IOP 2013 - HEPP & APP Group Meeting

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University of Liverpool

IOP Institute of Physics 2013 High Energy and Astro Particle Physics

Book of Abstracts

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Welcome/Introduction

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Plenary - PP Experimental, LHC GPDs / **129**

Status of Standard Model measurements at the LHC

Author: Veronique Boisvert[1]

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The LHC has concluded its successful first run with unprecedented luminosity, giving the detectors a large sample of data to perform detailed measurements. A review of recent standard model results from the LHC is presented, giving an emphasis on results from ATLAS and CMS about QCD,diboson and top quark physics.

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Status of BSM Searches at the LHC

Author: Monica D'Onofrio[1]

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The LHC's first run came to an end in February after three years of extraordinary performance. Major advances in physics have been achieved, including the discovery of a new Higgs-like particle. An extensive program of searches for new physics phenomena beyond the Standard Model (BSM) is pursued by the major experiments using the full dataset delivered in 2012.
In this talk, the most recent results on BSM searches from the ATLAS, CMS and LHCb collaborations are presented, covering a broad number of models and scenarios.

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Status of the LHC Higgs Programme (SM & BSM)

Author: Monica Vazquez Acosta[1]

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The latest results of the recently discovered Higgs-like boson from the ATLAS and CMS experiments will be reviewed. Measurements of the properties of this new particle, including the mass will be presented. Searches for Higgs-like bosons in models beyond the Standard Model will also be discussed.

Plenary - PP Experimental, Flavour and Neutrinos / 100

Status of Quark Flavour Physics

Author: Tim Gershon[1]

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A brief review of the status of quark flavour physics, with emphasis on recent new results, is presented.

Plenary - PP Experimental, Flavour and Neutrinos / 142

Future Long-Baseline Neutrino Experiments

Author: Robert Wilson[1]

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Results from the last decade of experiments have established that neutrinos are remarkably different than they appear in the Standard Model of particle physics: they have nonzero mass, flavor mix with one another and oscillate between generations. These features are rare indications of physics beyond the Standard Model so new theoretical and experimental work is needed to understand neutrino properties and their role in the Universe as the most abundant known particle of matter. I will first describe briefly the expected neutrino oscillation parameter sensitivity of the current or near-future experiments, T2K and NOvA, followed by future experiments currently under design: the Europe-based LBNO and the US-based LBNE. The science goals for these programs are primarily the determination of leptonic CP violation, the neutrino mass hierarchy, evidence for non-standard interactions and underground physics, including the exploration of proton decay and supernova neutrinos.

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Non Accelerator Neutrino Physics

Author: Jeanne Wilson[1]

[1] *Queen Mary, University of London*

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In this talk I will discuss some current neutrino experiments that look at non-accelerator neutrinos sources - solar, reactor, geo and supernovae - using SNO+ as the main example of experimental techniques. I discuss first how these experiments help us probe fundamental neutrino properties, and secondly, what we can learn about the sources from measurements of the neutrinos they produce.

Plenary - PP Experimental, Flavour and Neutrinos / 124

Absolute mass and neutrinoless double beta decay

Author: Justin Evans[1]

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The question of whether the neutrino is its own antiparticle, and the value of the absolute neutrino mass, are two of the most important unknowns in particle physics. A number of experiments are searching for neutrinoless double beta decay, in order to address these questions. The last year has marked the beginning of a new era for the field of neutrinoless double beta decay, with new results from EXO-200 and KamLAND-Zen, and a number of new experiments preparing to come on line. UK groups are involved in the SuperNEMO experiment, which is entering its construction phase, and SNO+, which is due to be taking data within the year. I will give an overview of the global status of neutrinoless double beta decay, and will then focus on the status of projects with UK involvement.

Plenary - PP Experimental, Flavour and Neutrinos / 106

Direct dark matter detection

Author: Chamkaur Ghag[1]

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Precision cosmology and detailed analysis of a wide variety of astronomical phenomena suggest that dark matter constitutes some 85% of the matter content of the Universe. While the evidence for its bulk existence is strong, an understanding of its particle nature remains elusive, and the requirement of an additional particle species to explain the dark matter provides compelling evidence for physics beyond the standard model of particle physics. The discovery of dark matter would therefore enlighten two of the outstanding problems of modern physics - the matter composition of the Universe and the extrapolation of the standard model.

Three particle signals of dark matter are being sought: production in colliders, detection of annihilation products, and direct scattering in underground searches. This talk will focus on the latter. Experiments search for characteristic energy depositions resulting from the scattering of dark matter particles from target nuclei. To hope to achieve this, backgrounds from known standard model processes must be sufficiently reduced to allow a signal to be observed, requiring deep underground operation to escape cosmic ray radiation and its consequences, shielding from known local sources of radiation, and construction from extremely radio-pure materials. In addition, novel design and analysis techniques are employed.

The latest results and plans of the worlds leading direct search projects will be presented. These include so-called Generation-2 instruments, with ton-scale target masses, and sensitivity sufficient for discovery under many current theoretical models. With these instruments, the solution to an 80 year old mystery, of fundamental importance to both particle physics and astronomy, may soon be at hand.

Track 1 / 75

Working Towards a Boosted Z to bb Measurement with the ATLAS Detector

Author: Luke Lambourne[1]

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The observation of a Z boson decaying to b quarks at a hadron collider is a difficult measurement to make due to the large QCD background. This talk will show work to develop methods to increase this low signal to background ratio, as part of the ongoing effort to measure the Z to bb signal with the ATLAS detector.

Track 4 / **126**

Status of the MICE Experiment

Author: Melissa George[1]

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Muon ionization cooling is the only solution to prepare the high brilliance muon beams that are necessary for a Neutrino Factory or Muon Collider. The International Muon Ionization Cooling Experiment (MICE) is a collaboration of over 70 scientists from 9 countries and is under development at the Rutherford Appleton Laboratory. MICE aims to be the first experiment to observe the ionizaion cooling of muons, specifically it aims to reduce the transverse emittance of the beam by 10%, and to measure it with an absolute precision of 0.1%. This talk outlines the current status of the experiment and its timeline for the future.

Track 2 / **117**

Boosted Hadronically Decaying W/Z bosons in ATLAS

Author: Rebecca Chislett[None]

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This talk will discuss the search for a boosted hadronically decaying W/Z boson reconstructed in a single jet using the ATLAS experiment at the LHC. The signal is identified using jet shapes calculated from the jet in its centre of mass frame and from this a cross section can be extracted. The peak is then used to investigate the effect of various jet grooming and substructure techniques, specifically pruning, trimming, area subtraction and splitting and filtering. The groomed jets are used both for the calculation of the shapes and the mass and the effect assessed in terms of pileup dependence, data-MC agreement and enhancement of the signal.

Track 3 / **85**

The forward backward asymmetry of the decay qq(bar)->Z/γ*->mu+mu- at LHCb

Author: Myfanwy Liles[1]

[1] *University of Liverpool (GB)*

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The forward backward asymmetry of the decay qq(bar)->Z/γ->*mu+mu- arises from the interference of vector and axial vector couplings of the Z and γ* to fermions. As such, the measurement of AFB is sensitive to the couplings of the boson to quarks and to muons. This measurement is also sensitive to the weak mixing angle sin2θW, an input to the Standard Model. At the LHC the observed asymmetry is diluted by an unknown initial quark direction, however, at LHCb the unique kinematic acceptance results in less of a dilution and a reduction in theoretical error. I present progress towards the measurement of both AFB and sin2θW at LHCb.

Track 4 / **60**

Updated results and measurements of the coupling properties of the new Higgs-like particle in the four lepton decay channel with the ATLAS detector

Author: Richard David Mudd[1]

[1] *University of Birmingham (GB)*

Corresponding Author: richard.mudd@cern.ch

Updated search results and property measurements are presented in the H->ZZ->4l decay channel using proton-proton collision data collected by the ATLAS detector during the 2011 and 2012 LHC runs.
An excess of events consistent with the production of a Standard Model Higgs Boson is observed at a mass of around 125 GeV.
The couplings of the new particle are probed for the first time with this channel, and will be also discussed.

Track 3 / **83**

Measurement of the Low Mass Drell-Yan Process at ATLAS

Author: Jack Robert Goddard[1]

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The low mass Drell-Yan differential cross-section has been measured as a function of the invariant mass of the lepton pair using the ATLAS Experiment at CERN. The measurement has been made using both the electron and muon channels using data recorded in 2011 in an invariant mass range of 26 < M < 66 GeV. The muon channel is also used with 2010 data to allow the invariant mass range to be extended down to 12 GeV. The 2011 electron and muon analyses have been combined and together with the 2010 analysis have been included in a QCD Fit which demonstrates the need for NNLO QCD fits in order to describe the data well. Comparison to theory curves also demonstrate the need to move beyond NLO to describe the data.

Track 1 / **105**

Ratio Measurement of W/Z + Jets at ATLAS

Author: Gregory James Fletcher[1]

Co-authors: Craig Anthony Sawyer [2]; Evelin Meoni [3]; Gerhard Immanuel Brandt [4]

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The current status of the R+Jets ratio measurement of W to Z production cross sections in association with jets with the ATLAS detector, using 7TeV pp collisions of the 2011 ATLAS dataset. Cross section ratios for the vector bosons decaying to electron and muons are measured for jets with transverse momentum PT > 30GeV and jet rapidity |y| < 4.4 and compared to predictions from different Monte Carlo generators and NLO calculations.

Track 2 / **39**

Top Quark Physics at Hadron Colliders

Author: Rhorry Gauld[1]

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Top quark production at the LHC is discussed. Studies of theoretical uncertainties in fixed order calculation and in the matching to parton showers will be presented. The focus of the talk will be to summarise the sensitivity of LHCb to measuring single-top and pair-production partial cross sections and their associated production asymmetries.

Track 3 / **55**

The search for the Standard Model Higgs boson using the 4 lepton final state and data taken by the ATLAS experiment at the Large Hadron Collider

Author: Karoline Elfriede Selbach[1]

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The latest search for the Standard Model Higgs boson is presented using the ATLAS experiment at the Large Hadron Collider. The channel analysed is the H->ZZ->4l channel where l denotes to muons and electrons. The results are based on 4.6 fb-1 data taken in 2011 at √s=7TeV and 13.0 fb-1 data taken in 2012 at √s=8TeV. The main analysis uses smoothed signal and background shapes from simulation. Cross-checks with are studied use analytical models for signal and background. Additionally, the latest per-event error mass fit will be presented together with the fit validation of the different models using toy Monte Carlo studies.

Track 4 / **62**

Signal selection efficiency and mass resolution in the H->ZZ*->4l decay channel with the ATLAS detector

Author: Andrew Daniells[1]

[1] *University of Birmingham (GB)*

Corresponding Author: andrew.daniells@cern.ch

Following the recent discovery, the ATLAS collaboration is performing detailed studies on the properties of the new boson. An important ingredient for these studies is the signal selection efficiency, which is studied using a Tag-and-Probe method applied on 20.7 fb^{-1} of Z->mumu and Z->ee data recorded by the ATLAS detector at \sqrt{s}=8TeV. Also, a technique to improve the signal mass resolution is presented, which is used to estimate the mass of the new particle.

Track 1 / **52**

Constraining QCD modelling uncertainties in ttbar events at ATLAS

Author: Kiran Daniel Joshi[1]

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The ATLAS measurement of ttbar production with a veto on additional central jet activity is presented, the results of which were used to constrain the size of QCD modelling uncertainties in ttbar events.
Ongoing work on alternative prescriptions for estimating such uncertainties will also be discussed.

Track 2 / **78**

Measurement of MET, HT and other global distributions in top pair events

Authors: Gregory Heath[1]; Jeson Jacob[None]; Joel Goldstein[1]; Lukasz Kreczko[1]; Philip Hugh Symonds[2]; Sergey Senkin[1]

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A differential cross section measurement of top quark pair production with respect to missing transverse energy (MET) is presented using 5.1 fb-1 of data collected with the CMS detector at the LHC at a centre of mass energy of 7 TeV. The analysis selects events with a single isolated high energy electron or muon, which is assumed to come from one of the W bosons produced in the decay of a top quark pair. The differential cross section is measured in bins of missing transverse energy. The analysis technique is applied for other global distributions, including hadronic transverse energy (HT), total transverse energy (ST) and transverse mass of the leptonic W boson (MT). The MET results based on a centre of mass energy of 7 TeV are consistent with the predictions of simulation, the 8 TeV results including the additional variables are expected soon.

Track 2 / **80**

Higgs to bbar at ATLAS, and the estimation of theoretical systematic uncertianties

Author: Ben Harry Smart[1]

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Corresponding Author: ben.smart@cern.ch

A new boson has been observed decaying to two photons and to four leptons. In order to determine whether this new particle is the long sought-after Higgs boson, it should be determined whether it also decays into b quark pairs. An overview of the search with the ATLAS Detector for a Higgs boson decaying into two b quarks, produced in association with a vector boson, will be presented. A look at the latest efforts to estimate theoretical systematic uncertainties for this search will also be presented.

Track 1 / **92**

Search for the standard-model Higgs boson decaying to tau leptons with the CMS detector

Author: Andrew Gilbert[1]

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

Corresponding Author: andrew.gilbert@cern.ch

This talk covers the search for the standard-model Higgs boson decaying to tau leptons using the CMS detector at the LHC. The most recent results are presented, using 4.9 fb^-1 of data taken at 7 TeV during 2011 and 19.4 fb^-1 at 8 TeV in 2012. The search utilises five final states, coming from the different decay modes of the tau, and a 95% CL upper limit is calculated by analysing the di-tau invariant mass spectrum.

Track 3 / **44**

Study on the production of a vector boson decaying to leptons in association with a Z or a Higgs boson decaying to a bb pair with the ATLAS experiment

Author: Chiara Debenedetti[1]

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We present the latest published results on the search for a
Standard Model Higgs boson produced in association with a W or a Z boson
and decaying to bb with the ATLAS experiment.
No significant excess is
observed in the data collected : 4.7fb-1 at sqrt(s)=7TeV and 13fb-1 in
sqrt(s)=8TeV.
The fit procedure will be detailed, with particular emphasis on the validation method employed.
As a proof of validity, WZ and ZZ production have been studied and result in a 4sigma observation

at a rate compatible with the SM prediction.
A Standard Model Higgs boson with mH=110GeV is excluded and the observed (expected) 95% C.L. limit on the cross section times branching ratio at mH=125GeV is evaluated at 1.8 (1.9) times the SM prediction.

Track 4 / **42**

The measurement of R_k (BF(B^+->K^+\mu^+\mu^-)/BF(B^+->K^+e^+e^-)) using data collected by LHCb in 2011/2012 to probe physics beyond the Standard Model

Author: Nicola Anne Skidmore[1]

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An analysis to measure the parameter R_k=BF(B^+->K^+\mu^+\mu^-)/BF(B^+->K^+e^+e^-)in the dilepton invariant mass squared region 1<q^2<6 GeV^2/c^4 using data collected by LHCb in 2011 and 2012 is presented. R_k is a probe of New Physics providing model-independent constraints on the Wilson Coefficients C_s and C_p complementary to those from the B(B_s->\mu^+\mu^-) measurement from LHCb in 2012. The analysis involves multivariate selections for B^+->K^+\mu^+\mu^- and B^+->K^+e^+e^- events. Because of the significant Bremsstrahlung of the electrons in the detector an extensive investigation into the fit model for the B^+->K^+e^+e^- signal and partially reconstructed background was performed.

Track 2 / **93**

Measuring charm mixing parameters using a model-independent technique in D0->KShh

Authors: Jordi Garra Tico[1]; Matthew John Charles[2]; Nick Torr[2]; Timothy Gershon[3]; Tomas Pilar[3]

[1] *University of Cambridge (GB)*

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A model-independent technique can be used to determine the mixing and CP violation parameters in the charm sector using D0->Kshh decays. The Dalitz plot is binned so that no description of the amplitude variation over the phase space is necessary. The analysis is sensitive to the relative sign of the mixing parameters and with additional data will achieve good sensitivity to CP violation parameters. The status of the analysis, based on the 1.0 fb-1 of data collected by LHCb in 2011, is presented.

Track 1 / **47**

Rare Charm Decays at LHCb

Author: Edward Thomas Greening[1]

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This talk introduces recent D meson decay results published by the LHCb experiment.
Such decays are unique in that unlike B and K decays, they provide information about the coupling of up-type quarks. These have the potential to be affected differently to down-type quarks by new physics.

Track 3 / **53**

Model dependent measurement of charm mixing and CPV parameters in prompt D0->KShh decays at LHCb

Author: Nick Torr[1]

Co-authors: Jordi Garra Tico [2]; Matthew John Charles [1]; Tomas Pilar [3]

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We present a model dependent technique for measuring the charm mixing and CPV parameters in prompt D0->KShh decays using 1fb-1 of data collected by LHCb detector during 2011. The complete analysis uses two techniques to extract the mixing parameters; a model dependent and a model independent, as one provides a systematic cross check of the other. This analysis is unique in its ability to access the relative sign of the mixing parameters and will be a flagship analysis of the LHCb upgrade.

Track 4 / **40**

Measurement of the isospin asymmetry in B->K(*)MuMu decays

Author: Patrick Haworth Owen[1]

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

Using the large heavy flavour cross section at the LHC, the Standard Model can be probed more precisely than ever before. Results comparing the rates of neutral and charged rare B decays using 1.0 fb-1 of luminosity collected at the LHCb detector are presented. This so-called “isospin asymmetry” is expected to very close to zero in the SM, however results show a significant deviation from this prediction.

Track 1 / **48**

Search for $B^0_{(s)} \to J/\psi K^0_S h^+ h^{(\prime)-}$

Author: Matthew Michael Reid[1]

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The LHCb dataset provides the potential to significantly improve the knowledge of $B^0_{(s)} \to J/\psi K^0_S h^+ h^{(\prime)-}$ decays. Exotic charmonia states have been observed (or claimed), produced in B decays together with a kaon, and decaying to $J/\psi h^+ h^{(\prime)-}$: the $X(3872)$ decaying to $J/\psi\pi^+\pi^-$, and the $X(4140)$ decaying to $J/\psi\phi$. These could be searched for in the $JJ/\psi K^0_S h^+ h^{(\prime)-}$ final states. We present progress towards measurements of the relative branching fractions and studies of the composition of $B^0_{(s)} \to J/\psi K^0_S h^+ h^{(\prime)-}$ decays.

Track 4 / **49**

First measurement of the CP-violating phase in hadronic Bs -> phi phi decays

Author: Sean Benson[1]

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A first measurement of the time-dependent CP-violating asymmetry in hadronic B_s ⟶ φφ decays is presented. In this decay channel, the CP -violating weak phase arises due to CP violation in the interference between B_s – bar{B}_s mixing and the b ⟶ s bar{s} s hadronic penguin decay amplitude. Using a sample of 1.0 fb^−1 of pp collision data collected at a centre-of mass energy of sqrt{s}=7 TeV with the LHCb detector, 880 ± 31 B_s ⟶ φφ signal decays are extracted. Using this sample, the phase is measured to be in the interval [−2.46, −0.76] rad at 68% confidence level. The p-value of the Standard Model hypothesis is 16%.

Track 3 / **89**

The Kaon Identification Detector for the NA62 Experiment at CERN

Author: Karim Massri[1]

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The NA62 Experiment aims to measure the branching ratio of the ultra-rare kaon decay $K^+ \to \pi^+\nu\bar{\nu}$ with 10\% precision, collecting $\sim$ 100 events in 2 years of data taking, starting in 2014. Assuming the value of the branching ratio as predicted by the SM ($BR(K^+ \to \pi^+\nu\bar{\nu}) = (8.5 \pm 0.7) \times 10^{-11}$), to collect enough statistics a high-intensity kaon beam is needed.
The highest intensity hadron beam available at CERN is a 800~MHz unseparated secondary beam, in which the kaon component is only the 6\% (50~MHz average). This means that pions and protons could contribute significantly to the background interacting with the passive material on the beam-line. Therefore, a kaon identification detector with a time resolution $lesssim$100~ps and with a kaon tagging efficiency~$gtrsim$95\% is essential to achieve the proposed level of sensitivity. The KTAG — an upgrade of the existing Differential Cherenkov detector CEDAR — has been developed to stand the high kaon rate and to achieve the proposed performances. In this talk the KTAG detector will be described and the results from the NA62 Technical Run in 2012 will be shown.

Track 2 / **41**

Measurement of CP observables in B0 -> D K*0

Author: Edmund Smith[1]

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The decay B0 -> D K*0 and the charge conjugate mode are studied using 1.0fb-1 of pp collision data collected by the LHCb experiment at sqrt(s) = 7TeV in 2011.

The CP asymmetry between the B0 and B0bar decay rates, is found to be A_d_KK = -0.45 +- 0.23 +- 0.02, where the first uncertainty is statistical and the second is systematic.

The ratio of the B-flavour averaged decay rates in D decays to CP and non-CP eigenstates is measured to be
R_d_KK = 1.36 (+0.37) (-0.32) +- 0.07.

These two measurements represent an important step towards constraining the CKM angle gamma from B0 -> D0 K*0 decays. This and the prospects for the 2012 dataset are discussed.

Plenary - Theory and Future / **122**

Precision Physics with leptons: g-2, LFV and EDMs

Author: Thomas Teubner[1]

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Precision experiments with leptons provide powerful tests of quantum field theory and the Standard Model and probe new physics in a way which is complementary to searches at the high-energy frontier.
I will discuss the status of and future prospects for the anomalous magnetic moment of the muon, lepton flavour violation and electric dipole moments.

Plenary - Theory and Future / **16**

Status of Cosmology and Implications for PP

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Plenary - Theory and Future / **98**

Where we go from here?

Author: Ben Gripaios[1]

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I will discuss, from a theorist's perspective, future prospects for HEP.

Plenary - Theory and Future / **21**

Future Facilities: The European Strategy

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HEPP Group AGM / **132**

Chair/Secretary/Treasurer Reports

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Track 3 / **87**

Delta ACP from Semileptonic Charmed Baryon Decays at LHCb

Authors: Alex Pearce[1]; Patrick Spradlin[2]; Sajan Easo[1]

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An analysis to measure delta ACP in Lambda_c baryons originating from semileptonic Lambda_b decays using 2011 LHCb data is presented.
The CP violation measurement delta ACP in this system is defined as

delta ACP = ACP(Lambda_c -> pK+K-) - ACP(Lambda_c -> ppi+pi-).

All production and detection asymmetries cancel to first order, the remaining contribution being direct CP violation.
The interest in charm sector CP violation originates from the recent LHCb results in D0 meson decays, which showed a 3.5 sigma deviation from the standard model prediction.
The branching fractions of the pK+K- and ppi+pi- modes, relative to the pK-pi+ mode, are measured as a cross check of the selection.
A multivariate analysis, along with tight particle identification requirements, is used to select the signal candidates.
The salient features of the analysis are presented, along with a discussion on the systematic errors involved.

Track 4 / **38**

chi_c and chi_b studies at ATLAS

Author: Andrew Stephen Chisholm[1]

[1] *University of Birmingham (GB)*

Corresponding Author: andrew.chisholm@cern.ch

Many years on from the discovery of the J/psi, our theoretical understanding of quarkonium production at hadron experiments is still far from satisfactory. The large data samples gathered at the LHC during 2010-2012, in conjunction with recent advances in theory, represent a fantastic opportunity for the LHC experiments to contribute to the improvement of this situation. The P-wave quarkonium states, including the chi_c and chi_b, play a significant role in the overall picture of quarkonium production at the LHC. I will present studies of the chi_c and chi_b states at ATLAS and discuss how these results can contribute to our wider understanding of quarkonium production at the LHC.

Track 1 / **37**

Electroweak Gauge Boson and Associated Jet Production at LHCb

Author: William James Barter[1]

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Measurements of Electroweak Gauge Boson Production at LHCb probe a previously poorly explored low x region of phase space. Such measurements provide unique constraints on PDFs, as well as providing tests of the Standard Model in regions where theoretical predictions have not been tuned. Results from LHCb are complementary to those made at the ATLAS and CMS experiments. This talk will cover detection of Electroweak Gauge Bosons at LHCb, jet reconstruction using LHCb's Particle Flow algorithm, and a measurement of Z+Jet production. We also report on recent improvements, and the outlook and potential for future measurements.

Track 2 / **95**

Double Jpsi Production at LHCb

Author: Andrew David Cook[1]

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The production of Jpsi pairs in proton-proton collisions at a centre of mass energy of 7 TeV has been studied using data collected with the LHCb detector in 2011

Track 1 / **125**

An Amplitude Analysis of D0->4pi at CLEO-C

Author: Jack Benton[1]

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Here we present a systematic amplitude analysis of the decay from D0 and D0-bar mesons to four charged pions, using the full dataset from Cleo-C. A genetic algorithm was used to refine the amplitude model while fitting to five dimensional Dalitz plots. While the model is of interest in its own right, the analysis also allows for the measurement of phase differences, such as from the CP violating phase gamma in the longer decay chain B->D(->4pi)K, seen at LHCb.

Track 2 / **50**

Time-Integrated Analysis of B0->phiK* at LHCb

Author: Dean Michael Lambert[1]

[1] *University of Edinburgh (GB)*

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B-meson decays involving loop processes allow to search for the indirect effects of new physics beyond the Standard Model. One such channel is the decay B0->phiK*. The worlds largest sample of this decay has been collected by the LHCb experiment. The experimental observables that can be studied in this channel will be discussed together with the experimental challenges. First results based on the sample of 1fb-1 collected by LHCb during the 2011 LHC proton-proton run will be discussed together with future prospects.

Track 4 / **113**

[HEPP] Measurements of Lambda_c+ -> p h h Branching Fractions with 2011 LHCb Data

Authors: Patrick Spradlin[1]; Paul Soler Jermyn[1]; Thomas Ruf[2]

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An analysis to measure the ratios of the $\Lambda_c^+ \to p^+h^-h^+, \{h = K, \pi\}$ $\mathcal{BF}s$ using 2011 LHCb data is presented. Two sources of Λ_c^+ are used, those produced promptly and those produced in semileptonic $\Lambda_b^0 \to \Lambda_c^+\mu^-\bar{\nu}$ decays. The analysis includes a search for the hitherto unobserved doubly-Cabibbo-suppressed mode $\Lambda_c^+ \to p^+\pi^-K^+$. The ratios measured are defined as
%\begin{equation*}
$\mathrm{BF}_{\Lambda_c^+\to p^+K^-K^+} \frac{}{\mathcal{BF}_{\Lambda_c^+\to p^+K^-\pi^+}, \frac{\frac{\mathcal{BF}_{\Lambda_c^+\to p^+\pi^-\pi^+}}{\mathcal{BF}_{\Lambda_c^+\to p^+K^-\pi^+}}, \frac{\mathcal{BF}_{\Lambda_c^+\to p^+\pi^-K^+}}{\mathcal{BF}_{\Lambda_c^+\to p^+K^-\pi^+}}}{}}. Aside from the obvious interest in observing a new decay mode$
$suppressed modes are currently poorly constrained, with errors of the order of 50\% on their PDG values. A multivariate \Lambda_c^+$
selection and daughter particle identification are used to select candidates. The treatment of efficiencies, systematics and current status of the measurements are presented.

Track 3 / **107**

b to (s , d) mu mu decays at LHCb

Author: Gregory Max Ciezarek[1]

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The flavour changing neutral current processes b to (s,d) mu mu are highly suppressed in the standard model,
and are sensitive to contributions from new particles. The first observation of B+ to pi mu mu is presented,
the first b to d mu mu mode to be measured. Minimal flavour violation (MFV) is the hypothesis that the only source of flavour
violation is the Yukawa couplings of the fermions to the Higgs, and is a widely used assumption in New Physics models. A test of MFV in
loop diagrams is presented, via a determination of | Vtd | / |Vts| from the ratio of B+ to pi mu mu and B+ to K mu mu branching fractions.

Track 4 / **81**

Searches for top squarks in ATLAS

Author: Josh McFayden[1]

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Searches for supersymmetric 3rd generation squarks at the LHC are well motivated by naturalness arguments. The exclusion of TeV scale first and generation squarks and gluinos by previous LHC searches makes these searches particularly interesting.
I will present the current status of the top squark searches in ATLAS including the most recent results with 8 TeV data. The focus will be on the searches for stop decay to a top+LSP in the all-hadronic final state.

Track 3 / **119**

Searching for Weakly Produced Supersymmetry at the ATLAS experiment

Author: Sarah Louise Williams[1]

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This talk focuses on the search for weakly produced Supersymmetric particles in the ATLAS experiment at the LHC using events with exactly two reconstructed leptons. This analysis was first performed using the 2011 dataset and an extension based on 2012 data is underway. This talk will discuss the motivations for the search, outline the signal processes of interest and the signal regions chosen. Because of the low signal cross sections for weak production processes, high background supression is required, and in both the 2011 and 2012 analyses most of the sensitivity is driven by signal regions based on the "Stransverse mass variable", which will be explained in the talk. In the case that no excess is observed over the Standard Model Background expectation, the results are used to exclude areas of SUSY parameter space where a statistically significant signal would have been observed.

Track 2 / **88**

SUSY searches in multi-lepton final states at ATLAS

Author: Stewart Martin-Haugh[1]

[1] *University of Sussex (GB)*

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The results of a dedicated search for supersymmetry in events with exactly three leptons and large missing transverse energy at the ATLAS detector are presented. In the absence of any deviation from Standard Model predictions, limits are placed on several supersymmetric scenarios.

Track 1 / **43**

Measurement of Δms and Δmd

Author: Thomas Michael Bird[1]

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The mass differences Δms and Δmd are extracted from the full 2011 LHCb dataset, using the decays B(s)⟶D(s) μ ν, where D(s)⟶K K π. Measured B momentum is reduced due to missing particles. This is corrected for using a simulation-based statistical correction, known as the k-factor. A novel resolution model, also taken from the simulation, is used to fit the proper time distributions and simultaneously fit the K K π-mass distributions, which separates the signal and combinatorial background. Standard LHCb flavour-tagging algorithms are combined with the muon charge to measure B mixing.

Track 4 / **111**

Search for New Physics using boosted Z bosons at CMS

Author: Tom Williams[1]

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Through the analysis of data from 7 & 8 TeV centre-of-mass energy pp collisions at the Large Hadron Collider (LHC) in CERN, the LHC experiments have been expanding the frontiers of particle physics into the TeV energy regime. In addition to the discovery of a Higgs-like boson last year, there are many searches for Beyond the Standard Model (BSM) theories at the Compact Muon Solenoid (CMS) experiment. Several BSM theories predict the production of highly boosted Z bosons in the LHC pp collisions, for example from the decay of a new heavy particle. In this talk, I will present my work on the search for such boosted Z boson events with the CMS detector.

Track 3 / **101**

Search for Non-Resonant exotic physics in the dilepton channels with the ATLAS detector at the LHC

Author: Liam Duguid[1]

Co-author: Tracey Berry [1]

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Presented is a search for nonresonant new phenomena, originating from either contact interactions or large extra spatial dimensions, carried out using events with either isolated ee or μμ. These events, produced at the LHC in proton-proton collisions at √s = 7 TeV, were recorded by the ATLAS detector. The data sample, collected throughout 2011, corresponds to an integrated luminosity of 4.9 and 5.0 fb-1 in the e+ e- and μ+ μ- channels, respectively. No significant deviations from the Standard Model expectation are observed. Using a Bayesian approach, 95% confidence level lower limits ranging from 9.0 to 13.9 TeV are placed on the energy scale of ℓℓqq contact interactions in the left-left isoscalar model. Lower limits ranging from 2.4 to 3.9 TeV are also set on the string scale in large extra dimension models. A look forward to advancements in the analysis for the data sample collected throughout 2012 is also discussed.

Track 1 / **64**

Search for Majorana neutrino production in same-sign dimuon final states with the ATLAS detector at 7 TeV

Author: Joel Alexander Klinger[1]

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A search for a heavy Majorana neutrino decaying into a W boson and a muon has been performed using the ATLAS detector at the LHC. The search is performed using events with two same-sign muons, at least two jets and low missing transverse momentum. The data used in the search were collected in pp collisions at √s = 7 TeV in 2011 and correspond to an integrated luminosity of 4.7 fb−1. No excess of events above the background prediction is observed and 95% confidence level upper limits are set on the cross section times branching ratio for the production of heavy Majorana neutrinos. The observed limits range from 28 to 3.4 fb for heavy neutrino masses between 100 and 300 GeV.

Track 2 / **70**

Search for ttbar resonances in ATLAS

Author: Danilo Enoque Ferreira De Lima[1]

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Alternatives to the Standard Model predict new particles which decay into top-antitop pairs and which could be detected in ATLAS. A leptophobic Z' and
Kaluza-Klein gluons from Randall-Sundrum models with extra dimensions were used as benchmark models for the analysis with identical generation parameters as in CDF and D0. The semileptonic decay of the top-antitop system is studied in this analysis. A resolved final state, with the final

jets being separated and a boosted scenario, identified by overlapping jets in the hadronic decay of the top, are orthogonalised, so that both can be combined coherently in the limit setting strategy. The irreducible background given by Standard Model top-antitop events are the largest contribution, followed by W+jets.

Track 1 / **59**

Status of SUSY after LHC Run I

Author: Andrew Fowlie[1]

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Corresponding Author: a.fowlie@sheffield.ac.uk

In light of the failed supersymmetry searches at the LHC, with Bayesian statistics, I discuss: Where is supersymmetry?, and, Is the most constrained supersymmetry model still viable? I briefly review recent experimental results – from collider and astroparticle physics - that constrain supersymmetry, and explain how we included such results in a Bayesian analysis of the Constrained Minimal Supersymmetric Standard Model (CMSSM). I identify the best regions in the CMSSM's parameter space and discuss the viability of the CMSSM.

Track 2 / **67**

Search for heavy resonances decaying to long-lived neutral particles in the displaced lepton channel with the CMS detector

Author: Emyr John Clement[1]

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A search is performed for a heavy resonance decaying to two long-lived massive neutral particles that each decay to dileptons. The process is detected experimentally via a distinct topological signature consisting of a pair of oppositely charged leptons originating at a vertex significantly displaced from the LHC beam spot. This talk will summarise the results of the search conducted on data collected by the CMS detector at the LHC during pp collisions at sqrt(s) = 7 TeV. An updated search using data collected at sqrt(8) TeV is underway and results are expected soon.

Track 3 / **63**

Search for high-mass dielectron resonances with ATLAS

Author: Yan Jie Schnellbach[1]

[1] *University of Liverpool (GB)*

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Search for new heavy neutral gauge bosons (Z') with dielectron final states with the ATLAS detector in proton-proton collisions with a centre-of-mass energy of 8 TeV.

Track 4 / **65**

Super Kamiokande: The T2K Far Detector

Author: None

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The T2K neutrino beam is created at J-PARC in the East of Japan and is aimed at Super Kamiokande (Super-K) 2.5° off-axis and 295km to the West. Super-K is a 50kT water Cherenkov detector upgraded in 2006 for use by the T2K experiment as a far detector. In this talk we present the status, data taking efficiency, and candidate events selection for both appearance and disappearance analyses. We also discuss developments in event reconstruction and event selection.

Track 2 / **76**

Muon anti-neutrino inclusive charged-current interactions in the T2K near detector

Author: Callum Lister[1]

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The muon neutrino beam of the T2K neutrino oscillation experiment contains a small contamination from anti-neutrinos. It is important to measure accurately this flux component since it: (a) forms a background to the oscillation measurements and; (b) gives the opportunity to study the poorly known anti-neutrino cross-section on carbon at neutrino energies of ~1GeV. This talk will outline a selection of inclusive muon anti-neutrino charged-current interactions in the ND280 (T2K's near detector situated 280m from the neutrino production target) and will present a preliminary analysis to extract the neutrino to anti-neutrino cross-section ratio.

Track 3 / **96**

Multinucleon-neutrino interactions and the T2K experiment

Author: Peter Sinclair[1]

[1] *Imperial College London*

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The T2K experiment is one of a new generation of neutrino physics experiments which is able to probe the structure of neutrino oscillations with unprecedented accuracy. In order to develop the precise measurements that are required to understand this new phenomenon, we need an accurate understanding of how neutrinos interact with conventional matter. My work focuses on developing and testing new Monte Carlo tools which will allow us to simulate interactions of neutrinos with multiple nucleons in the initial state. With these we hope to reduce the cross-section systematic uncertainties on the T2K measurements and extract more powerful results from the T2K data.

Track 4 / **74**

Building the Askaryan Radio Array (ARA) - The search for ultra-high energy neutrinos at the South Pole

Author: Jonathan Davies[1]

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Ultra-high energy neutrinos from sources outside our solar system provide an opportunity to study particle physics at energies unobtainable at terrestrial accelerators. This weakly interacting messenger can be used to probe the high energy Universe alongside the astro-physical objects and mechanisms that produce them.

The Askaryan Radio Array (ARA) is a new teraton-scale ultra-high energy neutrino detector under construction in the deep radio-transparent ice near the South Pole. ARA will consist of an array of 37 sub-detectors designed to detect radio emission from neutrino induced cascades with primary energies greater than 1017eV.

This talk will report on the successful installation and initial performance of the first four ARA sub-detectors.

Track 1 / **72**

Optical Calibration of SNO+

Author: James Sinclair[1]

Co-author: Simon Peeters [2]

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Situated 2 km underground in Sudbury, Northern Ontario, the SNO+ detector consists of an acrylic sphere 12 m in diameter containing 780 tons of target mass, surrounded by approximately 9,500 PMTs. For SNO, this target mass was heavy water, however the change to SNO+ is defined by the change of this target mass to a novel scintillator. With the lower energy threshold, low intrinsic radioactivity levels and the best shielding against muons and cosmogenic activation of all existing neutrino experiments, SNO+ will be sensitive to exciting new physics. The experiment will be studying solar, reactor, super nova and geo-neutrinos, though the main purpose of SNO+ is the search for neutrinoless double-beta decay of Nd-150. To meet the requirements imposed by the physics on detector performance, a detailed optical calibration is needed. Source deployment must be kept to a minimum and eliminated if possible, in order to meet the stringent radiopurity requirements. This led to the development of the Embedded LED/laser Light Injection Entity (ELLIE) system. This is a discussion concerning requirements on and methods of optical calibration in SNO+, focusing on the deployed laserball and the external ELLIE system.

Track 3 / **66**

Event reconstruction and background rejection in the SNO+ experiment

Author: Ian Coulter[1]

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The SNO+ experiment, which will begin operations this year, is designed to confront a broad range of physics topics. These include: neutrino-less double beta decay, solar neutrinos, geo-neutrinos, reactor neutrinos, supernova neutrinos and unusual modes of nucleon decay. In order to address these goals, the detector will undergo several phases of operations in which the inner volume will, in turn, be filled with water, pure scintillator and then metal-loaded scintillator. Each phase and physics topic poses different challenges for event reconstruction and relevant background rejection algorithms. This talk will describe the current state of development for such algorithms.

Track 4 / **68**

Deployed calibration sources in SNO+

Author: Matthew Mottram[1]

[1] *University of Sussex*

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SNO+ is a multipurpose neutrino experiment located 2km underground in Sudbury, Canada, which will begin operation this year. The detector consists of 8 kilotonnes of ultra-pure water shielding, with an array of ~9500 PMTs, surrounding a central O(1 kTonne) interaction volume. SNO+ will operate in three distinct phases, with a different material in the interaction volume during each phase: water, scintillator and scintillator with double beta-decay isotope. The calibration of the detector will involve both in-situ optical calibrations and the deployment of optical and radioactive sources. While the use of such deployed calibration sources are essential to the physics programme of SNO+, they also pose the risk of introducing backgrounds into the detector. This talk will give an overview of the various deployed sources that will be used by SNO+, in the context of the physics goals of the experiment. Source container designs and deployment methods will also be discussed.

Track 2 / **104**

Leptonic topologies for the study of neutral current single pi0 events in the T2K near detector

Author: Zachary Williamson[1]

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This presentation outlines additional efforts to use the near detector to measure the cross section for single pi0 production. Such processes are relatively rare in the tracker region and this work will consider additional, less restrictive topologies to increase statistics. Specifically, this work will focus on single pion neutral current interactions where one or both of the decay gammas produce only a single electron/positron of reconstructable energy, in addition to pair producing gammas. From these criteria, a set of six specific sub-topologies, which will be discussed in this presentation, are being developed, which will exploit the near detector's tracker region to the fullest.

Track 1 / **45**

Measurement of neutrino induced neutral current single pi0 production in the near detector of the T2K experiment.

Author: Helen O'Keeffe[1]

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Single pi0 production is one of the most significant backgrounds in the T2K nu-e appearance measurement and due to uncertainties in the production cross-section, it is one of the most difficult to constrain. Measurements of neutral current single pion production in the near detector can be extrapolated to the far detector and used to constrain this background. An analysis that uses a specific two-gamma signature in the tracker region of the near detector to select such events has been developed and will be used to extract production rates in the near future. This talk will describe selection cuts used, expected purity and selection efficiency derived from analysis of Monte Carlo samples. Comparisons of Monte Carlo distributions with those from a sub-set of data will be shown and a projection of the expected number of events for 3 x 10E20 PoT exposure (Run I+II+III) will be given.

Track 4 / 36

Muon neutrino disappearance at T2K

Author: Thomas Dealtry[1]

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T2K is an off-axis long-baseline neutrino experiment, using the J-PARC muon-neutrino beam to look for muon-neutrino disappearance (to measure θ_{23} and Δm^2_{32}) and electron-neutrino appearance (to measure θ_{13}). Super-Kamiokande, a 22.5 kton fiducial water Cerenkov detector located 295 km from the neutrino source, is used as the far detector. I report the result of the muon-neutrino disappearance search, using data up to summer 2012. The best-fit value of the oscillation parameters gives $|\Delta m^2_{32}| = 2.44 \times 10^{-3} eV^2$ and $\sin^2 2\theta_{23} = 1.00$, and the 90% C.L. exclusion region is competitive with other experiments.

Track 2 / 82

The resummation of the low-phistar domain of Z production

Authors: Andrea Banfi[1]; Lee Tomlinson[2]; Mrinal Dasgupta[3]; Simone Marzani[4]

[1] *University of Freiburg*

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The presence of large logarithms in QCD corrections to observables spoils the validity of a calculation truncated at finite order and calls for an all-orders approach. The QT (transverse momentum) spectrum of massive lepton pairs, produced in hadron colliders by the Drell-Yan mechanism, has received a great deal of attention in electroweak phenomenology. We present and discuss a next-to-next-to-leading log (NNLL) resummed calculation of a related observable, namely phistar, that was recently introduced because of its distinct experimental advantages, but which is nonetheless sensitive to similar physics: soft-collinear gluon emission in the initial state. We also present various comparisons to collision data at Tevatron and the LHC.

Track 3 / **84**

Detecting electron neutrinos in the T2K near detector

Author: Benjamin Smith[1]

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T2K was the first experiment to show evidence for muon neutrinos oscillating into electron neutrinos. This showed that theta_13 — one of the mixing angles in the PMNS matrix which describes neutrino oscillations — is non-zero, and 1km-baseline reactor experiments have since precisely measured this parameter. Precision measurements of other neutrino oscillation parameters will arise from combining T2K's results with those of reactor experiments, but full exploitation of these combinations requires further improvement in T2K's nu_mu->nu_e appearance analysis. The largest background in this measurement comes from intrinsic electron neutrinos in the beam, which can be constrained by measuring the unoscillated spectrum at ND280, the T2K near detector. This talk will detail the improvements I have made to the selection of electron neutrino events, and explain how the measurement will be used to constrain the T2K flux prediction and predicted number of events at Super-Kamiokande, the T2K far detector.

Track 1 / **90**

An expanded CCQE cross-section analysis at ND280

Author: Terry Duboyski[1]

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To expand upon the T2K ND280 NuMu Tracker analysis we begin to explore currently unaddressed phase-space for use in a CCQE cross-section measurement.

Track 4 / **61**

EURECA – A Cryogenic Dark Matter Detector

Author: Xiaohe Zhang[1]

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The EURECA (European Underground Rare Event Calorimeter Array) collaboration aims to construct and operate a cryogenic tonne-scale dark matter detector. The chosen technology is low-temperature calorimeters that combine the detection of a heat signal for precise energy measurement with either ionization or scintillation for efficient event type identification. The aim is to probe WIMP-nucleon scalar scattering cross-sections at the 10^-10 pb sensitivity level. The current status of the conceptual design, R&D work and future prospects will be presented.

Track 1 / **23**

Perturbative Non-Equilibrium Thermal Field Theory

Author: Peter Millington[1]

Co-author: Apostolos Pilaftsis [2]

[1] *University of Sheffield*

[2] *University of Manchester*

In arXiv:1211.3152, we present a new perturbative formulation of non-equilibrium thermal field theory, based upon non-homogeneous free propagators and time-dependent vertices. The resulting time-dependent diagrammatic perturbation series are free of pinch singularities without the need for quasi-particle approximation or effective resummation of finite widths. Introducing a physically meaningful definition of particle number densities, we derive master time evolution equations for statistical distribution functions, which are valid to all orders in perturbation theory and to all orders in a gradient expansion. For a scalar model, we truncate these evolution equations in a loopwise sense, whilst still capturing the dynamics on all time-scales. We show that the early-time transient behaviour of this system is dominated by non-Markovian energy-violating processes.

Track 3 / **115**

Radon monitoring and reduction for the DRIFT directional dark matter experiments

Author: Stephen Sadler[1]

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Radon gas is a source of background in the Directional Recoil Information From Tracks (DRIFT) experiment and as such, a major radon reduction effort has taken place over the past several years. Two complimentary techniques for measuring the radon emanation rate in DRIFT will be presented, followed by an overview of the materials screening and replacement effort for the current detector, DRIFT-IId, and its successor DRIFT-IIe.

Track 2 / **71**

Extreme Galactic particle accelerators - the case of HESS J1640-465

Authors: Peter Eger[1]; Stefan Ohm[2]

Co-author: Collaboration H.E.S.S. [3]

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[3] *https://www.mpi-hd.mpg.de/hfm/HESS*

HESS J1640-465 is one of the most extreme Galactic TeV gamma-ray sources that has been discovered with the High Energy Stereoscopic System (H.E.S.S.). The emission is likely associated to the shell-type supernova remnant (SNR) G338.3-0.0 with an estimated distance of ~10 kpc, making HESS J1640-465 the most luminous Galactic source in the TeV regime. Recent multi-wavelength observations led to the interpretation that the TeV emission might be associated to an X-ray pulsar wind nebula in the center of the SNR.

Here we report on follow-up observations of HESS J1640-465 from 2004 to 2011 with H.E.S.S. and a re-analysis of archival XMM-Newton data to revisit the underlying radiation mechanisms and interpretation of the TeV signal from this region. The new H.E.S.S. data reveal a significantly extended TeV morphology with a substantial overlap with the northern part of the SNR shell. These new spectral and morphological results suggest that
at least part of the TeV emission is likely of hadronic origin with a total energy
in interacting protons of up to $W_p n_H \sim 4 \times 10^{52} (d/10\mathrm{kpc})^2$\,erg\,cm^{-3}.

Plenary - APP Experimental / **18**

Extreme Astrophysics with the Cherenkov Telescope Array

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The Cherenkov Telescope Array (CTA, www.cta-observatory.org [www.cta-observatory.org]) is a global (27 nations, 1000 scientists, 150ME) project for gamma-ray astronomy planned for construction in 2014-2020. This high-profile project with ambitious and exciting science and technology is likely to capture the public imagination and the breadth and depth of the CTA science case has made it a key project in astronomy and particle astrophysics across the world. To reach the desired sensitivity CTA will consist of ~100 telescopes of several sizes. TeV gamma-rays are signatures of some of the most violent and intriguing phenomena in the universe, indicating sites of relativistic particle acceleration at PeV energies and possible signatures of dark matter. In this talk I will introduce CTA and the UK role. The UK is heavily involved in prototype camera work for a unique dual-mirror design for the Small Size Telescopes, and I will explain our concept and progress on this Compact High Energy Camera (CHEC).

Plenary - APP Experimental / **51**

Challenges in Nuclear Astrophysics: nucleosynthesis in novae, x-ray bursts and type Ia supernovae

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Many stars form binary or multiple systems, with a fraction hosting one or two degenerate objects (white dwarfs and/or neutron stars) in short-period orbits, such that mass transfer episodes onto the degenerate component ensue. This scenario is the framework for a suite of violent stellar events, such as type Ia supernovae (SNIa), classical novae (CNe) or type I X-ray bursts (XRBs).
The expected nucleosynthesis accompanying these cataclysmic events is very rich: CNe are driven by proton-capture reactions in competition with beta-decays, proceeding close to the valley of stability, up to Ca. XRBs are powered by a suite of nuclear processes, including the rp-process (rapid p-captures and beta-decays), the 3alpha-reaction, and the alpha-p-process (a sequence of (alpha,p) and (p,gamma) reactions); here, the nuclear flow proceeds far away from the valley of stability, merging with the proton drip-line beyond A = 38, and reaching eventually the SnSbTe-mass region,
or beyond. In SNIa, the detailed abundances of the freshly synthesized elements depend on the peak temperature reached and on the excess of neutrons and protons (which depend in turn on the metallicity of the white dwarf progenitor as well as on the density at which the thermonuclear runaway occurs); they constitute the major factory of Fe-peak elements in the Galaxy, and roughly speaking, the abundance pattern of their
ejecta is the result of four different burning regimes: NSE and incomplete Si-, O-, and C-Ne-burning.

In this talk, I'm going to address recent progress in the modeling of these astrophysical scenarios, with emphasis on the nuclear processes involved and on their associated uncertainties. Sensitivity studies aimed at identifying key reactions that deserve to be (experimentally) improved will be presented as well.

Plenary - APP Experimental / 94

The Search for Gravitational Waves

Author: James Hough[1]

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Gravitational waves – a prediction of Einstein's General Relativity – are still among the most elusive signals from far out in the Universe. Over the past decade the laser interferometric detectors LIGO, Virgo and GEO 600 have been commissioned and operated at their design or close to design sensitivity. However in keeping with source strength predictions and, as expected, no gravitational wave signals were observed.
Now these detectors are being upgraded and observations will begin again around 2015 with the real expectation that signals from coalescing binary systems will be observed. Such is the confidence currently, that a new detector is being built in Japan in the Kamioka mine and the third of the LIGO detectors is likely to be transferred to India, thus creating a truly world-wide network.
In this talk I will explain the nature of gravitational waves, why it is scientifically important to observe them, and the current state of the field.

Plenary - APP Experimental / 116

Dark Matter Searches with the Fermi-LAT

Author: Michael Gustafsson[None]

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Weakly Interacting Massive Particles (WIMPs) are promising dark matter particle candidates that may annihilate or decay into gamma rays detectable by the Fermi Large Area Telescope (Fermi-LAT). The Fermi-LAT has been collecting data for over 4 years, leading to an improved understanding of our gamma-ray sky. The search for a potential dark matter signal in this data is an important task, and I will present recent results from various indirect WIMP searches performed by the collaboration. There has been recent excitement with the report of a line-like spectral feature around 130 GeV, localized in the Galactic center, and I will discuss the current status.

Track 4 / 121

Real-Time Gravitational Wave Data Analysis

Author: Clive Tomlinson[1]

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General Relativity predicts that astrophysical systems or events with high mass-energy flux emit gravitational waves, a time varying curvature of space-time which carry energy, and propagate at the speed of light. The spatial strain induced by a passing gravitational wave (GW) is exceedingly small (~10-21), making their detection amidst instrumental noise a highly technical challenge. To date, GWs have not been detected directly. The effort to detect GWs has resulted in a global network of GW detectors (LIGO Scientific Collaboration). In collaboration with optical/radio astronomy,
confirmation is sought by coincident detection of GWs and associated electromagnetic events.
This has motivated the need to improve signal detection efficiency in real time, to enable rapid response targeted electromagnetic searches.

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Our research at Sheffield has focused on developing low latency signal processing tools, conce
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Track 2 / **57**

Liquid Scintillator Time Projection Chamber

Author: Nicola McConkey[1]

Co-author: Yorck Ramachers [1]

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Results are presented from a small-scale experiment to investigate the use of room temperature organic liquid scintillators as the active medium for a time projection chamber (TPC).

The optical properties of liquid scintillators have long been known, but their ability to transport charge has remained, until now, largely untested. The idea of using room temperature liquids as an active medium for an ionisation chamber was first presented in [1]. Since then the range of liquid scintillators available has been greatly developed.

A selection of organic liquid scintillator cocktails have been tested, and it has been shown that charge can be transported over at least 20mm using an electric field of 0.5kVcm^{-1} in the liquid scintillator Di-isopropyl napthalene (DIN).

Forthcoming measurements include the drift speed and length in these media, energy spectra, quenching factors, with a view to particle tracking.

[1] R. A. Holroyd, D. F. Anderson, Nucl. Instr. Meth. A 236 (1985) 294-299

Track 3 / **56**

Gamma Rays From Galaxy Clusters?

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High-energy emission is expected from clusters of galaxies on a range of scales and via several channels, including processes driven by the AGN within the central brightest cluster galaxy (BCG), acceleration of cosmic rays at merger shocks, and the annihilation of dark matter particles. Hard X-ray and radio synchrotron signatures evidence the presence of non-thermal particles inside the cluster volume, whilst the presence of dark matter is inferred from gravitational effects. Depending

on the angular size of the cluster and the source of emission, these signals may be point-like or extended when observed with the Fermi Large Area Telescope (LAT).
Three candidate source samples (totalling ~300 objects) were constructed, of clusters containing a radio-bright BCG, clusters with diffuse non-thermal emission in the radio waveband, and promising targets for dark matter annihilation signatures. LAT data were extracted and analysed for each sample, and in order to imitate a deeper observation, the output fields were stacked. Upper limits calculated on the gamma-ray emission within the target region are at least an order of magnitude more constraining than limits on individual candidate sources. The study has also established significant emission in several fields, the details of which will be presented.

Track 1 / **69**

Future prospects for measuring the extragalactic background light and probing for axion signatures

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At TeV photon energies the universe has a high optical depth due to the
presence of extragalactic background light (EBL) photons from stars and star-formation which provide a target for pair production. Measuring the amount of absorption in the gamma-ray spectrum from a relatively distant object such as an active galactic nucleus (AGN) reveals information about the level of the EBL, which in turn provides information about star formation history. We examine how sensitive next generation ground-based gamma-ray telescopes such as the Cherenkov Telescope Array (CTA) will be to different EBL models which have been proposed. We also consider the prospects of such telescopes detecting axion signatures- a decrease in the level of
absorption predicted by extensions to the standard model.

Track 1 / **34**

Measuring the photon yield in the RICH subdetectors at LHCb

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The RICH is a subdetector of the LHCb experiment, it is used to distinguish between Pions,Kaons and Protons in a momentum range of 1-100 GeV. The RICH detects Cherenkov radiation which is emitted by particles as they pass through gas and aerogel mediums. The performance of the detector is dependent on the photon yield - the number of Cherenkov photons that are detected by the RICH. This presentation describes the statistical technique which is used to measure the photon yield.

Track 3 / **114**

First Results from Cherwell a CMOS sensor for particle physics

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Design and manufacturing of a Monolithic Active Pixel Sensor in a CMOS Image Sensor (CIS) 180 nm technology.

The Arachnid collaboration, UK

The Arachnid collaboration has been set up in the UK to develop CMOS Monolithic Active Pixel Sensors. The first device of this collaboration is named Cherwell. The Cherwell device consists of several arrays of pixel optimised either for vertexing or for calorimetry. For the former, two subarrays were designed. The first one has 96x48 pixels on a 25 um pitch. Each pixel consists of a low-noise 4T pixel, lifted from the previously tested sensor FORTIS. The readout is on a rolling shutter base with a fine resolution 10-bit, single-slope column parallel ADC. The second array has a similar structure but the column-parallel ADC was folded back into the array, to generate strixels. The use of the INMAPS process allows the PMOS transistors for the ADC to be isolated into deep P-wells islands, thus preserving the 100% fill factor of the pixel. The pixels for calorimetry are arranged into 2 arrays: one of 96x48 pixels on a 25um pitch and the one of 48x24 pixels on a 50 um pitch. Readout is done through column-parallel ADC as the ones used for the tracking array. The pixel architecture is built around the same 4T pixel mentioned above, but has additional devices to provide snapshot and in-pixel correlated double sampling (CDS) capability. At the periphery of the 25um pixel array, additional circuitry is added to provide charge summing of 2x2 pixels during readout. The Cherwell sensor was manufactured on a standard resistivity as well as on high (>1kOhm cm) epitaxial wafers. This latter would allow the charge collection to be helped by an electric drift field. The sensor is currently being characterised with different sources of radiation and experimental results will be presented at the conference.

Track 2 / **46**

CASCADE – RF cavity experiment to search for hidden sector photons

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Co-authors: Amos Dexter [1]; Graeme Burt [1]; Ian Bailey [1]; John Dainton [2]; Nathan Woollett [1]; Peter Williams [3]; Philippe Goudket [3]; Shrikant Pattalwar [4]; Steven Jamison [5]; Swapan Chattopadhyay [6]; Trina Thakker [3]

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String-theory based extensions of the Standard Model (SM) introduce a set of new particles and fields. The only renormalizable interaction with the visible SM can occur via kinetic mixing of SM photon with the hidden sector photon (HSP).

These photon oscillations can be studied with “light shining through wall” type of experiments. One of these experiments is being built by the CASCADE (CAvity Search for Coupling of A Dark sEctor) collaboration. CASCADE experiment consists of two RF cavities that are isolated from each other and shielded from external RF sources. When power is fed into the first cavity, a proportion of the

photons will mix into HSPs and propagate to the second cavity, and mix back to SM photons with an identical frequency to the original photons.

We will present the first measurement setup utilizing two 1.3 GHz copper cavities at liquid nitrogen temperatures. We will also discuss the anticipated physics reach and future upgrades to the measurement setup.

Track 4 / **73**

Development of the tracking detector for SuperNEMO and analysis of double-beta decay in 48Ca using NEMO3 data.

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SuperNEMO is a low background experiment with the aim of observing neutrinoless double beta decay, an extremely rare nuclear decay which is the only known method for determining whether neutrinos are Majorana or Dirac particles. The detector comprises tracker and calorimeter submodules, the former currently being built in the UK. This talk will focus on the effort towards the development of the low background tracker, in particular its gas mixing system and the very stringent requirements on the emanation of 222Rn into the tracking volume. A study of the ageing of the tracking chamber will also be presented. Finally, a preliminary analysis of the double-beta decay of 48Ca will be shown.

Track 1 / **120**

Development of a Reliable Target Mechanism for the Muon Ionisation Cooling Experiment

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The International Muon Ionisation Cooling Experiment (MICE) is a proof of principle demonstration of ionisation cooling for application in a future neutrino factory or muon collider. The experiment will measure the beam emittance before and after cooling to a high precision using individual particle measurements.
MICE is under construction at the Rutherford Appleton Laboratory (UK), where a transport beam line has been commissioned. Particles are produced inside the ISIS Proton Synchrotron by means of a target mechanism that dips a small titanium shaft into the beam at the end of an acceleration cycle, removing it 10ms later to prevent unnecessary activation of the accelerator.
These requirements are met with a precise linear motor capable of accelerating at 80g, while maintaining a controllable insertion depth. The conditions within ISIS prevent the use of lubricants and need the mechanism to operate for months without direct interaction.

Track 2 / **112**

Charged-current 1pi0 analysis with the ND280 detector of the T2K experiment.

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The cross-section uncertainty for neutrino interactions with associated pi0-meson production is an important systematic uncertainty in the measurement of electron-neutrino appearance within the Super-Kamiokande (far) detector of the T2K experiment. The pi0 analysis group of ND280 (near) detector are developing multiple parallel analyses with the aim of producing several pi0, inclusive and exclusive, cross-section measurements to help reduce this important systematic uncertainty.
The focus of this talk will be on the development of selection cuts which first select muons from charged-current interactions in the fine grain detectors of the ND280 tracking detector region. Secondly, reject charged particle backgrounds, particularly charged pions, which contaminate the desired exclusive 1pi0 final state. And finally, the selection of pi0 decay photons within the electromagnetic calorimeters which surround the tracking region of the ND280 detector.

Track 3 / **109**

Charm and new physics opportunities at colliders

Author: Gianluca Inguglia[1]

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Time-dependent studies in B mesons have enabled us to study in great detail the properties of the unitarity triangle. We describe a set of decay channels of the D^0 meson that can be used not only as an indirect test of CP conservation/breaking in the up sector of the standard model but also to infer properties of the charm unitarity triangle (ie the internal angle beta_c). Furthermore, possible new physics scenarios that may enhance the value of the beta_c angle in the charm unitarity triangle are introduced.

Track 4 / **118**

ATLAS Phase-II High Luminousity Hybrid Planar Pixel Sensors UK design and Testbeam update

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To extend the physics reach of the LHC, upgrades to the accelerator are planned which will increase the peak luminosity by a factor of 5 to 10. This will increase the occupancy and the radiation damage of the inner trackers.To cope with the elevated occupancy, the ATLAS experiment plans to

introduce an all-silicon inner tracker with the High Luminosity-LHC (HL-LHC) phase-II upgrade. This translates to an increase in area covered by pixels from 2 m2 to somewhere between 5-7 m2 in the current ATLAS pixel baseline layout. This increase necessitates the need for more cost effective pixel modules. Work will be shown on large area quad n-in-p geometry hybrid modules for use at large radii in the outer pixel layers and disks, as well as small single devices with standard and increased resolution along the R phi direction will be discussed, featuring test beam, lab measurements and simulations.

Track 3 / **54**

The DEAP-3600 Dark Matter Experiment

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DEAP-3600 is a tonne-scale single-phase liquid argon dark matter experiment currently under construction at SNOLab, Ontario, Canada that will see first data in early 2014. This talk will discuss dark matter detection in single-phase liquid argon detectors, the DEAP-3600 detector design, and the calibration systems.

Track 2 / **91**

Impact of transverse coupling on the ATLAS luminosity calibration in the gaussian-beam limit

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The calibration of the absolute luminosity scale at ATLAS is performed by dedicated van der Meer (vdM) scans. The current process assumes the factorisation of the luminosity distribution in the horizontal and vertical directions (x and y, respectively). I study a model in which the individual beam densities are parameterised as single-Gaussians. The model includes the possibility of having a non-zero x-y correlation within each beam, as well as non-zero beam crossing angles. The model parameters are systematically constrained by comparing with a set of equations, for which it has been possible to derive fully-analytically, the various movements of the luminous region. The implication of non-zero x-y beam correlation on the measured luminosity has been considered for numerous vdM scans performed at ATLAS over the last three years.

Track 4 / **141**

WIMP searches with liquid xenon: LUX and LZ

Author: Henrique Araujo[1]

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We present the status of two WIMP search projects based on two-phase xenon emission detectors: the Large Underground Xenon (LUX) experiment, presently in the final stages of commissioning at the Sanford Underground Laboratory, and the LZ (LUX-ZEPLIN) project, a next-generation experiment featuring a 7-tonne xenon target being developed by US, UK and Portuguese teams. The LUX detector contains 350 kg of ultra-pure liquid xenon; the self-shielding capability of this dense medium allied to the precise reconstruction of particle interaction sites in three dimensions will allow the definition of a 100-150 kg fiducial volume featuring extremely low background rates. LUX will start its hunt for WIMP dark matter very soon. The LZ project is being developed in parallel, and it is envisaged that its multi-tonne target will occupy the same infrastructure after LUX. LZ will probe the entire parameter space presently favoured by theory down a WIMP-nucleon scalar cross-section of order 10^-12 pb.

Track 1 / **79**

SCT ATLAS Upgrade

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The LHC is currently on its first upgrade phase (PHASE-0) and anticipating 2 further upgrades with the last phase (PHASE-II) foreseen for 2022-2023. PHASE-II will aim to increase the integrated luminosity of the LHC to ten times fold the original LHC design luminosity. The so called HL-LHC will introduce harsher conditions in terms of particle count and radiation dosage. An international R&D collaboration is currently working on designing a new structure for part of the inner detector of the ATLAS experiment, the Semi-Conductor Tracker (SCT). The new SCT has planar sensors fabricated from p-type wafers that are suitable for the HL-LHC. The sensors and their readout electronics have special support structures called “staves” for the barrel region of the detector and “petals” for the end-caps region. Several prototypes have been produced with different readout electronics, powering schemes and other system aspects.

This talk will present the progress done so far on the design of the SCT and in particularly focus on the electrical design and testing of a multi-module prototype “stavelet” that serves as a proof of design for the stave.

Track 4 / **97**

T symmetry invariance tests in neutral meson decays

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The laws of quantum physics can be studied under
the mathematical T operation that inverts the direction of time.
Strong and electromagnetic forces are known to be invariant under temporal inversion, however the weak force is
not. The BaBar experiment recently exploited the quantum-correlated production

of neutral B mesons to show that T is a broken symmetry. Here
we show that it is possible to perform a wide
range of tests of quark flavour changing processes,
described by the weak interaction, under the T symmetry in order to
validate the Kobayashi-Maskawa mechanism and the Standard Model of particle physics.

Track 3 / **130**

Searches for supersymmetry using the alphaT variable

Author: Darren Lee Burton[1]

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Searches for Supersymmetry in all hadronic final states at 8TeV, with the dimensionless kinematic variable alphaT as the main discriminator between events with genuine and mis-reconstructed missing transverse energy.

Track 1 / **58**

R&D efforts for the next generation of very large scale Liquid Argon detectors for Neutrinos and Dark Matter.

Author: Roxanne Guenette[1]

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Liquid Argon (LAr) detectors are an excellent choice for neutrino detection and direct dark matter searches mainly due to their scalability. The next generation of experiments aims to construct very large scale detectors, however a lot of R&D is still required to demonstrate the technology. For example, both neutrino and dark matter experiments utilise the scintillation light produced in the argon, and so understanding the optical properties of LAr is crucial for larger scale detectors. I will review some of the R&D efforts dedicated to demonstrate the scalability of LAr detectors and to improve our understanding of the optical properties of LAr.

Track 2 / **128**

Top Quark Search at LHCb

Author: Henry Brown[1]

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Searches are on-going at LHCb top explore the top quark sector, which has yet to be measured at high eta at LHCb, providing a theoretical overview, and discussion of a dilepton+b jet analysis.

Plenary - Future of the Programme / **102**

Upgrades at the LHC

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The high luminosity upgrade programme of the LHC has emerged as one of the highest priorities for CERN and European Particle Physics in the recent European Strategy consultation process.

I will review the physics motivation for this programme, the proposed detector upgrades and the ongoing R&D.

Plenary - Future of the Programme / **22**

The APPEC Roadmap and Strategy

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Plenary - Future of the Programme / **30**

The CERN Programme

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Plenary - Future of the Programme / **31**

The View from the USA

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Plenary - Future of the Programme / **86**

The View from Japan

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The discovery of a new particle which is consistent with the Higgs Boson has opened up a new era in particle physics. Its precise measurements develops physics beyond the current Standard Model. Japanese high energy community issued a report “Future HEP Projects of Japan” in March 2012. In the report early realization of linear collider is given. In October 2012, based on the consensus of the HEP community of japan, another statement on which contains a recommendation for hosting

ILC in Japan with an energy upgrade path in stage staring from a Higgs Factory, was published. in the end of 2012, Technical Design Report of ILC was issued by international efforts. In the light of these developments, the HEP community of Japan propose to push for the construction of ILC in Japan. Other HEP projects, neutrino experiments and other flavour physics will be also discussed in the talk.

Plenary - Future of the Programme / **33**

Conference Close

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APP Group AGM / **133**

Chair/Secretary/Treasurer Reports

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STFC Town Meeting / **134**

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STFC Town Meeting / **135**

European Strategy for Particle Physics Update

STFC Town Meeting / **136**

PPAP Activities

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STFC Town Meeting / **138**

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Discussion