proton and electron respectively. Under this model the lepton-baryon asymmetry is a reflection time-space dimensional asymmetry and the relationship of the hidden dimension size, (in esu units) ro = eˆ2/(mocˆ2) ,where c is the speed of light, where mo=(mpme)ˆ1/2 , to the Planck Length, rp =(Ghbar/cˆ3)ˆ1/2 : is ln(ro/rp) = (mp/me)ˆ1/2 and mirrors the lepton-baryon separation. Inversion of this formula leads to a highly accurate formula for G, the Newton Gravitaion constant. Improvement of this model to apply corrections near the Planck scale results a formula for G further improvement in accuracy(in esu):
G = alpha (eˆ2/moˆ2)exp(-2((mp/me)ˆ1/2 -.86/(mp/me) ⋯) = 6.6728 x 10ˆ-8 dyn-cmˆ2-gˆ-2, where alpha is the fine structure constant. In the GEM theory of long range field unification (Brandenburg 1988, ,1995, 2010) gravity fields are equivalent to an array of ExB drift cells or Poynting vectors and EM and gravity fields separate with the appearance of the Kaluza-Kline 5th dimension. The predicted hidden dimension size is 3000.0 MeV and lies right between the eta-c and J/psi particles and almost exactly on the Sigma (3000) baryon. Assuming a model where the proton-electron (lepton-baryon) field unification occurs in a U(1) symmetry with imaginary rotation angle determined by normalized charge q/e and a multiplier ln(s') where s'= (mp/me)ˆ1/2 (the square root of the mass ratio) we obtain approximately, with qP =chbar (the Planck charge) , we obtain the approximate relation: MP/mp = exp(ln(s')qP/e) , where MP is the Planck Mass, when combined with the previous relations, we

obtain, to leading order, "The Transcendental Cosmos Equation"relating the value of alpha to s': s'= ln(s') (1/alphaˆ1/2 +1) –ln(1/alpha)˜42.85...This is similar to the "MIT Bag Model" (Chodos et al. ,1974)result s' ˜ (4pi/alpha)ˆ1/2 Humorously, this recalls the number "42" which appeared in Hichhikers Guide to the Galaxy as the " answer to life, the universe, and everything" however, this author makes no such claims.
Brandenburg J.E. (1988) APS Bull.,33, 1, p.32.Brandenburg, J. E., (1995), Astrophysics and Space Science, 227, pp. 133.Brandenburg J.E. (2010) OSAPS Meeting .Chodos, R. L. Jaffe, K. Johnson, and C. B. Thorn,(1974) Phys. Rev. D 10, 2599 Klein, Oskar Zeitschrift fur Physik, 37, 895, (1926).Sakharov A.D. JETP 5,24-27, (1967).

Summary:

Allowing Kaluza-Kline hidden dimension to do 'double duty' as the generator of both lepton and baryon numbers as well as allowing the separate appearance of EM and gravity fields, creates, with the triggering appearance of the hidden dimension of a selected size, a cosmos filled with hydrogen with two long-range forces, EM and Gravity. Rather than a grand unification this a "petite" unification, involving only the long-range forces of nature, which none-the-less gives a thumbnail sketch of the cosmos as it is. The hidden dimension size corresponds to 3000MeV , right between the eta-c and j/psi particles and almost exactly on the sigma(3000) baryon.

Neutrino Physics / **188**

Charged Particle Tracking in NOvA

Author: Nicholas Raddatz[1]

[1] *University of Minnesota*

Corresponding Author: raddatz@physics.umn.edu

The NuMI Off-Axis v Appearance (NOvA) experiment is a long baseline neutrino oscillation experiment using a neutrino source created from the NuMI Beamline at Fermilab. The experiment will study the oscillations of muon neutrinos to electron neutrinos using two functionally identical plastic, liquid scintillator filled detectors placed 14 milliradians off-axis to the NuMI beam. Charged current neutrino interactions will be used to observe the neutrino flavor from identification of the final state lepton. Reconstruction of muon charged particle tracks plays an important role in both the short term goals of detector alignment and calibration as well as longer term oscillation analyses through the identification of muon charged current events. A preliminary method of muon track recognition and track fitting based on a Kalman filter is presented.

Particle Astrophysics and Cosmology / **189**

Studying Cosmic Acceleration with the Dark Energy Survey

Author: Masao Sako[1]

[1] *University of Pennsylvania*

Corresponding Author: masao@sas.upenn.edu

The Dark Energy Survey (DES) will use a new massive imaging instrument, the Dark Energy Camera (DECam), to study the properties of the mysterious, presently-dominant source of energy that is causing the universe to go through an accelerating expansion. The camera will be installed on the 4-meter Blanco telescope at the Cerro Tololo Inter-American Observatory and commissioning is expected to start in the end of 2011. Over five years, DES will carry out a

high-precision photometric survey of 5000 square degrees to detect and study the properties of over 300 million galaxies in the southern sky. Repeat observations of a smaller patch in the sky will discover thousands of Type Ia supernovae for precision distance measurements. We will describe how the four complementary probes of dark energy – weak lensing, galaxy clusters, baryon acoustic oscillations, and supernova – will help improve our understanding of the nature of the mysterious dark energy.

Top Quark Physics / 192

HollowConeSieveForTops

Authors: Peisi Huang[1]; Vernon Barger[1]

[1] *Department of Physics-University of Wisconsin-Madison*

Corresponding Author: peisi.huang@cern.ch

The LHC is a top factory: in the SM about 8,000 top pairs should have been produced with more than 47 pb−1 integrated luminosity already taken per detector at 7 TeV. Since the LHC center-of-mass energy is high compared to the top mass, the tops will typically be highly boosted, so that the decay products are close to each other. Thus, in the detector, at first sight, the top decay products may look like a fat jet instead of the several separate ones of which it is composed. In the top reconstruction, to catch all the three main decay products of a top a a single fat jet, it is natural to use a large jet size. If a large R = 1.5 is used, it is likely that two jets will be constructed in the event (one from the top and the other from the t), while more will be constructed using a small R.
The light jets behave differently from the top jets, in that the number of reconstructed light jets does not vary with
R. So, after subtracting light jets from dijet events, the top contribution can be seen in the variation of the number
of jets with cone size R. We develop the "hollow cone "idea to tag top pairs. Consider the anti-kt algorithm as a "perfect cone "algorithm. When a larger cone size is used, both a ttbar event and a QCD dijet event will give two jets, when a smaller cone size is used, a ttbar event will have more jets while a QCD dijet event still have two. This means, for a fat jet with a large cone size, after subtracting a jet of small cone size in the interior, if some jets remain in the hollow cone, the jet is likely to be
a top jet, and if there is no jet in the hollow cone, it is likely to be a light quark jet or a gluon jet.
Our top tagging algorithm proceeds in the following steps, trying to separate top pairs from the QCD dijet events:
1) Reconstruct jets using the anti-kt jet algorithm with R = 1.5 to obtain a set of jets. The number of jets is
njets.
2) Redo the jet reconstruction,with R = 0.6 (or R = 0.7), following recent works of ATLAS and CMS , to
obtain another set of jets.
3) Keep the event as a tt candidate if n_{jets,R=1.5} = 2 and n_{R=0.6 }>2 .
4) Go into the 2 jets reconstructed in step 1, find all the subjets for each fat jet, for a fat jet of invariant mass of mj , undo the last step of jet clustering to obtain two jets j1 and j2, with
invariant masses mj1 and mj2 (mj1 > mj2). If mj1 <0.9 mj , keep both j1 and j2, otherwise, keep only j1 to add to
the subjet list and decompose further. Add ji to the jet substructure list if mji < 30 GeV, otherwise decompose ji
iteratively. If the total number of subjets is less than 4, reject the event, because a hadronic top and one semileptonic
top should give 4 subjets in total, and two hadronic tops will result in 6 subjets.
5) See whether there is a W inside either of the 2 fat jets, if not, reject the event. To do this, look into a fat jet and
iterate over all of the 2 subjets configurations. After the jet filtering, if the invariant mass of the 2 subjes falls
in the window of 65 GeV to 95 GeV, tag that configuration as a W.
6） See whether either of the two jets has a subjet can be tagged as a b jet. The jet candidates of a W

must not be
tagged as a b-jet. Keep other b-tagged events.
7)Any event that survives the above sequence is tagged as a tt event.
Backgrounds:
The main backgrounds are Wbbbar and Z bbbar. Since there will be b jets in both cases, and the Z mass is close to
W mass, these two backgrounds are indistinguishable in their hadronic decay channels. Other backgrounds are the
QCD dijets from light quarks and gluons and QCD multi-jet events. QCD dijets events will be gotten rid of by the "
hollow cone "cut, since the anti-kt jet algorithm is collinear and infrared safe. QCD trijet events will be eliminated
by requiring 4 or more subjets. With fake b-jets, Wjj and Zjj events contribute to the background also.we apply the following cuts in
sequence :
cut 1 : The "hollow cone"sieve. Require njets = 2 and nveto > 2.
cut 2 : Total number of subjets >=4.
cut 3 : A hadronic W can be tagged.
cut 4 : A b jet can be tagged.
After the cut, ttbar is 4.05 pb, Wbbbar is down to 0.18, Zbbbar is down to 0.43, Wjj is down to 0.08, Zjj is down to 0.26.
The resulting ratio of hadronic tops to semileptonic tops is 2.81, which is consistent with the ratio of decay branching
fractions of 3.13. The transverse momentum distribution of tagged top shows that the method is picking top jets instead of light jets,
and also demonstrates that top jets with relatively low pt can be tagged. Former top tagging techniques require the
pT of the top to be harder than 200 GeV.

Summary:

1 We introduce a new top tagging method, using the anti-kt algorithm to define jets, events with nj = 2 fat jets of cone size R = 1.5 are decomposed into R = 0.6 sub-jets and retained if nj (R=0.6) >=4 . One pair of sub-jets reconstructs the W-mass and another jet is tagged as a b-jet, as necessary for hadronic or semileptonic events of ttbar origin.
2 This 'hollow cone'method distinguishes the tt events from the light parton QCD dijet events.

Neutrino Physics / **193**

Search for Electron Neutrino Appearance in MINOS

Author: Mhair Orchanian[1]

[1] *Caltech*

Corresponding Author: mho@caltech.edu

The MINOS Collaboration continues its search for electron neutrino appearance in the NuMI beam at Fermilab. Neutrinos in the beam interact in the Near Detector, located 1 km from the beam source, allowing us to characterize the backgrounds present in our analysis. In particular, we can estimate the number of electron neutrino candidate events we expect to see in the Far Detector (735 km away, in the Soudan mine in northern Minnesota) in the presence or absence of muon neutrino to electron neutrino oscillation. Recent efforts to improve the sensitivity of the analysis, including upgrades to the event identification algorithm and fitting procedure, are discussed, and the latest results from the search are presented.

Hadron Spectroscopy / **194**

First observation of the h_b(1P) and h_b(2P) bottomonium states

Author: David Asner[1]

[1] *Pacific Northwest National Laboratory*

Corresponding Author: david.asner@pnl.gov

We report the observation of the h_b(1P) and h_b(1P)p spin-singlet bottomonium states produced in the reaction e^+e^-\to h_b(1P)n\pi^+\pi^- with significances of 5.5\,\sigma and 11.2\,\sigma, respectively. We find that M[h_b(1P)]=(9898.25\pm 1.06^{+1.03}{*-1.07})\,*mathrm{MeV}/c^2 and M[h_b(1P)p]=(10259.76\pm0.64^{+1.43}{*-1.03})\,\mathrm{MeV}/c^2, which correspond to measurements of the P-wave hyperfine splittings \Delta M_{ m HF}=(1.62\pm1.52)\,\mathrm{MeV}/c^2 and (0.48^{+1.57}_{-1.22})\,\mathrm{MeV}/c^2, respectively. We also report measurements of the cross sections for e^+e^-\to h_b(1P)n\pi^+\pi^- relative to the cross section for the e^+e^-\to\Upsilon(2S)\pi^+\pi^- reaction. These results are obtained from a 121.4\,{\rm fb}^{-1} data sample collected with the Belle detector near the \Upsilon(5S) resonance at the KEKB asymmetric-energy e^+e^- collider.

Detector Technology and R&D / **195**

Belle II Detector: Status and Proposed US Contribution

Author: James Fast[1]

[1] *Pacific Northwest National Laboratory*

Corresponding Author: james.fast@pnnl.gov

Over the course of the last decade, the Belle detector at the KEKB collider has collected over 1 ab^{-1} of integrated luminosity, allowing for a number of precision measurements of the Standard Model, including confirmation of the Kobayashi-Maskawa mechanism of CP violation. In June of 2010, KEKB and Belle were shut down to begin upgrading both the accelerator and detector. The increased luminosity of the new accelerator, Super-KEKB, coupled with significant improvements in background rejection and sensitivity of the upgraded detector, Belle II, will ultimately provide a dataset approximately 50 times larger than that obtained with Belle. The US groups in Belle II have chosen to focus their efforts on areas of the detector that will have high impact on the physics and that match their expertise and experience: high precision particle identification (especially at higher momenta), muon/KL identification and monitoring of the electron-positron beams - during commissioning and operation. In this presentation, we review the plans and status of the SuperKEKB/Belle II upgrade. Additionally, we describe the proposed US contributions to Belle II which take advantage of –and leverage–US expertise in detector and electronics design, accelerator instrumentation, and existing US facilities.

Heavy Flavor Physics / **196**

Measurement of the production fraction times branching fraction f(b->Lambda_b)xB(Lambda_b -> J/psi Lambda)

Author: Ivan Heredia De La Cruz[1]

[1] *Centro Invest. Estudios Avanz. IPN (CINVESTAV)*

Corresponding Author: ivan.heredia.de.la.cruz@cern.ch

The $\Lambda_b(udb)$ baryon is observed in the decay $\Lambda_b \to J/\psi\Lambda$ using 6.1 fb^{-1} of $p\bar{p}$ collisions collected with the D0 detector at

$\sqrt{s} = 1.96$ TeV. The production fraction multiplied by the branching fraction for this decay relative to that for the decay $B^0 \to J/\psi K^0_s$ is measured to be 0.345 ± 0.034 (stat.) $\pm$ 0.033 (syst.) $\pm$ 0.003 (PDG).
Using the world average value of $f(b \to B^0) \cdot \mathcal{B}(B^0 \to J/\psi K^0_s) = (1.74 \pm 0.08) \times 10^{-5}$, we obtain $f(b \to \Lambda_b) \cdot \mathcal{B}(\Lambda_b \to J/\psi \Lambda) = (6.01 \pm 0.60\,\text{(stat.)} \pm 0.58\,\text{(syst.)} \pm 0.28\,\text{(PDG)}) \times 10^{-5}$. This measurement represents an improvement in precision by about a factor of three with respect to the current world average.

Heavy Flavor Physics / 197

Measurement of the relative branching fraction of Bs -> J/psi f_0(980), f_0(980) -> pi+pi- to Bs-> J/psi phi, phi -> K+K-

Author: Braden Keim Abbott[1]

[1] *Department of Physics and Astronomy-University of Oklahoma*

Corresponding Author: babbott@fnal.gov

A measurement of the relative branching fraction of $B^0_s \to J/\psi f_0(980)$, $f_0(980) \to \pi^+\pi^-$ to $B^0_s \to J/\psi\phi$, $\phi \to K^+K^-$ is presented. The decay mode $B^0_s \to J/\psi f_0(980)$ is an interesting mode since it is a CP eigenstate and allows the measurement of the CP-violating phase ϕ_s. Using approximately 8 fb^{-1} of data recorded with the D0 detector at the Fermilab Tevatron Collider, a relative branching fraction of $0.210 \pm 0.032(\text{stat}) \pm 0.036(\text{syst})$ is found.

CP-Violation / 198

Anomalous like-sign dimuon charge asymmetry at D0

Author: Bruce Hoeneisen[1]

[1] *Universidad San Francisco de Quito*

Corresponding Author: bruce1@fnal.gov

We present an improved measurement of the charge asymmetry A of like-sign dimuon events in 9 fb^{-1} of $p\bar{p}$ collisions recorded with the D0 detector at a center-of-mass energy $\sqrt{s} = 1.96$ TeV at the Fermilab Tevatron collider. From A, we extract the like-sign dimuon charge asymmetry in semileptonic b-hadron decays. We also study the dependence of charge asymmetry on muon impact parameter. Additional constraints on the CP violation in the B meson sector are also derived from a measurement of the flavor-specific semileptonic asymmetry in the $B^0_d \to \mu D + X$ channel.

CP-Violation / 199

Measurement of CP violating parameters in the decay Bs -> J/psi phi

Author: Avdhesh Chandra[1]

[1] *Rice University*

Corresponding Author: avdhesh@fnal.gov

We report a new measurement of the CP-violating phase ϕ_s, of the decay width difference for the two mass eigenstates $\Delta\Gamma_s$, of the mean B_s^0 lifetime $\overline{\tau}_s$, and of magnitudes of the decay amplitudes, from the flavor-tagged decay $B_s^0 \to J/\psi\phi$. For the first time, we consider possible contributions from the decay $B_s^0 \to J/\psi K^+K^-$, with the K^+K^- in a s wave. This measurement is based on 8 fb^{-1} of $p\overline{p}$ collisions recorded with the D0 detector at a center-of-mass energy $\sqrt{s} = 1.96$ TeV at the Fermilab
Tevatron collider.

Perturbative and non-Perturbative QCD / 203

Measurement of the Cross Section for Prompt Isolated Diphoton Production in p\bar p Collisions at \sqrt{s} = 1.96 TeV

Author: Costas Vellidis[1]

Co-authors: Alexander Pronko [2]; Raymond Culbertson [1]

[1] *Fermilab*

[2] *LBNL*

Corresponding Author: vellidis@fnal.gov

The production of prompt photon pairs with large invariant mass in hadron collisions is a large irreducible background in searches for a low mass Higgs boson decaying into a photon pair, as well as in searches for new phenomena, such as new heavy resonances, extra spatial dimensions or cascade decays of heavy new particles. Precise measurements of the diphoton production differential cross sections for various kinematic variables and their theoretical understanding are thus very important for these searches. Diphoton production is also used to check the validity of perturbative quantum chromodynamics (pQCD) and soft-gluon resummation methods implemented in theoretical calculations. Diphotons are expected to be dominantly produced by quark-antiquark annihilation and in kinematic regions with high gluon luminosity, especially at low invariant mass, by gluon gluon fusion through a quark loop diagram. Prompt photons may also result from quark fragmentations in the hard scattering, although a strict photon isolation requirement significantly reduces the fragmentation contributions.

The diphoton production cross section, differential in kinematic variables sensitive to the reaction mechanism, is measured using 5.4/fb of data collected with the CDF II detector. The high statistics of the measured sample allows for a higher precision scan over a much more extended phase space than previous measurements. The overall systematic uncertainty is limited to about 30%. The results of the measurement are compared with three state-of-the-art calculations, applying complementary techniques in describing the reaction. All three calculations, within their known limitations, reproduce the main features of the data. By including photon radiation in the initial and final states, a parton shower MC suitable for background simulations in searches for a low mass Higgs boson and new phenomena proves competitive with full NLO calculations.

Summary:

We report a measurement of the cross section of prompt isolated photon pair production in p\bar p collisions at a total CM energy of 1.96 TeV using data of 5.4/fb integrated luminosity collected with the CDF II detector at the Fermilab Tevatron. The measured differential cross section is compared with three perturbative QCD predictions, a Leading Order (LO) parton shower Monte Carlo and two Next-to-Leading Order (NLO) calculations. The NLO calculations reproduce most aspects of the data. By including photon radiation from quarks before and after hard scattering, the parton shower Monte Carlo becomes competitive with the NLO predictions.

Electroweak Physics / **204**

Studies of Z/gamma* differential cross sections in ppbar collisions with the D0 detector

Author: Rafael Lopes de Sa[1]

[1] *Stony Brook University*

Corresponding Author: rafael.lopesdesa@stonybrook.edu

We use up to 7.3 fb-1 of ppbar collisions collected with the D0 detector study different differential distributions for Z/gamma*produced in ppbar collisions at the Tevatron collider. In one study we investigate the transverse momentum distribution of the Z/gamma* boson by using a novel observable that has reduced sensitivity to the effects of experimental resolution and efficiency, allowing detailed investigations of QCD predictions for the dependence of the Z boson transverse momentum on its rapidity. In a second study we investigate the angular distribution of the Z/gamma* decay products as a function of their invariant mass and derive measurements of the electroweak mixing angle and of the Z-light quark couplings.

Electroweak Physics / **205**

Diboson production in ppbar collisions at sqrt(s)=1.96 TeV with the D0 detector

Author: Michael Cooke[1]

[1] *Fermilab*

Corresponding Author: mpc@fnal.gov

We present measurements of the production cross sections for W/Z+gamma and W/Z+Z boson pairs using up to 8.6 fb-1 of ppbar collisions recorded with the D0 detector at the Fermilab Tevatron collider. In addition to comparing the total cross section measurements with the QCD predictions, we investigate differential distributions and set limits on possible anomalous couplings in the triple gauge boson vertices

Electroweak Physics / **209**

W boson mass and width measurements at D0

Author: Daniel Boline[None]

Corresponding Author: daniel.boline@stonybrook.edu

We present a precise measurement of W boson mass measurement in electron decay channel using data collected by the D0 detector at the Fermilab Tevatron collider. A binned likelihood fit method is used to extract the mass information from the transverse mass, the electron transverse momentum and missing transverse energy distributions. We also present a precise direct measurement of W boson width using the events with large transverse mass. The W mass result can be used to put stringent indirect limits on the SM Higgs boson mass.

Particle Astrophysics and Cosmology / 211

The Dark Energy Camera - A new Instrument for the Dark Energy Survey

Author: Jiangang Hao[1]

[1] *Fermilab*

Corresponding Author: jghao@fnal.gov

The Dark Energy Survey (DES) is a next generation optical survey aimed at understanding the expansion rate of the universe using four complementary methods: weak gravitational lensing, galaxy cluster counts, baryon acoustic oscillations, and Type Ia supernovae. To perform the survey, the DES Collaboration is building the Dark Energy Camera (DECam), a 3 square degree, 520 Megapixel CCD camera which will be mounted at the prime focus of the Blanco 4-meter telescope at the Cerro Tololo Inter-American Observatory. The survey will cover 5000 square-degrees of the southern galactic cap with 5 filters (g, r, i, z, Y). DECam will be comprised of 74 250 micron thick fully depleted CCDs: 62 2k x 4k CCDs for imaging and 12 2k x 2k CCDs for guiding and focus. Construction of DECam is nearing completion. In order to verify that the camera meets technical specifications for the Dark Energy Survey and to reduce the time required to commission the instrument on the telescope, we have constructed a full sized "Telescope Simulator" and are performing full system testing and integration prior to shipping to CTIO. An overview of the DECam design and the status of the construction and integration tests will be presented

Summary:

The Dark Energy Camera is a new 520 Magapixel wide field imager for the Dark Energy Survey. In this presentation we will highlight some of the key design elements of this new instrument and discuss performance tests and our plans for commissioning which will begin this fall.

Perturbative and non-Perturbative QCD / 212

Measurement of three-jet differential cross sections $boldsymbol{d\sigma_{\textbf{3jet}}/dM_{\textbf{3jet}}}$ in $boldsymbol{p\bar{p}}$ collisions at $boldsymbol{\sqrt{s} = 1.96}$ TeV

Author: Lee Sawyer[1]

[1] *College of Engineering and Science-Louisiana Technical Universi*

Corresponding Author: lee.sawyer@cern.ch

We present the first measurement of the inclusive three-jet differential cross section as a function of the invariant mass of the three jets with the largest transverse momenta in an event in $p\bar{p}$ collisions at $\sqrt{s} = 1.96\,\mathrm{TeV}$.
The measurement is made in different rapidity regions and for different jet transverse momentum requirements and is based on a data set corresponding to an integrated luminosity of $0.7\,\mathrm{fb}^{-1}$ collected with the D0 detector at the Fermilab Tevatron Collider.
The results are used to test the three-jet matrix elements in perturbative QCD calculations at next-to-leading order in the strong coupling constant.
The data allow discrimination between parametrizations of the parton distribution functions of the proton.

Perturbative and non-Perturbative QCD / 213

Azimuthal decorrelations and multiple parton interactions in $boldsymbol{\gamma + 2\,\mathrm{jet}}$ and $boldsymbol{\gamma + 3\,\mathrm{jet}}$ events in $boldsymbol{p\bar{p}}$ collisions at $boldsymbol{\sqrt{s} = 1.96}$ TeV

Author: Dmitry Bandurin[1]

[1] *Kansas State University*

Corresponding Author: bandurin@fnal.gov

Samples of inclusive $\gamma + 2\,\mathrm{jet}$ and $\gamma + 3\,\mathrm{jet}$ events collected by the D0 experiment with an integrated luminosity of about 1 fb^{-1} in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV are used to measure cross sections as a function of the angle in the plane transverse to the beam direction between the transverse momentum (p_T) of the γ+leading jet system (jets are ordered in p_T) and p_T of the other jet for $\gamma + 2\,\mathrm{jet}$, or p_T sum of the two other jets for $\gamma + 3\,\mathrm{jet}$ events. The results are compared to different models of multiple parton interactions (MPI) in the {\sc pythia} and {\sc sherpa} Monte Carlo (MC) generators. The data indicate a contribution from events with double parton (DP) interactions and are well described by predictions provided by the {\sc pythia} MPI models with p_T-ordered showers and by {\sc sherpa} with the default MPI model. The $\gamma + 2\,\mathrm{jet}$ data are also used to determine the fraction of events with DP interactions as a function of the azimuthal angle and as a function of the second jet p_T.

Perturbative and non-Perturbative QCD / 216

Measurement of the elastic $boldsymbol{p\bar{p}}$ differential cross section in the range $boldsymbol{0.25 < |t| < 1.2}$ GeV at $boldsymbol{\sqrt{s} =}$1.96 TeV

Author: Andrew Gerhart Brandt[1]

[1] *University of Texas at Arlington*

Corresponding Author: brandta@uta.edu

The elastic proton-antiproton scattering process is studied as a function of the four-momentum transfer squared $|t|$ at a center-of-mass energy of 1.96 TeV. Scattered protons and antiprotons are selected by using forward roman pot detectors that were installed around the D0 interaction point of the Tevatron. The data presented correspond to a dedicated period of low luminosity running of the D0 experiment. Comparison to data from other experiments at lower energies is presented.

Education and Outreach / 217

HiSPARC: On the interface between outreach and scientific research

Author: Charles Timmermans[1]

[1] *Radboud University, Nijmegen, Netherlands*

The HiSPARC project is a high school cosmic ray project that originated in the Netherlands. The aim of this project is to have high school students participate in building and running a scientific project, thereby increasing their enthusiasm for science in general. We are experimenting with different detector configurations, performing a calibration on the KASCADE site, and exploring the physics of a distributed setup. At the same time, we are moving cosmic ray physics in the standard curriculum of the Dutch high schools. Furthermore, there is an international expansion. Recently, a HiSPARC cluster was realized in Aarhus, Denmark, and work is underway on clusters in the United Kingdom.

Perturbative and non-Perturbative QCD / 219

Measurement of the Cross Section of the Associated Production of Photons and b-quark Jets at CDF

Author: Tingjun Yang[1]

[1] *FNAL*

Corresponding Author: tjyang@fnal.gov

The study of final states with an isolated high energy photon and an identified b-quark jet is a testing ground for QCD predictions at the hadron collider. A cross section measurement provides a probe of the hard scattering dynamics within the proton, and a cross-check of the predictions of its b-quark content, whose parton density function is indirectly extracted from constraints on the gluon dentiy functions. We will present the preliminary results on the measurement of this cross section using an integrated luminosity of 7.0 fb-1 collected with the CDF II detector.

Top Quark Physics / 221

Measurements of spin correlation in $boldsymbol{t\bar{t}}$ production at D0

Author: Kenneth Bloom[1]

[1] *Department of Physics and Astronomy-University of Nebraska*

Corresponding Author: kenbloom@unl.edu

We measure the correlation between the spin of the top quark and the spin of the anti-top quark in $t\bar{t} \to W^+bW^-\bar{b}$ final states produced in $p\bar{p}$ collisions at a center of mass energy $\sqrt{s} = 1.96$˜TeV, using data collected with the D0 detector at the Fermilab Tevatron collider. The correlation is extracted using a double differential angular distribution and a novel technique using matrix element integration is used to increase the sensitivity of the result, Measurements are performed in both the dilepton and lepton+jets final states.

Top Quark Physics / **224**

Search for flavor changing neutral currents in decays of top quarks

Author: Carrie McGivern[1]

[1] *University of Kansas*

Corresponding Author: mcgivern@fnal.gov

We present a search for flavor changing neutral currents
in decays of top quarks. The analysis is based on a search for
$t\bar{t} \to \ell' \nu \ell \bar{\ell}$+jets ($\ell, \ell' = e, \mu$) final
states using 4.1~{\rm fb}$^{-1}$ of integrated luminosity of $p\bar{p}$
collisions at $\sqrt{s} = 1.96$~{\rm TeV}. We extract limits on the branching
ratio $B(t \to Zq)$ ($q = u, c$ quarks), assuming anomalous tuZ
or tcZ couplings. We do not observe any sign of such anomalous coupling and
set a limit of $B < 3.2\%$ at 95\% C.L.

Top Quark Physics / **228**

Measurement of the W boson helicity in top quark decays using 5.4 fb-1 of ppbar collision data

Author: Amitabha Das[1]

[1] *University of Arizona*

Corresponding Author: adas@fnal.gov

We present a measurement of the helicity of the W boson produced in top quark decays using $t\bar{t}$ ~decays in the ℓ+jets and dilepton final states selected from a sample of 5.4 fb^{-1} of collisions recorded using the D0 detector at the Fermilab Tevatron $p\bar{p}$ collider. We measure the fractions of longitudinal and right-handed W bosons to be $f_0 = 0.669 \pm 0.102$ [± 0.078 (stat.) $\pm$ 0.065 (syst.)] and $f_+ = 0.023 \pm 0.053$ [± 0.041 (stat.) $\pm$ 0.034 (syst.)], respectively. This result is consistent at the 98\% level with the standard model.
A measurement with f_0 fixed to the value from the standard model yields $f_+ = 0.010 \pm 0.037$ [± 0.022 (stat.)$\pm$ 0.030 (syst.).]

Top Quark Physics / **237**

Measurement of the forward-backward charge asymmetry in top quark production in ppbar collisions at sqrt{s} = 1.96 TeV

Author: Douglas Orbaker[1]

[1] *University of Rochester*

Corresponding Author: dorbaker@pas.rochester.edu

We present measurements of the integrated forward-backward charge asymmetry in $t\bar{t}$ production in $p\bar{p}$ collisions using data collected with the D0 detector at the Fermilab Tevatron collider, using both the lepton+jets and dilepton final states. We present the raw measurement as well as results obtained after correcting for acceptance and detector effects and present also measurements as a

function of invariant mass of the $t\bar{t}$ pair. We also investigate the dependence ofthe asymmetry on the total transverse momentum of the $t\bar{t}$ pair.

Top Quark Physics / **238**

Single top production in ppbar collisions at sqrt(s)=1.96 TeV with the D0 detector

Author: Reinhard Schwienhorst[1]

[1] *Michigan State University*

Corresponding Author: schwier@pa.msu.edu

We present measurements of the single top production cross in ppbar collisions at sqrt(s)=1.96 TeV using data collected with the D0 detector and corresponding to up to 5.4 fb-1 of integrated luminosity. We obtain both measurements of the inclusive production cross section as well measurements for the separate s- and t-channel production processes. These measurements are used to set constraints on the |Vtb| element of the CKM matrix. We also investigate for possible CP violation in the production of single top quarks and for the existence of possible resonances in the s-channel.

Beyond the Standard Model / **243**

Search for a heavy neutrino and right-handed W of the left-right symmetric model with CMS detector

Author: Nathaniel Joseph Pastika[1]

[1] *School of Physics and Astronomy-University of Minnesota*

Corresponding Author: nathaniel.joseph.pastika@cern.ch

The left-right (LR) symmetric model explains the origin of the parity violation in weak interactions and predicts the existence of additional heavy right-handed W and Z' gauge bosons. In addition, heavy right-handed neutrino states arise naturally within the LR symmetric model. These neutrinos can be partners of light neutrino states, related to their non-zero masses through the see-saw mechanism. This makes the searches of heavy right-handed W and neutrino interesting and important. This talk is about the first search for signals from the heavy W and N production with the CMS Experiment at the LHC.

Perturbative and non-Perturbative QCD / **244**

Measurements of W/Z boson production in associations with jets at D0

Author: Ashish Kumar[1]

[1] *Department of Physics-Physics Faculty-State University of New Y*

Corresponding Author: ashish.kumar@cern.ch

We present measurements of total and differential cross sections for the production of W or Z bosons in association with jets, including detailed study of the production of heavy flavor jets, using up to 6

fb-1 of ppbar collisions collected with the D0 detector at the Fermilab Tevatron collider. We present measurements of the inclusive W+n jets total cross sections (with n=1-4) and also differential cross sections for the n-th jet transverse momentum and rapidity. We also present measurements of the W/Z+b-jets production, two important background processes in the searches for the Higgs boson. All measurements are compared to NLO QCD calculations and to Monte Carlo simulations.

Beyond the Standard Model / **245**

Missing-ET insensitive search for new physics such as R-parity Violation with multileptons

Author: Sanjay Ravi Ratan Arora[1]

[1] *Dept. of Physics and Astronomy-Rutgers, State Univ. of New Jers*

Corresponding Author: sanjay.ravi.ratan.arora@cern.ch

Anticipating a data sample of the order of hundreds pb^{-1} at a collision energy of 7 TeV by the CMS experiment at LHC in 2011, we probe new physics such as matter symmetry violation in the leptonic sector in theories with partner articles with a signature of three or more leptons in the final state. The search is organized to minimize reliance on specific kinematic variables to reduce SM backgrounds and we illustrate it by application to R-parity violating scenarios of new physics which are not necessarily accompanied by missing ET. We also estimate Standard Model backgrounds for individual channel with a maximal use of data-based methods to avoid reliance on simulation.

Beyond the Standard Model / **246**

Search for New Physics with Mono-Jet and Missing Transverse Energy in 7 TeV pp collisions at CMS

Author: SARAH MALIK[1]

[1] *UNIVERSITY COLLEGE LONDON*

Corresponding Author: smalik@hep.ucl.ac.uk

A study of events with missing transverse energy plus a single energetic jet using 35 pb$^-$1 of pp collision data at 7 TeV, collected by the CMS detector at LHC is presented. This topolgy is a signature of large extra dimensions in the framework of the ADD model, and the unparticles. The number of observed events is in good agreement with the prediction of the Standard Model. The 95\% CL limits on the number of extra dimensions and energy scale of the model are set, leading to significant improvement to the current limits on parameters of both models.

Beyond the Standard Model / **247**

Search for pair-production of scalar leptoquarks

Author: Emanuela Barberis[1]

[1] *Department of Physics-Northeastern University*

Corresponding Author: emanuela.barberis@cern.ch

Leptoquarks are hypothetical particles carrying both lepton and quark flavor. They are predicted by Grand Unified Theories, technicolor and composite models among others. Results from the searches for pair production of first and second generation leptoquarks at the CMS experiment with 7 TeV data are presented.

Beyond the Standard Model / **251**

Search for GMSB SUSY and extra dimensions in diphoton+missing ET and Z+photon+missing ET final states at D0

Author: Yunhe Xie[1]

[1] *Fermilab*

Corresponding Author: xie@fnal.gov

We report the result of two searches for final states with either two photons and large missing transverse energy or with a Z boson, a photon and large missing transverse energy, using data collected with the D0 detector at the Fermilab Tevatron collider and corresponding to integrated luminosities of up to 6.3 fb-1. The result of these searches are interpreted in the framework of gauge mediated supersymmetry models and in models with extra dimensions and limits are set on the parameters of these models.

Beyond the Standard Model / **255**

Model independent search for new phenomena in ppbar collisions at sqrt(s) = 1.96 TeV

Author: Peter Renkel[1]

[1] *postdoc*

Corresponding Author: renkel@physics.smu.edu

We present a model independent search for physics beyond the standard model in lepton final states. We examine data in 120 unique final states from 1.07 fb-1 of at ppbar collisions at sqrt(s) = 1.96 TeV collected with the D0 detector. We conclude that all discrepancies seen can be attributed to modeling issues and do not claim evidence of new physics.

Neutrino Physics / **256**

Searching for Coherent Neutrino Scattering at a Decay-at-Rest Neutrino Source

Author: Enectali Figueroa-Feliciano[1]

Co-authors: A. Anderson [1]; C. Ignarra [1]; G. Karagiorgi [2]; J. M. Conrad [1]; J. Spitz [3]; K. Scholberg [4]; M. H. Shaevitz [2]

[1] *MIT*

[2] *Columbia University*

[3] *Yale University*

[4] *Duke University*

Coherent elastic neutrino- and WIMP-nucleus interaction signatures are expected to be quite similar. Next-generation ton-scale dark matter detectors could discover neutrino-nucleus coherent scattering in an underground laboratory. A high intensity pion- and muon- decay-at-rest neutrino source recently proposed for oscillation physics at underground laboratories would provide the neutrinos for these measurements. We show that discovery of this interaction is possible with a 2 ton year exposure of a ton-scale experiment such as GEODM. Furthermore, a dedicated coherent scattering experiment using low-temperature Ge crystals and/or nobel liquids placed close (˜10 m) to the neutrino source would see hundreds to thousands of events per year. These higher statistics would enable new limits on non-standard neutrino interactions and searches for sterile neutrinos through short-baseline oscillations. We discuss the potential sensitivity of such an experiment to light sterile neutrino models with Delta mˆ2 of order 1 eVˆ2, a region that contains the best-fit 3+1 and 3+2 models to LSND and MiniBooNE data.

Beyond the Standard Model / **257**

A search for charged massive long-lived particles at D0

Author: Juliette Alimena[1]

[1] *Department of Physics-Brown University*

Corresponding Author: juliette.alimena@cern.ch

We report on a search for charged massive long-lived particles (CMLLPs), based on 5.2 fb^{-1} of data collected
with the D0 detector at the Fermilab Tevatron $p\bar{p}$ collider. CMLLPs are predicted in many theories of physics
beyond the Standard Model. We look for events in which one or more particles are reconstructed as muons
but have speed and ionization energy loss dE/dx inconsistent with muons produced in beam collisions. We
present 95\% C.L. upper limits on the production cross section for $\tilde{\tau}$ and exclusion mass
ranges for $\tilde{\chi}^{\pm}$ in two SUSY scenarios and for long-lived $\tilde{t}$ squarks.

Beyond the Standard Model / **259**

Searches for vector quarks, leptoquarks and heavy gauge bosons at D0

Author: Lidija Zivkovic[1]

[1] *Brown University*

Corresponding Author: lidiaz@fnal.gov

We present the results of three searches for new physics in ppbar collisions at sqrt(s)=1.96 TeV using up to 5.4 fb-1 of data collected with the D0 detector at the Fermilab Tevatron collider. We search for hypothetical vector-like quarks which decay into a W or a Z boson and one additional jet, for first generation leptoquarks using the final state with two jets, one electron and missing transverse energy, and for heavy gauge bosons decaying to electron pairs. Upper limits on the cross section for the different final states are set and lower limits on the masses of these hypothethical particles are derived.

Beyond the Standard Model / 260

Search for universal extra dimensions and supersymmetry in like-sign dimuon events using 7.3 fb-1 of D0 data

Author: Jason Mansour[1]

[1] *University of Göttingen*

Corresponding Author: jason.mansour@cern.ch

We present a search for universal extra dimensions (UED) and supersymmetry (SUSY) in the two like-sign muons final state. The data set corresponds to an integrated luminosity of 7.3 fb-1 collected by the D0 detector at a $p\bar{p}$ center of mass energy of 1.96 TeV at the Fermilab Tevatron Collider. No evidence for physics beyond the standard model is observed and limits are set on the size of the compactification scale R_cˆ−1 in the minimal UED model and on the SUSY parameter space in supergravity inspired models.

Particle Astrophysics and Cosmology / 262

Current and Future Dark Matter Searches with SuperCDMS Experiment

Author: Oleg Kamaev[1]

[1] *Queen's University*

The Cryogenic Dark Matter Search (CDMS) experiment and its successor, SuperCDMS, use solid-state detectors operated near 40 mK to search for Weakly Interacting Massive Particles (WIMPs). The experiment measures the ionization and athermal phonons from particle interactions to discriminate WIMP candidate events (nuclear recoils) from background events (electron recoils) with very high efficiency. To further increase the discrimination power, and the resulting sensitivity of the experiment, SuperCDMS has developed an improved detector technology and produced interleaved Z-sensitive Ionization and Phonon (iZIP) detectors. In addition, to reduce the background induced by cosmic-ray particles, SuperCDMS is planning to relocate from the present site at the Soudan Underground Laboratory (Minnesota, USA) to a deeper underground site at SNOLAB (Sudbury, Canada). In this talk I will describe the experiment, the performance of the iZIP detectors, and future plans for SuperCDMS at SNOLAB.

Electroweak Physics / 287

Study of Wgamma and Zgamma production at the LHC

Author: Al Goshaw[1]

[1] *Duke University*

Corresponding Author: goshaw@phy.duke.edu

We have used the ATLAS detector to study W and Z bosons produced with high energy photons in pp collisions at sqrt(s) = 7 TeV. We select Wgamma and Zgamma events from the interactions p+p -> l + nu + gamma + X and p+p -> l + l + gamma + X where the lepton is a muon or electron. The photon is required to be isolated and separated from the lepton(s) by dR(l-gamma)>0.7. The measurement is based upon data collected by the ATLAS experiment in 2011. The production cross sections and

the kinematic distributions of the leptons and photons are compared to Standard Model predictions and to predicted sources of new physics.

Beyond the Standard Model / **288**

The ATLAS Search for Resonances in the Inclusive Dijet Final State

Author: Georgios Choudalakis[1]

[1] *University of Chicago, Enrico Fermi Institute*

Corresponding Author: georgios.choudalakis@cern.ch

I present the latest result from the ATLAS search for resonant production of new particles decaying in two jets, using data taken in 2011.

Summary:

I present the latest result from the ATLAS search for resonant production of new particles decaying in two jets, using data taken in 2011.

Heavy Flavor Physics / **289**

Updated Search for B->mumu Decays at CDF

Author: Kevin Pitts[1]

[1] *University of Illinois*

Corresponding Author: kpitts@illinois.edu

We report the latest results of a CDF search for B->mumu decays using 6.9/fb of data.
Doubled statistics with respect to the previous iteration and several analysis improvement provide results that are the most sensitive from a single-experiment to date.

Heavy Flavor Physics / **290**

Updated Search for Non-SM Physics in B->K(*)mumu Decays at CDF

Author: Austin Napier[1]

[1] *Tufts University*

Corresponding Author: austin.napier@cern.ch

We present updated measurements of branching fractions, polarization,
and muon forward-backward asymmetry in B−>K mu mu final states using
6.7/fb of data collected by the CDF detector. A search for Lambda_b −> Lambda mu mu decays will also be shown. The results are the most sensitive from a single experiment to date.

CP-Violation / **292**

Updated Measurement of Charmless B Decays at CDF

Author: Benjamin Carls[None]

We present world-leading results on CP-violating asymmetries and branching fractions of several decay modes of B0, Bs , and Lambda_b hadrons into charmless two-body final states using 6/fb of data collected by the CDF experiment.

Heavy Flavor Physics / **294**

Bc and Suppressed Bs Decays at CDF

Author: William Wester[1]

[1] *Fermi National Accelerator Lab. (Fermilab)*

Corresponding Author: william.wester@cern.ch

We present new results of CDF measurements of Bc and suppressed Bs decays.
The first measurement of the Bc lifetime in an exclusive fully-reconstructed final state is reported.
An improved measurement of the Bs->DsDs decay is reported along with a measurement of the branching ratio and lifetime for Bs->J/psif0 decays and the first measurement of a CP violating asymmetry in Bs->phiphi decays.

Particle Astrophysics and Cosmology / **295**

Rejection of Backgrounds in the DMTPC Dark Matter Search Using Charge Signals

Author: Jeremy Lopez[1]

[1] *MIT*

Corresponding Author: jplopez@mit.edu

The Dark Matter Time Projection Chamber (DMTPC) experiment uses a time projection chamber filled with low pressure CF4 gas to detect the direction of WIMP-induced nuclear recoils. Recoils from WIMPs in the galactic dark matter halo are expected to have a directional signal distinct from all known backgrounds. Recent work has been done to develop instrumentation to read out both the scintillation and charge signals from the TPC. This talk will describe the charge readout systems of the DMTPC detector and will discuss their performance in identifying nuclear recoils and rejecting gamma and electron backgrounds.

Heavy Flavor Physics / **296**

New Measurements of Production and Polarization of Heavy Mesons at CDF

Author: Niharika Ranjan[1]

[1] *Purdue University*

We present a new measurement of the Upsilon(1S), (2S), and (3S) polarization in dimuon events from p-pbar collisions at 1.96 TeV, using the CDF detector at the Tevatron. The measurement is conducted exploiting the full 3-dimensional angular distributions over a pT range of 2-40 GeV/c, based on data comprising an integrated luminosity of 6.0 fb-1. We also report the first measurement of production cross-section of low-pt D0 mesons at the Tevatron..

CP-Violation / **297**

First ADS Analysis of B+ –> D0 K Decays in Hadron Collisions

Author: Paola Garosi[None]

Corresponding Author: paola.garosi@pi.infn.it

We report the first measurement of branching fractions and CP-violating asymmetries of doubly-Cabibbo suppressed B+ –> D0 K decays in hadron collisions, using the approach proposed by Atwood, Dunietz, and Soni (ADS) to determine the CKM angle gamma in 7.0 fb-1 of data. The ADS parameters are determined with accuracy comparable with B factory measurements.

Particle Astrophysics and Cosmology / **298**

The DarkSide Program at LNGS

Author: Alex Wright[1]

[1] *Princeton University*

Corresponding Author: ajw@princeton.edu

DarkSide is a direct detection dark matter program based on two-phase argon time projection chambers using argon from underground sources that is naturally depleted in 39Ar. DarkSide-50, the first physics detector in the DarkSide program, will be deployed within the Borexino CTF tank in Gran Sasso Laboratory, Italy. The unique combination of the CTF muon veto, ultra-low background construction techniques, depleted argon, and a dedicated high efficiency neutron veto based on boron-loaded liquid scintillator should give DarkSide-50 the ability to convincingly demonstrate a background expectation of a fraction of an event in a 0.1 tonne-year exposure. This will not only give the experiment the ability to probe for WIMP interactions with a cross-section sensitivity of 10E-45cm2, but also allow it to demonstrate the ability of larger, tonne-scale, detectors in the DarkSide program to operate background free.

Beyond the Standard Model / **299**

Higgs Production through Top-prime decays at the LHC

Authors: Bogdan Dobrescu[1]; Meenakshi Narain[2]; Saptaparna Bhattacharya[2]

[1] *Theoretical Physics Department, Fermi National Accelerator Laboratory*

[2] *Brown University*

Corresponding Author: saptaparna.bhattacharya@cern.ch

We explore LHC signatures of vectorlike quarks, which are hypothetical fermions whose left- and right-handed components have the same electroweak quantum numbers. We consider interactions of such a quark, top-prime, with the top quark via a Yukawa coupling and with a bottom quark through a W boson. We look at Higgs production through the decay of the top-prime in a top-prime pair production channel through QCD at the LHC with $\sqrt{s} = 7$ TeV. Such a process depends only on the top-prime mass. In this channel, we consider semi-leptonic W-boson decays. This choice is dictated by the reduction of QCD background and a higher cross section than the corresponding much cleaner di-leptonic channel. We suggest a background discrimination strategy involving b-tagging and a lepton in the final state. The possibility of the top-prime decaying into a light (120 GeV/c^2) and a relatively heavier Higgs (150 GeV/c^2) will be explored. The mixing angle between the top and the top-prime, which is a parameter of the model, has been chosen judiciously so that the analysis remains as model independent as possible.

Heavy Flavor Physics / 300

Updated Measurement of B(Bs -> Ds(*)+Ds(*)-) and Determination of Delta Gamma_CP

Author: Sevda Esen[1]

[1] *University of Cincinnati*

Using fully reconstructed B_s mesons, we measure the branching fractions for the decays of $B_s \to D_s^{(*)+} D_s^{(*)-}$ exclusively. Assuming these decay modes saturate decays to CP-even final states, the branching fraction determines the relative width difference between the CP-odd and CP-even B_s states. The results are based on a data sample collected with the Belle detector at the $\Upsilon(5S)$ resonance with an integrated luminosity of 122 fb^{-1} at the KEKB asymmetric-energy e^+e^- collider.

Neutrino Physics / 301

Neutrino Oscillation Results from T2K

Author: Glenn Lopez[1]

[1] *Stony Brook University*

Corresponding Author: glopez@nngroup.physics.sunysb.edu

The T2K experiment is a long baseline neutrino oscillation experiment designed to directly measure ν_e appearance, thereby providing a measurement of θ_{13}, the last unknown neutrino mixing angle. In addition, T2K will make precision measurements of Δm^2_{23} and $\sin^2(2\theta_{23})$ via measurement of ν_μ disappearance. To achieve these goals, a beam of muon neutrinos is produced at the Japanese Proton Accelerator Research Complex in Tokai, Japan. At a distance of 280 meters from the the beam origin, a set of detectors has been constructed in order to measure the properties of the beam before oscillation. The Super-Kamiokande detector 295 kilometers away serves as the far detector that measures the beam after oscillation. T2K began the first data taking run in January 2010 and concluded in June 2010 and accumulated 0.323×10^{20} POT. The second data taking run began in November 2010 and concluded in March 2011 and accumulated 1.108×10^{20} POT. I will summarize the results of the analysis from these runs.

Heavy Flavor Physics / **302**

b-Tagging at ATLAS

Author: Gordon Watts[1]

[1] *Department of Physics-University of Washington*

Corresponding Author: gwatts@uw.edu

The ATLAS detector, one of the two general purpose detectors at the LHC, has collected several hundred inverse picobarnes since the start of 2011 running. The large dataset has allowed deeper studies of bottom-quark tagging performance than before possible. Bottom-quark tagging is an important signal/background selection tool used in top analyses, SUSY analyses, Exotics analyses, and Standard Model analyses - anytime heavy flavor is important in the final state. In this talk I will give a very brief overview of ATLAS b-tagging and concentrate on the performance studies, calibrations, and lessons learned with this large dataset.

Beyond the Standard Model / **303**

Triggering on Long Lived Particles at ATLAS

Author: Steve Alkire[1]

[1] *Department of Physics-University of Washington*

A number of extensions of the Standard Model result in neutral and weakly-coupled particles that decay to multi hadrons or multi leptons with macroscopic decay lengths. These particles with decay lengths that can be comparable with ATLAS detector dimensions represent, from an experimental point of view, a challenge both for the trigger and for the reconstruction capabilities of the ATLAS detector. We will present a set of signature driven triggers for the ATLAS detector that target such displaced decays, evaluate their performance for some benchmark models. In 2011 ATLAS has collected several hundred inverse picobarns and we will present a description of the triggers and their early performance.

Detector Technology and R&D / **305**

STUDY OF THE RADIATION-HARDNESS OF VCSEL/PIN

Author: K. K.Gan Gan[1]

[1] *The Ohio State University*

Corresponding Author: kass.1@osu.edu

STUDY OF THE RADIATION-HARDNESS OF VCSEL/PIN
K.K. GAN, H.P. KAGAN, R.D. KASS, H. MERRITT,
J. MOORE, A. NAGARKAR, D.S. SMITH, M. STRANG

Department of Physics, The Ohio State University, Columbus, OH 43210, USA

Optical links are now widely used in high energy physics experiments for data transmission. The links substantially reduce the volume of metallic signal cables freeing up valuable detector space. In addition, the fibers eliminate the cross talk between metallic cables and electrical ground loops between the front-end electronics and the data acquisition system. The high bandwidth of opto-electronics is well suited for multiplexing many input channels and allows for introduction of error

checking and error recovery transmission protocols. These features are especially important in experiments where radiation can induce Single Event Effects (SEE) in the digital electronics. Optical communication using parallel optics is now an industry standard, providing a compact solution. The silicon pixel tracker of the ATLAS experiment at the LHC use VCSEL arrays to generate the optical signals at 850 nm and PIN arrays to convert the signals back into electrical signals for further processing. The devices have been proven to be radiation-hard for operation at the LHC.

The LHC is now the highest energy and luminosity hadron collider. However, planning is already underway to increase the luminosity by a factor of five to 5x1035 cm-2s-1. The required data bandwidth and radiation-hardness of the upgraded detector must also be increased. We use the Non Ionizing Energy Loss (NIEL) scaling hypothesis to estimate the radiation dose for the optical link upgrades. The estimate is based on the assumption that the main radiation effect is bulk damage in the VCSELs and PINs with the displacement of atoms. After five years of operation with an integrated luminosity of 3,000 fb-1, we expect the GaAs devices to be exposed to 2.82 x 1015 1-MeV neq/cm2 at the radius of 37 cm from the interaction region. We study the response of the optical devices to a high dose of 24 GeV protons. The expected equivalent fluence is 5.4 x 1014 p/cm2. We also irradiated a small sample of devices to 300 MeV/c pions to test the NIEL hypothesis.
We packaged the PINs and VCSELs at OSU for the irradiation. In the past few years, we irradiated a small sample of VCSEL arrays of various speeds from Finisar, Optowell, and ULM Photonics using 24 GeV/c protons. We observe significant degradation in the optical power during the irradiation but some of the power can be recovered by annealing in the laboratory. Based on the study, we identified the 10 Gb/s array from Finisar as the most radiation hard and irradiated a much larger sample in 2010 to study the variation in the radiation hardness within a sample. The post-irradiation characterization of the devices is currently in progress in the laboratory and we will present the result of the characterization at the conference. In addition, two arrays were irradiated with 300 MeV/c pions and the degradation will be compared with that from the irradiation using protons as a test of the NIEL hypothesis.
In the past few years, we also irradiated a small sample of PIN arrays of various speeds from Finisar, Optowell, and ULM using 24 GeV/c protons. We observe significant degradation in the PIN responsivity during the irradiation but some of the loss can be recovered by operating at higher bias voltage. Based on the study, we identified the 3.125 Gb/s array from Optowell as the most radiation hard and irradiated a sample of twenty arrays in 2009 to study the variation in the radiation hardness within a sample. Unfortunately, post-irradiation analysis in the laboratory revealed that some of the devices broke down at relatively low bias voltage. Consequently we decided to irradiate a sample of twenty arrays from ULM in 2010. The degradation in responsivity is significant but acceptable. The arrays have been fully characterization in the laboratory and we will present the result of the study at the conference. In addition, two arrays were irradiated with 300 MeV/c pions and we will compare the degradation with that using protons as a test of the NIEL hypothesis.

Summary:

We investigate the feasibility of using VCSEL and PIN arrays in the optical links for the planned upgrades of the detectors at the LHC, CERN. We irradiated high-speed VCSEL (Vertical-Cavity Surface-Emitting Laser) and PIN arrays with 24 GeV/c protons at CERN and 300 MeV/c pions at PSI up to the equivalent dose of a few 1015 1-MeV neq/cm2. The arrays irradiated were fabricated by Finisar, Optowell, and ULM Photonics. The irradiation using two species of particles allows us to test the hypothesis that the damage is proportional to the non-ionizing energy loss (NIEL) in a device. The results from the irradiations will be presented.

Heavy Flavor Physics / 306

Three-Pion Decays of the tau Lepton, the a_1(1260) Properties, and the a_1-rho-pi Lagrangian

Author: Peter Lichard[1]

Co-author: Martin Vojik [1]

[1] *Silesian University in Opava*

We show that the a_1-rho-pi Lagrangian is a decisive element for obtaining a good phenomenological description of the three-pion decays of the tau lepton. We choose it in a two-component form with a flexible mixing parameter sin(theta). In addition to the dominant a_1-> rho+pi intermediate states, the a_1-> sigma+pi ones are included. When fitting the three-pion mass spectra, three data sets are explored: (1) ALEPH 2005 pi-pi-pi+ data, (2) ALEPH 2005 pi-pi0pi0 data, and (3) previous two sets combined together and supplemented with the ARGUS 1993, OPAL 1997, and CLEO 2000 data. The corresponding confidence levels are (1) 28.3%, (2) 100%, and (3)7.7%. After the inclusion of the a_1(1640) resonance, the agreement of the model with data greatly improves and the confidence level reaches 100% for each of the three data sets. From the fit to all five experiments [data set (3)] the following parameters of the a_1(1260) are obtained m_{a_1}=(1233+/-18) MeV, Gamma_{a_1}=(431+/-20) MeV. The optimal value of the Lagrangian mixing parameter sin(theta)=0.459+/-0.004 agrees with the value obtained recently from the e+e- annihilation into four pions.

Neutrino Physics / **308**

Highlights from MINERvA's first year

Author: Aaron McGowan[1]

[1] *University of Rochester*

Corresponding Author: mcgowan@pas.rochester.edu

The MINERvA detector, operating since 2009 in the NuMI beam line at Fermilab, has collected neutrino and antineutrino scattering data on a variety of nuclear targets. The detector is designed to identify events originating in plastic scintillator, lead, carbon, iron, water, and liquid helium. The goals of the experiment are to measure precisely inclusive and exclusive cross sections for neutrino and antineutrino interactions for these targets. We present preliminary kinematic distributions for charged current quasi-elastic scattering and other processes.

Education and Outreach / **309**

MARIACHI: Science by Scientists, Teachers and Students

Author: Helio Takai[1]

[1] *Physics Department, Brookhaven National Laboratory*

Corresponding Author: takai@bnl.gov

The MARIACHI initiative involves a community with diverse academic backgrounds to explore forefront science. We focus on the study of cosmic rays. Our flagship theme has been the development of a new technology for the detection of cosmic rays, namely forward scattering radar. Over the years many other research subjects have been added to the list of our interests and they are now in various stages of development. We believe that by creating an environment where teachers and students can work together in the pursuit of science, each can learn about science first hand. In this presentation we will give an overview of the experiment and lessons learned. In particular we will discuss how large numbers of students get involved in the data analysis from the experiment. Impressions about the educational impacts will be given.

Beyond the Standard Model / **310**

Interpretation of SUSY Searches in ATLAS with Simplified Models

Author: Hideki Okawa[1]

[1] *UC Irvine*

Corresponding Author: hideki.okawa@cern.ch

We present the status of interpretations of Supersymmetry searches in ATLAS using simplified models. Such models allow a systematic scan through the phase space in the sparticle mass plane, and in the corresponding final state kinematics. Models at various levels of simplification have been studied in ATLAS. The results can be extrapolated to more general new physics models which lead to the same event topology with similar mass hierarchies.

Neutrino Physics / 311

MINOS Electron-neutrino Appearance Analysis

Author: Xiaobo Huang[1]

[1] *Argonne National Laboratory*

Corresponding Author: xiaobo.huang@anl.gov

MINOS is a long-baseline neutrino oscillation experiment which started commissioning in 2005. MINOS has provided many physics opportunities in the past few years. It has made best measurement of Δm^2_{32} and made the first measurement of $\Delta \bar{m}^2_{32}$. MINOS also set the most stringent limit to the fraction of active neutrinos transition to sterile neutrinos. MINOS made attempts to measure θ_{13} and has obtained comparable limit with the current best limit depending on the CP-violation phase and the neutrino mass hierarchy. With more data and improved analysis technique, MINOS might also set better limit to θ_{13} within this year. Since MINOS will end soon, MINOS+ has been proposed to run the experiment at high energy mode.

Detector Technology and R&D / 312

Calibration and Performance of the ATLAS Muon Spectrometer

Author: Edward Diehl[1]

[1] *University of Michigan*

Corresponding Author: diehl@umich.edu

The ATLAS muon spectrometer is designed to measure muon momenta with a resolution of 4% @ 100 GeV/c rising to 10% @ 1 TeV/c track momentum. The spectrometer consists of precision tracking and trigger chambers embedded in a 2T magnetic field generated by three large air-core superconducting toroids. The precision detectors provide 50 micron tracking resolution to a pseudo-rapidity of 2.7. The system also includes an optical monitoring system which measures detector positions with 40 micron precision. I will report on the calibration and performance of the ATLAS muon spectrometer in the first year of LHC data.

Top Quark Physics / 314

Measurement of Top Quark Properties in CDF

Author: Zhenbin Wu[1]

[1] *Baylor University*

Corresponding Author: zhenbinwu@gmail.com

The top quark was discovered at the CDF and D0 experiments in 1995.Its properties within the Standard Model are fully defined. The measurement of the top quark mass and the verification of the expected properties have been an important topic of experimental top quark physics since. We will present the recent measurements of top quark properties in CDF.

Top Quark Physics / **315**

Search for new physics in ttbar + MET -> b bbar qqbar qqbar final state in ppbar collisions at sqrt(s) = 1.96 TeV

Author: Marco Bentivegna[None]

Corresponding Author: marco.bentivegna@roma1.infn.it

We present a search for a new particle T' decaying to a top quark via T'-> t + X, where X goes undetected. We use a data sample corresponding to 5.7 inverse fb of integrated luminosity of ppbar collisions with sqrt(s) = 1.96 TeV, collected at Fermilab Tevatron by the CDF II detector. Our search for pair production of T' is focused on the hadronic decay channel, ppbar -> T'Tbar' -> ttbar + XX -> bqqbar bbarqqbar +XX. We interpret our results in terms of a model where T' is an exotic fourth generation quark and X is a dark matter particle. The data are consistent with standard model expectations. We set a limit on the generic production of T'Tbar' -> ttbar + XX, excluding the fourth generation exotic quarks T'at 95% confidence level up to mT' = 400 GeV/c2 for mX < 70 GeV/c2.

Particle Astrophysics and Cosmology / **316**

Constraining Light Dark Matter with CDMS II and SuperCDMS

Author: Scott Hertel[1]

[1] *Department of Physics*

Corresponding Author: hertel@mit.edu

There has been much recent interest in Weakly Interacting Massive Particle (WIMP) models with masses below 10 GeV/cˆ2. Data from the Cryogenic Dark Matter Search (CDMS II) have been reanalyzed to give increased sensitivity to these models. Using a lowered, 2 keV recoil energy threshold, we have reanalyzed data from eight germanium detectors operated at the Soudan Underground Laboratory, and used these data to place constraints on light WIMP models. We discuss the compatibility of these results with possible low-mass WIMP signals from the DAMA/LIBRA and CoGeNT experiments, and also discuss prospects for improving SuperCDMS sensitivity to light WIMPs by operating existing detectors in a high-voltage mode.

Heavy Flavor Physics / **317**

Measurements of Charm Mixing and CP Violation at Belle

Author: Debabrata Mohapatra[1]

[1] *Virginia Tech*

Corresponding Author: dmohapat@vt.edu

We report an improved measurement of Dˆ0-Dˆ0bar mixing using the time dependence of the Dalitz plot of the decay mode Dˆ0->K_Sˆ0 piˆ+ piˆ-. In addition, we report results of searches for CP violation in the decays Dˆ0->K_Sˆ0 Pˆ0 where P0 denotes a neutral pseudo-scalar meson which is either a piˆ0, eta or etaˆ'. The result for Dˆ0->K_S piˆ0 is the most sensitive search for CP violation in the Dˆ0 system to date. These results are based on a large data sample collected by the Belle detector at the KEKB asymmetric energy electron positron collider.

CP-Violation / **318**

Measurements of CP Violation in B Decay at Belle

Author: Himansu Sahoo[1]

[1] *University of Hawaii*

Corresponding Author: himansu@phys.hawaii.edu

We present the final measurement of time-dependent CP violation in the neutral B decays into charmonium and a Kˆ0 meson with a large data sample containing 772 million B \bar{B} pairs collected at the Upsilon(4S) resonance with with the Belle detector at the KEKB asymmetric-energy e+e- collider. We also reports the first results on CP violation in the radiative penguin decay Bˆ0->K_S phi gamma and Bˆ0->omega K_S gamma, improved measurements of CP violation in Bˆ0->piˆ+ piˆ- and Bˆ0\to a_1ˆ+- piˆ-+ decays as well as new measurements of B decays to rhoˆ0 rhoˆ0 and pairs of charm mesons.

CP-Violation / **319**

Measurement of the CKM Angle phi_3/gamma at Belle

Author: Leo Piilonen[1]

[1] *Virginia Tech*

Corresponding Author: piilonen@vt.edu

We present the first evidence for B->D K, D->Kˆ+ piˆ- and measurements of related observables used in the Atwood-Dunietz-Soni (ADS) method to determine the CKM parameter phi_3 (also known as gamma). Measurement of related B->Dˆ* Kˆ- modes are also reported. We report the first measurement of phi_3 using model-independent analysis of the Dalitz plot of B->D K, D->K_Sˆ0 piˆ+ piˆ-.

These results are based on the full 710 fbˆ-1 Belle B\bar{B} data sample collected at the KEKB e+e- collider.

Particle Astrophysics and Cosmology / 320

Status of the LUX Dark Matter Experiment

Author: Jeremy Chapman[1]

[1] *Brown*

Corresponding Author: jeremy_chapman@brown.edu

The Large Underground Xenon (LUX) experiment will facilitate direct detection of Weakly Interacting Massive Particles (WIMPs) with a 350 kg xenon TPC. LUX will be able to detect 100 GeV WIMPs with scalar cross section as low as 7e−46 cm2, equivalent to ˜0.5 events/100 kg/month in a 100 kg inner fiducial volume. Electromagnetic background event rates are limited below 5e−4 events/keV/kg/day by an extensive screening and background modeling program, and assume a conservative 99.5% electron recoil event rejection and 50% nuclear recoil acceptance for WIMP signatures.
LUX is currently in the initial deployment phase at the Sanford Surface Laboratory at Homestake, during which all detector hardware and the full electronics chain are being extensively characterized. A miniature water shield reduces ambient electromagnetic backgrounds to rates allowing data taking via radioactive calibration sources. The underground deployment phase will begin in November 2011, with WIMP search data taking beginning shortly thereafter. LUX will surpass all existing dark matter limits for WIMPs with mass above ˜10 GeV within days after beginning its science run.

Top Quark Physics / 321

Measurement of Tau Leptons from Top Quark Pair Production and Decay in ATLAS

Authors: Allison McCarn[1]; Mark Neubauer[1]; Viviana Cavaliere[1]

[1] *Department of Physics-Univ. Illinois at Urbana-Champaign*

Corresponding Author: allison.renae.mc.carn@cern.ch

The top quark can be used as a probe of new physics, particularly when it decays into non-SM particles. One promising example is the decay of a top quark into a charged Higgs boson and b-quark. Charged Higgs bosons occur naturally in extended Higgs sectors and for a wide range of models can decay nearly exclusively into a tau lepton and a neutrino. In this talk, we summarize the searches for tau leptons from SM top quark pair production and decay, and their interpretation as a probe of physics beyond the standard model using the ATLAS detector.

Particle Astrophysics and Cosmology / 322

Testing Inflation with Dark Matter Halos (Primordial Non-Gaussianity in Large-scale Structure)

Author: Marilena Loverde[1]

[1] *Institute for Advanced Study*

Corresponding Author: marilena@ias.edu

Cosmic inflation provides a mechanism for generating the early density perturbations that seeded the large-scale structures we see today. Primordial non-Gaussianity is among the most promising of few observational tests of physics at this epoch. At present non-Gaussianity is best constrained by the cosmic microwave background, but in the near term large-scale structure data may be competitive so long as the effects of primordial non-Gaussianity can be modeled through the non-linear process of structure formation. I will discuss recent work modeling effects of a few types of primordial non-Gaussianity on the large-scale halo clustering and the halo mass function. More specifically, I will compare analytic and N-body results for two variants of the curvaton model of inflation: (i) a tau_NL" scenario in which the curvaton and inflaton contribute equally to the primordial curvature perturbation and (ii) ag_NL" model where cancellations vanish the usual quadratic f_NL term in the potential, but give rise to a large cubic term.

Computing in HEP / **323**

ATLAS data analysis on Grid

Author: Sergey Panitkin[1]

[1] *Department of Physics - Brookhaven National Laboratory (BNL)*

Corresponding Author: panitkin@bnl.gov

In 2010 and 2011 the ATLAS Collaboration at LHC collected a large volume of data and published a number of ground breaking papers. The Grid-based ATLAS distributed computing infrastructure played a crucial role in enabling timely analysis of the data. We will present the architecture and general features of the ATLAS distributed analysis system, and discuss the performance of the system and the underlying Grid infrastructure as an analysis platform. We will also discuss future directions in the evolution of ATLAS distributed analysis aimed at improvement of analysis capabilities, robustness and efficiency of the system.

Neutrino Physics / **324**

Simulation of Reactors for Antineutrino Experiments Using DRAGON

Author: Lindley Winslow[1]

[1] *Massachusetts Institute of Technology*

Corresponding Author: lwinslow@mit.edu

From the discovery of the neutrino to the precision neutrino oscillation measurements in KamLAND, nuclear reactors have proven to be an important source of antineutrinos. As their power and our knowledge of neutrino physics has increased, more sensitive measurements have become possible. The next generation of reactor antineutrino experiments require more detailed simulation of the reactor core. Many of the reactor simulation codes are proprietary which makes detailed studies difficult. Here we present the results of the open source DRAGON code and compare it to other industry standards for reactor modeling. We use published data from the Takahama reactor to determine the quality of the simulations. The propagation of the uncertainty to the antineutrino flux is also discussed.

Particle Astrophysics and Cosmology / 325

New Perspectives on Indirect Detection: Dark Matter in the Sun and Other Stars

Author: Andrew Zentner[1]

[1] *University of Pittsburgh*

Corresponding Author: zentner@pitt.edu

Any program to identify dark matter relies on direct detection of dark matter scattering in low-background experiments, collider signatures, and indirect astrophysical signatures of dark matter. I will review contemporary constraints from indirect searches for dark matter. I will then present several new perspectives on the indirect detection of dark matter. First I will focus on the Sun and show how searches for high-energy neutrinos from the Sun in conjunction with searches by direct detection experiments can constrain the physics of the dark matter. I will then discuss the effects that dark matter may have on stars, particularly low-mass stars, and how these effects may give rise to unique, observable signatures. In particular, low-mass stellar populations may have different properties at different positions within the Milky Way galaxy and in nearby, external galaxies. The shift in stellar properties from one environment to the next should be correlated with the abundance of dark matter inferred for each galaxy. With a number of ongoing and forthcoming large astronomical surveys capable of studying stellar populations in detail, such signatures of dark matter may offer new methods to probe dark matter physics in parameter regimes that are inaccessible to other indirect techniques.

Electroweak Physics / 328

Z boson property at Tevatron: angular coefficients and Afb of Drell-Yan process

Author: Jiyeon Han[1]

[1] *University of Rochester*

Corresponding Author: ji.yeon.han@cern.ch

We report on the first measurement of the angular distribution of final state lepton and also the forward and backward asymmetry (Afb) which is sensitive to Weinberg angle in $p\bar{p} \rightarrow \gamma^*/Z \rightarrow \ell^+\ell^- + X$ events produced at $\sqrt{s} = 1.96TeV$. The data sample collected by the CDF II detector. The angular distributions are studied as a function of the transverse momentum of the lepton pair. The Lam-Tung relation which is only valid for a spin-1 description of the gluon is also tested.

Computing in HEP / 334

An outlook of the user support model to educate the users community at the CMS Experiment

Author: Sudhir Malik[1]

[1] *University of Nebraska/FNAL*

Corresponding Author: sudhir.malik@cern.ch

The CMS (Compact Muon Solenoid) experiment is one of the two large general-purpose particle physics detectors built at the LHC (Large Hadron Collider) at CERN in Geneva, Switzerland. In order to meet the challenges of designing and building a detector of the technical complexity of CMS, a globally distributed collaboration has been assembled with different backgrounds, expertise, and experience. An international collaboration of nearly 3500 people from nearly 200 institutes in 40 different countries built and now operates this complex detector. The diverse collaboration combined with a highly distributed computing environment and Petabytes/year of data being collected makes CMS unlike any other High Energy Physics collaborations before. This presents new challenges to educate and bring users, coming from different cultural, linguistics and social backgrounds, up to speed to contribute to the physics analysis. CMS has been able to deal with this new paradigm by deploying a user support structure model that uses collaborative tools to educate and reach out its users via a robust software and computing documentation, a series of hands on tutorials per year facilitating the usage of common physics tools, annual hands-on-learning workshops on physics analysis and user feedback to maintain and improve the CMS specific knowledge base. This talk will describe this model that has proved to be successful compared to its predecessors in other HEP experiments where structured user support was missing and the word of mouth or sitting with experts one-on-one was the only way to learn tools to do physics analysis. To carry out the the user support mission worldwide, an LHC Physics Center (LPC) was created few years back at Fermilab as a hub for US physicists. The LPC serves as a "brick and mortar" location for physics excellence for the CMS physicists where graduate and postgraduate scientists can find experts in all aspects of data analysis and learn via tutorials, workshops, conferences and gatherings. Following the huge success of LPC, a center at CERN itself called LHC Physics Center at CERN (LPCC) and Terascale Analysis Center at DESY have been created with similar goals. The CMS user support model would also facilitate in making the non-CMS scientific community learn about CMS physics. A good example of this, is the effort by HEP experiments, including CMS, to focus on data preservation efforts. In order to facilitate its use by the future scientific community, who may want to re-visit our data, and re-analyze it, CMS is evaluating the resources required. A detailed, good quality and well maintained documentation by the user support group about the CMS computing and software may go a long way to help in this endeavor.

Electroweak Physics / 336

The Epsilon Expansion via Hypergeometric Functions and Differential Reduction

Author: Scott Yost[1]

Co-author: Mikhail Kalmykov [2]

[1] *The Citadel*

[2] *II Inst. Theoretical Phys., U. Hamburg*

Corresponding Author: scott.yost@citadel.edu

Higher-order diagrams required for radiative corrections to mixed electroweak and QCD processes at the LHC and anticipated future colliders will require numerically stable representations of the associated Feynman diagrams. The hypergeometric representation supplies an analytic framework that is useful for deriving such stable representations. We discuss the reduction of Feynman diagrams to master integrals, and compare integration-by-parts methods to differential reduction of hypergeometric functions. We describe the problem of constructing higher-order terms in the epsilon expansion, and characterize the functions generated in such expansions.

Higgs Physics / 339

Higgs Tansverse Momentum Distributions at the LHC

Authors: Ambar Jain[1]; Duff Neill[1]; Ira Rothstein[1]; Jui-Yu Chiu[1]

[1] *Carnegie Mellon University*

Corresponding Author: jychiu@andrew.cmu.edu

In this talk I will present a factorization theorem for the Higgs transverse momentum spectrum using SCET (Soft Collinear Effective Theory). This theorem allows us systematically resum large logarithms of p_T in the regime $m_h \gg p_T \gg \Lambda_{QCD}$. The transverse momentum distributions of Higgs produced via gluon fusion will be presented and compared to previous results derived using effective field theory, as well as the results of Collins Soper and Sterman (CSS). The differences will be illuminated. I will also present new results for the Higgs p_T spectrum for b-quark fussion.

Perturbative and non-Perturbative QCD / **340**

The Rapidity Renormalization Group

Authors: Ambar Jain[1]; Duff Neill[1]; Ira Rothstein[1]; Jui-Yu Chiu[1]

[1] *Carnegie Mellon University*

Corresponding Author: jychiu@andrew.cmu.edu

We introduce a systematic approach for the resummation of perturbative series which involve large logarithms not only due to large invariant mass ratios but large rapidities as well. Series of this form can appear in a variety of gauge theory observables. The formalism is utilized to calculate the jet broadening event shape and and transverse momentum (p_T) distributions in a systematic fashion to next to leading logarithmic order. An operator definition of the factorized cross section as well as a closed form of the next-to leading log cross section are presented.

Heavy Flavor Physics / **341**

Relating B_s Mixing and B_s -> mu+mu- with New Physics

Author: Gene Golowich[1]

Co-authors: Alexey Petrov [2]; Gagik Yeghiyan [2]; JoAnne Hewett [3]; Sandip Pakvasa [4]

[1] *U Mass*

[2] *Wayne State University*

[3] *SLAC National Accelerator Laboratory*

[4] *University of Hawaii*

Corresponding Author: golowich@physics.umass.edu

We perform a study of the Standard Model (SM) fit to the mixing quantities Delta M_{B_s} and Delta Gamma_{B_s}/Delta M_{B_s} in
order to bound contributions of New Physics (NP) to B_s mixing.
We then use this to explore the branching fraction of B_s -> mu+mu-
in certain models of NP. In most cases, this constrains NP amplitudes
for B_s -> mu+mu- to lie below the SM component.

Neutrino Physics / **342**

Lorentz noninvariant neutrino oscillations without neutrino masses

Author: Kerry Whisnant[1]

Co-authors: Danny Marfatia [2]; Jiajun Liao [1]; Vernon Barger [3]

[1] *Iowa State University*

[2] *University of Kansas*

[3] *University of Wisconsin-Madison*

Corresponding Author: whisnant@iastate.edu

The bicycle model of Lorentz noninvariant neutrino oscillations without neutrino masses naturally predicts maximal mixing and a 1/E dependence of the oscillation argument for muon-neutrino to tau-neutrino
oscillations of atmospheric and long-baseline neutrinos, but cannot also simultaneously fit the data for solar neutrinos and KamLAND. We search for other possible structures of the effective Hamiltonian for Lorentz noninvariant oscillations without neutrino mass that naturally have 1/E dependence at high neutrino energy. Due to the lack of any evidence for direction dependence, we consider only direction-independent models. Although a number of models are found with 1/E dependence for atmospheric and long-baseline neutrinos, none can also simultaneously fit solar, reactor and short-baseline neutrino data.

CP-Violation / **343**

CP violation - minireview

Author: Jure Zupan[1]

[1] *Unknown*

Corresponding Author: jure.zupan@cern.ch

I will review the present status of CP violating observables in low energy observables and the progress in their precision that can be expected for in the future. I will discuss what deviations from Standard Model can potentially teach us about new physics and also discuss recent hints of non-Standard Model CP violating sources in heavy quark transitions.

Poster Session / **344**

Interparticle forces in scalar QFTs with non-linear mediating fields

Author: Alexander Chigodaev[1]

[1] *York University*

Corresponding Author: achigoda@yorku.ca

We study the interparticle potentials for few-particle systems in a scalar theory with a non-linear mediating field of the Higgs type. We use the variational method, in a reformulated Hamiltonian formalism of QFT, to derive relativistic three and four particle wave equations for stationary states of these systems. We show that the cubic and quartic non-linear terms modify the attractive Yukawa potentials, which are dominant at small interparticle distances, by new terms that produce confining and quasi-confining interparticle potentials.

Accelerator Physics / 345

Muon Collider Progress: Accelerators

Author: Michael Zisman[1]

[1] *Lawrence Berkeley National Laboratory*

Corresponding Author: mszisman@lbl.gov

A muon collider would be a powerful tool for exploring the energy-frontier with leptons, and would complement the studies now under way at the LHC. Such a device would offer several important benefits. Muons, like electrons, are point particles so the full center-of-mass energy is available for particle production. Moreover, on account of their higher mass, muons give rise to very little synchrotron radiation and produce very little beamstrahlung. The first feature permits the use of a circular collider that can make efficient use of the expensive RF system and whose footprint is compatible with an existing laboratory site. The second feature leads to a relatively narrow energy spread at the collision point. Designing an accelerator complex for a muon collider is a challenging task. Firstly, the muons are produced as a tertiary beam, so a high-power proton beam and a target that can withstand it are needed to provide the required luminosity of ˜1 x 10ˆ34 cmˆ−2sˆ−1. Secondly, the beam is initially produced with a large 6D phase space, which necessitates a scheme for reducing the muon beam emittance ("cooling"). Finally, the muon has a short lifetime so all beam manipulations must be done very rapidly. The Muon Accelerator Program, led by Fermilab and including a number of U.S. national laboratories and universities, has undertaken design and R&D activities aimed toward the eventual construction of a muon collider. Design features of such a facility and the supporting R&D program will be described.

Summary:

Advantages and challenges of a muon collider are presented, along with a description of the ingredients of such a facility. We also briefly describe the R&D program under way at various U.S. national laboratories and universities in support of a muon collider design.

Computing in HEP / 346

The Tiers of US ATLAS: Integrating a Distributed Computing Facility for LHC Physics

Author: Robert W Gardner[1]

[1] *University of Chicago*

Corresponding Author: robert.w.gardner@cern.ch

DRAFT

We discuss the US ATLAS experience in deploying, integrating and operating a set of distributed computing centers into a single, logical computing facility suitable to meet the simulation and analysis requirements for the first years of LHC physics. Particular attention is paid to the Tier 2 layer in the LHC computing hierarchy, which is a focal point of activity supporting centrally managed tasks from CERN, managed data transfers to and from the Tier 1 center at Brookhaven National Laboratory as well as Tier 1 and Tier 2 centers in Europe and Asia, sporadic user-driven transfers to university-based Tier 3 clusters, as well as chaotic analysis activity from a globally distributed collaboration. The Tier 2 centers provide a resource at an intermediate scale in HEP: larger than typical physics departmental computing clusters but smaller than facilities at the national laboratories, and therefore present a unique set of challenges. We describe new challenges emerging as the computing model evolves to meet the needs of ATLAS physics, implying Tier 2 computing scales reaching multiple-Petabyte storage systems and many-thousand computing cores.

Higgs Physics / 347

$H^{\pm} \to \chi^{\pm}\chi^{0} \to 3\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ Searches

Author: Caleb Lampen[1]

[1] *University of Arizona*

Corresponding Author: lampen@physics.arizona.edu

In some supersymmetric (SUSY) models, a charged Higgs boson ($H^{\pm}$) can decay into a chargino-neutralino ($\chi_i^{\pm}\chi_j^0$) pair producing a final state containing three leptons (electron/muon) and missing transverse energy ($3\ell + E_{\mathrm{T}}^{\mathrm{miss}}$). Such a decay could provide extra sensitivity to the $H^{\pm}$, especially in the region of SUSY parameter space near tanβ = 7, where the $H^{\pm}$ decays to Standard Model particles have reduced significance. We present a signature search on ATLAS data, setting an exclusion limit on an excess of $3\ell + E_{\mathrm{T}}^{\mathrm{miss}}$ events over the Standard Model background. Such an excess could be evidence of generic SUSY, the $H^{\pm} \to \chi_i^{\pm}\chi_j^0$ decay, or both.

Neutrino Physics / 348

Three-Parameter Lorentz-Violating Model for Neutrino Oscillations

Author: Jorge S Diaz[1]

Co-author: V. Alan Kostelecky [1]

[1] *Indiana University*

Corresponding Author: jsdiazpo@indiana.edu

A three-parameter model of neutrino oscillations is presented. It is based on a simple Lorentz- and CPT-violating texture and is consistent with compelling oscillatory signals and null tests involving atmospheric, accelerator, reactor, and solar neutrinos. The solar and atmospheric mixing angles are fixed by the texture at both low and high energies instead of being independent parameters as in most descriptions. One natural feature of the model is anomalous appearance signals in MiniBooNE at low energies, consistent with recent observations for both neutrinos and antineutrinos. Simple texture-preserving extensions of the model can accommodate the recent MINOS anomaly and the LSND signal.

Neutrino Physics / 349

Neutrino-Nucleus Interactions

Author: Rex Tayloe[1]

[1] *Dept of Physics, Indiana University*

Corresponding Author: rtayloe@indiana.edu

A thorough understanding of the physics of neutrino nucleus scattering continues to evade us even after 50 years of experimental work. This is mainly caused by the challenges of these experiments that include beams with large energy uncertainty, low event rates, and large backgrounds. Progress has been made in recent years with new results from improved experiments. It is important to

continue this work as current and near-future neutrino oscillation experiments require better understanding of these neutrino-nucleus interactions. This talk will survey the current state of measurements and models and will examine future prospects for progress.

Top Quark Physics / **350**

Mini-review of the top quark physics

Author: Kirill Melnikov[1]

[1] *Johns Hopkins University*

Corresponding Author: melnikov@pha.jhu.edu

I will present a theoretical overview of the top quark physics.
I will discuss the status of theoretical description of various processes at hadron colliders that are used to extract the information about dynamics of top quarks, and their quantum numbers such mass, spin and charge.

Neutrino Physics / **351**

Neutrino Physics with SciBooNE

Author: Morgan Wascko[1]

[1] *Imperial College London*

Corresponding Author: m.wascko@imperial.ac.uk

SciBooNE (FNAL E954) is designed to measure precise neutrino cross sections on carbon in the one GeV region. Moreover, SciBooNE can serve as a near detector for MiniBooNE neutrino and antineutrino oscillation searches. I will present SciBooNE's most recent results on neutrino cross section measurements and the search for neutrino disappearance with MiniBooNE.

Education and Outreach / **352**

The Multimedia Project Quarked!

Author: Alice Bean[1]

Co-author: Teresa MacDonald [2]

[1] *Department of Physics and Astronomy*

[2] *University of Kansas*

Corresponding Author: abean@ku.edu

Can exposure to fundamental ideas about the nature of matter help motivate children in math and science and support the development of their understanding of these ideas later? Physicists, designers, and museum educators at the University of Kansas created the Quarked!™ Adventures in the subatomic Universe project to provide an opportunity for youth to explore the subatomic world in a fun and user friendly way. The project components include a website (www.quarked.org) and facilitated hands-on shows. These are described and assessment results are presented. Questions

addressed include the following. Can you engage elementary and middle school aged children with concepts related to particle physics? Can young children make sense of something they can't directly see? Do teachers think the material is relevant to their students?

Beyond the Standard Model / **353**

Search for High-Mass States with Lepton Plus Missing Transverse Energy Using the ATLAS Detector at Center of Mass Energy of 7 TeV

Author: James David Degenhardt[1]

[1] *Department of Physics and Astronomy - University of Pennsylvania*

Corresponding Author: james.degenhardt@cern.ch

The ATLAS detector has been used to search for high-mass states decaying into a single high momentum lepton and missing energy, such as new heavy charged gauge bosons. Based on proton-proton collisions at a center of mass energy of 7 TeV produced at the Large Hadron Collider, the latest search results for a W' decaying to lepton plus neutrino are presented.

Beyond the Standard Model / **354**

Searches for Long-lived particles and displaced vertices with the ATLAS experiment

Author: Vivek Jain[1]

[1] *Indiana University*

Corresponding Author: vjain@albany.edu

The discovery of a new type of a heavy long-lived particle (LLP) would be of fundamental significance, since no such particles exist in the Standard Model. LLPs are anticipated in a wide range of physics models which extend the Standard Model, such as supersymmetry (SUSY) and universal extra dimensions. Since LLPs produced in the 7 TeV pp collisions at the CERN LHC can be slow (beta«1) and penetrating, time-of-flight and anomalous dE/dx energy loss measurements are promising ways to search for LLPs, in the cases where they are charged. We also report on a search for heavy particles whose decay takes place a significant distance from their production point. Production of such particles is expected in various new-physics scenarios, a well motivated example of which is supersymmetry with R-parity violation. Searches using the ATLAS experiment are presented, with the techniques and results described.

Beyond the Standard Model / **355**

Search for Stopped Long-lived particles with the ATLAS experiment

Author: Josh Cogan[1]

[1] *SLAC National Accelerator Laboratory*

Corresponding Author: joshua.godfrey.cogan@cern.ch

Massive, long-lived particles (LLP) are predicted in several supersymmetry and beyond the Standard Model scenarios. In some cases these heavy objects, if
produced in 7 TeV pp collisions at the CERN LHC, may lose all of their energy and come to rest within the detector volume. We describe the search for gluino
R-hadrons which have been captured within the ATLAS detector volume, particularly the calorimeter, and decay at some later time, dictated by the lifetime of
the particle. Events containing one or more jets, potentially produced from the 2- or 3- body decays of the gluinos stopped within the calorimeter are
isolated. Although the analysis is motivated by the search for long-lived gluinos we are also sensitive to the decays of other long-lived particles which
may be captured by ATLAS. Candidate events are triggered in the empty bunch crossings in order to remove collision backgrounds. Simple selection criteria
enable the discrimination of signal-like events from backgrounds, which arise from cosmic muons, noise and beam related sources.

CP-Violation / **357**

A New CP Violating Observable for the LHC

Authors: Joshua Berger[1]; Monika Blanke[1]; Yuval Grossman[1]

[1] *Cornell University*

Corresponding Author: jb454@cornell.edu

We study a new type of CP violating observable that arises in three body decays. We consider decays that are dominated by an intermediate resonance that can go on shell. In many cases, the decay can occur via two different orderings. The required CP-even phase arises due to the different virtualities of the resonance in the two diagrams corresponding to these orderings. This method can be an important tool for accessing new CP phases at the LHC and future colliders.

Higgs Physics / **358**

The Combination of Higgs Searches with the ATLAS Detector

Author: Haichen Wang[1]

[1] *University of Wisconsin-Madison*

Corresponding Author: haichen.wang@cern.ch

Upper limits on the cross section of Standard Model Higgs boson production at the Large Hadron Collider (LHC) running at a centre-of-mass energy of 7 TeV are determined, based on the searches performed by the ATLAS Collaboration. Models with a fourth generation of heavy leptons and quarks with Standard Model-like couplings to the Higgs boson are also investigated.

Beyond the Standard Model / **359**

Search for multilepton final states of supersymmetry at the ATLAS Detector

Author: Jeremiah Jet Goodson[1]

[1] *Department of Physics - State University of New York (SUNY)*

Corresponding Author: jeremiah.jet.goodson@cern.ch

The results of a search for supersymmetry in multilepton final states using the ATLAS detector is presented. Such signals require three or more leptons, jets, and missing transverse energy. This channel provides the advantage that the contribution due to standard model backgrounds is expected to be very low. Results from the 2011 data-taking will be reported.

Higgs Physics / **360**

Searches for Diboson Production in the Lepton + MET + Jets Final State in ATLAS

Author: Mark Neubauer[1]

[1] *University of Illinois at Urbana-Champaign*

Corresponding Author: msn@illinois.edu

The study of diboson production at high energy colliders tests the electroweak sector of the standard model (SM) and provides a sensitive probe of new physics beyond the SM. An important example is the production of a Higgs boson with mass greater than 140 GeV/cˆ2 which decays primarily to W boson pairs. The diboson decay channel where one W boson decays to leptons and the other vector boson decays to quarks leading to high energy jets is particularly interesting due to its large branching fraction as compared to all-leptoninc channels but is also challenging due to large backgrounds, particularly from W+jets.

We present searches for diboson production in the lepton + MET+ jets final state using \sqrt(s)=7 TeV collision data collected by the ATLAS detector during the 2011 run. Particular emphasis is placed on searches for (1) the SM Higgs boson with mass above the W pair production threshold and (2) SM WW+WZ production.

Detector Technology and R&D / **361**

A Fast Hardware Tracker for the ATLAS Trigger System

Author: Mark Neubauer[1]

[1] *University of Illinois at Urbana-Champaign*

Corresponding Author: msn@illinois.edu

In hadron collider experiments, triggering the detector to store interesting events for offline analysis is a challenge due to the high rates and multiplicities of particles produced. The LHC will soon operate at a center-of-mass energy of 14 TeV and at high instantaneous luminosities of the order of 10ˆ34 to 10ˆ35 / cmˆ2 / second. A multi-level trigger strategy is used in ATLAS, with the first level (L1) implemented in hardware and the second and third levels (L2 and EF) implemented in a large computer farm. Maintaining high trigger efficiency for the physics we are most interested in while at the same time suppressing high rate physics from inclusive QCD processes is a difficult but important problem. It is essential that the trigger system be flexible and robust, with sufficient redundancy and operating margin. Providing high quality track reconstruction over the full ATLAS detector by the start of processing at L2 is an important element to achieve these needs. As the instantaneous

luminosity increases, the computational load on the L2 system will significantly increase due to the need for more sophisticated algorithms to suppress backgrounds.

The Fast Tracker (FTK) is a proposed upgrade to the ATLAS trigger system. It is designed to enable early rejection of background events and thus leave more L2 execution time by moving track reconstruction into a hardware system that takes massively parallel processing to the extreme. The FTK system completes global track reconstruction with near offline resolution shortly after the start of L2 processing by rapidly finding and fitting tracks in the inner detector for events passing L1 using pattern recognition from a large, pre-computed bank of possible hit patterns.

We describe the FTK system design and expected performance in the areas of b-tagging, tau-tagging, and lepton isolation which play and important role in the ATLAS physics program.

Field and String Theory / **362**

Triangle Anomaly in QCD Plasma with Magnetic Field: Chiral Magnetic Effect and Chiral Magnetic Wave

Authors: Dmitri Kharzeev[1]; Ho-Ung Yee[2]

[1] *SUNY, Stony Brook and BNL*

[2] *SUNY, Stony Brook*

We consider relativistic QCD plasma containing charged chiral fermions in an external magnetic field, e.g a chirally symmetric quark-gluon plasma created in relativistic heavy ion collisions.
In the presence of net axial charges, there is an induced electromagnetic current along the magnetic field due to triangle anomaly: this is Chiral Magnetic Effect (CME). We discuss CME in several complementary approaches. We show that triangle anomalies also imply the existence of a new type of collective gapless excitation in this system that stems from the coupling between the density waves of the electric and chiral charges; we call it "the Chiral Magnetic Wave" (CMW). The CMW exists even in a neutral plasma, i.e. in the absence of the axial and vector chemical potentials. We demonstrate the existence of CMW and study its properties using several different approaches. We also discuss the phenomenological implications of the CMW for heavy ion collisions; CMW can induce a charge-dependent elliptic flow for pions, which may be observed experimentally.

Electroweak Physics / **363**

WZ Cross Section Measurement and Limits on Anomalous WWZ couplings with the ATLAS Detector at 7 TeV

Author: Yusheng Wu[1]

[1] *Univ. of Michigan / Univ. of Sci. & Tech. of China*

Corresponding Author: yusheng.wu@cern.ch

We will report on a recent measurement of WZ production cross section and limits on anomalous WWZ couplings using LHC proton-proton collision data collected by the ATLAS Detector at 7 TeV center-of-mass energy in 2011. The measurement is carried out on the WZ leptonic decay channels yielding three isolated high-pT leptons and large transverse momentum imbalance in the events. The background events mainly come from ZZ, Z+jets, Top and Drell-Yan processes, which are estimated using both MC simulations and collision data. Based on the observations and the signal and background predictions, the ATLAS WZ detection sensitivity and the production cross-section will be reported. The method and the results on probing the WWZ anomalous couplings using the selected WZ events will be presented.

Beyond the Standard Model / 364

Search for high mass dilepton resonances in pp collisions at sqrt(s)=7 TeV with the ATLAS experiment

Author: Dominick Olivito[1]

[1] *University of Pennsylvania*

The ATLAS detector has been used to search for high mass e e or mu mu resonances, such as new heavy neutral gauge bosons. This talk will present the latest search results for a high mass state decaying to dilepton pairs, in proton-proton collisions at a center of mass energy of 7 TeV at the Large Hadron Collider using data recorded by the ATLAS experiment in 2011.

Field and String Theory / 366

Axion monodromy

Author: Albion Lawrence[1]

[1] *Brandeis University*

Corresponding Author: albion@brandeis.edu

Simple inflation models using a pseudo Nambu-Goldstone boson (PNGB) as the inflaton require an axion decay constant at or above the Planck scale. Models which generate potentially observable gravitational waves also require scalar fields with super-Planckian ranges. These models are hard to justify in UV-complete theories. One way around the problem is the phenomenon of "axion monodromy". I present two models which realize this phenomenon, one motivated by string theory and the other arising in a 4d large-N quantum field theory that has an M-theory dual. In the former case, we study the effective field theory of this model, show that with some caveats it is a suitable model for high-scale inflation, and discuss interesting instabilities of the model. In the latter case we study the detailed potential and potential instabilities of the model, show that it leads to a potentially viable model of PNGB-driven inflation, and argue that the model becomes unstable in the regime that would support slow-roll eternal inflation.

Beyond the Standard Model / 367

Inclusive Search for Same-Sign Dileptons

Author: Benjamin Cerio[1]

[1] *Physics Department-Duke University*

Corresponding Author: bcc11@phy.duke.edu

We present an inclusive search for events with two isolated leptons (e or μ) of the same electric charge in pp collisions at $\sqrt{s} = 7$ TeV. The data are selected from events recorded in the ATLAS detector in 2011. With a small Standard Model background, the same sign dilepton signature is a powerful testing ground for new physics. The distributions of kinematical variables are presented, and compared to the Standard Model predictions.

Particle Astrophysics and Cosmology / 368

Multidimensional Quantum Tunneling: A Perturbative Approach

Author: Nathaniel Reden[1]

Co-authors: Albion Lawrence [1]; Cecilia Garraffo [2]

[1] *Brandeis University*

[2] *Brandeis University, Harvard-Smithsonian Center for Astrophysics*

Corresponding Author: nireden@brandeis.edu

We revisit multidimensional quantum tunneling, as a model for studying the state of the inflaton after a tunneling transition from a false vacuum. Previous approaches to the subject make some technically incorrect assumptions about the validity of the WKB approximation. I will present a new method that avoids these mistakes, in more carefully treating the separation between the tunneling and transverse directions. When the transverse modes begin in the adiabatic ground state in the false vacuum, we compute excitations of the transverse degrees of freedom above the adiabatic ground state as it exits the potential barrier, and the dependence of this excitation on the false vacuum and the barrier configuration. I will discuss the full field theory problem in this context.

Education and Outreach / 369

Getting Science Beyond the Research Community: Examples of Education and Outreach from the IceCube Project

Author: James Madsen[1]

[1] *University of Wisconsin River Falls*

Corresponding Author: james.madsen@uwrf.edu

The combination of cutting-edge discovery science with the exotic Antarctic environment provides an ideal vehicle to excite and engage a wide audience. Examples of how the International IceCube Collaboration has brought the Universe to the classroom and the general public via the South Pole will be presented.

Heavy Flavor Physics / 370

Electron Vetos and Taus at ATLAS

Author: Susie Bedikian[1]

[1] *Physics Department-Yale University*

Corresponding Author: susie.bedikian@cern.ch

I will present strategies used to separate electron signatures from tau lepton signatures with the ATLAS detector, one of the general purpose detectors on the LHC ring at CERN. Taus can decay leptonically, to electrons or muons and neutrinos, or hadronically, to a number of neutral and charged hadrons and neutrinos. These decays happen before the taus reach the inner-most layer of the detector, thus the work of recognizing the tau decay products is challenging. As electron and QCD signatures resemble those of taus, vetos must be applied. The results of those cut-based and multivariate electron veto techniques will be shown.

Accelerator Physics / 371

Precision Calibration of the Luminosity Measurement in ATLAS

Author: Eric Torrence[1]

[1] *University of Oregon*

Corresponding Author: eric.torrence@cern.ch

A precision luminosity measurement is of critical importance for the ATLAS physics program, both for searches for new physics as well as for precision measurements of Standard Model cross-sections. The calibration of the luminosity is based on three so-called van der Meer scans that were performed in 2010. These scans determine the convolved beam sizes in the vertical and horizontal directions, and together with precise knowledge of the beam currents are used to determine an absolute luminosity scale. Based on this analysis ATLAS has determined the luminosity with a total uncertainty of 3.4% for the 2010 data recorded at root(s) = 7 TeV.

Detector Technology and R&D / 372

Performance of Particle Identification with the ATLAS Transition Radiation Tracker >

Author: Elizabeth Hines[1]

[1] *Department of Physics and Astronomy-University of Pennsylvania*

Corresponding Author: elizabeth.hines@cern.ch

The ATLAS Transition Radiation Tracker (TRT) is the outermost of the three sub-systems of the ATLAS Inner Detector at the Large Hadron Collider at CERN. In addition to its tracking capabilities, the TRT provides particle identification (PID) ability through the detection of transition radiation X-ray photons. The latter functionality provides substantial discriminating power between electrons and hadrons in the momentum range from 1 to 200 GeV. In addition, the measurement of an enhancement of signal time length, which is related to high specific energy deposition (dE/dx), can be used to identify highly ionizing particles, increasing the electron identification capabilities at low momentum and improving the sensitivity of searches for new physics. This talk presents the commissioning of TRT PID during early 2010 7 TeV data taking. Performance in 2010 and 2011 demonstrating the TRT's ability to identify electrons, complementary to calorimeter based identification methods, will also be shown.

Particle Astrophysics and Cosmology / 373

Daily Modulation of the Dark Matter Signal in Crystalline Detectors

Author: Nassim Bozorgnia[1]

Co-authors: Graciela Gelmini [1]; Paolo Gondolo [2]

[1] *UCLA*

[2] *University of Utah*

Corresponding Author: nassim@physics.ucla.edu

The channeling effect in crystals refers to the orientation dependence of charged ion penetration in crystals. In direct dark matter crystalline detectors, a channeled ion recoiling after a collision with a WIMP gives all its energy to electrons. Thus channeling increases the ionization or scintillation signal expected from a WIMP. Channeling is a directional effect which depends on the velocity distribution of WIMPs in the dark halo of our Galaxy and could lead to a daily modulation of the signal. I will present estimates of the expected amplitude of the daily modulation in direct dark matter detectors, both due to channeling and just due to the rotational velocity of the Earth around itself.

Heavy Ion Physics/Hot and Dense QCD / 374

Transverse Momentum Broadening in Weakly Coupled Quark-Gluon Plasma

Author: Mindaugas Lekaveckas[1]

Co-authors: Christopher Lee [1]; Francesco D'Eramo [1]; Hong Liu [1]; Krishna Rajagopal [1]

[1] *MIT*

Corresponding Author: lekaveck@mit.edu

Jet quenching parameter or, equivalently, transverse momentum broadening distribution function is an important quantity which helps to understand energy losses in heavy ion collisions and get insights into properties of the de-confined quark-gluon plasma. SCET provides framework to calculate jet quenching parameter at weak coupling using expectation value of two space-like separated light-like Wilson lines which can be evaluated for desired medium. In this work we evaluate transverse momentum broadening distribution function for the quark-gluon plasma in thermal equilibrium using Hard Thermal Loop (HTL) resummed effective thermal field theory and estimate corrections to this approximations.

Perturbative and non-Perturbative QCD / 375

Measurement of multi-jet cross-sections at ATLAS

Authors: Matthew Cleary Tamsett[1]; The ATLAS Collaboration[2]

[1] *College of Engineering and Science-Louisiana Technical Universit*

[2] *CERN*

Corresponding Author: matthew.cleary.tamsett@cern.ch

Inclusive multi-jet production is studied using the ATLAS detector for proton-proton collisions with a center-of-mass energy of 7 TeV. The data sample corresponds to an integrated luminosity of 2.43 pbˆ-1, using the first proton-proton data collected by the ATLAS detector in 2010. Results on multi-jet cross sections are presented and compared to both leading-order plus parton-shower Monte Carlo predictions and next-to-leading-order QCD calculations.

Top Quark Physics / 376

Measurement of Single-top Quark Production with the ATLAS Detector

Author: Jenny Holzbauer[1]

[1] *Michigan State University*

Corresponding Author: jenny.lyn.holzbauer@cern.ch

We use 2011 data from the ATLAS detector to isolate the production of single-top quarks. This electroweak top-quark production is expected to be sensitive to new physics such as flavor changing neutral currents or W' production, and can also be an important background for processes like the Higgs boson production. The data for this analysis are collected from collisions occurring at 7 TeV center-of-mass energy and then several selections are applied to these events. The selections are determined from studies of simulated events and chosen to isolate the signal while removing background events, based on the kinematic signature of the single-top quark process. We report the likelihood that the resulting sample of data events are single-top quarks and discuss the kinematics of this process.

Neutrino Physics / **377**

SciNOvA: A measurement of neutrino-nucleus scattering in a narrow-band beam

Author: Xinchun Tian[1]

[1] *Univesrity of South Carolina*

Corresponding Author: tianxc@fnal.gov

SciNOvA is a proposed experiment to deploy a fine-grained scintillator detector in front of the NOvA near detector to collect neutrino-nucleus scattering events in the NUMI, off-axis, narrow-band neutrino beam at Fermilab. This detector can make unique contributions to the measurement of charged- and neutral-current quasi-elastic scattering; and neutral-current π^0 and photon production. These processes are important to understand for fundamental physics and as backgrounds to measurements of electron neutrino appearance oscillations. The talk will present the strategy and science case of the SciNOvA experiment.

Field and String Theory / **378**

From Navier-Stokes to Einstein

Author: Irene Bredberg[1]

Co-authors: Andy Strominger [1]; Cynthia Keeler [1]; Vyacheslav Lysov [1]

[1] *Harvard University*

Corresponding Author: bredberg@fas.harvard.edu

We discuss a mathematically precise realization of suggestions of a holographic duality relating fluids and spacetime horizons which began with the black hole membrane paradigm in the 70's and resurfaced recently in studies of the AdS/CFT correspondence. Our explicit construction shows that every solution of the incompressible Navier-Stokes equation can be related to a solution of the vacuum Einstein equations. The fluid described by the Navier-Stokes equation in p+1 dimensions lives on the timelike boundary of the p+2 dimensional Einstein solution. We consider a "near-horizon"

limit in which the boundary surface becomes highly accelerated. The near-horizon expansion in gravity is shown to be mathematically equivalent to the hydrodynamic expansion in fluid dynamics, and the Einstein equation reduces to the incompressible Navier-Stokes equation. Moreover, we discuss a connection to the Petrov classification of spacetimes in four dimensions (and its higher dimensional generalizations).

Summary:

We discuss a holographic connection between the Navier-Stokes equation and the Einstein equations.

Neutrino Physics / **379**

Status of the Long-Baseline Neutrino Experiment LBNE

Author: Jon Urheim[1]

[1] *Indiana University*

Corresponding Author: urheim@indiana.edu

LBNE is an experiment being designed to probe the parameters of neutrino mixing accessible through nu_mu to nu_e oscillation measurements at the atmospheric L/E scale. It will consist of a new neutrino beam line and Near Detector complex at Fermilab, and one or more very large Far Detector modules, nominally to be sited underground in the Homestake Mine in South Dakota. In addition to the long-baseline neutrino program, the Far Detector system will enable a variety of other physics studies with unprecedented sensitivity, including searches for nucleon decay and supernova neutrino bursts. We will report on the status of the conceptual design for the experiment, now being finalized in preparation for DOE's CD-1 milestone.

Heavy Ion Physics/Hot and Dense QCD / **380**

Triangularity and Dipole Assymetry in Ideal Hydrodynamics

Author: li Yan[1]

[1] *Stony Brook University*

Corresponding Author: goodwill.yan@gmail.com

We introduce a cummulant expansion to parameterize possible initial conditions
in heavy ion collisions. We show that the cummulant expansion converges and can
systematically reporduce the results of the Glauber type initial conditions.
At third order in the gradient expansion, the cummulants are described with the
triangularity
$llangler^3 \cos 3(\phi - \psi_{1,3})$
$rrangle$, and a dipole
assymetry,
$llangler^3 \cos(\phi - \psi_{1,3})$
$rrangle$. We show that the
orientation angle of the dipole assymetry $\psi_{1,3}$
has a 20% assymetry out of plane for mid-central collisons.
This leads to a small net v_1 out of plane.
In peripheral and mid-central collisions the
orientation angles $\psi_{1,3}$ and $\psi_{3,3}$ are strongly correlated, but this correlation disappears towards central collisions.
We study the ideal

hydrodynamic response to these cummulants and determine the associated v_1/ϵ_1
and v_3/ϵ_3 for a massless ideal gas. The space time development of v_1 and
v_3 is clarified with figures. These figures show that v_1 and v_3
develop towards the edge of the nucleus, and consequently the final spectra are more sensitive to the viscous dynamics of freezeout.
The hydrodynamic calculations for v_3 is provisionally compared to Alver and Roland fit of STAR inclusive two particle correlation functions. Finally, we propose to
measure the v_1 associated with the dipole assymetry by measuring
$llangle \cos(\phi - 3\Psi_{R3} + 2\Psi_{R2})$
$rrangle$ where Ψ_{R3}
is an experimental estimate for the triangular event plane while Ψ_{R2}
is the usual quadrupole event plane plane estimate.
This experimental measurement would provide convincing evidence for the
strong correlation between $\psi_{1,3}$ and $\psi_{3,3}$, and by association
the hydrodynamic interpretation of two particle correlations at RHIC.

Top Quark Physics / 381

Discriminating Top-Antitop Resonances using Azimuthal Decay Correlations

Authors: Brock Tweedie[1]; Matthew Baumgart[2]

[1] *Boston University*

[2] *Johns Hopkins*

Corresponding Author: bat42@pitt.edu

Top-antitop pairs produced in the decay of a new heavy resonance will exhibit spin correlations that contain valuable coupling information. When the tops decay, these correlations imprint themselves on the angular patterns of the final quarks and leptons. I will discuss how to probe the structure of a resonance's couplings to tops by measuring the azimuthal angles of the tops' decay products about the production axis. These angles exhibit modulations from helicity interference which are typically O(0.1-1), and which by themselves allow for discrimination of spin-0 from higher spins, measurement of the CP-phase for spin-0, and measurement of the vector/axial composition for spins 1 and 2. For relativistic tops, the azimuthal decay angles can be well-approximated without detailed knowledge of the tops' velocities, and appear to be robust against imperfect energy measurements and neutrino reconstructions. I will illustrate this point in the highly challenging dileptonic decay mode, which also exhibits the largest modulations. I will comment on the relevance of these observables for testing axigluon-like models that explain the top quark A_{FB} anomaly at the Tevatron, through direct production at the LHC.

Detector Technology and R&D / 382

SciBath: A novel tracking detector for measuring neutral particles underground

Author: Rex Tayloe[1]

[1] *Dept of Physics, Indiana University*

Corresponding Author: rtayloe@indiana.edu

The SciBath prototype detector consists of 90 liters of liquid scintillator
containing 768 wavelength-shifting fibers aligned in a three dimensional grid.
This unique design allows reconstruction of charged particle tracks

in arbitrary directions. While constructed as a prototype
neutrino detector it is also able to detect neutrons in the 1-100MeV range with
O(30%) efficiency and energy resolution. The device is currently being commissioned
and will be deployed in the fall of 2011 to measure neutrinos and neutrons 100m underground
in the Fermilab MINOS near-detector area. The latest results will
be presented along with plans to deploy at other locations to measure
fast-neutron backgrounds for underground experiments.

Education and Outreach / **383**

Plain English Summaries of Experimental Results

Author: Michael Barnett[1]

[1] *Lawrence Berkeley National Lab*

Corresponding Author: barnett@lbl.gov

Press releases are issued by labs when a major result
such as a discovery is announced. More commonly, we write
papers that are not worthy of a press release. Nonetheless,
many in the public are quite interested to see progress in
our experiments. Tevatron experiments have pioneered plain
English summaries of experimental papers, and the concept is
spreading to the LHC experiments. It is difficult to write
a good plain English summary. We should develop this art-form
further.

Detector Technology and R&D / **384**

Using Large-Area Micro-channel Plate Photosensors in the Next Generation Water Cherenkov Neutrino Detectors

Author: Mayly Sanchez[1]

[1] *Argonne National Laboratory*

Corresponding Author: mayly.sanchez@anl.gov

The next generation of neutrino experiments will require massive and/or high resolution detectors to reach the sensitivity needed to measure CP violation in the lepton sector and the neutrino mass hierarchy. Recently the Large Area Picosecond Photo Detectors (LAPPD) Collaboration has begun developing new methods to fabricate a 20cm-square thin planar multichannel plate photosensors. The application of these novel devices to large water Cherenkov detectors could significantly enhance background rejection and vertex resolution in these detectors by improving spatial and timing information. We present details of the MCP fabrication method, status of the LAPPD project as well as preliminary results on the reconstruction capabilities for neutrino events in Water Cherenkov detectors.

Higgs Physics / **385**

Search for the Standard Model Higgs boson in H->ZZ decay channels with the ATLAS detector

Author: G Carrillo Montoya[1]

[1] *Department of Physics-University of Wisconsin*

Corresponding Author: g.carrillo.montoya@cern.ch

The SM Higgs boson in the medium and high mass ranges has a large branching ratio for decays to a pair of neutral weak bosons. Three decay modes of the Z boson pair have been explored by ATLAS. One Z is typically produced on-shell, which can be tagged using leptonic decay products. The decay of the second Z(*) leads to three independent search channels: llqq, llvv and llll. Background compositions and topologies differ among these channels. The llqq search can use jet information to reduce top and Z+jets backgrounds; the llvv search requires a good understanding of missing transverse energy, while the 4 lepton ('golden') channel is almost background-free and, owing to its low production rate, needs excellent lepton efficiencies in order to be sensitive.

This talk summarizes results in all three H->ZZ channels using data collected in 2011.

Neutrino Physics / **386**

The ArgoNeuT experiment

Author: Roxanne Guenette[1]

[1] *Yale University*

Corresponding Author: roxanne.guenette@yale.edu

The ArgoNeuT project features a 175 liter Liquid Argon (LAr) Time Projection Chamber (TPC) that was located upstream of the MINOS near detector in the NuMI neutrino beam at Fermilab. The project is part of the LAr TPC development program in the US and has helped initiate the development of simulation and reconstruction tools for LAr TPCs. In addition to the development goals, ArgoNeuT will perform several cross-section measurements on Ar in the few-GeV energy range. A total of 1.35E20 Protons on Target were accumulated and data analysis is ongoing. I will review the experiment and its status, as well as preliminary results from the data analysis.

Beyond the Standard Model / **387**

Search for Heavy Vector-like Quarks at ATLAS in pp Collisions at $\sqrt{s}$=7 TeV

Authors: Alex Penson[1]; Erkcan Ozcan[2]; Florencia Canelli[3]; Gokhan Unel[4]; Joe Tuggle[3]; Jordan Webster[3]; Merlin Davies[5]; Piyali Banerjee[6]; Samuel Meehan[3]; Tulay Donszelmann[7]

[1] *Columbia University*

[2] *University College London*

[3] *University of Chicago*

[4] *University of California at Irvine*

[5] *Universite of Montreol*

[6] *University of Montreol*

[7] *University of Sheffield*

Corresponding Author: smeehan12@gmail.com

We perform a search for vector-like quarks more massive than the top quark coupling to lighter generations using data collected with the ATLAS detector. The W and Z bosons are reconstructed in the $W \to l^{\pm}\nu$ and $Z \to l^{+}l^{-}$ where $l = e, \mu$. The vector-like quark is reconstructed from the W or Z and the highest p_T jet.

Electroweak Physics / **388**

A Measurement of the Ratio of the W+ 1 Jet to Z + 1 Jet Cross Sections with ATLAS

Authors: Andrew Robert Meade[1]; Benjamin Brau[1]

[1] *University of Massachusetts*

Corresponding Author: ameadephysics@gmail.com

The measurement of hadronic activity recoiling against W and Z vector bosons provides an important test of perturbative QCD, as well as a method of searching for new physics in a model independent fashion. We present a study of the cross-section ratio for the production of W and Z gauge bosons in association with exactly one jet R-jets= (W+1jet)/(Z+1jet), in pp collisions at sqrt(s) = 7 TeV. The study is performed in the electron and muon channels with data collected with the ATLAS detector at the LHC. The ratio R-jets is studied as a function of the cumulative transverse momentum pT distribution of the jet. Residual systematic uncertainties are parameterized in the same pT distribution. This result can be compared to NLO pQCD calculations and the prediction from LO matrix element + parton shower generators.

Field and String Theory / **389**

Minimal Holography: Higher spin gravity from 2d CFTs

Authors: Matthias R. Gaberdiel[1]; Rajesh Gopakumar[2]; Suvrat Raju[2]; Thomas Hartman[3]

[1] *ETH Zurich*

[2] *Harish-Chandra Research Institute*

[3] *Institute for Advanced Study*

Corresponding Author: tomhartman@gmail.com

It was recently conjectured that higher spin gravity in three dimensions is holographically dual to a simple, exactly solveable conformal field theory called the W_N minimal model. This raises the possibility of tackling some difficult questions in holography or quantum gravity by performing exact computations at all values of the coupling. I will describe the motivation for studying simplified models of holography based on higher spin gravity, and prove that in this particular duality the spectrum matches exactly at large N.

Field and String Theory / **391**

The Fermion Sign Problem at Finite Density, and Large N Orbifold Equivalence

Authors: Aleksey Cherman[1]; Brian Tiburzi[2]

[1] *Cambridge DAMTP*

[2] *MIT CTP*

The study of QCD at finite baryon density is severely hampered by the so-called fermion sign problem. As a result, we have no known first principles approach to study nuclear matter, or neutron stars from QCD. On the surface, the large Nc limit does not seem to simplify matters. In this limit, however, one can exploit dualities that exist between strongly coupled gauge theories. I will focus on some rather novel orbifold equivalences that have recently been discovered at finite density. These equivalences relate strongly coupled theories plagued by a sign problem, to strongly coupled theories free of sign problems. As a result, such dualities give deeper insight into the nature of the sign problem and possibly provide a way to simulate QCD at finite density in the large Nc limit.

Detector Technology and R&D / **392**

Studies of VCSEL failures in the optical readout systems of the ATLAS silicon trackers and Liquid Argon calorimeters

Author: Mark Cooke[1]

[1] *LBNL*

Corresponding Author: mark.stephen.cooke@cern.ch

The readout systems for the ATLAS silicon trackers and liquid argon calorimeters utilize vertical-cavity surface-emitting laser (VCSEL) diodes to communicate between on and off detector readout components. A number of these VCSEL devices have ceased to function well before their expected lifetime. We summarize the failure history and present what has been learned so far about the possible causes, and present lifetime projections for the devices that have not failed.

Beyond the Standard Model / **393**

Search for Randall-Sundrum Gravitons at the LHC, Recent Results from the ATLAS Collaboration

Author: Evan Wulf[1]

[1] *Columbia University*

Corresponding Author: earwulf@nevis.columbia.edu

With a substantial increase in luminosity at the LHC, 2011 is an exciting
time for searches for new physics. The Randall-Sundrum model, in which a
warped extra dimension is introduced to resolve the hierarchy problem, predicts a spectrum of massive excited gravitons. There is significant
potential for discovery of the lightest of these gravitons. The latest
results from the ATLAS Collaboration for RS gravitons decaying to diphoton and dielectron final states will be presented.

Accelerator Physics / **394**

Towards 20 T accelerator magnets: a road to super-high energy colliding beams

Author: Alexander Zlobin[1]

[1] *Fermilab*

Corresponding Author: zlobin@fnal.gov

For a fixed size of a circular collider, its energy is limited by the strength of bending dipole magnets. Moreover, for both linear and circular machines, their maximum luminosity is determined (among other factors) by the strength of quadrupole magnets used for the final beam focusing. That is why there has been a permanent interest to higher-field and higher-field gradient accelerator magnets from the high-energy physics and particle accelerator community.
The highest fields in accelerator magnets have been achieved using superconducting electromagnets. The ultimate field of these magnets is limited by the superconductor critical parameters such as critical field Bc2, critical temperature Tc and critical current density Jc. There are two classes of practical superconducting materials suitable for accelerator magnets - so called Low-Temperature Superconductors (NbTi, Nb3Sn, Nb3Al) and High-Temperature Superconductors (BSCCO, YBCO). The maximum field of NbTi accelerator magnets used in all present high-energy machines including LHC is limited by ˜10 T at operating temperature ˜1.8 K. The magnetic fields above 10 T threshold became possible thanks to the Nb3Sn superconductor. Nb3Sn accelerator magnets can provide operating fields up to ˜15 T and significantly increase the coil temperature margin. Accelerator magnets with operating field above 15 T would require using high-field high-temperature superconductors, which have highest upper critical magnetic field Bc2. However, due to the substantially higher cost and lower critical current density in magnetic fields below 15 T, a hybrid approach with Nb3Sn superconductor in fields below 15 T is a quite attractive option even though the Nb3Sn and HTS materials require different coil processing. This paper discusses the status and main results of the state-of-the-art Nb3Sn accelerator magnets and outlines a roadmap towards the 20 T class magnets.

Top Quark Physics / **395**

Improving the Top Quark Forward-Backward Asymmetry Measurement at the LHC

Authors: Thomas Rizzo[1]; Yang Bai[1]; Zhenyu Han[2]

[1] *SLAC*

[2] *Harvard University*

We explore methods for improving the top quark forward-backward asymmetry measurement at the LHC. We identify variables which distinguish top pairs produced from gluons versus quarks. These variables include the top quark rapidity, mass and rapidity of the top-antitop system, the top quark polarization and the top-antitop spin correlation. We obtain the best axes for measuring the top quark polarization and the top-antitop spin correlation. We apply our methods on two representative models: the axigluon model and the W-prime model, and show that significant improvements on the top quark forward-backward asymmetry measurement at the LHC can be achieved.

Poster Session / **396**

Complex Path Integral as a Fractional Fourier Transform

Author: Daniel Ferrante[1]

Co-author: Gerald Guralnik [1]

[1] *Brown University*

Corresponding Author: danieldf@brown.edu

Lately, it is becoming increasingly clear that extending the Feynman Path Integral into the Complex domain yields desirable properties. A first hint in support of such construction can be seen from the connection between SUSY Quantum Mechanics and the Langevin dynamics: analytically continuing the Langevin leads into different SUSY Quantum Mechanical systems (which share the same algebra of observables). Secondly, new results by E. Witten have brought forward new results in 3-dimensional Chern-Simons theory (in the form of Complex geometries) and Super Yang-Mills theory in four dimensions, as well as the relation between Khovanov homology and systems of branes.

Given a system of D0-branes, it is possible to understand it in terms of a Fourier Transform. As such, we can extend this system into the Complex plane, reinterpreting the Path Integral as a Fourier Transform over a certain integration cycle, which results in a Fractional Fourier Transform. This can be further understood in terms of the Phase Space of this system, where the Fractional Fourier Transform is related to the Wigner function. In this way, we realize that the label of our Fractional Fourier Transform, which is the Path Integral quantizing the system, acts as the parameter determining the vacuum state. Therefore, the allowed values of this label, for which the Path Integral converges, determine the quantum phases of the system. This can be immediately extended to Matrix models and Lie algebra-valued ones (known as Group Field Theory): the same results hold, so long as certain properties of the Action are satisfied, guaranteeing the convergence of the Path Integral.

These results can be dimensionally extended to systems of Dp-branes, showing some relations with the Geometric Langlands Duality and Mirror Symmetry. Furthermore, they can also be understood in terms of coherent state quantization, which opens a window into quantum tomography, and quantum chaos.

Summary:

The Path Integral will be extended into the Complex plane and presented from the point of view of the Fractional Fourier Transform.

Particle Astrophysics and Cosmology / 397

Ultra High Energy Cosmology with the POLARBEAR Telescope

Author: Brian Keating[1]

Co-authors: Adrian Lee [2]; Andrew Jaffe [3]; Aubra Anthony [4]; Bryan Steinbach [2]; Chris Cantalupo [5]; Christian Reichardt [2]; David Boettger [1]; Eric Linder [5]; Erin Quealy [2]; Hans Paar [1]; Helmuth Spieler [5]; Huan Tran [5]; Jacob Howard [2]; Josquin Errard [6]; Julian Borrill [7]; Kam Arnold [2]; Masashi Hazumi [8]; Matt Dobbs [9]; Mike Myers [2]; Nathan Miller [1]; Nathan Stebor [1]; Nils Halverson [4]; Oliver Zahn [10]; Paul Richards [2]; Peter Ade [11]; Peter Hyland [9]; Radek Stompor [6]; Stephanie Moyerman [1]; Takayuki Tomaru [8]; William Holzapfel [2]; Zigmund Kermish [2]

[1] *UCSD*

[2] *UC Berkeley*

[3] *Imperial College*

[4] *University of Colorado*

[5] *LBNL*

[6] *Universite Paris 7*

[7] *LBNL, UC Berkeley*

[8] *KEK*

[9] *McGill University*

[10] *UC Berkeley, LBNL*

[11] *University of Cardiff*

Corresponding Author: smoyerman@gmail.com

Recent studies of the temperature anisotropy of the Cosmic Microwave Background (CMB) lend support to an inflationary origin of the universe, yet no direct evidence verifying inflation exists. Current generation experiments now focus on the polarization anisotropy in the CMB, specifically the curl component of the CMB's polarization (called the "B-mode"), which is undetected to date. The theory of inflation predicts the existence of a primordial gravitational wave background that imprints a unique signature on the polarization B-mode at large angular scales. The CMB B-mode signal also encodes gravitational lensing information at smaller angular scales, which bears the imprint of large scale cosmological structures. The quest for detection of these signals; each of which is orders of magnitude smaller than the CMB temperature, has motivated the development of background-limited detectors with precise control of systematic effects.
The POLARBEAR experiment is designed to perform a deep search for the signature of gravitational waves from inflation and to characterize lensing of the CMB by large-scale structure. POLARBEAR is a 3.5 meter ground-based telescope with four arc-minute angular resolution at 150 GHz.
At the heart of the POLARBEAR's receiver is an array featuring 1274 antenna-coupled superconducting transition edge sensor bolometers (TESB) cooled to 0.25 Kelvin. POLARBEAR is designed to reach a tensor-to-scalar ratio of 0.025 after two years of observation – more than an order of magnitude improvement over the current best results, which would test physics at energies near the GUT scale.
POLARBEAR had an engineering run at Cedar Flat, California in 2010 and will begin observations in the Atacama Desert in Chile in 2011.

Summary:

Overview of the POLARBEAR telescope, projected finding, and impact on the field of cosmology.

Field and String Theory / 400

Strongly-Coupled Quarks and Colorful Black Holes

Author: Justin Vazquez-Poritz[1]

Co-author: MD Razikul Islam [1]

[1] *New York City College of Technology*

Corresponding Author: jvazquez-poritz@citytech.cuny.edu

We use gauge-gravity duality to study the behavior of strongly-coupled quarks moving on a black hole background. The supergravity background consists of a six-dimensional Schwarzschild-black string AdS soliton, for which the bulk horizon is a string that extends from the AdS boundary down to an infra-red floor. By going to higher energy scales, the regime of validity of the classical supergravity background can be extended closer to the singularity than might be naively expected from the four-dimensional perspective. Small black holes created by the Large Hadron Collider could typically carry color charges inherited from their parton progenitors. Then the dynamics of a quark moving close to the black hole depend on the curved spacetime geometry as well as the strong

interaction between the quark and the color-charged black hole. We also consider how the characteristics of interactions between quarks, such as the quark-antiquark screening length, are altered by the presence of the black hole. We also present a supergravity background which generalizes the Schwarzschild-black string AdS soliton.

Field and String Theory / 401

New Mathematics for Old Scattering Amplitudes

Author: Marcus Spradlin[1]

[1] *Brown University*

Corresponding Author: marcus_spradlin@brown.edu

Scattering amplitudes have played a central role in quantum field theory since its inception. Recent years have seen remarkable progress in our understanding of their previously hidden mathematical simplicity, and in our ability to compute previously intractable scattering amplitudes, both for theoretical and phenomenological purposes. In this talk I will review several of the latest advances on scattering amplitudes in Yang-Mills theory, including on-shell methods and new mathematical technology for dealing with multi-loop amplitudes.

Perturbative and non-Perturbative QCD / 402

LHC Sensitivity to Wbb Production via Double Parton Scattering at 7 TeV

Authors: Chris Jackson[1]; Ed Berger[2]; Gabe Shaughnessy[3]; Seth Quackenbush[2]

[1] *University of Texas-Arlington*

[2] *Argonne National Laboratory*

[3] *Argonne National Laboratory/Northwestern University*

We investigate the potential to observe double parton scattering at the LHC in the W b bbar -> e nu b bbar process. Double parton scatterings occur when two partons inside the same hadron each undergo a high scale interaction with two partons of another hadron. The rate for this process is expected to be approximated by the product of the usual single parton distribution functions with appropriate normalization, but can be high when one process is a significant fraction of the total inelastic cross section, and non-negligible when compared to single parton interactions with the same final state. Due to the expected independence of each of the two high scale interactions, the kinematics should distinguish single parton from double parton events. Once isolated, measuring the rate of these double interactions determines the effective cross section, the normalization parameter of the independent scattering approximation. This in turn can tell us about nonperturbative models that attempt to describe and predict multi-parton interactions.

Our analysis tests the efficacy of several kinematic variables in isolating the double parton process of interest from the single parton process and other backgrounds for the first 10 fbˆ-1 of integrated luminosity at the 7 TeV Large Hadron Collider. These variables are constructed to expose the independent 2-to-2 nature of each subprocess, pp -> l nu and pp -> b bbar. Among these are S_pT', a variable which measures the momentum balance of the bb and lepton pairs; S_phi, which peaks when each pair is back-to-back in azimuthal angle; and Delta-Phi, which measures the angle between the two planes of each pair, and is expected to be uncorrelated in the double parton case. We use next-to-leading order predictions of these processes and backgrounds in our analysis to account for extra partons that may spoil simple 2-to-2 picture to test the robustness of these variables. We

find that the double parton process can be “discovered” with high significance and measured at this luminosity.

Perturbative and non-Perturbative QCD / 403

Study of Particle Correlations in ATLAS

Author: Rishiraj Pravahan[1]

[1] *University of Texas at Arlington*

Corresponding Author: rishiraj.pravahan@cern.ch

This talk describes minimum bias measurements using proton proton collisions at the ATLAS detector at the LHC at center of mass energies of 900 GeV and 7 TeV. Studies of charged particle multiplicity distributions and multiparticle correlations which are used to investigate soft QCD processes are presented. The measurements are compared with various theoretical models and Monte Carlo generators.

Computing in HEP / 404

ATLAS Analysis Data Distribution and Panda PD2P

Author: Alden Stradling[1]

[1] *UT Arlington*

Corresponding Author: alden.stradling@cern.ch

The PanDA Distributed Analysis system has been used in the ATLAS collaboration and beyond as a resilient and scalable distributed processing and analysis system. Using a central pull and distributed push (pilot job) model for task definition and job tracking, it integrates with many kinds of local batch system, data management software, and security models.

One of the principal challenges in making user jobs responsive comes from data location – since jobs go to the data, popular datasets at limited numbers of locations will attract too much user activity for the site’s resources. The data are too large, however, to pre-position at all sites. PanDA has pioneered an approach to data management integration called P2DP, which automates data distribution to user analysis sites based on usage and popularity of particular datasets. By tuning the parameters that trigger these data replications, we optimize the balance between the data replication and user concentration.

The strengths and tradeoffs of both the PanDA pilot and the P2DP model will be discussed, and we will examine throughput and efficiency, security versus flexibility, and the ongoing process of tuning the system to be more responsive and intelligent.

Poster Session / 405

NS5 Branes on the Resolved Cone over $Y^{p,q}$

Authors: Catherine Whiting[1]; Vincent Rodgers[1]

Co-authors: Elena Caceres [2]; Leo Rodriguez [1]; Leopoldo Pando Zayas [3]

[1] *University of Iowa*

[2] *Universidad de Colima*

[3] *University of Michigan*

Corresponding Author: catherine-whiting@uiowa.edu

The AdS/CFT correspondence provides a powerful tool to attack very important questions of strong coupling dynamics using gravitational duals. The Klebanov-Stassler prototype has a large family of duals that contain $calN = 1$ SYM. A new and distinct family of supergravity solutions containing a sector dual to $calN = 1$ SYM might be related to the resolved cone over Einstein-Sasaki spaces. In this work
we extend the construction of five brane solutions on the resolved cone over $Y^{p,q}$ spaces by expanding the generalizations of the complex deformations in the context of the warped resolved deformed conifold. This work augments recent work which established the existence of supersymmetric five branes solutions wrapped on two-cycles of the resolved cone over $Y^{p,q}$ in the probe limit. We present an ansatz and the corresponding equations of motion. Here we attempt to solve the field equations and give explicit solutions with the expected properties for theory related to strongly coupled Yang-Mills theories.

Poster Session / **406**

Strictly Calculate the Electron Mixing-loop Chain Propagator in SM

Author: Haiyan Tang[1]

Co-author: Chen Xue-wen [1]

[1] *Department of Mathematics and Physics, Chongqing University of Science and Technology, Chongqing, China*

Corresponding Author: luwen.thu@gmail.com

Employing the electroweak standard model(SM), we analyzed and discussed the framework form of electron mixing-loop chain propagator and its renormalization in detail; then achieved the analytic count. Based on it we acquired the analytic solution of electron mixing-loop chain propagator which composed of serious of different physical loops. This study would offer certain academic reference to the discussion and applying about normal complex propagators in both theoretical analyzing and application.

Summary:

Keywords: Standard Model; mixing-loop chain propagator; renormalization.

Electroweak Physics / **407**

Review of Electroweak Physics at Hadron Colliders

Author: Frank Petriello[1]

[1] *Northwestern University*

Corresponding Author: f-petriello@northwestern.edu

Experiments at the Tevatron and the LHC have recently studied the electroweak gauge sector of the Standard Model with impressive breadth and precision. In this talk we discuss several new experimental results, and the theoretical progress they have spurred.

Low Energy Searches for Physics Beyond the Standard Model / 408

The Enriched Xenon Observatory for double beta decay

Author: Timothy Daniels[1]

[1] *University of Massachusetts*

Corresponding Author: tvdaniels@physics.umass.edu

The Enriched Xenon Observatory (EXO) is an experimental program designed to search for the neutrinoless double beta decay (0nbb) of Xe-136. Observation of 0nbb would determine an absolute mass scale for neutrinos, prove that neutrinos are massive Majorana particles (indistinguishable from their own antiparticles), and constitute physics beyond the Standard Model. The current phase of the experiment, EXO-200, uses 200 kg of liquid xenon with 80% enrichment in Xe-136, and also serves as a prototype for a future 1-10 ton scale EXO experiment. The double beta decay of xenon is detected in an ultra-low background time projection chamber (TPC) by collecting both the scintillation light and the ionization charge. The detector is now operational at Waste Isolation Pilot Plant (WIPP) in New Mexico. It was first run with natural xenon to fully commission it and study its performance. Preparation for physics data taking is underway. The projected two-year sensitivity for neutrinoless double beta decay half-life is 6.4E25 y at 90% confidence level. In view of a future ton scale experiment, the collaboration is performing R&D to realize an ideal, background-free search for which the daughter nucleus produced by the double beta decay is also individually identified. In this talk, the current status and preliminary results from EXO-200 will be presented, and prospects for a ton scale EXO experiment will be discussed.

Neutrino Physics / 409

Solar and Atmospheric Neutrino Physics with Super-Kamiokande

Author: Roger Wendell[1]

[1] *Duke University*

Corresponding Author: raw22@phy.duke.edu

We present neutrino oscillation results based on data samples from all four phases of the experiment (SK-1 through SK-4) over a 15 year running period. Atmospheric neutrino data spanning 5 orders of magnitude in neutrino energy and 4 orders of magnitude in baseline are used to constrain the mixing parameters of neutrino oscillation as well as search for non-standard effects. Solar neutrino data is also used to constrain mixing parameters and search for evidence of day night differences and spectral distortion.

CP-Violation / 410

Bs -> J/psi phi at CMS

Author: Giordano Cerizza[1]

[1] *Department of Physics and Astronomy-College of Arts and Science*

Corresponding Author: giordano.cerizza@cern.ch

The Bs meson is studied with the CMS detector at LHC.
The time-dependent measurements of the Bs decay into

J/Psi Phi and of the rate of the rare decay into mu mu potentially provide indirect constraints on physics beyond the Standard Model. This talk presents the first cross section measurement for Bs->J/Psi phi production based on data taken in 2010 and discusses prospects of the lifetime-difference and CP measurements with CMS.

Accelerator Physics / 411

Experimental program at Accelerator Test Facility

Author: vitaly yakimenko[1]

[1] *bnl*

Corresponding Author: yakimenko@bnl.gov

Few representative experimental results from a 20 year old history of the dedicated advanced accelerator R&D user facility will start the presentation. Evolution of the facility, its current capabilities and experimental program will be discussed in details. Monoenergetic Ion beam generation in laser plasma interaction and observation of Coherent Synchrotron Radiation suppression with shielding plates in the bending magnet will be used to illustrate recent results at ATF. Experimental plans and future upgrades will be also discussed.

Field and String Theory / 412

String Landscape and Supernovae Ia

Author: Louis Clavelli[1]

[1] *University of Alabama*

Corresponding Author: lclavell@bama.ua.edu

If the string landscape has any validity, the universe has in the past and should in the future make transitions to
other local (or absolute minima). A prime model for the physics of
a future universe is the zero vacuum energy minimal supersymmetric standard model or one
of its variations with all susy breaking terms put to zero. If we assume that this transition is accelerated in dense matter, some aspects of supernovae Ia which are challenging to the standard accretion picture
can be naturally explained.

Higgs Physics / 413

Electroweak symmetry breaking and the higgs beyond the standard model

Author: Takemichi Okui[1]

[1] *Florida State University*

I will provide a concise, coherent overview of electroweak symmetry breaking from a modern perspective, focusing on models that contain a naturally light higgs boson. In particular, I will review theories with supersymmetry and those in which the higgs field is a pseudo-Nambu-Goldstone boson.

Particle Astrophysics and Cosmology / **414**

After LUX: The LZ Program

Author: David Malling[1]

Co-authors: Jeremy Chapman [1]; Simon Fiorucci [1]

[1] *Brown University*

Corresponding Authors: david_malling@brown.edu, fiorucci@brown.edu

The Large Underground Xenon (LUX) dark matter search experiment is currently being deployed at the Sanford Laboratory at Homestake in South Dakota (see Rick Gaistkell's talk), as a precursor to DUSEL. In partnership with more international institutions, we are already thinking about the next (two) experiment(s) that will follow: LZ-S (3 t) and LZ-D (20 t). This talk describes the work accomplished to date, the direction we are going, and the expected science schedule.

Neutrino Physics / **415**

The 600 Ton ICARUS Liquid Argon Experiment at the LNGS

Author: David Cline[1]

[1] *UCLA*

Corresponding Author: david.cline@cern.ch

We review briefly the R&D effort that went into the construction of the 600 Ton Liquid Argon TPC. The detector is operating very well with electron drift distances near 4m. The detector is exposed to the CNGS beam from CERN and is collecting neutrino events. More than 130 Neutrino events have been observed. Other physics goals include exotic proton decay and sterile neutrinos. ICARUS is also a prototype for much larger multikilo Ton detectors being designed around the world.

Neutrino Physics / **416**

Low Energy Neutrino Astronomy in Super-Kamiokande

Author: Michael Smy[1]

[1] *UCI*

Corresponding Author: msmy@uci.edu

Super-Kamiokande is sensitive to neutrino interactions between 4 and 100MeV via elastic scattering and inverse beta decay. I will present Super-Kamiokande's ongoing measurements of solar neutrinos and its searches for supernova neutrinos.

Higgs Physics / 417

Review of recent theoretical developments in Higgs physics

Author: Radja Boughezal[1]

[1] *Argonne National Lab.*

Corresponding Author: rboughezal@hep.anl.gov

The search for the SM Higgs boson is reaching a critical juncture.
Either evidence will be found or an exclusion will be set during the upcoming LHC year of running.
We review the recent experimental results and the theoretical progress that has enabled the search for the Higgs.

Heavy Ion Physics/Hot and Dense QCD / 418

Triangular Flow in Relativistic Heavy Ion Collisions in an Event-by-Event Hybrid Approach

Author: Hannah Petersen[1]

[1] *Duke University*

Triangular flow has been shown to be an interesting new observable to gain insights about the properties of hot and dense strongly interacting matter as it is produced in heavy ion collisions at RHIC and LHC. We will present triangular flow results for Au+Au collisions at the highest RHIC energy calculated in a hybrid approach that includes a non-equilibrium initial evolution and an ideal hydrodynamic expansion with a hadronic afterburner in 3+1 dimensions. By comparing the hybrid approach calculation with a pure transport approach, the influence of viscosity is studied. In addition, the potential of triangular flow for constraining the initial state granularity will be discussed. We compare the results from Au+Au collisions at 200 GeV per nucleon to Pb+Pb at LHC energies and find that the fluctuations/v3 values at LHC are surprisingly similar. Furthermore, the longitudinal long-range correlations of the triangular flow event plane angle are explored for initial conditions from a partonic and a hadronic transport approach. We conclude that longitudinal long-range correlations are not a unique signature for flux tube-like initial conditions, but can also be produced by other mechanisms.

Neutrino Physics / 419

KATRIN: an experiment to determine the neutrino mass

Author: Florian Fränkle[1]

[1] *University of North Carolina at Chapel Hill*

Corresponding Author: fraenkle@email.unc.edu

The KArlsruhe TRItium Neutrino (KATRIN) experiment is a next generation, model independent, large scale experiment to determine the mass of the electron anti-neutrino by investigating the kinematics of tritium beta-decay with a sensitivity of 200 meV/c2. The measurement setup consists of a high luminosity windowless gaseous molecular tritium source (WGTS), a differential and cryogenic pumped electron transport and tritium retention section, a tandem spectrometer section (pre-spectrometer and main spectrometer) for energy analysis, followed by a detector system for counting transmitted beta-decay electrons. To achieve the desired sensitivity, the WGTS, in which

tritium decays with an activity of about 10e11 Bq, needs to be stable on the 0.1% level in injection pressure and temperature at an absolute value of about 30 K. With the capability to create an axial magnetic field of 3.6 T the WGTS is going to be one of the world's most complex superconducting magnet and cryostat systems. The main spectrometer (length 24 m, diameter 10 m), which works as a retarding electrostatic spectrometer, will have an energy resolution of 0.93 eV at 18.6 keV. For the precise energy analysis at the tritium endpoint, a retarding potential of -18.6 kV is needed with 1 ppm stability. To reach the background level needed to achieve the sensitivity, it will be operated at a pressure of 10e-11 mbar. This talk will give an overview of the KATRIN experiment and and its current status.

Perturbative and non-Perturbative QCD / **420**

Parity- and Time-Reversal-Violating Form Factors of the Deuteron

Author: Emanuele Mereghetti[1]

[1] *University of Arizona*

Corresponding Author: emanuele@physics.arizona.edu

We calculate the electric-dipole and magnetic-quadrupole form factors of the deuteron that arise as a low-energy manifestation of parity and time-reversal violation in quark-gluon interactions of effective dimension four and six: the QCD vacuum angle, the quark electric and chromo-electric dipole moments, and the gluon chromo-electric dipole moment. Within the framework of two-flavor chiral perturbation theory, we show that the relative sizes of the corresponding moments allow an identification of the symmetry-breaking source.

Accelerator Physics / **421**

New Methods of Particle Collimation in Colliders

Author: Giulio Stancari[1]

[1] *Fermi National Accelerator Laboratory*

Corresponding Author: stancari@fnal.gov

The hollow electron beam collimator is a novel concept of controlled halo removal for intense high-energy beams in storage rings and colliders. It is based on the interaction of the circulating beam with a 5-keV, magnetically confined, pulsed hollow electron beam in a 2-m-long section of the ring. The electrons enclose the circulating beam, kicking halo particles transversely and leaving the beam core unperturbed. By acting as a tunable diffusion enhancer and not as a hard aperture limitation, the hollow electron beam collimator extends conventional collimation systems beyond the intensity limits imposed by tolerable losses. The concept was tested experimentally at the Fermilab Tevatron proton-antiproton collider. Results on the collimation of 980-GeV antiprotons are presented.

Low Energy Searches for Physics Beyond the Standard Model / **422**

Search for a Neutron Electric Dipole Moment at the Paul Scherrer Institut

Author: Philipp Schmidt-Wellenburg[1]

[1] *Paul Scherrer Institut*

Corresponding Author: philipp.schmidt-wellenburg@psi.ch

At the new ultracold neutron source at the Paul Scherrer Institut(PSI) a collaboration of 15 European institutions is setting up an experiment to search for the nEDM with improved sensitivity. The same apparatus which provided the present best limit on the nEDM (d < 2.9 x 10-26 ecm 90% CL, Baker et al., Phys. Rev. Lett. 97 (2006) 131801), was moved from the Institut Laue Langevin (ILL) in spring 2009 to PSI. Since then it was thoroughly investigated and several components have been upgraded and improved. Most remarkable are: the HV system, the magnetic field control and demagnetization method, the mercury co-magnetometer, and an additional 12 channel array of scalar cesium magnetometers.
In December 2010 we could store first UCN in our apparatus at PSI. This spring the co-magnetometer was running continuously during several weeks for a measurement of the mercury geometric phase, one of the most important systematic effects.
In general all subsystems are working. We have ongoing studies improving the understanding of systematic effects. First data taking runs are scheduled for autumn 2011. Expected statistics might be sufficient to improve on the previous result. Two hundred nights of data taking in 2012 and 2013 should increase the sensitivity to dn < 5×10-27 ecm in the case of a null result.

Simultaneously the collaboration is developing an entire new apparatus to further gain an order of magnitude in sensitivity
O(10-28) from 2015 onwards.

Accelerator Physics / **423**

High-luminosity operation of RHIC and future upgrades

Author: Wolfram Fischer[1]

[1] *BNL*

Corresponding Author: wolfram.fischer@bnl.gov

The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory has now operated for a decade. Over this time the 2 physics programs at RHIC, based on heavy ion and polarized proton collisions respectively, have seen a substantial increase in performance and a variety of operating modes. The performance increases are presented with the dominant limiting effects, and upgrade plans for the next decade. The heavy ion luminosity upgrade is primarily based on stochastic cooling in store, and an increase in the longitudinal focusing. A new polarized source is expected to increase both the polarization and luminosity. For the latter electron lenses are also implemented to partially compensate the head-on beam-beam effect. In addition, a number of new operating modes are considered.

Accelerator Physics / **424**

Novel Accelerator Methods and Technologies for KEKB Upgrade

Author: John Flanagan[1]

[1] *KEK*

Corresponding Author: john.flanagan@kek.jp

The KEKB B factory is being upgraded to search for physics beyond the Standard Model, with a target luminosity of 8x10^35 cm^-2 s^-1, a factor of 40 times greater than the world record luminosity

achieved at KEKB. To achieve this target luminosity the upgraded machine, SuperKEKB, will require the use of new advances in accelerator technology, among them the development of a low-emittance, high-bunch-charge injector system, a high-beam-current vacuum system incorporating the latest electron-cloud mitigation techniques, an interaction region design that provides a low beta function at the collision point while minimizing emittance growth due to fringe fields and maximizing the dynamic aperture, and beam diagnostics and feedback for monitoring and controlling low-emittance beams and their collisions. This talk will discuss the design challenges facing SuperKEKB, and the technologies that are being developed to meet them.

Top Quark Physics / **425**

A Measurement of the ttbar Cross Section and the Top Quark Mass in the Hadronic Tau + Jets Decay Channel at CDF

Author: Daryl Hare[1]

Co-author: Eva Halkiadakis [1]

[1] *Rutgers University*

We present a measurement of the ttbar cross section as well as the first measurement of the top quark mass in hadronic tau + jets events from 1.96 TeV ppbar collisions at CDF. Events require a single lepton identified as a hadronic tau, missing Et, and 4 jets of which at least one must be tagged as a b jet. Both the cross section and the mass are extracted from unbinned likelihood functions. The cross section uses a Poisson likelihood function based on the observed number of events and the predicted number of signal and background events for a given ttbar cross section. The mass is extracted from a likelihood fit is based on per-event probabilities calculated from leading-order signal (ttbar) and background (W+jets) matrix elements. Our goal is to directly identify this final state for the first time at CDF as well as to provide the first measurement of the top quark mass in this decay channel.

Low Energy Searches for Physics Beyond the Standard Model / **426**

A Search for the Electric Dipole Moment of the Neutron

Author: Paul Huffman[1]

[1] *North Carolina State University*

Corresponding Author: paul_huffman@ncsu.edu

The experimental search for a neutron electric dipole moment could reveal new sources of time-reversal (T) and charge-conservation-and-parity (CP) violation and challenge proposed extensions to the Standard Model. The goal of the present experiment is to improve the measurement sensitivity of the neutron EDM by two orders of magnitude.

The physics goals of this experiment remain timely and of unquestioned importance. There is ample reason to expect a nonzero value for the neutron EDM: many theories predict EDM values within the six orders-of-magnitude window between the current limit and the value allowed by the Standard Model. The results of this experiment could make a significant complementary contribution to the search for new physics at the Large Hadron Collider (LHC).

The experiment is based on the magnetic-resonance technique of rotating a magnetic dipole in a magnetic field. Polarized neutrons and polarized 3He atoms are confined in a bath of superfluid 4He at a temperature of 450 mK. When placed in an external magnetic field, both the neutron and 3He magnetic dipoles precess in the plane perpendicular to the magnetic field. The neutron EDM

is determined from the difference in the precession frequencies of the neutrons and the 3He atoms when a strong electric field is applied either parallel or anti-parallel to the magnetic field. The 3He serves as a volume comagnetometer to minimize magnetic-field systematic effects. Due to shielding effects, 3He should have a negligible electric dipole moment.

Improvements over previous experiments arise from an increased electric field due to the excellent dielectric properties of superfluid 4He, an increase in the total number of ultracold neutrons (UCNs) stored, and an increased measurement time due to the longer storage of UCN in the cryogenic container.

I will review the present status of the construction of the nEDM experiment and outline its role within the context of the international efforts to measure electric dipole moments.

Neutrino Physics / **427**

Project 8: Using Radio Frequencies to Measure the Neutrino Mass

Author: Noah Oblath[1]

[1] *MIT*

Corresponding Author: nsoblath@mit.edu

It is well known that the neutrino masses affect the shape of the energy spectrum of tritium beta-decay electrons. However, experiments have yet to measure that distortion. The Project 8 experiment proposes to measure the spectral distortion in a novel way: using radio-frequency techniques to detect and measure the energies of the beta-decay electrons. We plan on measuring the radiation created from the cyclotron motion of the electrons in a strong magnetic field. I will report on the status of a prototype that is designed to demonstrate single-electron detection at energies near the tritium endpoint, 18.6 keV. I will also discuss the possibilities for scaling up to a neutrino-mass experiment, and the projected sensitivity.

Neutrino Physics / **428**

Short Baseline Neutrino Oscillations

Author: Zarko Pavlovic[1]

[1] *Los Alamos National Laboratory*

Corresponding Author: zarko@fnal.gov

The MiniBooNE experiment is a short baseline experiment designed to test whether the excess of $\bar{\nu}_e$ events observed in the LSND experiment is due to neutrino oscillations. If the LSND signal is due to neutrino oscillations it would imply Physics Beyond the Standard Model such as the existence of sterile neutrinos. In this talk I will briefly discuss the sterile neutrino oscillation models. I will summarize the oscillation results from MiniBooNE experiment as well as some intriguing recent results from reactor and gallium solar neutrino calibration experiments which are sensitive to the same parameter space. Finally, I will conclude with a future outlook.

Accelerator Physics / **429**

Project-X: stepping stone for future accelerator-based HEP at Fermilab

Author: Bob Tschirhart[1]

[1] *-Fermilab*

Corresponding Author: tsch@fnal.gov

Fermilab is leading an international consortium to develop the design of "Project-X"which is an accelerator complex based on a new H- linac that will drive a broad range of experiments at the Intensity Frontier. Project X will provide multi-MW beams from the Main Injector over the energy range 60-120 GeV, simultaneous with mult-MW beams at 3 GeV. The Project-X research program includes world-leading sensitivity in long-baseline neutrino experiments, neutrino scattering experiments, and a rich program of ultra-rare decay and electric dipole moment experiments that are sensitive to most new physics scenarios beyond the Standard Model. Shared technology development with the International Linear Collider and the Muon Collider will establish a bridge to future facilities at the energy frontier. This talk will describe the Project-X accelerator configuration, associated performance projections, status of the accelerator and research program R&D and the strategy for moving forward.

Detector Technology and R&D / 430

ATLAS pixel detector upgrades

Author: Mauricio Garcia-Sciveres[1]

[1] *LBNL*

Corresponding Author: mgarcia-sciveres@lbl.gov

The ATLAS experiment is building an "Insertable B-Layer" (IBL) pixel detector to be installed on a replacement beam pipe in 2013. This detector is using the new FE-I4 pixel readout chip recently developed. The IBL will fit inside and not alter the existing ATLAS pixel detector. However, the possibility is being studied to replace the pixel whole detector in 2017 with a lower mass, higher performance instrument based on the FE-I4 chip and new mechanical structures.

Detector Technology and R&D / 431

Upgrade plans of the CMS detector

Author: Daniela Bortoletto[1]

[1] *Purdue*

Corresponding Author: daniela.bortoletto@cern.ch

Overview of upgrade plans.

Detector Technology and R&D / 432

Non accelerator HEP instrumentation challenges

Author: Carter Hall[1]

[1] *University of Maryland*

Corresponding Author: crhall@umd.edu

Broad overview of applications outside accelerators

Detector Technology and R&D / 433

Status of particle flow calorimetry

Author: Jose Repond[1]

[1] *Argonne National Laboratory*

Corresponding Author: repond@hep.anl.gov

Summary of challenges, development, and prospects.

Plenary Session / 434

Celebrating the Tevatron: Machine

Author: Stephen Holmes[1]

[1] *Fermilab*

Corresponding Author: holmes@fnal.gov

For 25 years the Tevatron Proton-Antiproton Collider was the highest energy collider in the world. This presentation will trace the origins of the Tevatron, the challenges that were overcome in creating high luminosity collisions of protons and antiprotons, the technological achievements that drove performance a factor of 400 beyond the initial performance goals, and the legacy of the Tevatron in paving the way for ever more advanced colliders.

Heavy Ion Physics/Hot and Dense QCD / 435

Probing hot and dense nuclear matter with particle correlations and jets at RHIC

Author: Hua Pei[1]

[1] *University of Illinois at Chicago*

Corresponding Author: hua.pei@cern.ch

The high energy nucleus-nucleus collision at RHIC has produced the quark matter where quarks and gluons are believed to be deconfined. Single particle spectra has shown that parton lose significant amount of energy in such medium. It's therefore important to further explore the medium properties using multi-particle correlations and jets.

In this contribution, we present recent results from RHIC on the following related analyses. We will discuss the studies of the "ridge" and the away-side correlation structure in central A+A collisions via multi-particles correlations. Higher order Fourier harmonics extracted from di-hadron correlations in comparison with initial density fluctuation models will be presented. Comparative analysis of hadron correlations with a high-energy particle vs. fully reconstructed jets will also be discussed.

Accelerator Physics / **436**

SRF Technology for Particle Accelerators: Progress Report

Author: Jean Delayen[1]

[1] *Old Dominion University*

Corresponding Author: delayen@jlab.org

The superconducting RF (SRF) technology is increasingly becoming the technology of choice for a wide range of particle accelerators. It has found applications in high energy and nuclear physics accelerators, spallation neutron sources, and light sources. The
opportunities offered by the SRF technology, and its challenges, will be presented and reviewed.

Accelerator Physics / **437**

Do optical-scale structures make suitable accelerators for colliders?

Author: Gil Travish[1]

[1] *UCLA*

Corresponding Author: travish@physics.ucla.edu

Of the various advanced accelerator schemes that promise high accelerating gradients, optical-scale structures offer a distinct set of performance parameters along with their own challenges. In addition to the promise of an order of magnitude improvement in accelerating gradients (to ˜GV/m) over conventional structures, these devices produce low charge, femto- to atto-second bunches at very high repetition rates (MHz-GHz). The implications for colliders are significant: beam disruption and background beamstraulung might be significantly reduced, but the bunch format may require changes in detectors and trigger systems. Some variants of the optical-scale structures can support flat (high-aspect ratio) beams, which may also be advantageous in a collider. In order to realized such a collider, these devices must demonstrate very high wall-plug efficiency, high reliability and long lifetimes. In this talk, I will attempt to answer the question posed in the title. I will review the present start-of-the-art in optical-scale structures and speculate on the mid- and long-term challenges to be overcome in order to prove their applicability to high-energy physics.

Accelerator Physics / **438**

Tevatron Accelerator Methods and Techniques Applicable for Future Accelerators

Author: Valeri Lebedev[1]

[1] *FNAL*

Corresponding Author: val@fnal.gov

The success of Tevatron Run II is based on advances in accelerator physics, as well as on the excellence and advances in engineering, instrumentation and machine operation. We review the main advances in accelerator physics which contributed to the luminosity growth and/or improvement of the Tevatron complex operations, and discuss their applicability to future colliders.

Accelerator Physics / 439

Status of the Super-B factory Design

Author: Walter Wittmer[1]

[1] *SLAC*

Corresponding Author: wittmer@slac.stanford.edu

The SuperB international team continues to optimize the design of an electron-positron collider, which will allow the enhanced study of the origins of flavor physics. The project combines the best features of a linear collider (high single-collision luminosity) and a storage-ring collider (high repetition rate), bringing together all accelerator physics aspects to make a very high luminosity of 10ˆ36 cm−2 sec−1. This asymmetric-energy collider with a polarized electron beam will produce hundreds of millions of B-mesons at the Y(4S) resonance. The present design is based on ex- tremely low emittance beams colliding at a large Piwin- ski angle to allow very low βy⊠ without the need for ultra short bunches. Use of crab-waist sextupoles will enhance the luminosity, suppressing dangerous resonances and allowing for a higher beam-beam parameter. The project has flexible beam parameters, improved dynamic aperture, and spin-rotators in the Low Energy Ring for longitudinal po- larization of the electron beam at the Interaction Point. Optimized for best colliding-beam performance, the facility may also provide high-brightness photon beams for synchrotron radiation applications.

Accelerator Physics / 440

Progress with Laser Plasma Wakefield Acceleration and Prospects of LPWA HEP Colliders

Author: Wim Leemans[1]

[1] *LBNL*

Corresponding Author: wpleemans@lbl.gov

Accelerators are essential tools of discovery and have many practical uses. More than three decades ago, lasers were proposed as power sources for driving novel accelerators based on plasmas as the accelerating medium. An overview will be presented of the basic principles of laser plasma accelerators (LPA) and of the research at LBNL. This includes the 2004 demonstration of high quality electron beams , the 2006 demonstration of GeV class beams from a 3 cm long accelerating structure , recent work on controlled injection , staging of modules and the BELLA project which aims at a 10 GeV meter scale accelerator. We then discuss the challenges of this technology towards applicability for advanced light sources and colliders.

Accelerator Physics / 441

eRHIC collider design status

Author: None

Corresponding Author: vl@bnl.gov

We present the design of future high-energy high-luminosity electron-hadron collider at RHIC called eRHIC. We plan on adding 20 (potentially 30) GeV energy recovery linacs to accelerate and to collide polarized and unpolarized electrons with hadrons in RHIC. The center-of-mass energy of eRHIC will range from 30 to 200 GeV. The luminosity exceeding 1034 cm-2 s-1 can be achieved in eRHIC using the low-beta interaction region with a 10 mrad crab crossing. We report on the progress of important eRHIC R&D such as the high-current polarized electron source, the coherent electron cooling and the compact magnets for recirculating passes. A natural staging scenario of step-by-step increases of the electron beam energy by builiding-up of eRHIC's SRF linacs and a potential of adding polarized positrons are also presented.

Accelerator Physics / **442**

Novel Beam Diagnostics for Future HEP facilities

Author: John Byrd[1]

[1] *LBNL*

Corresponding Author: jmbyrd@lbl.gov

To meet the energy and luminosity requirements of future HEP machines, advances are required in accelerator instrumentation and technology in many diverse areas, such as: acceleration, component alignment and stability, fast timing instrumentation and optics, photocathodes, pulsed power components, photon detectors, halo monitors, collimators, lasers, insertion devices, noninvasive profile monitors, high resolution position monitors, trapped ion diagnostics, and feedback systems. We will discuss the prospects for these advanced diagnostic techniques with an emphasis on high impact technologies that can significantly enhance the performance and scientific output of future machines.

Accelerator Physics / **443**

High Gradient RF Progress : Toward Tev-scale Accelerators

Author: Sami Tantawi[1]

[1] *SLAC*

Corresponding Author: tantawi@slac.stanford.edu

Research on the basic physics of high-gradient, high frequency accelerator structures and the associated RF/microwave technology are essential for the future of discovery science, medicine and biology, energy and environment, and national security. We will review the state-of-the-art for the development of high gradient linear accelerators.

Accelerator Physics / **444**

Beam-Driven Plasma Wakefield Acceleration

Author: Patric Muggli[1]

[1] *University of Southern California*

Corresponding Author: muggli@mpp.mpg.de

The plasma wakefield accelerator (PWFA) concept is experiencing renewed interest thanks to the recent experimental results that showed that ultrarelativistic electrons can gain as much as 42GeV in only 85cm of plasmas. In the PWFA a short particle bunch drives large amplitude wakefields in a neutral plasma. The wakefields can have a very large longitudinal component (>10GV/m) that leads to energy loss and energy gain, and a very strong transverse component (>1MT/m) that naturally lead to propagation of the bunch over long distances with small transverse size. This combination can lead to very large energy gain over very short distances, making the PWFA concept very attractive for a future, more compact and affordable electron/positron linear collider. However, beyond these physics experiments that prove that such fields can be driven in plasmas, the acceleration of good quality electron and positron bunches must be demonstrated. The questions of efficiency and available drive beam energy and power must be addressed. Toward this goal a new facility, FACET will come into operation this year at SLAC, delivering ultra-short electron and positron bunches to meter scale plasmas. These single bunches can be tailored into trains of drive and witness bunches. Low energy experiments are conducted at the Brookhaven National Laboratory Accelerator Test Facility to explore resonant excitation of plasma wakefields and the possibility large energy gain through large transformer ratios. A new experimental program using high-energy proton bunches available at CERN is being proposed to investigate the possibility of generating TeV-calss electron bunches in a single plasma cell. The PWFA principle will be described, recent key experimental results, and plan and prospects for current and future experiments will be presented.

Accelerator Physics / 445

Future Linear Collider Applications with Laser-Driven Dielectric Structures

Author: Robert Byer[1]

[1] *Stanford University*

Corresponding Author: byer@stanford.edu

The dielectric laser acceleration (DLA) concept leverages well-established industrial fabrication capabilities and the commercial availability of tabletop lasers to reduce cost, while offering significantly higher accelerating gradients, and therefore a smaller footprint. In contrast to other novel accelerator schemes, desirable luminosities would be obtained by operating with very low charge per bunch but at extremely high repetition rates. This research has signficant near and long-term applications, which we will discuss. And as a consequence of its unique operating parameter regime, the predicted energy loss due to beam-beam interaction is small.

Low Energy Searches for Physics Beyond the Standard Model / 446

EDMs and their implications

Author: Yingchuan Li[1]

[1] *Brookhaven National Lab*

Corresponding Author: ycli@quark.phy.bnl.gov

The Electric Dipole Moments (EDMs) provide an unique way of probing CP violations. The search for neutron and atom EDMs has reached very high precision after many decades of effort. I will

discuss the implications of the EDM search on the theory of SM, SUSY, as well as the Baryogenesis scenarios. In particular, based on the study of the interplay of EDMs and electroweak Baryogenesis in MSSM, we learn that the wino-driven scenario has been ruled out by current EDM bounds, and the bino-driven scenario is the only viable scenario. With the next generation of EDM experiments that are projected to push the sensitivity by another 2 to 3 orders of magnitude, the parameter space of the bino-driven scenario can also be fully covered.

CP-Violation / 447

Lattice weak matrix elements and CP violation in the LHC era

Author: Amarjit Soni[1]

Co-author: Enrico Lunghi [2]

[1] *BNL*

[2] *University of Indiana*

Corresponding Author: soni@bnl.gov

The role of lattice matrix elements in refined tests of the Standard Model and for search of new physics will be discussed. Although the results from the lattice in conjunction with data from B-factories provided a confirmation of the CKM-paradigm of CP violation a few years ago, since then improved calculations and better data
from experiments is now yielding strong indications that the single phase in the CKM-matrix is not enough. Repercussions for some BSMs will also be discussed

Heavy Ion Physics/Hot and Dense QCD / 448

The Wake of a Quark Moving Through Hot QCD Plasma vs. N=4 SYM Plasma

Author: JUHEE HONG[1]

Co-authors: Derek Teaney [1]; Paul Chesler [2]

[1] *Stony Brook University*

[2] *MIT*

Corresponding Author: jhong@grad.physics.sunysb.edu

We present the energy density and flux distribution of a quark moving through the high temperature QCD plasma and compare it with that in strongly coupled N=4 SYM plasma.

The Boltzmann equation is reformulated as a Fokker-Planck equation at leading log approximation and is solved numerically with non-trivial boundary conditions in momentum space. We use the kinetic theory and take the Fourier transform to calculate the energy and momentum density in real space. The angular distribution exhibits the transition to the ideal hydrodynamics and is analyzed with the first and second order hydrodynamic source.

The AdS/CFT correspondence allows the same calculation in strong coupling regime. Compared to the kinetic theory, the energy-momentum tensor is better described by hydrodynamics even after accounting for the differences in the shear viscosities. We argue that the difference between Boltzmann and AdS/CFT comes from the second order hydrodynamic coefficient tau_pi, which is generically large compared to the shear length in a theory based on the Boltzmann equation.

Poster Session / 449

Sticky Dark Matter

Author: Alexey Petrov[1]

Co-author: Andriy Badin [2]

[1] *Wayne State University*

[2] *Duke University*

Corresponding Author: apetrov@physics.wayne.edu

There is experimental evidence that Dark Matter (DM) makes up about 25\% of the Universe mass and is most likely nonrelativistic. We explore possibility of creation and existence of bound states of Dark Matter and standard model (SM) particles. Such bound states can be potentially created and detected during direct DM search experiments (DAMA, CDMS, XENON etc.). We work in model-independent effective field theoretic approach to determine conditions under which such bound states can be created. Our results appear to be dependent on nuclei used in DM direct detection experiments. In this scenario we determine the region of DM parameter space that provides simultaneous fit to DAMA and CDMS data.

Field and String Theory / 450

Local Conformal Symmetry and Prediction of Antigravity in the History of the Universe

Author: Itzhak Bars[1]

[1] *Univ. Southern California*

Corresponding Author: bars@usc.edu

Einstein's theory of General Relativity and its couplings to matter in 3+1 dimensions can be slightly enlarged with the requirement of a local scale (conformal) symmetry and the corresponding gauge degrees of freedom. This form of the theory, which is a prediction coming from 2T-gravity in 4+2 dimensions, has no dimensionful constants, not even the gravitational constant, and requires all scalar fields to be conformally coupled to gravity and to the rest of matter. The theory can be gauge fixed to either the usual gravity theory in the Einstein frame (thus generating the gravitational constant), or to other equivalent forms that lead to the complete set of exact analytic solutions of the usual Friedmann equations. These analytic cosmological solutions, which are geodesically complete at singularities, reveal many surprising properties that are not noticeable with approximate cosmological solutions. In particular, it is predicted that the universe is cyclic and furthermore it has a period of antigravity between every big crunch and the following big bang.

Heavy Ion Physics/Hot and Dense QCD / 451

Conformal hydrodynamics in Minkowski and de Sitter spacetimes

Author: Amos Yarom[1]

[1] *Princeton University*

Corresponding Author: ayarom@princeton.edu

I will show how to generate non-trivial analytic solutions to the conformally invariant, relativistic fluid dynamic equations by appealing to the Weyl covariance of the stress tensor. The technique I will present recasts the relativistic conformally invariant Navier-Stokes equations in four-dimensional Minkowski space as a static flow in three-dimensional de Sitter space times a line. The solution obtained can be thought of as a generalization of Bjorken flow. The simplicity of the de Sitter form of the flow enables a study of second order viscous corrections and linearized perturbations.

Heavy Ion Physics/Hot and Dense QCD / 452

Identified Hadron Production from the RHIC Beam Energy Scan Program in the STAR experiment

Author: lokesh kumar[1]

[1] *Kent State University*

Corresponding Author: lokesh@rcf.rhic.bnl.gov

The current focus at RHIC is the Beam Energy Scan (BES) program to study the QCD phase diagram — temperature (T) vs. baryon chemical potential (μ_B). The BES program aims to verify some predictions from QCD: that a cross-over occurs at μ_B = 0, and that there exists a first-order phase transition at large μ_B and a critical point at an intermediate μ_B. The spectra and ratios of produced particles can be used to extract T and μ_B in different energies and system sizes.

The Solenoidal Tracker At RHIC (STAR) experiment has collected data for Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7 GeV, 11.5 GeV, and 39 GeV in year 2010. One of the advantages during the BES program was the enhanced particle identification with availability of full Time-Of-Flight detector. In addition, STAR collected Cu+Cu collisions at 22.4 GeV in year 2005.

We present mid-rapidity spectra (p_T or $m_T - m_0$), rapidity density, average transverse mass, and particle ratios for identified hadrons from the STAR experiment. The centrality and transverse momentum dependence of the particle yields and ratios will be compared to existing data at lower and higher beam energies and to various transport models like AMPT and UrQMD. Collision dynamics are studied systematically in the framework of chemical and kinetic freeze-out and their properties extracted from the particle ratios and spectra.

Field and String Theory / 454

Fuzzy Twistors and Emergent Gravity

Author: Jonathan Heckman[1]

[1] *Institute for Advanced Study*

Corresponding Author: jheckman@ias.edu

We describe a novel regulator of four-dimensional N = 4 Super Yang-Mills theory on a four-sphere. The regulator involves a lift of the theory to a large N matrix model on a non-commutative twistor space. As opposed to other known regulators, this regulator naturally retains both gauge invariance, and the symmetries of the spacetime. We present evidence that in the large N limit, the twistor matrix model correctly reproduces gauge theory scattering amplitudes. We further show that the 1 / N corrections describe an emergent gravitational sector which correctly reproduces tree level scattering amplitudes for Einstein gravity.

Hadron Spectroscopy / 455

Probing Scalar Mesons Below and Above 1 GeV

Author: Amir Fariborz[1]

[1] *SUNY Institute of Technology*

Corresponding Author: fariboa@sunyit.edu

Scalar mesons play important roles in low-energy QCD and are known to be nontrivial states in hadron spectroscopy. Within the context of a generalized linear sigma model that includes two nonets of scalar mesons (a two-quark nonet and a four-quark nonet) and two nonets of pseudoscalar mesons (a two-quark nonet and a four-quark nonet) a collective description of scalar and pseudoscalar mesons below and above 1 GeV is studied. In this study, the quark contents of these states are probed and estimates on their quark components are extracted. Within the same framework various low-energy scatterings (such as pi pi scattering and pi K scattering) as well as decays such as eta prime to eta pi pi, are also investigated and the properties of scalar mesons are probed. This presentation will provide an overview of these investigations and will discuss future directions.

Detector Technology and R&D / 456

ATLAS detector upgrade plans

Author: Venetios Polychronakos[1]

[1] *Department of Physics-Brookhaven National Laboratory (BNL)*

Corresponding Author: polychronakos@bnl.gov

Overview of plans for ATLAS detector upgrades up to 2022.

Heavy Ion Physics/Hot and Dense QCD / 457

The Rise and Fall of the Ridge at RHIC and the LHC

Author: Paul Sorensen[1]

[1] *BNL*

Corresponding Author: prsorensen@bnl.gov

The centrality dependence of the low pt ridge correlations exhibits an interesting centrality dependence: it rises quickly with centrality but then in the most central collisions falls again. This centrality dependence is seen for 62.4 GeV, 200 GeV, and 2.76 TeV data. In this talk, I discuss how the rise and fall of the ridge demonstrates that the ridge is connected to the initial eccentricity. I discuss the connection of the away-side correlations to the near-side correlations and also explain why RHIC should collide Pb ions instead of Au ions.

Heavy Ion Physics/Hot and Dense QCD / **459**

Deconfinement and chiral transition in QCD at finite temperature

Author: Peter Petreczky[1]

[1] *BNL*

Corresponding Author: petreczk@bnl.gov

I am going to discuss new lattice results on the deconfinement and chiral aspects of the transition in QCD at non-zero temperature. I will report on calculations performed using the Improved Staggered Quark action on Nt=6, 8 and 12 lattices. I will show continuum extrapolation for several quantities that are discussed in connection with the transition at non-zero temperature as well as the determination of the chiral transition temperature in the continuum limit. Finally I will discuss new findings for the equation of state.

Higgs Physics / **460**

Higgs Boson Differential Distributions from Effective Field Theory

Authors: Frank Petriello[1]; Sonny Mantry[2]; Ye Li[3]

[1] *Northwestern University and Argonne National Lab*

[2] *University of Wisconsin at Madison*

[3] *Northwestern University*

Corresponding Author: mantry147@gmail.com

Theoretical knowledge of the low transverse momentum (pT) distribution of the Higgs boson, plays an important role in search strategies for the Higgs. In the region of low pT, much smaller than the Higgs mass, large logarithms spoil the perturbative expansion and must be resummed. We apply effective field theory techniques and derive a new factorization and resummation formula for the pT-spectrum which is free of Landau poles. The factorization theorem is in terms of Impact-parameter Beam Functions (iBFs).
In the non-perturbative pT region, the iBFs correspond to fully unintegrated PDFs and can be interesting nucleon-structure objects in their own right. We also apply this formalism to the Drell-Yan process and give a comparison of our result to Tevatron data.

Heavy Ion Physics/Hot and Dense QCD / **461**

Results from Pb+Pb Collisions with the ATLAS Detector at the LHC

Author: Peter Alan Steinberg[1]

[1] *Brookhaven National Laboratory (BNL)*

Corresponding Author: peter.steinberg@bnl.gov

A broad program of measurements using heavy ion collisions is underway in ATLAS, with the aim of studying the properties of QCD matter at high temperatures and densities. This talk describes measurements performed using up to 9 μb-1 of lead-lead collision data provided at a nucleon-nucleon center-of-mass energy of 2.76 GeV by the Large Hadron Collider and collected by the ATLAS Detector during November and December 2010. We will be presenting results on inclusive charged particle multiplicities and elliptic flow to study the global features of the collisions as a function of centrality, pseudorapidity and transverse energy. Higher order Fourier coefficients will also be shown to assess the importance of more complicated event-wise geometric fluctuations. The study of the microscopic properties of the system will be addressed with high pT probes. Muon measurements provide access to W and Z bosons which are potentially sensitive to modifications of the nuclear PDFs, as well as heavy flavor. Charged particle spectra, particularly at high pT, are sensitive to the overall suppression of jets and their modified fragmentation. Finally, jet rates, asymmetries and fragmentation properties offer a more direct look at the physics of jet quenching than has been available at previous facilities.

Low Energy Searches for Physics Beyond the Standard Model / 462

A New Part-Per-Million Measurement of the Positive Muon Lifetime and Determination of the Fermi Constant

Author: David Webber[1]

[1] *University of Wisconsin-Madison*

Corresponding Author: dwebber@hep.wisc.edu

on behalf of the MuLan Collaboration

The Fermi constant, G_F, describes the strength of the weak force and is determined most precisely from the mean life of the positive muon, tau_mu. Advances in theory have reduced the theoretical uncertainty on G_F as calculated from tau_mu to a few tenths of a part per million (ppm). Until recently, the remaining uncertainty on G_F was entirely experimental and dominated by the uncertainty on tau_mu. We report the MuLan collaboration's recent 1.0 ppm measurement of the positive muon lifetime. This measurement is over a factor of 15 more precise than any previous measurement, and is the most precise particle lifetime ever measured. The experiment used a time-structured low-energy muon beam and an array of plastic scintillators read-out by waveform digitizers and a fast data acquisition system to record over 2 x 10ˆ12 muon decays. Two different in-vacuum muon-stopping targets were used in separate data-taking periods. The results from these two data-taking periods are in excellent agreement. The combined results give tau_{muˆ+}(MuLan)=2196980.3(2.2) ps. This measurement of the muon lifetime gives the most precise value for the Fermi constant: G_F(MuLan) = 1.1663788 (7) x 10ˆ-5 GeVˆ-2 (0.6 ppm). It is also used to extract the muˆ-p singlet capture rate, which determines the proton's weak induced pseudoscalar coupling g_P.

Heavy Ion Physics/Hot and Dense QCD / 463

Effective theory for jets in medium

Author: grigory ovanesyan[1]

Co-author: Ivan Vitev [1]

[1] *LANL*

Corresponding Author: ovanesyan@lanl.gov

We revisit the jet broadening and radiative energy loss problems in heavy ion collisions from effective theory point of view. Soft collinear effective theory (SCET) describes the dynamics of QCD at high energies and is particularly suitable for calculations involving jets. By modifying its Lagrangian to include medium interactions we develop an effective theory for jets in medium. A number of issues are addresses in this new language. We demonstrate the gauge invariance of results for jet broadening and radiative energy loss. We show how the cross-section for radiative corrections to jet production factorizes for QCD hard processes. We include the effect of the nuclear recoil in the medium and quantify it for RHIC and LHC energies. Also we calculate the radiative energy loss beyond the conventional soft gluon approximation, extending the previous results to large x values. We discuss the phenomenological applications for RHIC and LHC.

Low Energy Searches for Physics Beyond the Standard Model / 464

The proton charge radius

Author: Paul Indelicato[1]

[1] *CNRS*

Corresponding Author: paul.indelicato@lkb.ens.fr

We have obtained a very accurate proton charge distribution radius by measuring the 2s-2p Lamb shift in muonic hydrogen[1]. The value we found, 0.84184(67)fm is roughly 10 times more accurate than the ones derived from either hydrogen spectroscopy or electron-proton elastic scattering. It is 5 standard deviations away from the CODATA 2008 value 0.8768(69) fm, which combines both types of measurements. The disagreement with the recently posted CODATA 2010 value 0.8775(51) fm [2] is even larger at 6.9 standard deviations. I will describe the experiment and the latest results on the other hyperfine component that we measured. I will discuss the latest theoretical evaluations and the implications of such a large disagreement, which has not been explained up to now.

[1] The size of the proton, R. Pohl, A. Antognini, F. Nez, F.D. Amaro, F. Biraben, J.M.R. Cardoso, D.S. Covita, A. Dax, S. Dhawan, L.M.P. Fernandes, A. Giesen, T. Graf, T.W. Hänsch, P. Indelicato, L. Julien, C.-Y. Kao, P. Knowles, E.-O.L. Bigot, Y.-W. Liu, J.A.M. Lopes, L. Ludhova, C.M.B. Monteiro, F. Mulhauser, T. Nebel, P. Rabinowitz, J.M.F. dos Santos, L.A. Schaller, K. Schuhmann, C. Schwob, D. Taqqu, J.F.C.A. Veloso and F. Kottmann. Nature 466, 213-216 (2010).
[2] http://physics.nist.gov/cgi-bin/cuu/Value?rp|search_for=proton+radius

Heavy Ion Physics/Hot and Dense QCD / 465

Monte-Carlo simulation of jets in heavy-ion collisions

Author: Bjoern Schenke[1]

[1] *BNL*

Corresponding Author: bschenke@quark.phy.bnl.gov

I present recent developments in simulating heavy-ion collisions using a Monte-Carlo event-generator to study high momentum probes. The simulation contains medium effects on the hard probes via the elastic and radiative energy loss and momentum broadening. The lower momentum bulk medium is simulated using relativistic hydrodynamics.
Apart from inclusive observables such as the nuclear modification factor, I present results for the di-jet asymmetry measured at the Large Hadron Collider, employing state of the art jet reconstruction methods.
I demonstrate that Monte-Carlo simulations are an essential tool for connecting fundamental theory to experiments and extracting important information about the properties of the medium created in heavy-ion collisions and its interactions.

Heavy Ion Physics/Hot and Dense QCD / 466

Gravitational collapse and far from equilibrium dynamics in holographic gauge theories

Author: Paul Chesler[1]

[1] *MIT*

Corresponding Author: pchesler@mit.edu

In recent years holography has emerged as a powerful tool to study non-equilibrium phenomena in certain quantum theories, mapping challenging quantum dynamics onto the classical dynamics of gravitational fields in one higher dimension. One interesting process accessible with holography is the formation of a quark-gluon plasma in strongly coupled non-Abelian gauge theories. In the dual gravitational description, the formation of a quark-gluon plasma maps onto the process of gravitational collapse and black hole formation. I will describe how one can use techniques from numerical relativity to study this process.

Plenary Session / 468

Closing Remarks

Author: Barry Barish[1]

[1] *Caltech*

Corresponding Author: barish@ligo.caltech.edu

Detector Technology and R&D / 469

New Optical Link Technologies for HEP Experiments

Authors: David Underwood[1]; Waruna Fernando[2]

Co-authors: Daniel Lopez [3]; Robert Stanek [4]

[1] *Argonne National Laboratory (ANL)*

[2] *Argonne National Lab*

[3] *Center for Nanoscale Materials, Argonne National Lab*

[4] *HEP - Argonne National Lab*

Corresponding Authors: bfernando@hep.anl.gov, dgu@hep.anl.gov

New Optical Link Technologies for HEP Experiments
B. Fernando, D. Underwood, R. Stanek, P.M. DeLurgio,
High Energy Physics, Argonne National Laboratory
D. Lopez, Center for Nanoscale Materials, Argonne National Laboratory

As a concern with the reliability and mass of current optical links in LHC experiments, we are investigating CW lasers and light modulators as an alternative to VCSELs. In addition we are developing data links in air, utilizing steering by MEMS mirrors and optical feedback paths for the control loop. Laser, modulator, and lens systems used are described, as well as two different electronic systems for a free space steering feedback loop.

Our prototype system currently operates at 1.25 Gb/s, but could be upgraded. This link works over distances of order meters. Such links might enable one to move communication lasers (e.g. VCSELs) and optical fibers out of tracking detectors, for reasons such as reliability and power consumption. Some applications for free space data links, such as local triggering and data readout and trigger-clock distribution and links for much longer distances are also discussed.

Heavy Ion Physics/Hot and Dense QCD / 470

Parton showers as sources of energy-momentum deposition in the QGP and implications for jet observables

Author: Richard Neufeld[1]

[1] *LANL*

Corresponding Author: neufeld@lanl.gov

I present results on the derivation of the distribution of energy and momentum transmitted from a primary fast parton and its medium-induced bremsstrahlung gluons to a thermalized quark-gluon plasma. The calculation takes into account the important and thus far neglected effects of quantum interference between the resulting color currents. From the result I obtain the rate at which energy is absorbed by the medium as a function of time and find that the rate is modified by the quantum interference between the primary parton and secondary gluons. This Landau-Pomeranchuk-Migdal type interference persists for time scales relevant to heavy ion phenomenology. The newly derived source of energy and momentum deposition is coupled to linearized hydrodynamics to obtain the bulk medium response to realistic parton propagation and splitting in the quark-gluon plasma. Implications for jet observables are discussed.

Heavy Ion Physics/Hot and Dense QCD / 471

Measurement of elliptic and higher order flow harmonics at $\sqrt{s_{NN}} = 2.76TeV$ Pb+Pb collisions with the ATLAS Detector.

Author: Soumya Mohapatra[1]

[1] *Department of Physics-State University of New York (SUNY)*

Corresponding Author: soumya@cern.ch

The flow harmonics v_n are important bulk observables in heavy ion collisions. They contain information about the initial geometry as well as the transport properties of the medium produced in heavy ion collisions. We present the measurements of flow harmonics v_2-v_6 using the EP method and two particle correlations method in broad p_T, η and centrality ranges using the ATLAS detector at LHC. ATLAS recorded, 9ub-1 Pb+Pb data in the 2010 heavy ion run. This large dataset and large detector acceptance :2\pi in azimuth and ± 2.5 units in η for charged hadrons, allows for a detailed study of the flow harmonics. The phase space regions where the two methods are consistent and where they disagree will be discussed. We show that the novel structures seen in two particle correlations such as the near and away side ridge as well as the so called "mach-cone" are entirely accounted for by the collective flow. Some interesting scaling relations between the v_n will also be shown.

Heavy Ion Physics/Hot and Dense QCD / 472

Jets and Jet-like Correlations at RHIC

Author: Helen Louise Caines[1]

[1] *Physics Department-Yale University*

Corresponding Author: helen.caines@yale.edu

I will present an overview of recent results on jets and
jet-like correlation measurements from the Relativistic Heavy-Ion Collider (RHIC) at Brookhaven National Laboratory.

Jets are produced in the initial hard scatterings of an event and can therefore be exploited as probes of the hot and dense medium produced in heavy-ion collisions. Previous RHIC results indicate that this medium, the Quark Gluon Plasma (QGP), is strongly coupled, with partonic degrees of freedom. High pT colored partons passing through the sQGP therefore believed to suffer energy loss via induced gluon radiation and elastic collisions, before exiting the medium and fragmenting in vacuum. Jet
reconstruction and high pT correlation studies allow us to investigate how the partons interact with the medium and how the medium responds to the partons moving through it. By comparing measurements from p-p and d-Au to those in Au-Au collisions at sqrt(s) = 200 GeV we aim to disentangle cold nuclear matter effects from those of the hot and dense sQGP.

Perturbative and non-Perturbative QCD / 473

Jet substructure and event shapes at high Q^2 in ATLAS

Author: David Miller[1]

Co-author: Ariel Schwartzman [1]

[1] *SLAC National Accelerator Laboratory*

Corresponding Author: david.w.miller@cern.ch

We present results on the measurement of hadronic jet event shapes and jet substructure in proton-proton collisions at sqrt(s) = 7 TeV with the ATLAS detector. These measurements constitute the first dedicated study of hadronic event shapes at high Q^2 in ATLAS. New results are also presented on the measurement of the substructure of these jets and in commissioning the tools for distinguishing the signatures of new boosted massive particles in the hadronic final state. Two fat" jet algorithms are used, along with the filtering jet grooming technique that was pioneered in ATLAS. New jet substructure observables are compared for the first time to data at the LHC. Finally, a sample of candidate boosted top quark events collected in the 2010 data is analyzed in detail for the jet

substructure properties of hadronictop-jets" in the final state. Together, these measurements demonstrate not only our excellent understanding of QCD in a new energy regime but open the path to using complex event-level and jet substructure observables in the search for new physics.

Heavy Ion Physics/Hot and Dense QCD / 475

Recent Results of Fluctuation and Correlation Studies from the QCD Critical Point Search at RHIC

Author: Terence John Tarnowsky[1]

[1] *Michigan State University*

Corresponding Author: terence.john.tarnowsky@cern.ch

Enhanced fluctuations and correlations have been observed in the phase transitions of many systems. Their appearance at the predicted QCD phase transition (especially near the expected critical point) may provide insight into the nature of the phase transition. Recent results from the QCD Critical Point Search at RHIC will be presented, with a focus on particle ratio (K/π, p/π, and K/p) fluctuations and their comparison to previous measurements and theoretical predictions.

Higgs Physics / 476

SUSY QCD Corrections to Higgs-b Production

Authors: Christopher Jackson[1]; Prerit Jaiswal[2]; Sally Dawson[3]

[1] *Physics Department, University of Texas, Arlington, Texas*

[2] *YITP, Stony Brook University*

[3] *aDepartment of Physics, Brookhaven National Lab*

The dominant production mechanism for Standard Model (SM) Higgs boson is gg->h. However, in certain beyond the SM scenarios, Higgs production with bottom quarks can become dominant due to enhanced bottom quark Yukawa coupling. One such model is the Minimal Supersymmetric Standard Model (MSSM) where the bottom Yukawa coupling to Higgs bosons, including the SM-like Higgs, gets significantly modified for large values of tan(beta) [defined as the ratio of the vacuum expectation values of the up and down type Higgs]. In this talk, I focus on one-loop supersymmetric QCD corrections to the subprocess b g->b h which is the leading order (LO) process in five flavor number PDF scheme (5FNS) when one bottom quark in the final state is tagged. In particular, I investigate the validity of the commonly used Delta_b approximation where one rescales the bottom Yukawa in MSSM in order to include large tan(beta) effects.

Higgs Physics / 477

The Beginnings of Spontaneous Symmetry Breaking in Elementary Particle Theory

Author: Gerald Guralnik[1]

[1] *Brown University, Providence RI 02912, USA*

Corresponding Author: gerry@het.brown.edu

I will give a theoretical perspective on the topic of symmetry and symmetry breaking, particularly as the basis of the electroweak theory at the time of the initial formulation and development of the Standard Model. I will also briefly discuss some of these ideas restated in more modern terms.

Summary:

The theoretical basis of dynamical symmetry breaking as applied to the standard model is reviewed with a modern perspective.

Top Quark Physics / 479

Search for new physics involving top quarks in ATLAS

Author: Tobias Golling[1]

[1] *Physics Department-Yale University*

Corresponding Author: tobias.golling@unige.ch

With 7 TeV proton-proton collisions data collected by the ATLAS detector we present searches for anomalous top-quark production and decay in several channels , including a search for top-quark pair production with anomalous missing transverse energy, top-quark pair resonances, fourth generation quarks decaying to top quarks.
Such phenomena can arise from a number of Standard Model extensions.

Heavy Ion Physics/Hot and Dense QCD / 482

QCD Critical Point and Event-by-event Fluctuations

Author: Misha Stephanov[1]

[1] *UIC*

Corresponding Author: misha@uic.edu

QCD critical point is a singularity on the QCD phase diagram with distinct signatures which make possible its discovery in heavy-ion collisions. I shall describe the characteristics of the non-monotonous behavior of observables measuring the magnitude and non-Gaussianity of event-by-event fluctuations as a function of the beam energy in the presence of the QCD critical point. I shall discuss implications for the RHIC Beam Energy Scan and what we can learn from recent data.

Low Energy Searches for Physics Beyond the Standard Model / 483

The Fermilab Muon (g-2) Experiment

Author: Bradley Lee Roberts[1]

[1] *Boston University*

Corresponding Author: roberts@bu.edu

Fermilab E989 has the goal to improve on the precision of the muon anomalous magnetic moment, a_mu = (g_mu - 2)/2 by at least a factor of 4 beyond the 0.54˜ppm relative precision obtained in E821 at Brookhaven. The precision storage ring will be relocated to Fermilab and installed in a new building. A new 8˜GeV/c proton beamline and 3.1˜GeV/c muon beamline will be built. The unique capabilities of Fermilab to produce a proton beam with pulses containing ˜ 1 X 10ˆ{12} protons at an advantageous duty factor will provide the necessary increase of statistics in a reasonable running time. This new experiment should clarify the apparent > 3 sigma difference between the experimental and Standard-Model values of a_mu.

Low Energy Searches for Physics Beyond the Standard Model / **484**

A proton EDM experiment: most sensitive to CP-violation beyond the SM

Author: Yannis Semertzidis[1]

[1] *BNL*

Corresponding Author: semertzidis@bnl.gov

High intensity polarized proton beams in storage rings make possible the development of an experiment to probe the proton electric dipole moment (EDM) with sensitivity of 10ˆ-29 e-cm. At this level it will be sensitive to new physics at the 3000 TeV and if new physics exists at the LHC scale, it will be sensitive at the sub-micro-radian level of CP-violating phases. The method utilizes an electric storage ring and polarized protons at their magic momentum (0.7 GeV/c) and takes advantage of several years of experience manipulating polarized beams in storage rings. The experimental concepts were scrutinized in two separate and very successful technical reviews, one in December 2009 and one in March 2011. The collaboration is expecting to submit the proton EDM proposal to DOE by the end of June 2011 for CD0.

Beyond the Standard Model / **485**

Search for Fourth Generation Quarks at CMS

Author: Michael Luk[1]

[1] *Brown University*

Corresponding Author: michael.ming.hong.luk@cern.ch

The Standard Model with three generations of quarks describes remarkably well all particle phenomena observed to date. Although adding a fourth generation of massive fermions is an obvious extension of the model, it became less popular ever since the limit on light neutrino flavors, and the precise measurements on the electroweak parameters, seem to disfavor such a possibility. However, indirect limits can never replace direct search for heavy particles. We present the results of a search for the heavy fourth generation quark using the CMS detector in pp collisions of the Large Hadron Collider.

Forum on Lepton Collider Physics in the LHC Era / **486**

Lepton Collider Forum

Author: Jonathan Feng[1]

[1] *UC Irvine*

Corresponding Author: jlf@uci.edu

Forum on Lepton Collider Physics in the LHC Era / 487

Electron Collider Physics

Author: Jonathan Bagger[1]

[1] *Johns Hopkins University*

Corresponding Author: bagger@triumf.ca

Forum on Lepton Collider Physics in the LHC Era / 488

ILC

Author: Andrew White[1]

[1] *University of Texas at Arlington*

Corresponding Author: andrew.white@cern.ch

Forum on Lepton Collider Physics in the LHC Era / 489

CLIC

Author: Lucie Linssen[1]

[1] *CERN*

Corresponding Author: lucie.linssen@cern.ch

Forum on Lepton Collider Physics in the LHC Era / 490

Muon Collider Physics

Author: Tao Han[1]

[1] *University of Wisconsin*

Corresponding Author: than@physics.wisc.edu

Forum on Lepton Collider Physics in the LHC Era / 491

Muon Collider

Author: Ronald Lipton[1]

[1] *Fermi National Accelerator Lab. (Fermilab)*

Corresponding Author: ronald.lipton@cern.ch

Heavy Ion Physics/Hot and Dense QCD / 492

Untriggered di-hadron correlations in Pb-Pb collisions at $\sqrt{s_{NN}} =$ 2.76 TeV

Author: Anthony Robert Timmins[1]

[1] *University of Houston*

Corresponding Author: anthony.timmins@cern.ch

We present measurements of untriggered di-hadron correlations as a function of centrality in Pb-Pb \sNN collisions, for charged hadrons with $p_T > 0.15$ GeV/c. These measurements provide a map of the bulk correlation structures in heavy-ion collisions. Contributions to these structures may come from jets, initial density fluctuations, elliptic flow, resonances, and/or momentum conservation. We decompose the measured correlation functions via a multi-parameter fit in order to extract the nearside Gaussian, the longer range $\Delta\eta$ correlation often referred to as the soft ridge. The effect of including higher harmonics (v_3 and v_4) in this procedure will be discussed. We investigate how the nearside Gaussian scales with the number of binary collisions. Finally, we show the charge dependence of the nearside Gaussian.

Low Energy Searches for Physics Beyond the Standard Model / 493

Measurement of the Proton's Weak Charge at the Qweak Experiment

Author: Jean-Francois Rajotte[1]

[1] *Ludwig-Maximilians-Univ. Muenchen*

Corresponding Author: jeanfrancois.rajotte@cern.ch

The Qweak experiment at Jefferson Lab measures the parity violating asymmetry of polarized electrons scattering of a proton target at very low momentum transfer. In the Standard Model, this asymmetry reveals the proton's coupling to the neutral vector current, the weak charge. This value, measured directly for the first time, provides a precision test of the Standard Model and constrains the possibility of relevant physics beyond the Standard Model. The planned precision will probe certain classes of new physics at the ˜2 TeV scale. In order to challenge the precise predictions, the asymmetry will be measured with a 4 percent accuracy. To achieve such a precision, great care has to be taken on many aspects of the experiment. The very low momentum transfer reduces the hadronic effects to the asymmetry and must be determined to half of a percent accuracy. Beam stability is controlled and monitored constantly and background events are carefully studied. An overview of the experiment will be presented, followed by a status report and expectations for the last phase of the data taking.

Heavy Ion Physics/Hot and Dense QCD / 494

Sound Propagation on Top of the Fireball

Author: Pilar Staig[1]

Co-author: Edward Shuryak [1]

[1] *Stony Brook University*

Corresponding Author: mstaigfe@ic.sunysb.edu

We study the effect that initial state fluctuations have on final particle correlations in heavy ion collisions. More precisely, we focus on the propagation of initial perturbations on top of the expanding fireball using the conformal solution derived by Gubser and Yarom for central collisions. For small perturbations, the hydrodynamic equations are solved by separation of variables and the solutions for different modes are added up to construct initial point-like perturbations, that are then allowed to evolve until freeze-out. The Cooper-Frye prescription is used to determine the final particle distribution. We present the two-particle correlation functions and their Fourier spectra obtained for different viscosities. We find that viscosity kills the higher harmonics, but that the Fourier spectra presents maxima and minima, similar to what is seen in the study of Cosmic Background Radiation. The difference between the first and the second maximum is used to estimate the viscosity of the medium.

Plenary Session / 495

Welcome

Author: Clyde Briant[1]

[1] *Vice President for Research (Brown University)*

Plenary Session / 496

Tanaka award

Author: Stephen Hoover[1]

[1] *University of Chicago*

Corresponding Author: hoover@kicp.uchicago.edu

Plenary Session / 497

LHC Luminosity and Energy Upgrades

Author: Steve Myers[1]

[1] *CERN*

Corresponding Author: steve.myers@cern.ch

Plenary Session / **498**

Future US Facilities

Corresponding Author: pjoddone@fnal.gov

Poster Session / **499**

Missing Transverse Energy Significance

Authors: Aleko Khukhunaishvili[1]; James Alexander[1]; Lawrence Gibbons[1]

[1] *Floyd R. Newman Laboratory-Cornell University*

Corresponding Authors: dayong.wang@cern.ch, ak427@cornell.edu

The missing transverse energy (MET) plays a fundamental role in the search for physics beyond the Standard Model at the LHC. We present an event-by-event assessment, the MET significance, of whether the observed MET is consistent with arising solely from detector-related limitations, such as measurement resolution and detection or reconstruction efficiency. We will introduce the formal definition of the significance, discuss our implementation, and show the results of performance studies of the particle flow MET significance in di-jet and $W \rightarrow e + \nu$ data samples collected with the CMS detector.

Education and Outreach / **501**

Round Table Discussion

Perturbative and non-Perturbative QCD / **506**

Mini-Review: Unravelling Jets at Colliders

Corresponding Author: szuberi@lbl.gov

Jets play an important role in a broad range of collider studies and there have been many recent developments in understanding them. Unravelling their structure enhances our ability to interpret data, search for new physics and develop our understanding of Monte Carlos. This talk reviews some theoretical developments in jet physics and their connection to recent experimental results.

Heavy Flavor Physics / **507**

Review of heavy flavor physics at the Tevatron

Author: Gavril Giurgiu[1]

[1] *Rowland Dept. of Phys. and Astron.-Johns Hopkins University (JH*

Corresponding Author: gavril.giurgiu@cern.ch

Heavy Flavor Physics / 508

Review of heavy flavor physics at the LHC

Author: Marina Artuso[1]

[1] *Department of Physics-Syracuse University*

Corresponding Author: marina.artuso@cern.ch

Low Energy Searches for Physics Beyond the Standard Model / 510

Results from MEG Experiment

Author: donato nicolo[1]

[1] *pisa university*

Corresponding Author: donato.nicolo@pi.infn.it

Low Energy Searches for Physics Beyond the Standard Model / 511

The COMET Experiment to Search for Muon to Electron Conversion

Corresponding Author: markl@hep.ucl.ac.uk

Hadron Spectroscopy / 512

The Status of Exotic Mesons Light and Heavy

Corresponding Author: weygand@jlab.org

Neutrino Physics / 513

The MINERvA Detector: Description and Performance

Author: Bari Osmanov[1]

[1] *University of Florida*

Corresponding Author: osmanov@fnal.gov

The MINERvA experiment is aimed at precisely measuring the cross-sections for various neutrino interaction channels. It is located in Fermilab in an underground cavern in front of the MINOS near

detector. MINERvA is a finely-grained scintillator with electromagnetic and hadron calorimetry regions. There are various nuclear targets located inside and in front of the detector for studying nuclear medium effects in neutrino-induced interactions. The installation was completed in March 2010 and since then the detector has been collecting data.
In my talk, I will describe the structure of MINERvA detector, calibration procedures, and performance. I will also outline recent physics results related to the nuclear targets part of the detector.

Neutrino Physics / 514

Constraining Sterile Neutrinos at IceCube

Author: Yu Gao[1]

[1] *University of Oregon*

Corresponding Author: ygao3@uoregon.edu

Recent observation of a potential a deficit in the anti-neutrino flux measurement at reactor experiments may suggest the possibility of sterile neutrino species with up to eVˆ2 mass-square scale. The upward neutrinos at the IceCube/DeepCore observatory provide an ideal test of the sterile neutrinos, as the very long distance through the Earth and matter effect allow the sterile species significantly impact the nu_mu -> nu_e transition possibility. We analyze the constraint on the sterile neutrinos with the IceCube's measurement of the angular distribution of muon neutrino events.

Plenary Session / 515

What Life is like as a Scientist in Congress

Author: Bill Foster[None]

Top Quark Physics / 516

Measurements of the top quark mass and width with the D0 detector

Author: Yuriy Ilchenko[1]

[1] *Southern Methodist University (SMU)*

Corresponding Author: yuriy.ilchenko@cern.ch

We present measurments of the top quark mass and width obtained using a data sample corresponding to 5.4 fb-1 of integrated luminosity collected with the D0 detector at the Fermilab Tevatron collider. The top quark mass is obtained via the direct reconstruction of the two t−>Wb decays in ttbar events selected in the dilepton+jets+missing transverse energy and lepton+jets+missing transverse energy final states. We discuss the various techniques used to extract the top mass and the recent reductions of some of the systematic uncertainties. The top mass is also derived from the measurement of the production cross section using higher-order
quantum chromodynamics calculations in two different renormalization schemes, and the results of this derivation are compared with those obtained from the direct reconstruction. We also investigate for possible differences in the mass of the top quarks and antiquarks and present a derivation of the totap width of the top quark obtained from the partial decay width Gamma(t−>Wb) and from the

measurement of the
single top quark production via t-channel diagrams.

Top Quark Physics / 517

Measurements of the top production cross section and properties with the D0 detector

Author: Liang Li[1]

[1] *University of California Riverside*

Corresponding Author: liangli@fnal.gov

We present measurements of the inclusive top quark pair production cross section in ppbar collisions at sqrt(s)=1.96 TeV utilizing data corresponding to an integrated luminosity of 5.3 fb-1 collected with the D0 detector at the Fermilab Tevatron collider. We both final states with one charged lepton, at least two jets and missing transverse energy, or final states with two charged leptons, at least one jet and missing transverse energy. We exploit both the kinematic features of the final states and the identification of jets originating from b-quarks to separate the ttbar production signal from backgrounds and obtain measurements of the cross sections which agree with the predictions of the standard model. We then investigate the ttbar final state and obtain a measurement of the top quark branching fractions into b-quarks. Finally we use the sample of ttbar events to investiage the color representation of the hadronically decaying W boson in the ttbar events, using a new calorimeter-based vectorial variable, the "jet pull", sensitive to the color-flow structure of the final state.

Beyond the Standard Model / 518

Searches for Large Extra Dimensions at CMS

Author: Alexey Ferapontov[1]

[1] *Department of Physics-Brown University*

Corresponding Author: alexey.ferapontov@cern.ch

Results of searches for Large Extra Dimensions (LED) in pp collisions at the center-of-mass energy of 7 TeV with the CMS detector are presented. Having analyzed the full 2011 dataset, we found no excess of events above the standard model (SM)
expectations. We set stringent limits on the multi dimensional Planck scale as well as masses of exotic objects that are consequences of the LED.

Higgs Physics / 519

Combined CDF and D0 upper limits on MSSM Higgs boson production in in proton-antiproton collisions at the Tevatron

Author: Louise Suter[None]

Corresponding Author: lsuter@fnal.gov

We present combined results on the search for a neutral Supersymmetric Higgs bosons with data collected at the CDF and D0 experiments. Data were collected in proton-antiproton collisions at a

centre of mass energy of 1.96 TeV during Run II of the Tevatron. The searches considered cover the main production and decay mechanisms for
Higgs bosons in tau and bottom quark final states. The resulting combination is interpreted in the context of different scenarios within the Minimal Supersymmetric Standard Model.

Higgs Physics / 520

Tevatron Measurement of WZ/ZZ (Z->bb) production cross section in proton-antiproton collisions at 1.96 TeV

Author: Gabriel Facini[None]

We present a measurement of the cross section for the simultaneous production of two vector bosons (WZ,ZZ), where one of the bosons decays leptonically (W->lv, Z->ll or Z->vv) and the other Z boson decays to bottom quarks. The measurement uses up to 8.5 fb-1 of data collected with the D0 and CDF detectors in proton-antiproton collisions at 1.96 TeV, and combines the three leptonic decay modes mentioned above. This final state is a direct analog to SM Higgs searches in final states of leptons plus bottom quark pairs, and thus provides a crucial validation benchmark of the Higgs boson signal isolation techniques involved.

Higgs Physics / 521

Search for the Higgs boson in leptonic ZZ* and semileptonic WW* decays in proton-antiproton collisions at 1.96 TeV

Author: Savanna Shaw[1]

[1] *MIchigan State University*

Corresponding Author: savannas@fnal.gov

We present a search for the Standard Model Higgs boson produced via the H->WW->*lvjj and H->ZZ*->4l processes at a center-of-mass energy of 1.96 TeV using up to 8.5 fb-1 of data collected with the D0 and CDF detectors at the Fermilab Tevatron collider. We search in events with either four charged leptons, or two jets, one charged lepton, and missing transverse energy. The four lepton channel provides a very clean signature, although at the expense of a low cross section time branching ratio. The semi-leptonic H->WW* channel has a relatively larger cross section times branching ratio, but is overcome by the large W+jets background. The procedures used to perform these searches will be discussed.

Higgs Physics / 522

Search for associated production of W and Higgs bosons in lvbb final states in proton-antiproton collisions at 1.96 TeV

Author: Duncan Brown[1]

[1] *CNRS / LPNHE Paris Universities VI and VII*

Corresponding Author: browndp@fnal.gov

We present a search for a low mass Standard Model Higgs boson produced in association with a W boson at a center-of-mass energy of 1.96 TeV with the CDF and D0 detectors at the Fermilab Tevatron

collider. The search is performed in events containing one
lepton (electron, muon or tau), an imbalance in the transverse energy, and one or two b-tagged jets with up to 8.5 fb-1 of data. This channel is one of the most powerful in the search for a low mass Higgs at the Tevatron. Prospects with the full Tevatron data sample and recent sensitivity improvements will be discussed.

Higgs Physics / **523**

Search for associated production of Z and Higgs bosons in bb+neutrino final states in proton-antiproton collisions at 1.96 TeV

Author: Tim Scanlon[1]

[1] *Imperial College/Fermilab*

Corresponding Author: tim.scanlon@cern.ch

We present a search for a low mass Standard Model Higgs boson produced in association with a Z boson decaying invisibly into a pair of neutrinos at a center-of-mass energy of 1.96 TeV with the CDF and D0 detectors at the Fermilab Tevatron collider. The final state is characterised by the presence of two b-tagged jets from the Higgs boson decay and a large imbalance in the transverse energy of the event. This channel is very powerful because of the large signal yields, but is experimentally challenging due to the large QCD backgrounds and absence of visible leptons in the final state. Prospects for results with the full data sample and recent improvements to the sensitivity will be discussed.

Higgs Physics / **524**

Searches for the Higgs boson in VH->VWW->leptons+X decays in p-pbar collisions at sqrt(s)=1.96 TeV

Author: Michael Cooke[None]

Corresponding Author: mpc@fnal.gov

We present searches for the standard model Higgs boson produced via the VH->VWW->leptons+X process at a center-of-mass energy of 1.96 TeV with the CDF and D0 detectors at the Fermilab Tevatron Collider. We require either two like charge-signed leptons (electron or muon) or three charged leptons (electron or muon). These channels provide significant sensitivity in the intermediate Higgs boson mass range. Inclusion of data up to 7.3 inverse fb and recent improvements to the sensitivity will be discussed.

Higgs Physics / **525**

Search for neutral Supersymmetric Higgs bosons in di-tau and b+di-tau final states in proton-antiproton collisions at 1.96 TeV

Author: Subhendu Chakrabarti[None]

Corresponding Author: subhendu@fnal.gov

We present a search for Higgs boson produced in the di-tau modes or via the associated h+b->tau-tau+b process at a center-of-mass energy of 1.96 TeV using data collected with the CDF and D0 detectors at the Fermilab Tevatron collider. In Supersymmetric models the Higgs boson production cross section can be significantly enhanced compared to the Standard Model; additionally the Higgs boson has a significant branching ratio to tau leptons at all masses. The di-tau and "b-tau" channels complement each other providing enhanced sensitivity for the search in the SUSY parameter space.

Higgs Physics / **526**

Search for charged and doubly-charged Higgs boson production in proton-antiproton collisions at 1.96 TeV

Author: Louise Suter[None]

Corresponding Author: lsuter@fnal.gov

We present searches for charged Higgs prodution in decays of top quarks and also pair production of doubly charged Higgs boson decaying to di-tau, di-muon, and muon+tau final states. The searches are performed in proton-antiproton collisions at a centre of mass energy of 1.96 TeV using an integrated luminosity of up to 7 fb-1 collected by the CDF and D0 experiments at the Fermilab Tevatron Colllider. We find no evidence for charged Higgs production and set limits on the production cross-section for a variety of theoretical models. This represents the first search for pair production of doubly-charged Higgs bosons decaying into tau leptons at a hadron collider.

Higgs Physics / **527**

Combined upper limits on Higgs boson production in the Standard Model, fourth generation and fermiophobic models in proton-antiproton collisions at 1.96 TeV at the Tevatron

Author: Richard Edward Hughes[1]

[1] *Ohio State University*

Corresponding Author: richard.edward.hughes@cern.ch

The combined results from CDF and D0 on direct searches for the standard model (SM) Higgs boson H in ppbar collisions at the Fermilab Tevatron at sqrt(s)=1.96 TeV are presented. Compared to the previous Tevatron Higgs search combination more data have been added, additional new channels have been incorporated, and some previously used channels have been reanalyzed to gain sensitivity. We use the latest parton distribution functions and gluon fusion to Higgs theoretical cross sections when comparing our limits to the SM predictions. In addition to limits on the SM, the results are interpreted in the context of a fermiophobic model in which the diphoton and WW final states are enhanced and also in the context of a model in which the gluon fusion production mode is enhanced by the existence of a fourth generation of fermions. With up to 8.0 fb-1 of data analyzed at CDF and D0, the 95% C.L. upper limits on Higgs boson are calculated.

Higgs Physics / **528**

Search for the Higgs boson in the H->gamma gamma decays in proton-antiproton collisions at 1.96 TeV

Author: Karen Bland[1]

[1] *Baylor University*

Corresponding Author: kbland@fnal.gov

Recent searches conducted at the Fermilab Tevatron for the Higgs boson in the diphoton decay channel are reported using 7.0/fb and 8.2/fb of data collected at the CDF and D0 experiments respectively. Although the standard model (SM) branching fraction is small, the diphoton final state is appealing due to better diphoton mass resolution compared with dijet final states. In addition, other models — such as fermiophobic models where the Higgs does not couple to fermions — predict much larger branching fractions for the diphoton decay. Here, results are presented for both a SM and fermiophobic Higgs boson as well as a SM search based on a combination of the CDF and D0 analyses.

Higgs Physics / 529

Search for Standard Model Higgs bosons in tau final states in proton-antiproton collisions at 1.96 TeV

Author: Elisabetta Pianori[1]

[1] *University of Pennsylvania*

Corresponding Author: elisabetta.pianori@cern.ch

Searches conducted at the Fermilab Tevatron for the Higgs boson in final states containing tau leptons are reported using data collected at the CDF and D0 experiments. The branching fraction for H-tau+tau is non-negligible for a low-mass standard model Higgs boson. In addition, in channels such as WH and H-WW, a W boson may decay into a final state including a tau lepton. This talk will summarize the recent efforts to improve the sensitivity to a standard model Higgs boson at the Tevatron by identifying tau leptons in the final state.

Higgs Physics / 530

Updated Search for Standard Model Higgs to WW Production Using up to 8.2 fb-1 at the Tevatron

Author: Benjamin Carls[None]

We report on the search for Standard Model (SM) Higgs boson to WW production in the final state of two charged leptons (e,mu) and two neutrinos from the collision of p-pbar pairs at sqrt(s) = 1.96 TeV. The data corresponds to 8.2 fb-1 by the CDF II detector and 8.2 fb-1 by the DZero detector on the Tevatron collider at Fermilab. The CDF version of the analysis implemented several improvements over the previous versions reported in the spring. In the CDF update, track and calorimeter isolation quantities for the leptons were recalculated to prevent mutual spoilage when two candidates are in close proximity to each other. Additionally, CDF has introduced a likelihood based category for forward electrons to recover candidates failing the original and still present cut based category. To maximize signal acceptance, events with same-sign dileptons and trileptons are included as separate regions to account for associated Higgs production with a Z or W boson via vector boson fusion. Additionally, the CDF analysis includes events with low dilepton invariant mass are included in a separate region to further improve acceptance. We then set confidence level limits at nineteen Higgs masses between 110 GeV and 200 GeV.

Higgs Physics / 531

Search for associated production of Z and Higgs bosons in llbb final states in proton-antiproton collisions at 1.96 TeV

Author: Michael Kirby[1]

[1] *Northwestern University*

Corresponding Author: kirby@fnal.gov

Searches for the standard model Higgs boson produced with a Z boson are presented based on data from the CDF and D0 experiments at the Fermilab Tevatron. In events consistent with the decay of the Higgs boson to a bottom-quark pair and the Z boson to electrons or muons, 95% credibility level upper limits are set on the ZH production cross section times the H -> b bbar branching ratio. Improved analysis methods enhance signal sensitivity relative to previous searches beyond the gain due to the larger data sample.

Higgs Physics / **532**

Search for neutral Supersymmetric Higgs bosons in bbb(b) final states in proton-antiproton collisions at 1.96 TeV

Author: Craig Group[None]

Corresponding Author: rcg6p@virginia.edu

A search for neutral Higgs bosons decaying into b-bbar, produced in association with b quarks in p-pbar collisions is presented. This process could be observable in supersymmetric models with high values of tan(beta) due to an enhancement of the production cross section. The event samples correspond to 2.6/fb of integrated luminosity collected with the CDF II detector and 5.2/fb of data from the D0 detector at the Fermilab Tevatron collider. We search for an enhancement in the mass of the two lead jets in events with three jets identified as coming from b quarks. Mass-dependent limits are set on sigma(p-pbar−>phi b) X BR(phi−>b-bbar) which are applicable for a narrow scalar particle produced in association with b quarks. The results are interpreted as limits on tan(beta) in supersymmetric Higgs models including the effects of the Higgs boson width.

Beyond the Standard Model / **533**

Search for narrow resonances in the lepton final state at CMS

Author: Gennadiy Kukartsev[1]

[1] *Department of Physics-Brown University*

Corresponding Author: gennadiy.kukartsev@cern.ch

Heavy Ion Physics/Hot and Dense QCD / **534**

Dihadron correlations in PbPb collisions at 2.76 TeV with CMS

Author: Yuting Bai[1]

[1] *Physics Department-University of Illinois at Chicago*

Corresponding Author: yuting.bai@cern.ch

Measurements of charged dihadron correlations from the CMS collaboration are presented for PbPb collisions at a center-of-mass energy of 2.76 TeV per nucleon pair over a broad range of pseudorapidity and the full range of azimuthal angle. With its large pseudorapidity coverage, the CMS tracker is ideally suited for detailed analyses of both short and long-range charged hadron correlations at the LHC. For the most central 0-5% collisions, a broadening of the away side dihadron correlation is observed at all pseudorapidities when compared to pp collisions. A significant correlated yield is observed for pairs of particles with small relative azimuthal angle but large longitudinal separation, commonly known as the ridge. The ridge persists out to relative pseudorapidity of 4 units and its effect is found to be stronger than what was previously observed at RHIC. The dependence of the ridge region shape and yield on transverse momentum and collision centrality has been measured. For particles of transverse momentum of 2–4 GeV/c, the ridge is found to be the most prominent when correlated to particles of 2–6 GeV/c, but diminishes at higher momentum. A Fourier analysis of the long-range two-particle correlations will be presented and discussed in the context of CMS measurements of higher order flow coefficients.

Beyond the Standard Model / **535**

Search for W' bosons at the CMS Experiment

Corresponding Author: tulika.bose@cern.ch

We present the latest results of searches for W' bosons using data collected by the CMS experiment.

Electroweak Physics / **536**

Measurement of the ZZ production cross section in proton-proton collisions at 7 TeV with the ATLAS detector

Author: Shih-Chieh Hsu[1]

[1] *Physics Division-Lawrence Berkeley National Lab. (LBNL)*

Corresponding Author: schsu@uw.edu

A measurement of the ZZ production cross section in proton-proton collisions at sqrts=7TeV using data collected by the ATLAS experiment at the LHC is presented. In a data sample corresponding to an integrated luminosity of 1.02 ifb, 12 candidate events of purely leptonically decaying Z bosons with electrons and/or muons in the final state were observed. The expected background contribution is 0.3−0.3+0.9ext(stat)−0.3+0.4ext(syst) events. The total cross section for on-shell ZZ production has been determined to be sigmaZZmathrmtot=8.4−2.3+2.7ext(stat)−0.7+0.4ext(syst)pm0.3extrm(lumi)pb and is in agreement with the Standard Model expectation of 6.5−0.2+0.3 pb calculated at the next-to-leading order in QCD. Limits on anomalous neutral triple gauge boson couplings are derived.

Poster Session / **537**

Sanford Underground Laboratory at Homestake

Author: Jaret Heise[1]

[1] *Sanford Underground Laboratory at Homestake*

Corresponding Author: jaret@sanfordlab.org

The status of the Sanford Underground Laboratory at Homestake in Lead, South Dakota will be presented. Excavation of new underground facilities at 4850 feet (about 1480 m) has been completed. Outfitting of the excavated space to house and support the Large Underground Xenon (LUX) detector searching for dark matter and the MAJORANA DEMONSTRATOR neutrinoless double-beta decay experiment is underway and is anticipated to be complete by early 2012. The capability to produce very low background copper by electroforming for the MAJORANA DEMONSTRATOR experiment is now operational at the 4850-foot level. Experiments associated with research in underground biology and geosciences are underway or planned at the Sanford Laboratory.

538

Introduction

Corresponding Author: ykkim@fnal.gov

Physics Opportunities with Project X / 539

Fermilab Strategy with LBNE and Project X

Corresponding Author: pjoddone@fnal.gov

Physics Opportunities with Project X / 540

Project X: Accelerator and Physics

Corresponding Authors: bcasey@fnal.gov, holmes@fnal.gov

Physics Opportunities with Project X / 541

DOE Sponsored Intensity Frontier Workshop

Corresponding Author: michael.procario@science.doe.gov

Physics Opportunities with Project X / 542

Q/A

Poster Session / 543

Semi-leptonic D_sˆ+ (1968) Decays as a Scalar Meson Probe

Author: Joseph Schechter[1]

Co-authors: Amir Fariborz [2]; Muhammad Shahid [1]; Renata Jora [3]

[1] *Syracuse University*

[2] *SUNY IT Utica*

[3] *University of barcelona*

Corresponding Author: mnshahid@phy.syr.edu

The unusual multiplet structures associated with the light spin zero mesons have recently attracted a good deal of theoretical attention. Here we present some aspects associated with the possibility of getting new experimental information on this topic from semi-leptonic decays of heavy charged mesons into an isosinglet scalar or pseudoscalar plus leptons.

Opportunities for U.S. Leadership in Underground-based Science / 544

Committee to Evaluate DOE-SC Options for Underground Science

Corresponding Author: shochet@hep.uchicago.edu

Opportunities for U.S. Leadership in Underground-based Science / 545

Underground Physics Research at NSF

Corresponding Author: kotcher@bnl.gov

Opportunities for U.S. Leadership in Underground-based Science / 546

NRC/NAS Study Report on Assessment of DUSEL and its Science

Corresponding Author: fisherp@mit.edu

Opportunities for U.S. Leadership in Underground-based Science / 547

Prospects for Underground High Energy Physics Experiments in the US

Forum on Physics and Modern Media / 548

Panel Discussion

Corresponding Authors: acho@aaas.org, michael.henry.schmitt@cern.ch, lvanpay@nsf.gov

Chair - Ken Bloom (Nebraska), Gordon Watts (UW Seattle)

Summary:

Chair - Ken Bloom (Nebraska), Gordon Watts (UW Seattle)

Beyond the Standard Model / **549**

MiniReview of Beyond the Standard Model Physics

Author: Kevin Black[1]

[1] *Department of Physics-Boston University*

Corresponding Author: kmblack@bu.edu

Over the last 30 to 40 years the Standard Model has had remarkable agreement with a large variety of experimental tests. With the large accumulated datasets at the Tevatron and the LHC the TeV scale is now being probed in detail. In this talk we will review the state of searches for physics beyond the Standard Model. In particular, we will focus on the recent results from the LHC which significantly expand the limits on many models and discuss a few interesting anomalies which have been observed at the Tevatron.

Plenary Session / **550**

Welcome

Public lecture: The Frontier of Physics and Beyond / **551**

The Frontier of Physics and Beyond

Author: Harrison Prosper[1]

[1] *Florida State University*

Corresponding Author: harry.prosper@cern.ch

The Large Hadron Collider at CERN, Switzerland, is the largest scientific instrument ever built. It may alter our perception of the basic laws of Nature. In this talk, I describe why we think, hope, the Large Hadron Collider will tell us something decisive about the frontier of physics and beyond. Potential discoveries may include new forces of nature, new dimensions of space and time, or new states of matter

Plenary Session / **552**

Welcome

Plenary Session / **553**

Welcome

DPF Instrumentation Task Force forum / **554**

Taskforce Charge, Status & Position Papers

Corresponding Authors: ian.shipsey@cern.ch, marcel.demarteau@cern.ch

DPF Instrumentation Task Force forum / **555**

Community Discussion

556

Computing the Universe

Author: Adrian Pope[1]

[1] *Argonne National Laboratory*

Corresponding Author: apope@anl.gov

Town hall meeting / **557**

Introduction

Corresponding Author: mcbride@fnal.gov

Town hall meeting / **558**

ECFA and European Strategy - Planning HEP in Europe

Corresponding Author: tatsuya.nakada@cern.ch

Town hall meeting / **559**

HEP Outreach and Education

Corresponding Author: gsnow@unlhep.unl.edu

Town hall meeting / 560

Accelerators and the DPF

Corresponding Author: england@slac.stanford.edu