The Future of Particle Physics in the Post-Higgs Landscape

Wednesday 03 April 2019 - Friday 05 April 2019

University of Southampton

Book of Abstracts

Contents

Joint Session / **14**

Aspects of Neutrino Flavour Using HESE in ICECUBE

Kareem Farrag[None]

New Directions in Particle Experiments / **6**

Bounds and Prospects for Stable Multiply Charged Particles at the LHC

Sandra Kvedaraite[None]

Colored and colorless particles that are stable on collider scales and carry exotic electric charges, so-called MCHSPs, exist in extensions of the Standard Model, and can include the top partner(s) in solutions of the hierarchy problem. In this talk I will present a recast of two production channels of MCHSPs: the "open" channel – where the particles are pair-produced above threshold, and are detectable in dedicated LHC searches for stable multiply charged leptons, and the "closed" channel – where a particle-antiparticle pair is produced as a bound state, detectable in searches for a diphoton resonance. We obtain current and projected bounds on the masses of MCHSPs with different quantum numbers. In all cases there is a crossover between dominance by open and closed searches at some charge. Moreover, we show that a joint observation in the open and the closed channels allows to determine the mass, spin, color, and electric charge of the particle.

Developments in Particle Theory / **24**

Cluster Adjacency of Scattering Amplitudes

Jack Foster[None]

Recent developments in scattering amplitudes have illuminated new mathematical structures in quantum field theory. Most notably research in N=4 Super Yang-Mills has led to the development of the cluster bootstrap program in which scattering amplitudes have a geometric interpretation through cluster algebras. In my talk I will discuss one new facet of this program - cluster adjacency - and what this means for the analytic properties of scattering amplitudes.

Joint Session / **13**

Cluster finding in XMM and DES data

Model Limitations and Exclusions / **16**

Current Status and Future of Flavour Physics

Marcella Bona[1]

[1] *Queen Mary University of London*

Corresponding Author(s): m.bona@qmul.ac.uk

placeholder title

New Directions in Particle Experiments / **3**

Data-driven corrections to ATLAS electron trigger simulation

Daniela Kock[None]

The High Level Trigger (HLT) system used in the ATLAS detector at the Large Hadron Collider provides high efficiency selection of a wide range of signals. Very important targeted signatures are those where we identify single or multiple electron candidate events in the data. This is because they have a very wide application in many type of physics searches, like Higgs searches, searches of physics Beyond the Standard Model (BSM), as well as Standard Model physics.
Understanding the differences in the efficiencies for the selection of such triggers in ATLAS data compared to Monte Carlo simulation is a key preliminary to any measurement (Standard Model as well as BSM).
the full Run II ATLAS data collected between 2015 and 2018. The differences in efficiency between data and Monte Carlo are studied using pure electron samples obtained from Z –> ee Monte Carlo and data. From these differences, correction factors have been calculated and will be applied in ATLAS by a large number of analyses.

New Directions in Particle Experiments / **2**

Diffractive Scattering at the LHC

Alexander Lind[None]

This talk will present a study of diffractive scattering of high-energy protons at the LHC. Hadronic diffraction is not well-understood and many alternative approaches exist. The Monte Carlo event generator Pythia follows a Pomeron-based approach, where the invariant mass of the diffractive system and the squared momentum transfer of the system is set up according to a phenomenological Pomeron flux parameterization. Simulated single diffractive events with a fast detector response simulation of the ATLAS and ALFA detectors have been compared to 13 TeV Run 2 data.

New Directions in Particle Experiments / **7**

Future Prospects of the SNO+ Experiment

Lorna Nolan[None]

The SNO+ experiment is a multi-purpose liquid scintillator neutrino experiment, with a main goal to search for neutrino less double beta decay of 130Te. In preparation for the liquid scintillator phase, the detector has been running with pure water as a detection medium for the past year. During this time, measurements of solar neutrinos with very low backgrounds have been made as well as new limits being placed on invisible modes of nucleon decay. In the future, as well as searching for neutrino less double beta decay, SNO+ will be able search for other physics including reactor antineutrinos, geoneutrinos and supernovae neutrinos. This poster will present existing SNO+ results and discuss planned measurements and their potential impact.

Model Building Post-Higgs / 18

GUTs and Modular symmetries as an origin of Flavour symmetries

Elena Perdomo Mendez[None]

I will give an introduction to modular symmetries and how

they can be interpreted as a family symmetry. Afterwards, I

will focus on an SU(5) model in 6d where the two extra dimensions are

compactified on a T_2/Z_2 orbifold, with a twist angle of \omega=ei2pi/3. Such construction suggests an underlying modular A_4 symmetry,leading to an effective \mu-\tau reflection symmetry at low energies.
This implies maximal atmospheric mixing and maximal leptonic CP violation.

Lattice QCD / 10

Heavy Quarks on the Lattice

Ryan Hill[None]

B mesons are ideally suited to test the Standard Model Flavour Sector through experimental measurements of the CKM matrix elements |V_ub| and |V_cb|. Theoretical calculations of these matrix elements are also required, which is where lattice QCD steps in. However, heavy quarks cannot be placed on the lattice in the same manner as light quarks. The lattice introduces discretisation errors that are proportional to ma, the product of the quark mass and lattice spacing. If this product is of order unity or above, as is the case for heavy quarks on current lattices, the discretisation errors become uncontrolled. This talk will primarily discuss how an anisotropic fermion action (the Relativistic Heavy Quark action) can be used to circumvent this discretisation problem, and enable simulations of semi-leptonic B meson decays to calculate theoretical values for |V_ub| and |V_cb|.

Developments in Particle Theory / 20

Holographic string theory

Andrew O'Bannon[None]

Developments in Particle Theory / 21

Holographic zero sound

Ronnie Rodgers[None]

This talk will focus on how holography can be applied to condensed matter physics. I will review the physics of zero sound in Fermi liquids, an excitation which resembles hydrodynamic sound but exists at low temperature. I will then discuss a class of holographic models which exhibit a phenomenon similar to zero sound. These holographic models describe systems which are most definitely not Fermi liquids, so the fact that they possess a zero sound-like excitation raises the question of whether other materials, in particular strange metals, may exhibit zero sound.

Model Limitations and Exclusions / **15**

How to Verify or Exclude Particle Physics Models

Michael Spannowsky[None]

placeholder title

Joint Session / **11**

Invited Talk

Asher Kaboth[None]

Joint Session / **12**

Is Gravity an Entropic Force?

New Directions in Particle Experiments / **4**

Jet tagging with neural networks

Henry Day-Hall[None]

The LHC has yet to achieve a discovery more exciting than the Higgs boson in 2012, but the collaboration has not given up hope of one. In the quest to observe physics Beyond the Standard Model (BSM) we probe higher luminocities, and employ new techniques to access previously elusive areas of phase space. One aspect of the phenomenology that is under active development is the identification of quark flavour from jets, known as jet tagging. A jet is a shot-gun like spray of particles caused by the hadronisation of a quark. If jet tagging was more robust for collimated jets, that is jets that overlap due to their low angle, it would be a boon to many searches.
This challenge is a approached using machine learning techniques, in particular deep neural networks.

Lattice QCD / **8**

Lattice QCD and Flavour Physics

Andreas Juettner[None]

Model Building Post-Higgs / **19**

Left-right supersymmetry after Higgs discovery

Harri Waltari[None]

The LHC has found a Higgs boson compatible with the Standard Model Higgs but no other particles despite intesive searches. Also dark matter direct detection experiments have reached the sensitivity to test WIMP candidates. I shall give a short introduction of left-right supersymmetry and then discuss what have we learned from (i) Higgs measurements, (ii) BSM searches and (iii) direct detection experiments.

New Directions in Particle Experiments / 1

Matter density profile effects on neutrino oscillations at T2HK and T2HKK

Susana Molina Sedgwick[1]

[1] *University of Southampton, QMUL*

Model Building Post-Higgs / 17

Model Building in the Post-Higgs World

David Miller[None]

placeholder title

Lattice QCD / 9

Position-Space Approach to the Hadronic Light-by-Light Scattering Contribution to the Anomalous Magnetic Moment of the Muon on the Lattice

Nils Asmussen[None]

Developments in Particle Theory / 23

Quantum gravity and cohomological methods

Alex Mitchell[None]

In this brief talk I discuss two aspects of a novel approach to quantum gravity, the first of these is the construction of evanescent operators of the dilaton which provides an initial direction to finding solutions to the inherent problems of non-renormalizability of quantum gravity. The second is the use of the Batalin-Vilkovisky anti-field technique and how this can be used with cohomological techniques to restrict the terms in our action. Following this I present a brief review of present and future work.

Developments in Particle Theory / 22

Renormalization Group Properties of the Conformal Mode

Matthew Kellett[None]

Placeholder

New Directions in Particle Experiments / 5

b-Jet Clustering Techniques for BSM Higgs Physics

Billy Ford[None]

In this talk we consider aspects of beyond the standard model phenomenology involving b-jet classification. In particular, we consider events involving an extended Higgs sector from 2HDMs, which decay into final states of multiple b-jets. We review how these jets are identified and tagged both at the LHC and in Monte Carlo simulation, including so called jet clustering algorithms, and pose the question of whether certain parameters and techniques can be optimised for particular LHC searches. Finally we hint at birthing a new way of performing this analysis for future use in looking for BSM physics at experiments.