IOP 2014 Joint HEPP & APP Group Meeting

Monday 7 April 2014 - Wednesday 9 April 2014

Royal Holloway, University of London

Book of Abstracts

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Welcome

Plenary 1 / **0**

The Status of Standard Model Measurements at the LHC

Corresponding Author: e.nurse@ucl.ac.uk

A review of recent Standard Model results from the ATLAS and CMS experiments utilising data from Run I of the LHC is given.
Results on jets, bosons plus jets, dibosons and top quark physics are discussed as well as observations of rare Standard Model processes.

Plenary 1 / **1**

The Status of Beyond Standard Model Searches at the LHC

Corresponding Author: henning.flacher@cern.ch

The search for physics beyond the Standard Model is a priority in the physics programme of the ATLAS and CMS collaborations. These searches cover a wide variety of experimental signatures and proposed models, ranging from, e.g., supersymmetry to heavy gauge bosons, extra dimensions and dark matter. In this talk the latest results obtained with up to 20/fb of data collected at 8 TeV centre-of-mass energy are presented and the implications on the parameter space of different new physics models are discussed.

Plenary 1 / **2**

The Status of the LHC Higgs Programme

Corresponding Author: bill.murray@stfc.ac.uk

The LHC Higgs programme has been spectacularly successful in discovering what has been variously called ‘A new boson’, ‘a Higgs-like boson’ and ‘a Higgs boson’ even while the machine was running well below design energy. But what do we really know about this particle? Why don’t we just call it ‘The Higgs boson’, and will we ever do so? And what can it tell us about the remaining mysteries such as Dark Matter? Bill Murray has been closely involved with this search with the ATLAS experiment at CERN’s LHC, and this talk contains the latest results on all these questions.

Plenary 1 / **20**

125 GeV Higgs, Now What?

Corresponding Author: quigg@fnal.gov

I will summarize the theoretical context for the search for the avatar of electroweak symmetry breaking, review what we have learned about H(125), and outline what we need to learn about the new particle. I will describe some of the questions raised and opportunities opened by the discovery of H(125), and how they influence our thinking about future accelerators. Finally, I will try to connect our studies of the Higgs sector with other explorations in particle physics.

Plenary 2 / **4**

PLANCK: 2013 Results and Future Prospects

Corresponding Author: adc1000@ast.cam.ac.uk

I review the main cosmology results from the 2013 Planck release. I will also discuss some developments since the original submission of the papers, and put the Planck results in the context of more recent results from the BICEP2 experiment.

Plenary 2 / **5**

Gamma Ray Astronomy

Corresponding Author: p.m.chadwick@durham.ac.uk

Gamma-rays provide a unique probe of the non-thermal universe, allowing us to investigate a wide range of astroparticle physics and astronomy. At present, instruments such as the space-borne Fermi telescope and the ground-based HESS, MAGIC and VERITAS telescopes are providing us with a wealth of results, covering active galactic nuclei, supernova remnants, pulsars, gamma-ray bursts and many more object classes, as well as areas of fundamental physics. This talk will look at the methods used to detect gamma rays, consider a few recent results that are relevant to astroparticle physics and provide an introduction to the next-generation ground-based instrument, the Cherenkov Telescope Array (CTA).

Plenary 2 / **7**

Dark Matter Direct Detection

Corresponding Author: james.nikkel@rhul.ac.uk

Physicists are still looking for what makes up most of our galaxy, and while there may be some hints, dark matter still has not been conclusively observed in the lab. I will present the current status of direct dark matter detection and the direction in which this research is headed.

Plenary 2 / **16**

Cosmology: What Will the Next Big Discovery Be?

Corresponding Author: ktfreese@umich.edu

Cosmology has just had a major discovery: gravity waves from the early Universe. The Cosmic Microwave Background polarization experiment BICEP2 has announced detection of B-modes, which can be explained as the gravitational wave signature of inflation. I will discuss the significance of these ground-breaking results for cosmology. This discovery, if confirmed in future data sets, is a "smoking gun"for inflation. Further, when combined with data from the Planck satellite, thousands of inflation models have now been ruled out. Remaining simple models are few, and include natural inflation and quadratic potentials. Natural inflation uses "axions"as the inflaton, where the term "axion"is used loosely for a field with a flat potential as a result of a shift symmetry. That inflation could be so dramatically confirmed so quickly as a theory of the earliest Universe comes as a great surprise, and now the details of the inflaton even stand to be tested. A second major direction for the near future of cosmology is the identification of the dark matter of the Universe. The approach is three-pronged: the hunt for new physics at the Large Hadron Collider; underground laboratories searching for astrophysical WIMPs; and indirect detection of dark matter annihilation products. The excitement in the community is palpable: the searches are unearthing unexplained signals that may herald dark matter particles as the next big discovery in cosmology.

Plenary 3 / **12**

Status of Quark Flavour Physics

Corresponding Author: muheim@ph.ed.ac.uk

With the successful start of the Large Hadron Collider at CERN
quark flavour physics has entered a new era. Unprecedented samples of
Beauty and charmed mesons and baryons have been collected
by the LHCb experiment, which was built for this purpose,
ATLAS and CMS also have large flavour physics
data samples and the Tevatron and B-factory experiments
continue to produce interesting results.
Highlights include the measurements of CP violation
in Bs mesons and the observation of the very rare decay Bs->mumu
as well as precision measurements of Bs and charm mixing
and B-hadron lifetimes. These results place strong constraints on the
parameter space of many models of physics beyond the Standard Model.

Plenary 3 / **13**

Probing New Physics through Flavour Violation

Observation of charged lepton flavour violation (CLFV) would provide a clear signal for physics beyond the Standard Model. Selected recent experimental results and near-term prospects for the searches for CLFV processes are discussed. The processes considered include $\mu \rightarrow e$ conversion, $\mu \rightarrow e\gamma$ decay and lepton flavour violating decays of the charged kaons.

Plenary 3 / **14**

Electric Dipole Moments, Recent Results and Prospects

Corresponding Author: w.c.griffith@sussex.ac.uk

Measurement of a non-zero permanent electric dipole moment (EDM) would be clear evidence of a new source of CP violation outside of the quark mixing CKM matrix, and would be a possible signature of Supersymmetry. I will give an overview of current EDM experiments, including searches for atomic EDMs, recent improvements on the electron EDM upper bound measured in polar molecules, and the status of efforts to improve the neutron EDM limit. I will also discuss the Fermilab muon g-2 experiment and its prospects for measuring the muon EDM.

Plenary 4 / 9

Long Baseline Neutrino Oscillation Results from Current Experiments

Corresponding Author: h.okeeffe@lancaster.ac.uk

In the last decade, neutrino experiments have provided overwhelming evidence for physics beyond the Standard Model. In this talk I will introduce the theory of neutrino oscillations and discuss current long-baseline neutrino oscillation experiments. Recent results from the T2K and MINOS experiments and prospects for the current generation of experiments will be presented.

Plenary 4 / 11

Neutrino Mass Searches with Beta Decay Experiments

Corresponding Author: j.j.hartnell@sussex.ac.uk

Neutrinos are the second most abundant particle in the universe and yet one of the least understood. Their fundamental nature, whether they are their own antiparticle, is not yet known and the heaviest neutrino has a mass that we currently only known to within a range that spans about two orders of magnitude. In this talk I will review single beta decay experiments, which give us a model independent measure of neutrino mass based solely on kinematic parameters and energy conservation; and double beta decay experiments that allow us to probe the nature of the neutrino and the scale of absolute neutrino mass. Recent results from experiments and updates on the next generation of experiments, in particular SNO+ and SuperNEMO will be described.

Plenary 4 / 6

Neutrino Particle Astrophysics

Corresponding Author: r.nichol@ucl.ac.uk

Neutrino particle astrophysics is a frontier field at the crossroads of particle physics and astrophysics. Given the low fluxes of astrophysical neutrinos, gigantic detection volumes are necessary to detect the weakly interacting particles. The past twelve months have been an exciting time in the field on neutrino particle astrophysics, with the IceCube experiment claiming the first evidence for high energy extra-terrestrial neutrinos. If confirmed this evidence will be the first time since 1987 that neutrinos have been detected from outside of our solar system. Results from the current generation of neutrino particle astrophysics experiments will be presented, along with the prospects of imminent future experiments. Finally, the possibilities for utilising neutrino particle astrophysics detectors to measure neutrino oscillations will briefly be addressed.

Parallel 1D / 23

Is there evidence for a Dark Matter signal in CoGeNT data?

Author: Jonathan Davis[1]

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The CoGeNT collaboration claim to have observed a signal of light Dark Matter scattering off nuclei in their detector, to a significance of approximately 2.5 sigma. I will critically assess these recent, and earlier, claims. I present a Bayesian analysis of the 1136 live days CoGeNT data, with particular focus on the removal of surface events through the use of nuisance parameters. I derive statistically robust confidence intervals using CoGeNT data, which fully incorporate this uncertainty, and show that the claims of signal in CoGeNT data are premature.

Parallel 1B / 26

Search for the decay $\Lambda_b^0 \to \Lambda^0 \eta^{(\prime)}$ at LHCb

Author: James Mccarthy[1]

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Decays involving η and $\eta\prime$ mesons are particularly interesting to theorists, as they allow some insight into the relatively poorly understood topic of $\eta - \eta\prime$ mixing. This subject has been covered extensively using decays of B and B_s mesons, however, no equivalent processes have been observed in the baryonic sector. This talk outlines the search for the rare decay $\Lambda_b^0 \to \Lambda^0 \eta(\prime)$, using data recorded by the LHCb experiment. Results of the recent search in the data recorded during 2012 are presented, and the prospects for improvement using the full data set are outlined.

Parallel 1E / 110

Search for Neutrinoless Double-β Decay of ^{100}Mo in the final NEMO-3 dataset

Author: Stefano Torre[1]

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The NEMO-3 detector, installed in the Modane underground laboratory, ran between February 2003 and January 2011. The NEMO-3 experiment employed a tracker and calorimeter detector technology to fully reconstruct the topology of the events generated in thin foils of active material. Thanks to its unique design, NEMO-3 studied the details of the Double-β decay in seven isotopes (^{100}Mo, ^{82}Se, ^{116}Cd, ^{150}Nd, ^{96}Zr, ^{48}Ca and ^{130}Te). We searched for neutrinoless Double-β (0νββ) decay of 100Mo, the largest sample of NEMO-3, using the complete set of collected data. With an exposure of 34.7 kg·y, no evidence for the 0νββ signal has been found, yielding the best limit for the light Majorana neutrino mass mechanism in this isotope. Taking into account nuclear model uncertainties this result is in the same sensitivity range as recently reported constraints on for the isotopes of ^{136}Xe

and ^{76}Ge. The same dataset is used to constrain other lepton number violating mechanisms of the $0\nu\beta\beta$ decay. In particular the most stringent constraints so far have been obtained for right-left symmetric and SUSY models. We describe this measurement.

Parallel 1C / 87

Compressed and Split Spectra in Minimal SUSY SO(10)

Authors: Frank Deppisch[1]; Nishita Desai[2]; Tomas Gonzalo[3]

[1] *University College London (UK)*

[2] *University of Heidelberg*

[3] *UCL*

The non-observation of supersymmetric signatures in searches at the Large Hadron Collider strongly constrains minimal supersymmetric models like the CMSSM. We explore the consequences on the SUSY particle spectrum in a minimal SO(10) with large D-terms and non-universal gaugino masses at the GUT scale. This changes the sparticle spectrum in a testable way and for example can sufficiently split the coloured and non-coloured sectors. The splitting provided by use of the SO(10) D-terms can be exploited to obtain light first generation sleptons or third generation squarks, the latter corresponding to a compressed spectrum scenario.

Parallel 1A / 40

Measurement of the distribution of $\varphi^\star$ in events containing dimuon pairs with masses between 30 and 500 GeV in 10.4 fb^{-1} of proton-antiproton collisions

Author: Xingguo Li[1]

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The variable $\varphi^\star$ probes the same physical effects as the $Z/\gamma^\star$ boson transverse momentum, but is less susceptible to the effects of experimental resolution and efficiency. Using 10.4 fb^{-1} of proton-antiproton collisions collected by the D0 detector at the Fermilab Tevatron, we measure the distribution of the variable $\varphi^\star$ in events containing dimuon pairs with masses between 30 and 500 GeV. The data are corrected for detector effects and presented in bins of dimuon rapidity and mass.

Parallel 1A / 25

A measurement of the $\phi^\star$ angle in Drell-Yan di-lepton pairs

Author: Samuel Webb[1]

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The $\phi^{\star}_{\eta}$ angle of Drell-Yan di-lepton pairs probes initial state gluon radiation and its definition relies only upon the well-measured lepton directions. The $\phi^{\star}_{\eta}$ distribution is sensitive to similar but complementary physics to the intermediate boson transverse momentum distribution. A measurement of the normalised $\phi^{\star}_{\eta}$ differential cross section around the Z-pole was made using the ATLAS detector at 7 TeV. In this talk progress towards an updated measurement using the full 8 TeV dataset is presented.

Parallel 1B / 27

Measurement of the differential branching fraction of the rare decay $\Lambda_b \to pK\mu\mu$ at LHCb

Author: Michael Kiss[1]

[1] *STFC (RAL)*

Using the data from the LHCb experiment at CERN , the flavour structure of physics beyond standard model (SM) is probed using one of the rare B-decay channels, namely the $\Lambda_b \to pK\mu\mu$ decay. This decay occurs through a flavour changing neutral current process mediated by electroweak penguin and box diagrams in the SM. It is forbidden at the tree level and suppressed at the one-loop level by the GIM (Glashow–Iliopoulos–Maiani) mechanism.
The first goal of the analysis is to use a dataset corresponding to 3fb-1 integrated luminosity collected by LHCb during 2011-12 to measure the differential branching fraction of this channel as function of the dimuon invariant mass squared. A multivariate event selection method was developed for this channel and the control channel $\Lambda_b \to pKJ/\psi$.
The general strategy of the analysis will be described. The features of the selection procedure and the steps involved in extracting the branching fraction will be presented. The systematic errors for this measurement also will be discussed.

Parallel 1D / 85

First results from the LUX dark matter experiment

Author: Lea Reichhart[1]

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A large number of astronomical and cosmological observations point towards the existence of an unknown dark component dominating the matter content of our Universe. The most compelling candidates for dark matter are Weakly Interacting Massive Particles (WIMPs), which may be detected in low background experiments located deep underground, searching for direct interactions of WIMPs with dedicated target materials. The Large Underground Xenon (LUX) experiment, operated in the Davis Campus of the SURF laboratory, USA, has announced results from its first science run in late 2013. From an exposure of 85 live days, having found no evidence of signal above expected background, LUX has set constraints on scalar WIMP-nucleon interactions above 7.6×10^{-46} cm^2 at 33 GeV/c^2 WIMP mass (90% CL). The sensitivity for light WIMPs (<10 GeV/c^2) is some 20 times higher than that of any other experiment, and the LUX result seriously challenges the interpretation of hints of signal claimed by other experiments as arising from low-mass WIMPs.

Parallel 1E / 101

Results of the NEMO-3 experiment and Low-radioactivity measurements for SuperNEMO with the BiPo detector

Author: Guillaume Eurin[1]

[1] *University College London (UK)*

The main goal of the SuperNEMO collaboration is to search for neutrinoless double-β decay.
This would prove that the neutrino is a Majorana particle ($\nu = \overline{\nu}$).
Today the best lower limits on half-lives of this process are set around 10^{24} - 10^{26} years as obtained by the NEMO-3 experiment (for the 2β isotope ^{100}Mo) and other experiments.
Several analyses are still ongoing, studying the different isotopes used for NEMO-3: ^{100}Mo, ^{82}Se, ^{96}Zr, ^{150}Nd, ^{48}Ca, ^{116}Cd.
SuperNEMO is the next generation experiment based on the NEMO-3 tracker-calorimeter detection principle.
Given the rareness of the processes studied here, the lowest possible levels of background are required.
These levels are too low to be reached using non destructive techniques such as High Purity Germanium detectors.
A new type of detector has been constructed, BiPo-3, targeting activities lower than can be achieved through γ spectrometry.
This detector is designed to measure contaminations in ^{208}Tl (around few μBq/kg) and ^{214}Bi (few dozen μBq/kg) in thin materials.
BiPo-3 has been fully operational at the Laboratorio Subterráneo de Canfranc (LSC, Spain) since January, 2013.
The NEMO-3 experiment, the status of the current analysis on ^{96}Zr and the results on ^{100}Mo and ^{82}Se will be presented.
The BiPo-3 detector will be described along with the radiopurity requirements for SuperNEMO source foils measurements.

Parallel 1C / 96

Searching for supersymmetry with compressed mass spectra at CMS

Author: Robyn Lucas[1]

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Supersymmetry scenarios in which squarks, particularly in the third generation,
are close in mass to the lightest supersymmetric particle are well motivated
and offer a possibility for hidden, natural SUSY. Traditional searches are insensitive to these compressed mass spectra scenarios due to the very soft decay products.
A search for light top squarks close in mass to the LSP at the CMS detector in 19.7 fb^{-1} of pp collisions at $\sqrt{s}$= 8 TeV is presented using events with one high p_T jet and a large transverse energy imbalance. By using monojet events to search for Initial State Radiation produced in association with top squarks, sensitivity to very compressed spectra is attained.

Parallel 1B / 28

The analysis of $B^0 \to K^{\star 0}\mu\mu$ decays at including S-wave contributions at LHCb

Author: Sam Cunliffe[1]

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

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A status report for the analysis of $B^0 \to K^\star(892)^0(\to K^+\pi^-)\mu^+\mu^-$ decays at the LHCb detector at the LHC is presented. This process is the decay of a beauty meson to a vector meson final state and produces an angular distribution in the final state decay products. This angular distribution is highly sensitive to the contributions from Beyond Standard Model theories. There is a scalar $K^{\star 0}$ component which enters into the analysis which has the effect of diluting the angular distribution. This so-called 'S-wave pollution' is addressed.

Parallel 1A / 29

Observation of electroweak Zjj production

Author: Christian Gutschow[1]

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Events with jets produced in association with a Z boson in proton-proton collisions can be used to study distributions sensitive to the vector boson fusion (VBF) process at CERN's Large Hadron Collider.

This process is interesting to study because of its similarity to the VBF production of a Higgs boson as well as its sensitivity to new physics via the WWZ triple gauge coupling.

Evidence for electroweak Zjj production beyond the 5σ level is presented using data collected by the ATLAS experiment in 2012.

This constitutes the first observation of a process involving a VBF diagram.

The detector-corrected cross sections measured in two fiducial regions are in excellent agreement with the Standard Model expectations.

Parallel 1D / 86

Delayed Coincidence Analysis for Determining the 85Kr Background in LUX

Author: Adam Bailey[1]

[1] *Imperial College*

^{85}Kr is an anthropogenic radioisotope which makes up a very small fraction of the Kr abundance in the atmosphere, and contributes to the background in double-phase xenon detectors searching for WIMP dark matter. It has a half-life of 10.8 years and decays predominantly via a β^- decay with an endpoint of 687 keV. Commercially available xenon procured for LUX contained 130 ppb g/g Kr/Xe, which would lead to unacceptably high background. Before the start of the experiment this was reduced to 4±1 ppt g/g by chromatographic separation, as this noble gas is not removed further by the standard purification methods during operation. Current measurements of the ^{85}Kr concentration use gas sampling assays to determine the overall Kr content with ppt sensitivity, and then assume a ratio of ^{85}Kr/Kr as measured in the atmosphere. It is prudent to try to assess this background by determining the ^{85}Kr content directly. This is possible due to a low branching ratio β^- decay providing a delayed $\beta - \gamma$ coincidence with $T_{1/2}$ ~1 μs. We present results from a search of these rare decays performed on the LUX data used to derive the WIMP result previously published.

Parallel 1C / 32

Supersymmetry searches in three lepton events at ATLAS

Author: Itzebelt Santoyo Castillo[1]

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The ATLAS experiment at the Large Hadron Collider (LHC) has collected an unprecedented amount of data in the 3 years of data taking since its start. In this talk I will discuss the latest results from the Supersymmetry (SUSY) searches in events with three leptons (electron/muon/tau) in the final state. The search is performed on the full dataset collected by the experiment in 2012, at a centre-of-mass energy of 8 TeV. No evidence of SUSY is found. Observations are consistent with the Standard Model and exclusion limits are set on various SUSY models (pMSSM and simplified models). These results improve on previous searches performed at ATLAS in final states with only electrons and muons.

Parallel 1E / 75

Status of the SuperNEMO experiment

Author: Pawel Guzowski[1]

[1] *University of Manchester*

The SuperNEMO experiment aims to search for neutrinoless double beta decay. If observed, this would show that the neutrino is its own antiparticle and be the first evidence for total lepton number violation. With 100 kg of source, a half-life sensitivity of order 10^{26} years (effective neutrino mass sensitivity down to 50 meV) can be achieved. The experimental techniques are similar to the predecessor NEMO-3 experiment, with a tracker-calorimeter setup. Decay electrons from a source foil pass through a magnetised tracker, aiding in particle identification, and the calorimeter measures their energy. The setup is able to measure the angular distribution of the decay products, which can aid in determining the underlying physical process behind the lepton number violation if observed. The unique design with separation of source and detector also allows the study of different isotopes concurrently. To prove the challenging radiopurity requirements of the experiment are achievable, a Demonstrator module is currently under construction and will start taking data next year. The current status of the Demonstrator production will be presented.

Parallel 1E / 122

The SNO+ Experiment

Author: Philip Jones[1]

[1] *QMUL*

A summary of the current status of the SNO+ experiment.

The SNO+ experiment located in the SNOLAB facility in Sudbury, Ontario, Canada will primarily search for neutrinoless double beta decay by deploying Te130 into a kTonne of liquid scintillator. The experiment will additionally study solar, geo, supernova (if one occurs) and reactor neutrinos as well as nucleon decay in a separate water phase.

Parallel 1D / 98

Multi Higgs doublet models

Author: Venus Keus[1]

Co-authors: Stefano Moretti [2]; Stephen King [3]

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Multi Higgs-doublet models (NHDMs) are amongst the simplest extensions of the Standard Model, motivated for instance by Supersymmetric scenarios. I will discuss NHDMs with various symmetry groups which contain viable dark matter candidates, preserved by the remnant of the symmetry after EWSB. I will describe the dark matter phenomenology of these models and look into new Higgs decay channels offered by the extra doublets and their effect on the Standard Model Higgs couplings.

Parallel 1C / 33

A search for supersymmetry using four or more leptons at ATLAS

Author: Zara Jane Grout[1]

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A search for supersymmetry is presented, using four or more leptons with the ATLAS detector using $\sqrt{s} = 8$ TeV data taken at the LHC during 2012. The motivations for this search. optimisation procedure and background estimation are outlined, and results presented for a number of RPC and RPV interpretations.

Parallel 1B / 54

Rare B decays in ATLAS: results and most recent updates on the 2012 analyses

Author: Cristiano Alpigiani[None]

Weak decays that are naturally suppressed in the Standard Model, such as processes with flavour-changing neutral-currents, are perfect for indirect searches of new physics. These decays allow us to investigate higher energy ranges with respect to direct searches thus representing a fundamental complementary tool.

Results on the ATLAS search for the $B_s \to \mu^+\mu^-$ rare decay will be presented together with the most recent updates on the 2012 analysis that will be published soon.

The ATLAS study of $B_d \to K^\star\mu^+\mu-$ is also reported where the parameters A_{FB} and F_L are extracted from the angular distribution of the final state.

Parallel 1A / **43**

Production of a Z Boson in association with b-jets measured with the ATLAS detector

Author: Peter Robert Davison[1]

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This talk will present the first differential cross section measurements for the production of a Z boson produced in association with at least two b-jets. Data was collected using the ATLAS detector running at a centre of mass energy of 7 TeV during 2011. The analysis selects events with a leptonically decaying Z boson (to two electrons or two muons) produced in conjunction with two jets tagged as originating from a b-hadron. The results are compared to different predictions calculated at LO and NLO.

Parallel 1A / **46**

QCD Estimation in V+jet Production at the LHC

Author: Craig Anthony Sawyer[1]

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One of the most challenges backgrounds to vector boson production in association with jets is that of QCD multijets. Current Monte Carlos struggle to model the background well and in adequate sample sizes. As a result data driven methods of estimation have been developed for use in precision analyses at the LHC. In this talk I will summarise the development of these methods in W+jet and R-jet (W/Z+jet) measurements at the LHC using the 2011 ATLAS dataset.

Parallel 1D / **58**

A DEAP Search for Dark Matter: An Overview of the DEAP-3600 Experiment

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DEAP-3600 is a single-phase liquid Argon dark matter detector currently under construction at SNOLAB in Canada with first physics data expected in the summer, 2014. DEAP has been designed to achieve extremely low background rates, including those from 39Ar β decays, neutron scatters, and surface α contamination, with the goal of measuring the spin-independent WIMP-nucleon cross section down to 10^{-46} cm^2 for a 100 GeV WIMP - a factor of 10 below current limits. Here an overview of the DEAP program will be presented including new results from DEAP-1 describing the background discrimination techniques and radon background measurements.

Parallel 1E / 113

Developing criteria for SNO+ Data Quality and Run Selection

Author: Ashley Back[1]

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The multi-purpose SNO+ detector, part of SNOLAB, is currently being filled with ultra-pure water, marking the first step before the addition of liquid scintillator and then Tellurium. While the level of water in the detector rises, the level of activity in preparation for commissioning is accordingly steadily increasing. Recent periods of continuous operation—each lasting of order two weeks—produced a wealth of "dark"data, which has already proved invaluable for testing critical systems. After presenting an overview of the SNO+ experiment, this presentation will focus on Front-end Calibrations, particularly Data Quality and Run Selection, based on analysis of the current "dark" data. An account of how the Data Quality Criteria were developed, is presented, followed by a discussion of how they are being verified and tuned using the recent SNO+ data.

Parallel 1B / 81

CP asymmetries in $B \to K^{(\star)}\mu\mu$ decays

Author: Simon Robert Magee Wright[1]

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Measurements of the direct CP asymmetry, A_{CP}, and the CP difference in the $\mu^+\mu^-$ forward-backward asymmetry, ΔA_{FB}, are made for the $B^0 \to K^{\star 0}\mu^+\mu^-$ and $B^+ \to K^+\mu^+\mu^-$ decay modes using pp collision data corresponding to an integrated luminosity of $3fb^{-1}$ collected by LHCb in 2011 and 2012. The respective control modes $B^0 \to J/\psi K^{\star 0}$ and $B^+ \to J/\psi K^+$ are used to account for detection and production asymmetries. The measurements are made in several bins of $\mu^+\mu^-$ invariant mass squared, q^2, vetoing the ϕ and charmonium resonance regions.

Parallel 1C / 38

Search for strongly produced SUSY particles in events with zero leptons, jets and missing transverse energy with the ATLAS detector.

Author: Gareth Thomas Fletcher[1]

[1] *University of Sheffield (GB)*

Corresponding Author: gareth.fletcher@cern.ch

The strong production of Supersymmetric particles at the LHC offers one of the best current direct discovery prospects for Supersymmetry. This talk will focus on the event topologies of zero leptons 2-6 jets and missing transverse energy. Based on recent searches with the ATLAS detector on 8 TeV LHC data searching for squarks and gluinos.

Summary:

This student talk will focus on the recent ATLAS searches for squarks and gluinos made with 20.3fb-1 8 TeV data. Highlighting signal production mechanisms, event selection background estimation and interruption of results.

Parallel 1C / 115

Searching for SUSY in the Jets+MET channel with the AlphaT kinematic variable

Author: Christopher Lucas[1]

[1] *University of Bristol (GB)*

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A search for Supersymmetry in the all-hadronic channel using the CMS detector will be presented. The analysis looks for a jets + MET signature using the alphaT kinematic variable. Events are categorised in independent bins of jet multiplicity, b-tagged jet multiplicity, and HT, the scalar sum of jet pT. Interpretations are shown in a variety of Simplified Model Spectra, including both gluino-mediated and direct squark production. Some investigations into future analysis sensitivity for compressed spectra models will also be discussed.

Parallel 1D / 125

A DEAPer Search for Dark Matter: Getting Ready for Data

Author: Alistair Butcher[1]

[1] *R*

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DEAP-3600 is a single phase liquid Argon dark matter detector based at SNOLab. Commissioning will start in May 2014 with first physics data is expected in the fall of 2014. This talk will present an overview of the analysis and calibration framework. In particular, some of the challenges found in characterising the photomultiplier tubes and their effect on timing based particle identification will be discussed.

Parallel 1A / 100

Central exclusive production at LHCb: current analyses and future detectors

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Central exclusive production (CEP) is a mechanism by which a final state is produced in isolation at central rapidity in an elastic collision. CEP provides a uniquely clean environment in which to carry out meson spectroscopy, and to search for evidence of phenomena such as gluon saturation.

We introduce CEP and discuss the suitability of the LHCb detector to its study. LHCb measurements of central exclusive charmonium production using dimuon final states are presented, and ongoing analyses extending these measurements to hadronic final states discussed. The predominant background to CEP analyses at LHCb is contamination from inelastic production; HeRSCheL, a system of forward detectors to be installed to veto this background, is presented.

Parallel 1E / 93

The FNAL muon g-2 experiment

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The 2004 measurement of the muon's anomalous magnetic moment by the E821 experiment at Brookhaven is the second most cited paper in experimental particle physics behind the observation of neutrino oscillations. This measured value differs by 3.6σ from the Standard Model (SM) prediction. This may be indicative of new physics beyond the SM or a statistical fluctuation. In this talk I will outline the role the UK is playing in a new experiment, E989, at FNAL, that will measure the muon's anomalous magnetic moment with a precision four times better than the E821 experiment and so resolve this issue. This precision is sufficient to establish evidence for new physics beyond the SM at more than 5σ should the present anomaly be confirmed.

Parallel 1B / 92

$B_s^0 \to D_s^{(*)+} D_s^{(*)-}$ Decays in LHCb

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The decay of a B_s^0 meson to two oppositely charged D_s mesons is one that is postulated to be almost exclusively CP even. Measuring the properties of this decay can therefore give important information about the behaviour of the B_s^0 system. This presentation will focus on the measurement of the inclusive branching fraction of $B_s^0 \to D_s^{(*)+} D_s^{(*)-}$, and will also consider other measurements made at LHCb using the same decay.

Parallel 1D / 30

The long term future of direct detection Experiments and the Neutrino barrier.

Author: Malcolm Fairbairn[1]

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The continuing search for dark matter will run into problems in the medium term future due to the background of neutrinos (especially from the Sun) which acts as a floor on the M-sigma plane beyond which it seems impossible to probe. We ask how far one can improve this situation using detailed energy, time and directional event information.

Parallel 1B / 137

Search for $B_s^0 \to \phi\pi^+\pi^-$ and $B_d^0 \to \phi\pi^+\pi^-$ decays in LHCb

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Using 3fb^{-1} of pp collision data collected at $\sqrt{s} = 7$ and 8 TeV by LHCb experiment in 2011 and 2012, first observation is made of the suppressed flavor changing neutral current (FCNC) decay mode $B_s^0 \to \phi(K^+K^-)f_0(980)(\pi^+\pi^-)$. In the $\pi^+\pi^-$ invariant mass range below 1100 MeV/c^2, the branching ratio, using the reference decay $B_s^0 \to \phi\phi$, is measured to be:

$\mathcal{B}(B_s^0 \to \phi\pi^+\pi^-) = [1.73 \pm 0.14 \pm 0.12^{+0.55}_{-0.46}\,\mathcal{B}(B_s^0 \to \phi\phi)] \times 10^{-6}$

This presentation also focus on the measurement other decays with same final state and give some evidence for $B_s^0 \to \phi\rho^0(770)$ and $B_d^0 \to \phi\pi^+\pi^-$ decays.

Parallel 1A / 52

Low Mu Run analysis on Measurement of the 2012 Inclusive Jet Cross Section in pp collisions at $\sqrt{s}$ =8 TeV using the ATLAS detector

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Jets are defined choosing the anti-kt algorithm with two radius parameters of 0.4 and 0.6. The inclusive double-differential cross section measurement at $\sqrt{s}$ =8 TeV at 2012 is performed as a function of jet transverse momentum, in bins of jet rapidity. The data sample with no pile-up has been collected on low mu run for detector calibration and "clean"physics studies. Additionally, it provides to measure the low-p_T . This talk will represent analysis of the inclusive jet double-differential cross-section on low mu run using function of the jet transverse momentum p_T and jet rapidity y, covering a range of 20 $\leq p_T$ < 430 GeV and |y| < 4.4.

Parallel 1E / 94

Magnetometry standard for the muon g–2 experiment

Author: Sam Henry[1]

[1] *University of Oxford*

A key requirement of the g–2 experiment, aiming to measure the muon anomalous magnetic dipole moment to 0.14ppm, is to monitor the magnitude of the magnetic field around the storage ring to 0.07ppm. This will be done with several hundred proton NMR magnetometers. These must all be calibrated against a standard magnetometer, to account for the ˜0.1ppm shifts of individual probes due to the magnetic properties of the materials. We are developing a 3He magnetometer to provide an independent check of the standard calibration probe used for the Brookhaven g–2 experiment, which was based on a spherical water sample.

Parallel 1C / 74

Searching for supersymmetry in events with large jet multiplicities using b-tagging and large-radius jets with 20 fb^{-1} of ATLAS data

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The Large Hadron Collider (LHC) ran in 2012 at the highest energy reached in a collider so far, allowing us to probe particle masses at the TeV scale. Strongly interacting particles at this mass scale are expected to decay in cascades, producing many jets from emissions of quarks and/or gluons and missing energy from weakly interacting daughters. This is the main target of the search for events with no leptons and large jet multiplicities, published recently by the ATLAS collaboration. The newest multi-jet analysis covers the full 2012 ATLAS data set, and has new features which improve sensitivity to various theoretical models. The results of the analysis are interpreted in various supersymmetric models, both R-parity conserving and violating. The new plans to measure the cross section of multijet events in 2012 data will also be briefly discussed.

Parallel 1D / 124

DMTPC Progress on Directional Dark Matter Detection

Author: Richard Eggleston[1]

[1] *RHUL*

The Dark Matter Time Projection Chamber (DMTPC) project aims to detect the direction of dark matter-induced nuclear recoils, in order to correlate a candidate signal with the astrophysical dark matter wind associated with the Earth's motion through the galactic dark matter halo. This talk will discuss recent progress with emphasis on directionality.

Parallel 1E / 37

A Search for Muon to Electron Conversion with COMET

Author: Andrew Edmonds[1]

[1] *UCL*

I will describe the COMET experiment, which will search for muon to electron conversion in aluminium, and I will also present some of the work I have done for it.

Parallel 1C / 42

Searching for strongly produced SUSY with like-charge leptons at ATLAS

Author: Thomas Gillam[1]

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The most recent ATLAS analysis searching for two like-charge or three leptons places improved bounds on several strongly-produced supersymmetric models, both simplified and phenomenological. Whilst the targeted event signatures have very low backgrounds from the standard model, there are contributions from fake and charge-flipped leptons. I shall present an overview covering the data-driven methods that are used to estimate the contribution from these in our signal regions, and summarise the main results of this analysis.

Parallel 1B / 145

Towards measurements of CKM parameters with loops and trees at LHCb

Author: Sam Hall[1]

[1] *Imperial College London*

Elements of the Cabibbo-Kobayashi-Maskawa (CKM) matrix are accessible through a variety of processes.
The Decay $B^{+\prime} \to D_s^+ \phi$ is an annihilation diagram at tree level, which is sensitive to V_{ub}.
While, contributions from the matrix element V_{ts} are present in the loop level decays $B^+ \to K^+\pi^+\pi^-\mu^+\mu^-$ and $B^+ \to \phi K^+\mu^+\mu^-$.
Results from LHCb for all these decays are presented.

Parallel 1A / 72

B-tagging Calibration Bias Using Semileptonic Jets

Author: Joshuha Thomas-Wilsker[1]

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The ATLAS experiment has several algorithms which are used to identify b-jets. In this talk I concentrate on the so-called "MV1"b-tagging algorithm, which includes information on displaced secondary vertices and the impact parameters of tracks as inputs into a Neural Network. To calibrate

this b-tagging algorithm we test how well it works on b-jets in simulation and then compare this with its performance on b-jets in data.

This calibration is performed on two types of b-jets, those that decay to a soft muon and neutrino, and those that do not. A ratio of performance in simulation and data is calculated to give a scale factor for each type of b-jet. A further comparison between the scale factors of the two types b-jet is provided in order to see if performing the calibration on b-jets that decay to a soft muon causes a bias. The calibration is performed on events with exactly two opposite sign leptons, two good jets, and large missing energy or large combined lepton plus jets transverse energy. This event selection provides a top pair enriched sample, which due to the large branching ratio of top quarks to b-quarks, also provides a sample enriched in b-jets.

Parallel 1C / 108

The CMSSM and NUHM1 after LHC Run 1

Author: Kees Jan De Vries[1]

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We show the results of global fits of the two constrained models of supersymmetry (SUSY): the constrained MSSM (cMSSM) and non-universal Higgs mass "1" (NUHM1). We take into account constraints from cosmology, electroweak precision observables, B-physics, Higgs physics and direct searches for SUSY at the LHC.

Parallel 1B / 112

A measurement of the CP-violation parameter γ from $B^{\pm} \to [hh]_D K^{\pm}$ decays

Author: Donal Hill[1]

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Determination of the CKM angle $\gamma = \arg[-V_{ud}V_{ub}^{\star}/(V_{cd}V_{cb}^{\star})]$ is one of the key goals of the LHCb experiment. The cleanest method to access this weak phase is through measurements of γ-sensitive observables in $B^{\pm} \to DK^{\pm}$ and $B^{\pm} \to D\pi^{\pm}$ decays. The largest interference and asymmetries, and thus the greatest sensitivities to γ, are expected in $B^{\pm} \to DK^{\pm}$ decays. The D meson must be reconstructed in a final state accessible to both D^0 and $\bar{D}^0$ mesons, such that interference between the two amplitudes can provide access to phase information. Two-body D meson decays into $K\pi$, πK, KK and $\pi\pi$ provide such a platform. In this talk, current LHCb results and imminent prospects on the subject will be presented.

Parallel 1A / 106

Top pair differential cross-section measurements with respect to MET, HT and other global distributions at CMS

Authors: Akram Khan[1]; Gregory Heath[2]; Jeson Abe Jacob[2]; Joel Goldstein[2]; Lukasz Kreczko[2]; Philip Hugh Symonds[1]; Sergey Senkin[2]

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Measurements of the top-quark pair differential cross-section with respect to global distributions including missing transverse energy, scalar sum of jet transverse momenta, scalar sum of total event scalar sum, leptonic W boson transverse momentum and leptonic W boson transverse mass have been carried out on 19.7fb⁻¹ of data at 8TeV obtained from the CMS detector at the LHC. After a tight selection, signal and background templates are fitted to data and the resulting number of signal events is unfolded to the true distribution using the Singular Value Decomposition method. The differential cross-section calculation produces results which were found to be consistent with Monte Carlo simulation. This study complements a previous study with respect to missing transverse energy on 5.1fb⁻¹ of data at 7TeV. A combined measurement on 7TeV and 8TeV data is currently in progress and is expected to be completed shortly.

Parallel 1E / 105

SQUID Magnetometry for Neutron EDM Experiments

Author: Amy Cottle[1]

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Neutron electric dipole moment (nEDM) experiments require precision magnetometry to correct for systematic effects due to magnetic field fluctuations. I discuss the options for such magnetometers and present details of a 12-SQUID magnetometry system constructed for use in a cryogenic nEDM experiment. This has been developed to operate in 0.5 K superfluid helium and installed and tested in apparatus at the Institut Laue Langevin, Grenoble. The system is designed to track fields at the 0.1 pT level, consistent with a proposed experimental limit on an nEDM of $d_n \sim 10^{-27}\, e$cm.

Parallel 1D / 62

Simple steps to analyse direct detection experiments without halo uncertainties

Author: Felix Kahlhoefer[1]

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Uncertainty in the local velocity distribution of dark matter is a key difficulty in the analysis of data from direct detection experiments. In my talk, I will propose a completely new approach for dealing with this uncertainty that does not involve any assumptions about astrophysics. By decomposing the dark matter velocity distribution into a sum of a large number of streams with different speeds and densities, we can find the velocity integral which best describes a given set of direct detection data for a hypothetical dark matter model. This method is conceptually simple, and numerically very efficient. I will discuss how to apply this method to estimate dark matter parameters independent of astrophysical uncertainties, choosing the ratio of proton to neutron couplings of dark matter as an interesting example.

Parallel 1A / 114

First Observation of the Associated Production of a Single Top Quark with a W Boson

Author: Duncan Leggat[1]

[1] *University of Brunel*

The observation of the associated production of a single top quark and W boson using 12.2 fb^{-1} of pp collisions at $\sqrt{s} = 8$ TeV with the CMS experiment is presented. A multivariate analysis based on kinematic variables was used to discriminate signal from the dominant ttbar background. The observed signal has a significance of 6.0σ and a cross section of $23.9^{+5.7}_{-5.6}$ pb.
A cut and count cross check analysis was also carried out, finding a signal with a significance of 3.6σ and a cross section of $33.9^{+8.6}_{-8.6}$. The results are in agreement with the
standard model expectation of $22.2 \pm 0.6 \pm 1.4$ pb.

Parallel 1E / 153

A prototype atomic interferometer for fundamental physics

Author: Oliver Burrow[1]

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Atom interferometers are precision instruments, currently capable of measuring forces an unprecedented precision, with this precision becoming more precise with the development of new techniques. Using atomic interferometers, a parameter search can be made to investigate the dark contents of the vacuum and shed some light on fundamental physics questions such as “What is the nature of dark energy?”. A prototype device is currently under construction at the University of Liverpool, and this talk will discuss the atom interferometer concept and the construction progress.

Parallel 2E / 103

Neutrino interactions and the T2K experiment

Author: Andrew Furmanski[1]

[1] *University of Warwick*

The T2K experiment is a long baseline neutrino oscillation experiment.
One of the largest sources of uncertainty in neutrino oscillation experiments comes from our poor understanding of neutrino interaction cross-sections.
I will explain why this is the case, and summarise the work that is being done to improve on the current situation.

Parallel 2A / 130

A software framework and toolkit for developing simulations of 2D pixel detectors

Author: Ashley Joy[1]

[1] *UCL*

X-CSIT (X-ray Camera SImulation Toolkit) is a software framework and toolkit for creating simulations of 2D X-ray pixel detectors. As a toolkit, X-CSIT is designed to be highly modular and adaptable to the wide variety and variations found in X-ray cameras. X-CSIT is under development at UCL for European XFEL, and will be used to create simulations of the three bespoke 2D detectors at European XFEL, AGIPD, LPD and DSSC. These simulations and X-CSIT will be integrated into the European XFEL software framework, Karabo, and through that be available to users to aid with planning of experiments and analysis of data. In addition X-CSIT will be released standalone publicly for other users, collaborations and groups to create simulations of their own detectors.

Summary:

Announcing X-CSIT, a software framework and toolkit for creating simulations of 2D X-ray pixel detectors.

Parallel 2C / 50

Evidence for Higgs Boson Decays to the $\tau\tau$ Final State with the ATLAS Detector

Author: Carl Jeske[1]

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I will present results of a search for the 125 GeV Higgs boson decaying to a pair of tau leptons. The dataset used is 20.3fb^{-1} of proton-proton collision recorded by the ATLAS detector at a centre of mass energy of 8 TeV. The observed (expected) deviation from the background only hypothesis corresponds to a significance of 4.1 (3.2) standard deviations. The measured signal strength is $\mu = 1.4^{+0.5}_{-0.4}$.
This constitutes evidence for the existence of Higgs to $\tau\tau$ decays and is consistent with the Standard Model expectation of a Higgs Boson with mass 125 GeV.

Parallel 2D / 95

Using cosmological data to study Dark Matter interactions with Standard Model particles

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Despite the large number of dedicated experiments, an understanding of the particle nature of dark matter and direct evidence for its existence have remained elusive. However, detection methods generally assume that dark matter consists of cold, massive particles (CDM). In this talk, I will discuss how cosmological data from the CMB and Large-Scale Structure can be used to study dark matter

interactions in a model-independent framework. I will show how small interactions with photons and neutrinos can have significant impact on structure formation, potentially solving key problems with the standard CDM cosmology.

Parallel 2B / 116

Search for CP violation in $B \to DK$, $D \to hh\pi^0$ decays at LHCb

Author: Nazim Hussain[1]

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Charged B decays of the form $B^{\pm} \to DK^{\pm}$ (where D represents either a D^0 or a $\bar{D^0}$) are powerful tools in the measurement of the CP-violating CKM angle γ. Channels where the D decays to a final state involving a π^0, such as $D \to \pi^{\pm}K^{\mp}\pi^0$, $D \to \pi^{\pm}\pi^{\mp}\pi^0$ and $D \to K^{\pm}K^{\mp}\pi^0$ are promising modes for these studies, but present challenges in the fierce environment of the LHC. In this talk I shall demonstrate that the excellent performance of the LHCb detector allows for high purity samples of these decay modes to be isolated, and consequently, their use in an ongoing CP-violation analysis using 3.0 fb^{-1} of data.

Parallel 2B / 117

Dalitz plot analysis of $B_s \to D^0K\pi$

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Dalitz plot analyses of $B^0_{(s)} \to D^0K\pi$ are interesting for multiple reasons. The decay $B^0 \to D^0K\pi$ can be used to make a measurement of the CKM angle γ. The B^0_s decay is interesting both as a potential background to the γ measurement but also to obtain branching fraction measurements for the various two body decays that contribute to $B^0_s \to D^0K\pi$ and to investigate D^{**}_s spectroscopy. I present preliminary results from a Dalitz plot analysis of $B^0_s \to D^0K\pi$ based on data from the LHCb experiment.

Parallel 2C / 31

ATLAS results on the Higgs boson properties in the decay channel $H \to ZZ \to 4\ell$

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This contribution will review the latest ATLAS results on the properties of the Higgs boson in the decay channel $H \rightarrow ZZ \rightarrow 4\ell$ using approximately 25 fb-1 of pp collision data collected during the LHC Run1 at 7 TeV and 8 TeV. The measurements of the mass and the couplings of the newly discovered boson are presented together with the spin-parity analysis results.

Summary:

Since the discovery of a Higgs-like boson by the ATLAS and
CMS experiments at the LHC, the emphasis has shifted towards
measurements of its properties. A review of the latest ATLAS results on the properties of the Higgs boson in the decay channel H—>ZZ—>4l channel using approximately 25 fb-1 of pp collision data collected during the LHC Run1 at 7 TeV and 8 TeV, is presented.
In the four lepton final state a clear excess of events over the background is observed at mH = 124.3 GeV with a significance of 6.6 standard deviations.
Thanks to the very good lepton's energy resolution was possible to perform a mass measurement which is found to be mH = 124.3+0.6-0.5 (stat)+0.5-0.3 (syst) GeV, and the signal strength (the ratio of the observed cross section to the expected SM cross section) at this mass is found to be μ = 1.7+0.5-0.4.
Moreover, a study of Higgs boson production mechanisms allows a first measurement of couplings with this channel. A spin-parity analysis is also performed on the events with reconstructed four-lepton invariant mass m4l satisfying 115 GeV < m4l < 130 GeV. The Higgs-like boson is found to be compatible with the SM expectation of 0+ when compared pair-wise with 0− , 1+ , 1− , 2+ , and 2− . The 0− and 1+ states are excluded at the 97.8% confidence level or higher using CLS in favour of 0+.

Parallel 2E / 141

Neutrinos in Gas at T2K

Author: Pip Hamilton[1]

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Cross-section measurements are extremely important for reducing systematic uncertainties in neutrino oscillation experiments, but are limited by our understanding of effects inside the target nucleus. Measuring neutrino interactions in gaseous detector allows the models used to simulate these effects to be empirically tested, thanks to the high spatial resolution of the detector and the relatively long range of even low-energy particles originating from the vertex (e.g. protons with a kinetic energy of 0.5 MeV).

This talk will give a brief overview of the project of measuring these interactions in the ND280 time projection chambers, before focusing on my work in developing a veto to reject entering backgrounds. It will then cover the future prospects for this work, which aims to make a world first measurement of neutrino interactions on gaseous argon.

Parallel 2D / 78

The LZ dark matter experiment

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The LUX-ZEPLIN (LZ) experiment is a next-generation search for Weakly Interacting Massive Particles, scaling the very successful double-phase xenon technology to multi-tonne target mass. LZ will be deployed at the 4850-ft level of the Sanford Underground Research Facility (South Dakota, USA) after completion of LUX, which is presently operating there. At its core, LZ will feature a 7-tonne (active) liquid xenon TPC surrounded by two outer 'veto'detectors. Particle interactions in the WIMP target generate two signatures: prompt scintillation light and ionisation charge, the latter transduced to a pulse of electroluminescence light in a thin gaseous layer above the liquid. Our strategy is to mitigate radiogenic backgrounds from detector materials through a combination of self-shielding, precise vertex location, coincidence vetoing, and xenon purification –to expose a background from astrophysical neutrinos. Electron recoils from solar pp neutrino scattering can be mostly discriminated by the ratio of the two signatures, which differs from that for nuclear recoil interactions which should be generated by WIMPs. We present the project status and the sensitivity reach of this exciting instrument.

Parallel 2A / 41

3D Silicon and 3D Diamond detectors for future upgrades of LHC experiments

Author: Iain Haughton[1]

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I present an overview on the development of cutting edge 3D diamond and 3D silicon detectors for future upgrades of LHC experiments, with a focus on work done in Manchester. A 3D geometry and its beneficial effects on a detectors radiation tolerance, signal speed and power dissipation have been extensively studied in silicon. As such, 3D silicon is a proven technology; it is included in the current phase 0 upgrade of ATLAS, and is a serious candidate for innermost layer tracking detectors at the High Luminosity LHC. Following the success of silicon, we are applying the concept of a 3D geometry to other semiconductor materials, specifically diamond, in the hope of creating a super radiation tolerant detector.

Parallel 2E / 139

Proton selection in the T2K near detector ND280

Author: Michail Lazos[1]

[1] *Liverpool University*

To study the neutrino interaction with one proton at the final state we need to make a proton selection. I will present my latest results of my proton selection. It is a very interesting channel and help us understand the CP violation in the lepton sector. The theory is well understood but the analysis is challenging as the background is much greater than the signal.

Parallel 2B / 56

Charmless three body decays at LHCb

Author: Rafael Silva Coutinho[1]

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The study of charmless three body decays with final states including a K^0 meson has an extensive number of application.
In this talk a review of the recent and ongoing analyses at LHCb will be reported. First, a search for previously unobserved decays of beauty baryons to the final states $K^0_S p\pi^-$ and $K^0_S pK^-$ is reported. The analysis is based on a data sample corresponding to an integrated luminosity of 1.0 fb^{-1} of pp collisions. The $\Lambda^0_b \to K^0_S p\pi^-$ decay is observed for the first time with a significance of $8.6\,\sigma$, and a measurement is made of the CP asymmetry, which is consistent with zero.
Moreover, with the recent measurement of branching fractions of the $B^0_{(s)} \to K^0_S h^+ h^{`-}$ decay modes ($h^{(`)} = \pi, K$) with 2011 data, a number of developments have been performed towards the analysis of the full dataset. In particular, the details considering a time integrated untagged Dalitz plot analysis will be described.

Parallel 2C / 44

Overview of 0-Lepton $Z(\nu\nu) + H(b\bar{b})$ Analysis and b-tagging MC Calibration

Author: Matthew Ian Jackson[1]

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Since its discovery a large effort has been made to improve analyses and confirm the properties of the Higgs Boson. At a mass of 125 GeV Higgs to $b\bar{b}$ is the dominant decay mode, however large QCD backgrounds prevent direct analysis, instead an analysis of Higgs to $b\bar{b}$ is considered where the Higgs is produced in association with a Vector Boson (W/Z). A brief overview of this analysis will be presented with particular focus on the $Z(\nu\nu)$ $H(b\bar{b})$ channel. Common to other analyses where high p_T jets are required flavour tagging is a dominant systematic in this analysis. Details of Monte Carlo studies helping to reduce these systematics are also presented.

Parallel 2D / 77

Building the background screening capability for LZ

Author: Chamkaur Ghag[1]

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The LZ dark matter experiment will require an unprecedented low background rate within its fiducial volume, defining strict constraints on radioactivity from construction materials that is further mitigated through the combination of powerful self-shielding from liquid xenon, 3D event vertex reconstruction, and external veto detector systems. An aggressive screening campaign with cutting-edge instrumentation must be performed, prior to construction, to measure the trace levels of radioisotopes in materials and construct the experiments background model.

To provide sufficient sensitivity for LZ and next generation rare event search experiments we are re-developing the UK's low-background screening capability. New ultra-low background HPGe detectors will be installed at the Boulby Underground Laboratory, itself undergoing substantial facility re-furbishment, to provide high sensitivity gamma spectroscopy for all DMUK and neutrino-less

double beta decay interests. Dedicated low-activity mass spectrometry instrumentation is being developed at UCL for part per trillion level contaminant identification to complement underground screening for complete assays and deliver crucial throughput demands. Finally, emanation screening at UCL, developed for SuperNEMO, delivers mitigation of radon background inaccessible to gamma or mass spectrometry techniques.

Parallel 2A / **47**

Characterisation of ATLAS planar pixel modules for ATLAS Upgrade

Author: Kate Doonan[1]

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Planar pixel sensors based on the Front-End-I4 (FE-I4) read-out developed for the Insertible b-Layer (IBL) are being characterised in laboratory tests and in test beams. Systematic tests are being performed to judge the performance of these sensors and read-out chips. Multiple geometries of pixel sensor have been developed. Laboratory tests include threshold and time-over-threshold tuning as well as source scans to determine bump-bond yield from the module-building process. Both data acquisition systems USBPix, developed at Bonn, and the RCE system, developed at SLAC, have been used to perform characterisations in the laboratory. A selection of modules have been irradiated to fluences expected after 10 years running at 14TeV in the pixel barrel of ATLAS. Both irradiated and un-irradiated modules have been tested in test beams in CERN (80GeV pions) and DESY (4GeV electrons) in conjunction with the EUTelescope. The data from the test beams is being reconstructed and analysed in order to determine efficiency and resolution of the sensors.

Summary:

Characterisation of FE-i4

Parallel 2C / **36**

The matrix element method in the search for dileptonic ttH(H→bb)

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With the expected reach of ttH(H→bb) not quite approaching Standard Model sensitivity, it is important to squeeze as much information out of the data as possible. The matrix element method calculates the probability of an event coming from signal (ttH) and background (ttbb) decay process by calculating the most likely kinematics of the hard scattering partons and comparing with the kinematics of the reconstructed objects. This talk will focus on ttH physics and the theory, implementation and results of the matrix element method in this channel.

Parallel 2B / **120**

Search for the two-body charmless baryonic B-decays $B^0 \to p\bar{p}$ and $B_s^0 \to p\bar{p}$ at LHCb

Author: John Beddow[1]

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Results from the recently published search for the rare decays $B^0 \to p\bar{p}$ and $B_s^0 \to p\bar{p}$ carried out using 0.92 fb^{-1} of 7 TeV proton-proton collisions collected by the LHCb experiment in 2011 will be presented (arXiv:1308.0961 [hep-ex]). The talk covers the physics motivation for the analysis and the tensions between existing theoretical predictions of the branching fractions, the selection criteria applied and a description of the Feldman-Cousins statistical analysis methods used to extract the branching fractions for the two decay channels. The status of an updated $B^0 \to p\bar{p}$ and $B_s^0 \to p\bar{p}$ analysis on the combined 2011 and 2012 data sets will also be presented as will details of a new analysis searching for the decay $B^+ \to p\bar{\Lambda}$.

Parallel 2D / 128

Beyond DEAP-3600: Development of a 50-tonne Next-Generation Liquid Argon Detector at SNOLAB

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Building on the experience with single-phase Liquid Argon detectors, wich are particularly well-suited for high-mass WIMP sensitivity, I will present a conceptual design for a next-generation 50-tonne detector. In this large detector, surface background events which are one of the primary concerns for DEAP-3600, are mitigated more readily with position reconstruction, ultimately allowing a more conventional and cost-effective detector design. The high-discrimination of LAr of electronic events also mitigates the effect the neutrino background is the limiting factor in the ultimate sensitivity of all dark matter detectors.

Parallel 2E / 129

Towards measuring charged current neutrino interactions in T2K's electromagnetic calorimeters

Author: Dominic Brailsford[1]

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We present the physics opportunities which can be explored with the Electromagnetic Calorimeters (ECals) of the Tokai-to-Kamioka (T2K) off-axis near detector (ND280). Due to the ECal's high mass, a large fraction of the neutrinos incident on ND280 interact within the constituent lead layers which form the ECal. This makes the ECal an excellent detector for use in making the world's first neutrino-lead charged current inclusive cross-section measurement at about 1 GeV as well as providing unique information about the T2K neutrino beam flux. The ECal reconstruction algorithms are currently tailored towards topologies for oscillation analyses. Such topologies prefer single charged particle tracks which originate from outside of the ECal fiducial volume. To fully reach the physics

potential of the ECal, the reconstruction algorithms are being updated with a method of pattern recognition which is capable of reconstructing neutrino interaction vertices. The reconstruction enhancement, together with the large T2K dataset, will provide important information about the neutrino interaction picture.

Parallel 2A / **88**

The CBC2 ASIC for 2S Modules at HL-LHC

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I will present the front-end readout ASIC for the High-Luminosity Upgrade of the CMS Strip Tracker. The CMS Binary Chip 2 is a full-scale prototype ASIC with 254 channels, capable of identifying high transverse-momentum trigger primitives by correlating hits between the two closely-spaced silicon strip sensors of the Tracker module. I will present the performance of the chip, together with the plans for its final version and an overview of current R&D activities, which include a first beam test of a prototype module and preliminary irradiation testing.

Parallel 2B / **109**

Time-dependent measurements of CP violation in charm

Author: Mark Elliot Smith[1]

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The method for the measurement of two charm CP violating observables, A_Γ and y_{CP}, is presented. The results for A_Γ are shown to be the most precise to date.

Parallel 2E / **102**

Selecting electron anti-neutrino charge current events in the ND280 tracker at T2K

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In 2014 the T2K experiment will reverse the polarity of the magnetic horns and begin running with an anti-neutrino beam for the first time. Differences in the oscillation probabilities between neutrinos and anti-neutrinos may provide insight into charge-parity violation in the leptonic sector. In order to measure the the anti-electron neutrino contamination in T2K's anti-muon neutrino beam, an anti-neutrino selection has been developed for the ND280 near detector and tested using Monte-Carlo simulations of an anti-neutrino beam. The electron anti-neutrino selection faces new challenges not seen in the electron neutrino selection. The most significant

challenge is the removal of protons which were removed by the charge requirement in the electron neutrino selection but are a significant background in the electron anti-neutrino analysis.

Parallel 2D / 35

The search for heavy neutrinos at NA62

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Heavy neutrinos are predicted by many beyond-the-Standard-Model theories of particle physics, with proposed masses ranging from a few eV/c^2 up to the Planck scale. Two-body kaon decays provide a method to search for these particles in a model independent manner, for masses between 100 MeV/c^2 and 388 MeV/c^2. In 2007, the NA62 experiment at CERN collected a large sample of charged kaon decays with a low intensity beam and minimum bias trigger conditions, which can be used to put limits on the mixing between heavy neutrinos and the Standard Model muon neutrino. Here, the method is discussed and the predicted sensitivity is compared with existing limits in the literature.

Summary:

NA62 can perform peak searches in existing data from kaon decays to place limits on the existence of heavy neutrinos.

Parallel 2C / 39

Novel Techniques to improve the Invariant Dijet Mass Reconstruction in the Standard Model Higgs boson resonance search $H \to b\bar{b}$ in association with a W/Z boson using the ATLAS detector

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An updated direct search for a Standard Model Higgs boson decaying into pairs of b quarks in association with a W or Z boson using the ATLAS detector at the LHC is presented. The search is performed in the three decay modes $ZH \to \nu\nu b\bar{b}$, $WH \to \ell\nu b\bar{b}$ and $ZH \to \ell\ell b\bar{b}$ with ℓ denoting either electrons or muons and has to cope with overwhelming backgrounds from the dijet production expected from QCD interactions. Final state radiation and reconstruction effects may decrease the $b\bar{b}$ resonance resolution significantly while comparably decreasing the probability of observing the decay over the background. This talk presents the development and evaluation of advanced techniques to improve the invariant dijet mass reconstruction.

Parallel 2A / 76

TORCH - a Cherenkov based Time-of-Flight Detetor

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Co-authors: Carmelo D'Ambrosio [2]; Christoph Frei [2]; David Cussans [1]; Didier Piedigrossi [2]; Johan Maria Fopma [3]; Lucia Castillo Garcia [4]; Neville Harnew [3]; Nicholas BROOK [5]; Roger Forty [2]; Rui Gao [3]; Thierry Gys [2]; Tibor Keri [3]

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TORCH (Time Of internally Reflected CHerenkov radiation) is an innovative time-of-flight system designed to provide particle identification over large areas up to a momentum of 10 GeV/c. Cherenkov photons emitted within a 1 cm thick quartz radiator are propagated by internal reflection and imaged on to an array of Micro-Channel Plate photomultiplier tubes (MCPs).

Performing 3-σ pion/kaon separation at the limits of this momentum regime requires a time-of-flight resolution per track of 10-15 ps, over a ˜10m flight path. With ˜30 detected photons per track the required single-photon time resolution is ˜70 ps.
This presentation will discuss the development of the TORCH R&D program and present an outline for future work.

Summary:

TORCH (Time Of internally Reflected CHerenkov radiation) is a highly compact Time-of-Flight (ToF) system utilizing Cherenkov radiation to achieve particle identification up to 10 GeV/c. At the upper limit of this momentum, a 10-15 ps resolution per track is required to achieve a 3-σ ToF difference between pions and kaons.

TORCH will consist of a 1cm thick radiator plate equipped with light guides along the top and bottom of the plate which focus the produced Cherenkov radiation onto a series of micro-channel plate photomultipliers (MCPs). Precise timing of the arrival of the photons and their association with a particle track is then used to determine the particle time-of-flight. Around 30 photons are expected to be detected per track which results in a required time resolution per photon of around 70 ps. The time of propagation of each photon through the plate is governed by its wavelength which affects both its speed of propagation and its Cherenkov emission angle, and by measuring this angle to 1mrad precision TORCH will correct for chromatic dispersion.

The performance of the system relies on the MCP combining fast timing and longevity in high radiation environments, with a high granularity to allow precise measurement of the Cherenkov angle. Development of a 53 mm x 53 mm active area device with 8x128 effective pixel granularity, sub 50ps time resolution and long lifetime is under way with an industrial partner as part of the TORCH development.

A GEANT-4 simulation of the TORCH detector and its performance is currently being developed, taking account of the contributions to the overall TORCH resolution. This talk will focus on the requirements of the TORCH design and R&D developments including progress toward a prototype and the development and laboratory tests of the MCP.

Parallel 2A / 90

LHCb's future vertex detector

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A major upgrade of the LHCb experiment is planned to start taking data in 2020.
The LHCb Vertex Locator will be replaced by a new and highly novel detector.
It will be based on radiation hard hybrid pixel sensors, with a pixel dimension of 55×55 μm, cooled using CO_2 flowing through microchannels integrated into the silicon.
During operation, the sensors will be only 5 mm from the LHC beams.
The general design, optimisation process and expected performance of this Vertex Locator will be described.

Parallel 2D / 55

A search for long lived neutral particles decaying to photons at the ATLAS detector

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Long lived neutral particles that decay within the volume of a particle detector to a photon and a dark matter candidate will leave a unique signature which cannot be explained by any Standard Model process providing clear evidence of new physics.

This talk will present an analysis performed on the data collected by the ATLAS Collaboration in 2011 at a center of mass energy of 7TeV searching for events containing two photons and a large amount of missing energy from the decay of long lived neutral particles. The results are interpreted in terms of Gauge Mediated Symmetry Breaking where the lightest neutralino is the long lived neutral particle which decays to a photon and a gravitino, the lightest Supersymmetric particle and dark matter candidate. Limits are set on the mass and the lifetime of the lightest neutralino. Improvements made to the method being used to analyse the 8TeV center of mass data collected in 2012 and preliminary results will also be presented.

Parallel 2C / 51

Search for the Higgs Boson $b\bar{b}$ decay with the ATLAS detector

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One of the main results of the Large Hadron Collider Run I was the discovery of the Higgs boson by ATLAS and CMS experiments. The boson has been discovered with a mass of around 125 GeV and all measurements performed so far are compatible with the Standard Model predictions.

However, clear evidence of the boson decaying to a pair of b-quarks has not been observed yet, despite it being the dominant decay mode predicted by theory, making this a crucial measurement to establish the nature of the boson.

The ATLAS search for the $b\bar{b}$ decay with the full Run I dataset is presented, considering the Higgs boson production in association with a vector boson (W, Z).

The analysis is validated with a measurement of WZ and ZZ production, with $Z \to b\bar{b}$, which is found to be compatible with the Standard Model expectation.

Parallel 2B / 83

D mixing in multi-body decays

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Although mixing in neutral K and B systems has long been established, mixing in neutral D mesons has only recently been observed. In fact, in 2012 LHCb published the first single observation of D mixing in $D^0 \to K^-\pi^+$ decays.

LHCb has now collected enough data to study D mixing in multi-body D decays such as $D^0 \to K^+\pi^-\pi^0$ and $D^0 \to K^+\pi^-\pi^+\pi^-$. Whilst these decay modes do not necessarily provide as much sensitivity to mixing, they provide us with another exciting opportunity.

D mixing results in a time dependent superposition of D^0 and $\bar{D}^0$ states. This superposition is defined by the dimensionless mixing parameters x and y. With knowledge of x and y from other analyses, we can now use D mixing to investigate the interference effects betweek D^0 and $\bar{D}^0$ amplitudes, including information on their relative phase.

In particular, one can constrain the coherence factor, $R_{K\pi\pi\pi}$, and average strong phase difference $\delta_{K\pi\pi\pi}$. These two parameters provide important input to extracting the CP violating phase γ in $B^\pm \to DK^\pm$ decays.

Parallel 2E / 104

Sensitivities to neutrino oscillation parameters of the Hyper-K experiment

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Hyper-Kamiokande is a next generation underground water Cherenkov detector which will serve as far detector of a long-baseline neutrino experiment in Japan (the natural extension of the already successful T2K experiment).

The upgraded facilities at J-PARC will deliver an off-axis narrow band (˜0.6 GeV) (anti-)neutrino beam (750kW˜1MW) and direct it to Hyper-K that will measure the appearance and disappearance parameters with unprecedented precision as well as potentially discover CP violation in the lepton sector.

Hyper-K consists of two cylindrical tanks lying side-by-side, whose total (fiducial) mass is 0.99 (0.56) million metric tons (about 20 (25) times larger than that of Super-K).
The inner detector region of the Hyper-K detector is covered by 99,000 20-inch PMTs (20% photocathode coverage of PMT density).
The near detector complex will include: INGRID and ND280 (on-axis and off-axis detector at 280 m from the target, already used by the T2K experiment) and a new near detector to be possibly built at 2 km from the target.
The near detectors will help constraining the neutrino flux and systematic errors.

If the mass hierarchy is known, Hyper-K is expected to determine the CP phase to better than 19 degrees for all possible values of delta and CP violation can be determined at 3 sigmas for 76% of the delta parameter space (considering 5 years exposure to neutrino beam produced by the 1.66 MW J-PARC proton synchrotron).

Parallel 2E / 111

Near Detector Simulations in LAGUNA-LBNO

Author: Thomas Stainer[1]

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LAGUNA-LBNO (Large Appartus studying Grand Unification and Neutrino Astrophysics for Long Baseline Neutrino Oscillations) is a feasibility study with the intent to host next generation neutrino detectors. These experiments possess the ability to probe the universe further with proposed detectors of the 100 kton scale. A basic overview of the long baseline experiment is presented with the focus on the Near Detector design. Monte Carlo
simulations form the basis of the study. A high pressure gas Argon TPC design is implemented and its capabilities are presented with neutrino energy reconstruction techniques employed.

Parallel 2C / 48

Search for the Standard Model Higgs Boson decaying to bb produced in association with a W boson with the ATLAS detector

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The most recent published results for the ATLAS search for a Standard Model Higgs Boson decaying to bb in association with a W boson will be presented. The Higgs decay to bb is a crucial test of the Standard Model Higgs Boson but the search must be made in associated production modes. The search has been performed using 4.7 fb^{-1} of data collected at $\sqrt{s}$=7TeV and 20.3 fb^{-1} at $\sqrt{s}$=8TeV. No significant excess is observed and limits are placed on the cross section times branching ratio.

Parallel 2B / 89

Crystal collimation for LHC

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One of the main challenges at the CERN Large Hadron Collider (LHC) is to handle the unprecedented stored beam energies that are expected to be up to 360MJ with 7˜TeV beams at 25˜ns bunch spacing. This may increase to 500˜MJ in the LHC High Luminosity upgrade project (HL-LHC). A complex collimation system, able to intercept and to absorb beam halo particles efficiently is used to

minimize losses onto superconducting magnets that could cause them to quench. The present collimation system consists of about 50 two-sided collimators per beam, which are precisely placed at the edge of the transverse beam envelope in a four-stage hierarchy. This system has worked very well during LHC Run˜1 at 3.5 and 4 TeV, essentially achieving the design cleaning inefficiency of about 10^{-5}. However, this will be not enough for the future operational challenges of the LHC and its upgrades. A very promising technology to overcome the limitations of the present system is based on silicon crystals instead of amorphous primary collimators. A bent crystal can be used as a primary collimator, using the principle of channeling by the atomic planes, to deflect halo particles onto a heavy absorber. Experimental tests have been carried out over the last 4 years at the CERN Super Proton Synchrotron (SPS), showing the feasibility of beam cleaning using channeling. Application in the LHC requires detailed simulations and the execution of beam tests in the LHC itself, which are foreseen in 2015. Extensive design studies have been carried out to integrate suitable crystals into the collimation system layout, and samples are presently being installed in the LHC. According to simulations, this should lead to an improvement of up to a factor 10 in collimation cleaning thanks to efficient steering of halo particles onto a single absorber. The design of the crystal layout for the first LHC beam tests and the state of simulation tools for crystal collimation studies, bench-marked against the SPS beam measurements, will be discussed.

Parallel 2D / 61

Search for high-mass dilepton resonances in 21 fb^{-1} of pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS experiment

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The ATLAS detector at the Large Hadron Collider is used to search for high mass resonances decaying to an electron-positron pair or a muon-antimuon pair. Results are presented from the analysis of pp collisions at a center-of-mass energy of 8 TeV corresponding to an integrated luminosity of approximately 21 fb^{-1}. A narrow resonance with Standard Model Z couplings to fermions is excluded at 95% C.L. for masses below 2.79 TeV in the electron channel, 2.53 TeV in the muon channel, and 2.90 TeV in the two channels combined. Limits on other model interpretations are also presented, including a Grand Unification model based on the E6 gauge group, Z^* bosons, Minimal $Z^{'}$ Models, a spin-2 Randall-Sundrum graviton, quantum black holes and a Minimal Walking Technicolor model with a composite Higgs boson.

Parallel 2A / 79

Sensor R&D for the stable operation of the LZ detector

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Maintaining stable operating conditions is of utmost importance in any dark matter detector. The LZ detector will be the largest two-phase liquid xenon detector ever constructed and as such will

require unsurpassed levels of monitoring. This talk will discuss R&D efforts to this end in the UK and will cover the development of position, liquid level and piezo-electric bubble sensors and of loop antennae for the detection of electric discharges.

Parallel 2C / 57

Using a Regressional Analysis to Improve the b-jet energy correction in $WH \rightarrow \ell\nu bb$ Searches at ATLAS

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Presented is a method to improve the b-jet energy resolution with the task of increasing the signal sensitivity in searches decaying to a b, anti-b quark pair in the final state. The machinery has been tested using Monte Carlo simulated samples in the process $WH \rightarrow l\nu bb$. The method trains a function through regression applying a correction factor to bring the reconstructed jet energy closer to that of generator level energy. This narrows the b anti-b jet mass peak of the signal, and therefore increases the signal to background separation

Parallel 2E / 140

Neutrino Oscillation Search With MINOS+

Author: Joseph O'Connor[1]

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Analysis of the complete set of MINOS accelerator and atmospheric data, combining ν_μ disappearance and ν_e appearance, was published in March 2014. This yielded precision measurements of Δm^2_{32} and $sin^2(\theta_{23})$ as well as early constraints on δ_{CP}. The first results from MINOS+, adding 2 years of atmospheric and 6 months of beam ν_μ disappearance data to the MINOS analysis, are due in the summer. Here I present work towards these results.

Parallel 2B / 123

Investigating the Microbunching Instability at Diamond Light Source

Author: William Shields[1]

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Diamond Light Source is a third generation synchrotron facility dedicated to producing radiation of outstanding brightness. Above a threshold current, the electron bunches are susceptible to a phenomenon known as the microbunching instability. The key feature of this instability is the emission of coherent radiation bursts, which have wavelengths of the order of the bunch length and smaller. The bursting at the threshold is emitted quasi-periodically, however increasing to a higher current results in the bursting to appear random in nature.

The high frequencies involved in these emissions make characterizing the phenomenon a challenging task. A setup at Diamond has been built, dedicated to the investigation of this phenomenon. An overview of the project will be presented, including a description of the instability, the experimental setup, and recent results.

Parallel 2A / 82

High voltage delivery in LZ

Author: Alfredo Tomas Alquezar[1]

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LUX-ZEPLIN (LZ) is a next-generation direct dark matter search experiment based on a 7-tonne double-phase xenon detector. The large active xenon target brings many benefits, namely outstanding self-shielding of an inner fiducial volume, but also some practical challenges, in particular the need to provide high voltages to sustain the required electric fields. LZ is undertaking a comprehensive R&D programme to address the different aspects involved, such as the development of feedthroughs with a design voltage of 200 kV, aiming for an operating voltage of 100 kV at the cathode electrode. Intriguing phenomenology has been emerging from previous attempts to sustain strong electric fields in ultrapure liquid noble gases, and our programme addresses the physics processes involved at a microscopic level too. Our understanding of the HV breakdown mechanisms will inform the engineering solutions and procedures adopted in LZ. In particular, a test system is being operated at Imperial College to study high field phenomena at the surface of thin metal wires, one of the most challenging aspects of HV delivery to noble liquids.

Parallel 2D / 73

Searches for violation of lepton flavour and baryon number in tau lepton decays at LHCb

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We report on searches for the lepton-flavour violating decay $\tau^- \to \mu^-\mu^+\mu^-$ and the lepton-flavour and baryon-number violating decays $\tau^- \to p\mu^-\mu^-$ and $\tau^- \to \bar{p}\mu^+\mu^-$, carried out using 1.0 inverse femtobarn of proton-proton collision data taken by the LHCb experiment at 7 TeV during 2011.
No evidence has been found for any signal, and limits have been set at 90% confidence level on the branching fractions: BF($\tau^- \to \mu^-\mu^+\mu^-$) $< 8.0 \times 10^{-8}$,
BF($\tau^- \to p\mu^-\mu^-$) $< 3.3 \times 10^{-7}$ and BF($\tau^- \to \bar{p}\mu^+\mu^-$) < 4.6×10^{-7}.
The result for BF($\tau^- \to \mu^-\mu^+\mu^-$) is consistent with previous limits, while the measurements of the $\tau^- \to p\mu^-\mu^-$ and $\tau^- \to \bar{p}\mu^+\mu^-$ decay modes represent the first experimental limits on these channels.

Parallel 2B / 155

The AWAKE experiment beam-plasma interaction simulations

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Parallel 2A / 121

The SoLid Experiment

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Oscillation to sterile neutrinos is considered as a possible explanation for the reactor and Gallium neutrino anomalies, which both measured a deficit of neutrinos at short distances from the respective sources.
The SoLid experiment will test this hypothesis by measuring neutrino energy spectra between 6-8 m from a reactor core and looking for distortions in the spectra at different distances caused by any oscillation.
The experiment uses a novel detector design built up from PVT scintillator cubes with one face covered by a mixture of lithium-6 fluoride and silver activated zinc sulphide.
Electron anti-neutrinos from the reactor are reconstructed from the detection of the positron and neutron from Inverse Beta Decay (IBD) events.
The positrons are detected in the PVT scintillator, while the neutrons thermalise and then react with the lithium-6, producing particles which are detected in the zinc sulphide scintillator.
Due to the properties of the two scintillators the positron and neutron signals can easily be distinguished.
The highly segmented detector means that precision timing and location of the detected neutron (relative to the prompt positron signal) can be used in identifying IBD events, enabling a strong suppression of an accidental combination of the background neutron signal with the high rate of gamma rays coming from the reactor.

The experiment will be performed at the BR2 research reactor at SCK-CEN in Mol, Belgium.
A small (8 kg) prototype detector was constructed in 2013 and has been deployed at the experimental site during a number of reactor on/off cycles.
The prototype detector is being used to understand the background signals expected for the experiment and to measure the detector response so that the full scale detector's design can be optimised.
In this talk the motivation for the experiment will be reviewed, the experimental set-up will be introduced and the detection principle will be explained using data collected by the prototype.

Parallel 2D / 80

Axion search prospects with the LZ experiment

Author: Paolo Beltrame[1]

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Whilst Weakly Interactive Massive Particles (WIMPs) remain the favoured candidates for dark matter, recent LHC results significantly constrain the available parameter space for several models, including supersymmetric neutralinos. Amongst alternative explanations for the astrophysical evidence of dark matter, axions –more specifically the so-called 'invisible'axions and axion-like-particles (ALPs) –are well motivated. Stars and the galaxy can be considered as the primary sources, while the most credited models presently are hadronic DFSZ and the GUT KSVZ. Liquid xenon is widely considered to be one of the best target media for detection of WIMPs using nuclear recoils. However these detectors also provide an extremely low radioactivity environment for electron recoils. Thus, very weakly interacting low-mass particles (<100 keV/c^2), such as the hypothetical axion, could be

detected as well in this case using the axio-electric effect. This process is equivalent of a photo-electric effect with the absorption of an axion instead of a photon. We present the LZ potential for these searches, testing the axion coupling to electron (gAe) and setting constraints on the solar axion mass according to the aforementioned models.

Parallel 2E / 34

Manifest causality in QFT with sources and detectors

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In arXiv: 1312.3871, we introduce a way to compute transition amplitudes in quantum field theory for scatterings between sources and detectors, that is scatterings over finite space-time domains. Our amplitudes are manifestly causal, by which we mean that the source and detector are always linked by a connected chain of retarded propagators. We illustrate how these amplitudes may be obtained from a path-integral representation that closely resembles the in-in formalism of thermal field theory, introduced by Schwinger and Keldysh. Finally, we prove the tree-level equivalence of these amplitudes with the S-matrix and comment on potential deviations at the level of loops.

Parallel 2C / 70

Evidence for the 125GeV Higgs boson decaying to a pair of tau leptons at CMS

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A search for the standard model Higgs boson decaying into a pair of tau leptons is presented, using data recorded by the CMS experiment in 2011 and 2012. The analysis includes all 6 possible final states of the two taus, each of which decays either hadronically or leptonically into an electron or muon. An excess of events over the expected contribution from backgrounds is observed, corresponding to a local significance of larger than 3 sigma for Higgs masses between 110 and 130 GeV. The excess is consistent with standard model predictions and provides evidence for the 125 GeV Higgs boson decaying into a pair of tau leptons.

Parallel 2B / 157

Muon tomography to monitor carbon sequestration

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Parallel 2A / 84

Detecting Special Nuclear Material With Muon Scattering Tomography

Author: Christian Thomay[1]

Co-authors: David Cussans [2]; Jaap Velthuis ; Paolo Baesso [1]

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We present a novel approach to the detection of special nuclear material using cosmic rays. Muon Scattering Tomography (MST) is a method for using cosmic muons to scan cargo con- tainers and vehicles for special nuclear material. Cosmic muons are abundant, highly penetrating, not harmful for organic tissue, cannot be screened against, and can easily be detected, which makes them highly suited to the use of cargo scanning. Muons undergo multiple Coulomb scattering when passing through material, and the amount of scattering is roughly proportional to the square of the atomic number Z of the material. By reconstructing incoming and outgoing tracks, we can obtain variables to identify high-Z material. In a real life application, this has to happen on a timescale of 1 min and thus with small numbers of muons. We have built a detector system using resistive plate chambers (RPCs): 12 layers of RPCs allow for the readout of 6 x and 6 y positions, by which we can reconstruct incoming and outgoing tracks. We also present the performance of an algorithm by which we separate high-Z targets from low-Z background, both for real data from our prototype setup and for MC simulation of a cargo container-sized setup.

Parallel 2E / 60

The N_2-dominated scenario of leptogenesis

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I shall briefly review the main aspects of leptogenesis, describing both the unflavoured and the flavoured versions of the N_2-dominated scenario. A study of the success rates of both classes of models has been carried out and I will comment on that, as well as on the incidence of corrective effects to the simplest scenario. I will then focus on the flavoured case and consider the conditions required by strong thermal leptogenesis, where the final asymmetry is fully independent of the initial conditions. Barring strong cancellations in the seesaw formula and in the flavoured decay parameters, I will show that strong thermal leptogenesis favours a lightest neutrino mass $m_1 >\sim 10\,\mathrm{meV}$ for normal ordering and $m_1 >\sim 3\,\mathrm{meV}$ for inverted ordering. Finally, I shall briefly comment on the power of future absolute neutrino mass scale experiment to either support or severely corner strong thermal leptogenesis.

This work is mainly based on *arXiv:1401.6185*

Parallel 2C / 151

Search for invisible Higgs decays in the VBF channel using the CMS detector

Author: João Pela[1]

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

Corresponding Author: joao.pela@cern.ch

All measurements of the 125 GeV boson to date indicate compatibility with a SM Higgs boson, but the associated uncertainties are large, and the possibility for non-SM properties remains. In addition, although additional SM-like Higgs bosons have been excluded over a wide mass range, additional Higgs bosons with exotic decay modes remains a possibility, and are predicted by many models. Invisible Higgs boson decay modes are possible, for example, through decays to neutralinos in supersymmetric models, or graviscalars in models with extra dimensions.
A search for invisible decays of Higgs bosons is present using the vector boson fusion production mode, using the full 2012 $\sqrt{s} = 8$ TeV dataset recorded by the CMS experiment. Events are selected with a dedicated trigger based on the vector boson fusion tag jet topology, together with large missing transverse energy. The offline selection makes further use of the tag jet topology. The results of this analysis were further combined with the associated production ZH channel to obtain additional sensitivity.

Plenary 5 / **3**

LHC Detector Upgrades

Corresponding Author: g.hall@imperial.ac.uk

Over the next decade a series of upgrades to both the LHC machine and the experiments which operate at the LHC will be carried out. Some of them are already under way. A brief summary will be given of the motivations for detector upgrades, with the accelerator schedule as it is currently foreseen, and a short review of the major elements of the upgrade plans for the four LHC experiments, highlighting the most important challenges.

Plenary 5 / **21**

The Next-Generation Particle Accelerator

Corresponding Author: frank.zimmermann@cern.ch

Options for the next high-energy electron-positron collider are reviewed, by comparing a linear-collider design - the ILC - with proposed circular collider Higgs factories such as FCC-ee/TLEP. This presentation sketches relative construction costs, some key intrinsic features of circular and linear colliders, issues related to electrical power consumption, interaction-point spot sizes, luminosity potential, energy scaling laws, technical risks, empirical commissioning times, and several possible future scenarios.

Plenary 5 / **10**

Future Long Baseline Neutrino Oscillation Experiments and Detectors

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

The next generation of accelerator neutrino oscillation experiments will have significant discovery potential for CP violation in the lepton sector. I will review the physics prospects of these experiments, with emphasis on the UK's role in them.

Plenary 5 / **8**

Gravitational Wave Detection: the Advanced Generation of Gravitational-Wave Detectors

Corresponding Author: sheila.rowan@glasgow.ac.uk

This talk will cover the status of activities for the construction and commissioning of the imminent generation of the gravitational GW detectors due to start first science runs next year. It will focus on the status of and plans for the Advanced LIGO observatories (in Hanford Washington, and Livingston Louisiana, USA) and Advanced Virgo (near Cascina, Italy), and their operation in the global network.

Plenary 6 / **19**

Why do we live in a Matter Dominated Universe?

Corresponding Author: silvia.pascoli@cern.ch

With the discovery of neutrino oscillations, the existence neutrino masses have been established pointing towards new Physics beyond the Standard Model. New compelling questions are open for the future: is lepton number conserved? Is there CP-violation? Where does the observed leptonic flavour structure come from? After a very brief overview of the related phenomenological issues, I will discuss the physics beyond the Standard Model which may be responsible for neutrino masses and how this can be related to the origin of the baryon asymmetry in the leptogenesis framework.

Plenary 6 / **15**

Particle Theory: Where We Go From Here

Corresponding Author: j.march-russell1@physics.ox.ac.uk

Plenary 6 / **17**

Accelerators: How Do We Get to 100 TeV?

Corresponding Author: shiltsev@fnal.gov

Particle colliders for high-energy physics have been in the forefront of scientific discoveries for more than half a century. The accelerator technology of the colliders has progressed immensely, while the beam energy, luminosity, facility size, and cost have grown by several orders of magnitude. The method of colliding beams has not fully exhausted its potential but has slowed down considerably in its progress. I will briefly review the development of the collider technology, examine near-term collider projects that are currently under development, derive a simple scaling model for the cost of large accelerators and colliding beam facilities based on costs of 17 big facilities which have been either built or carefully estimated. The cost parametrization will guide our consideration of possible future frontier accelerator facilities. I will conclude with an attempt to look beyond the current horizon and to find what paradigm changes are necessary for breakthroughs in the field.

Plenary 7: STFC Town Meeting and the Global Programme / 64

Town Meeting: State of the STFC

Corresponding Author: john.womersley@stfc.ac.uk

Plenary 7: STFC Town Meeting and the Global Programme / 65

Science Board Report

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Q&A

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The Global Strategy in Particle Physics

Corresponding Author: tatsuya.nakada@cern.ch

Plenary 7: STFC Town Meeting and the Global Programme / 67

Panel on Future Directions in Particle Physics

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RAL Particle Physics Department

Corresponding Author: david.wark@stfc.ac.uk

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End

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LHC Detector Upgrades

Author: Geoff Hall[1]

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

Corresponding Author: g.hall@imperial.ac.uk

Over the next decade a series of upgrades to both the LHC machine and the experiments which operate at the LHC will be carried out. Some of them are already under way. A brief summary will be given of the motivations for detector upgrades, with the accelerator schedule as it is currently foreseen, and a short review of the major elements of the upgrade plans for the four LHC experiments, highlighting the most important challenges.

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The Status of Beyond Standard Model Searches at the LHC

Author: Henning Flacher[1]

[1] *University of Bristol (GB)*

The search for physics beyond the Standard Model is a priority in the physics programme of the ATLAS and CMS collaborations. These searches cover a wide variety of experimental signatures and proposed models, ranging from, e.g., supersymmetry to heavy gauge bosons, extra dimensions and dark matter. In this talk the latest results obtained with up to 20/fb of data collected at 8 TeV centre-of-mass energy are presented and the implications on the parameter space of different new physics models are discussed.

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Pile-up subtraction and suppression for jets in ATLAS

Author: Craig Anthony Sawyer[1]

[1] *University of Oxford (GB)*

Corresponding Author: craig.sawyer@cern.ch

2012 saw unprecedented levels of pile-up (multiple interactions per bunch crossing) in collisions at the LHC. This presented a challenging environment in which to calibrate jets for use in both precision analyses and new physics searches. This poster details the jet-area-based pile-up suppression techniques that were developed by ATLAS for 2012 data taking and form the first stage in the jet energy calibration scheme.

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Thick GEM R&D for Low-Mass Dark Matter Searches

Author: Andrew Scarff[1]

[1] *University of Sheffield*

This work is to progress with R&D on using Thick GEMs (ThGEM) in a gaseous time projection chamber (TPC) for directional particle detection. It has the potential to be used for low mass WIMP detection with a major area of work being to focus electrons to smaller electrodes to lower the costs in any scale up that may be required.

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Planck: 2013 results and future prospects

Author: Anthony Challinor[1]

[1] *University of Cambridge*

Corresponding Author: a.d.challinor@ast.cam.ac.uk

I review the main cosmology results from the 2013 Planck release. I will also discuss some developments since the original submission of the papers, and put the Planck results in the context of more recent results from the BICEP2 experiment.

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Cosmogenic background study for the Long-Baseline Neutrino Experiment

Author: Thomas Warburton[1]

[1] *University of Sheffield*

Cosmogenic background for a 10 kton liquid Argon time projection chamber (LAr-TPC) surface detector for LBNE is simulated. It is found that through the use of effective cuts a detector would be able to observe neutrino oscillation. The effectiveness of these cuts is hoped to be shown through analysis of a 35 ton prototype that takes data in early 2015.

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Neutrino Mass Searches with Beta Decay Experiments

Author: Jeff Hartnell[1]

[1] *University of Sussex*

Corresponding Author: j.j.hartnell@sussex.ac.uk

Neutrinos are the second most abundant particle in the universe and yet one of the least understood. Their fundamental nature, whether they are their own antiparticle, is not yet known and the heaviest neutrino has a mass that we currently only known to within a range that spans about two orders of magnitude. In this talk I will review single beta decay experiments, which give us a model independent measure of neutrino mass based solely on kinematic parameters and energy conservation; and double beta decay experiments that allow us to probe the nature of the neutrino and the scale of absolute neutrino mass. Recent results from experiments and updates on the next generation of experiments, in particular SNO+ and SuperNEMO will be described.

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Muon Tomography for Carbon Storage Monitoring

Author: David Woodward[1]

[1] *The University of Sheffield*

Muon transport simulations have been performed in Geant4 to test the sensitivity of muon tomography for monitoring carbon storage. An accurate geological model of the overburden above the Boulby mine has been used and CO2 injection is simulated by changing the bulk density of a volume of rock. The change in muon flux through a 1000 mˆ2 detector at a depth of 776 m after CO2 injection is predicted to be statistically significant after ˜ 5% of a year.

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The Status of the LHC Higgs Programme

Author: Bill Murray[1]

[1] *University of Warwick (GB)*

Corresponding Author: bill.murray@stfc.ac.uk

The LHC Higgs programme has been spectacularly successful in discovering what has been variously called 'A new boson', 'a Higgs-like boson' and 'a Higgs boson' even while the machine was running well below design energy. But what do we really know about this particle? Why don't we just call it 'The Higgs boson', and will we ever do so? And what can it tell us about the remaining mysteries such as Dark Matter?
Bill Murray has been closely involved with this search with the ATLAS experiment at CERN's LHC, and this talk contains the latest results on all these questions.

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Dark Matter Direct Detection

Author: James Nikkel[1]

[1] *Royal Holloway University of London*

Corresponding Author: james.nikkel@rhul.ac.uk

Physicists are still looking for what makes up most of our galaxy, and while there may be some hints, dark matter still has not been conclusively observed in the lab. I will present the current status of direct dark matter detection and the direction in which this research is headed.

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The Next Accelerator

Author: Frank Zimmermann[1]

[1] *CERN*

Corresponding Author: frank.zimmermann@cern.ch

Options for the next high-energy electron-positron collider are reviewed, by comparing a linear-collider design - the ILC - with proposed circular collider Higgs factories such as FCC-ee/TLEP. This presentation sketches relative construction costs, some key intrinsic features of circular and linear colliders, issues related to electrical power consumption, interaction-point spot sizes, luminosity potential, energy scaling laws, technical risks, empirical commissioning times, and several possible future scenarios.

Summary:

Options for the next high-energy electron-positron collider are reviewed and compared.

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Scatter, Scatter, Scintillation Photons in Solid and Liquid Argon, Xenon, and Krypton

Author: Emily Grace[1]

[1] *R*

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The speed and path traveled of light in vacuum is well known and easy to predict. Once light travels though a medium, the speed changes and the light becomes likely to scatter. The speed change and scattering is directly related to the wavelength of the light and thermodynamical properties of the medium in which it travels. This is of particular interest to those using argon, xenon, or krypton scintillating detectors under different thermodynamic conditions for proper optical modeling. Using previously published data on the temperature dependent index of refraction of liquid and solid argon, xenon, and krypton and the Sellmeier equation, we have extrapolated the index of refracation at the scintillation wavelength and used this to calculate the Rayleigh scattering length at this wavelength.

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Electric Dipole Moments, Recent Results and Prospects

Author: Clark Griffith[1]

[1] *University of Sussex*

Measurement of a non-zero permanent electric dipole moment (EDM) would be clear evidence of a new source of CP violation outside of the quark mixing CKM matrix, and would be a possible signature of Supersymmetry. I will give an overview of current EDM experiments, including searches for atomic EDMs, recent improvements on the electron EDM upper bound measured in polar molecules, and the status of efforts to improve the neutron EDM limit. I will also discuss the Fermilab muon g-2 experiment and its prospects for measuring the muon EDM.

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CASCADE

Author: Nathan Woollett[1]

Co-authors: Ian Bailey [1]; Matti Kalliokoski [2]; Peter Williams [3]

[1] *Lancaster University*

[2] *CERN (CH)*

[3] *STFC Daresbury Laboratory*

Corresponding Author: n.woollett@lancaster.ac.uk

Currently there are a number of 'Light Shining Through a Wall'(LSW) experiments taking place to search for weakly-interacting sub-eV particles(WISPs). The hidden sector photon(HSP) is an example of a WISP which, if massive, could be detected though kinetic mixing with the Standard Model photon. As HSPs do not couple electrically, they can be searched for using an LSW experiment. For HSP rest masses corresponding to microwave frequencies such an experiment can be made from copper or superconducting cavities, similar to those used in accelerators.

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Top-quark width studies at ATLAS

Authors: Javier Alberto Murillo Quijada[1]; John Allan Wilson[1]; Juergen Thomas[1]; Simon Head[1]

[1] *University of Birmingham (GB)*

Corresponding Author: javier.alberto.murillo.quijada@cern.ch

A preliminary study of the top-quark width (Γ_{top}) is performed using the ATLAS collaboration official Monte Carlo (MC) samples corresponding to proton-proton collisions with centre of mass energy of $\sqrt{s}$ = 8 TeV and scaled to integrated luminosity $\int Ldt$ = 20.3fb^{-1}. Templates with different values of Γ_{top} are generated assuming an underlying truth top mass distribution with relativistic Breit-Wigner shape, as modelled in the MC generator. The reconstructed top mass has been obtained by minimising a χ^2 function and simulated experiments have been studied.

Summary:

A preliminary study of the top-quark width (Γ_{top}) is performed using the ATLAS collaboration official Monte Carlo (MC) samples corresponding to proton-proton collisions with centre of mass energy of $\sqrt{s}$ = 8 TeV and scaled to integrated luminosity $\int Ldt$ = 20.3fb^{-1}. Templates with different values of Γ_{top} are generated assuming an underlying truth top mass distribution with relativistic Breit-Wigner shape, as modelled in the MC generator. The reconstructed top mass has been obtained by minimising a χ^2 function and simulated experiments have been studied.

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Low Mu Run analysis on Measurement of the 2012 Inclusive Jet Cross Section in pp collisions at $\sqrt{s}$ =8 TeV using the ATLAS detector

Author: Hilal Kucuk[1]

[1] *University of London (GB)*

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Jets are defined choosing the anti-kt algorithm with two radius parameters of 0.4 and 0.6. The inclusive double-differential cross section measurement at $\sqrt{s}$ =8 TeV at 2012 is performed as a function of jet transverse momentum, in bins of jet rapidity. The data sample with no pile-up has been collected on low mu run for detector calibration and "clean"physics studies. Additionally, it provides to measure the low-p_T . This talk will represent analysis of the inclusive jet double-differential cross-section on low mu run using function of the jet transverse momentum p_T and jet rapidity y, covering a range of 20 $\leq p_T$ < 430 GeV and |y| < 4.4.

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125 GeV Higgs, Now What?

Author: Chris Quigg[1]

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

Corresponding Author: quigg@fnal.gov

I will summarize the theoretical context for the search for the avatar of electroweak symmetry breaking, review what we have learned about $H(125)$, and outline what we need to learn about the new particle. I will describe some of the questions raised and opportunities opened by the discovery of $H(125)$, and how they influence our thinking about future accelerators. Finally, I will try to connect our studies of the Higgs sector with other explorations in particle physics.

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Probing New Physics through Flavour Violation

Author: Evgueni Goudzovski[1]

[1] *University of Birmingham*

Observation of charged lepton flavour violation (CLFV) would provide a clear signal for physics beyond the Standard Model. Selected recent experimental results and near-term prospects for the searches for CLFV processes are discussed. The processes considered include $\mu \to e$ conversion, $\mu \to e\gamma$ decay and lepton flavour violating decays of the charged kaons.

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The Use of Artificial Neural Networks to Detect Supernova Remnants in the Fermi Deep Field

Author: Samuel Timothy Spencer[1]

Co-author: Sam Nolan [1]

[1] *University of Durham*

Artificial neural networks, such as multi-layer perceptrons, are computer programs designed to mimic the pattern recognition performed by organic brains. They have many uses in particle physics and astronomy, where a small signal is swamped by a large (but identifiable background). In this poster we will present a novel implementation of a neural net to detect and classify sources with both the Fermi Space Telescope and the planned Cherenkov Telescope Array (CTA). As an example of one use of neural nets in gamma-ray astrophysics, we present evidence to support the use of

such programs to detect fine structure in Supernova Remnants. Such structure in the gamma-ray image, as seen with the Fermi Space Telescope, is indicative of the acceleration of cosmic-ray protons. This study utilises toy models of supernova remnants as viewed by telescopes with different point spread functions, training multi-layer perceptrons on various parameters of the images, and then comparing the mean probabilities of signal generated when the networks were cross-tested. This work indicates that neural nets have a role to play in source characterisation against a diffuse gamma-ray background and could potentially further constrain the role Supernova Remnants play in cosmic-ray acceleration.

Summary:

Artificial neural networks were used to identify Supernova Remnants in images from the Fermi Space Telescope.

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Particle Detectors of the Future

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Neutrino Particle Astrophysics

Author: Ryan Nichol[1]

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Neutrino particle astrophysics is a frontier field at the crossroads of particle physics and astrophysics. Given the low fluxes of astrophysical neutrinos, gigantic detection volumes are necessary to detect the weakly interacting particles. The past twelve months have been an exciting time in the field on neutrino particle astrophysics, with the IceCube experiment claiming the first evidence for high energy extra-terrestrial neutrinos. If confirmed this evidence will be the first time since 1987 that neutrinos have been detected from outside of our solar system. Results from the current generation of neutrino particle astrophysics experiments will be presented, along with the prospects of imminent future experiments. Finally, the possibilities for utilising neutrino particle astrophysics detectors to measure neutrino oscillations will briefly be addressed.

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Long Baseline Neutrino Oscillation Results from Current Experiments

Author: Helen O'Keeffe[1]

[1] *L*

Corresponding Author: h.okeeffe@lancaster.ac.uk

In the last decade, neutrino experiments have provided overwhelming evidence for physics beyond the Standard Model. In this talk I will introduce the theory of neutrino oscillations and discuss current long-baseline neutrino oscillation experiments. Recent results from the T2K and MINOS experiments and prospects for the current generation of experiments will be presented.

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A search for direct production of supersymmetric sbottom and stop squarks in events with 2 b-jets, 1 lepton and missing energy

Author: Calum Michael Macdonald[1]

[1] *University of Sheffield (GB)*

Corresponding Author: calum.macdonald@cern.ch

This poster presents the current status of a search for direct production of sbottom and stop scalar quarks with a 50% branching ratio for sbottom or stop decays into neutralinos or charginos. In this search the mass difference between the lightest chargino and lightest neutralino is assumed to be small. Presented here is the current state of the analysis of final states consisting of 2 b-tagged jets, one lepton and large missing energy, from data collected in 2012 at a centre of mass energy of 8 TeV with an integrated luminosity of 20.3 inverse femtobarns

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Low Energy Reconstrucion of π^0 Decay Photons in ND280, the T2K Near Detector

Author: Michael Wallbank[1]

[1] *University of Sheffield*

Corresponding Author: m.wallbank@sheffield.ac.uk

The ND280 uses different sub-detectors in an attempt to reconstruct particle tracks as accurately as possible for analysis and in
order to understand the neutrino beam structure before oscillation occurs. Integral to this process are the Electromagnetic
Calorimeters (ECals), used for the reconstruction of neutral particles and the identification of charged particles. Some analyses,
such as π^0 reconstruction (imperative for understanding systematics and background), rely heavily on the ECals, so their
importance cannot be underestimated. Here their effectiveness at reconstructing low energy photons is considered in order to
evaluate which parts of the process could be improved and facilitate further development of the reconstruction algorithms.

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Optical calibration for the DEAP-3600 dark matter experiment

Author: Talitha Bromwich[1]

[1] *University Of Sussex*

DEAP-3600 is a liquid Argon-based dark matter detection experiment which utilises the organic crystalline solid 1,1,4,4-tetraphenyl-1,3-butadiene (TPB) to absorb scintillated 128nm UV light and re-emit it as 440nm visible light. Here I present the results of TPB evaporations and techniques for analysing the topography of the TPB layer using an atomic force microscope, preliminary tests on

UV-range LEDs that will be used to replicate the Argon-scintillated light in calibration and plots modelling the sensitivity of the DEAP experiment.

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Liquid Argon R&D for LBNE and the 35-ton prototype

Author: Matthew Thiesse[1]

[1] *University of Sheffield*

Corresponding Author: m.thiesse@sheffield.ac.uk

The Long-Baseline Neutrino Experiment 35-ton prototype detector was built to evaluate and demonstrate liquid argon time projection chamber design elements specific to the full-scale LBNE far detector, such as modular anode plane assembly elements and membrane cryostat technologies. The work presented here relates to several areas of liquid argon detector R&D involving argon purity and high voltage discharge. Due to the large fields needed to drift charged particles and the comparatively low electric breakdown voltages of liquid and gaseous argon, a CMOS camera system is developed to monitor, identify, and diagnose electric discharge such as coronae or sparks on certain TPC elements. A stainless steel housing was also designed to isolate the camera and components from the ultra-pure argon in the detector. A recirculating liquid argon test stand is being built to investigate the effect of argon purity on processes such as electric discharge as well as electron diffusion.

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MWPC R&D for background reduction in DRIFT

Author: Anthony Ezeribe[1]

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

Radon Progeny Recoils (RPRs) have been identified as a major source of background emanating from the vessel in DRIFT dark matter experiment. We present our R&D work towards developing a new data acquisition system with low radon prone materials at reduced cost for the new generations of the detector, DRIFT IIe and DRIFT III due for installation by June 2014 and 2020 respectively. A low radon multiplexing board (MUXB) capable of combining 20 channels of signals to a single channel with high precision at 20 MHz is presented. Plans to optimise the performance of the MUXB with signals from our card edge MWPC whose 20 μm anode wires are placed in-between 50 μm grid wires were also discussed. Other special conditions considered while designing the MWPC to improve on its performance compared to what is used in DRIFT IId were also included. Future plans of the research were also reviewed.