YTF 22

Thursday, 15 December 2022 - Friday, 16 December 2022

Centre for Particle Theory, Durham

Book of Abstracts

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Gong Show Talks / **2**

Coupling metric-affine gravity to a Higgs-like scalar field

Authors: Claire Rigouzzo[1]; Sebastian Zell[2]

[1] *King's College London*

[2] *EPFL*

Corresponding Author: claire.rigouzzo@kcl.ac.uk

General relativity (GR) exists in different formulations. They are equivalent in pure gravity but generically lead to distinct predictions once matter is included. After a brief overview of various versions of GR, we focus on metric-affine gravity, which avoids any assumption about the vanishing of curvature, torsion, or nonmetricity. We use it to construct an action of a scalar field coupled nonminimally to gravity. It encompasses as special cases numerous previously studied models. Eliminating nonpropagating degrees of freedom, we derive an equivalent theory in the metric formulation of GR. Finally, we give a brief outlook of implications for Higgs inflation.

Type of presentation:

5 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Gravity

Full Length Talks / **3**

Analyticity of the wavefunction of the universe

Author: Santiago Agui Salcedo[1]

[1] *Cambridge University*

In recent years there has been an increasing interest in the interplay between amplitudes and cosmological correlators, in particular in the use of amplitudes techniques to constrain cosmological correlators. In this talk, I will give an overview of the formalism of the wavefunction of the universe and how it relates to cosmological correlators. After this, I will review the success of the S-matrix programme in studying the analytic properties of the amplitude of scattering A(s,t) in a gapped theory. Among the many results, I will focus on the sum rules for Wilson coefficients, which relate the coefficients in an EFT expansion with an integral of the UV completion of the theory. To incorporate the sum rules to the wavefunction of the universe framework, we define off-shell wavefunction coefficients whose analytic structure is fixed by its tree-level diagrams. The resulting sum rules encapsulate a larger set of Wilson coefficients than those from amplitudes. Finally, I will address future research in the rich interplay between amplitudes and cosmology.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Cosmology

Full Length Talks / 4

Cornering the Two Higgs Doublet Model

Author: Oliver Atkinson[1]

[1] *University of Glasgow*

By applying a comprehensive set of flavour observables, Higgs measurements, BSM searches, electroweak precision measurements and theoretical considerations, we are able to place the tightest constraints yet on the allowed parameter space of the Two Higgs Doublet Model, examining all four main types. Based on work from 2107.05650, 2202.08807, 2207.02789.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Beyond the Standard Model

Full Length Talks / 5

Constraining Heavy Neutral Leptons with DUNE & Neutrinoless Double Beta Decay

Authors: Patrick Bolton[1]; Frank Deppisch[2]; Mudit Rai[3]; Zhong Zhang[2]

[1] *INFN*

[2] *UCL*

[3] *Pittsburgh*

Corresponding Author: ucapzz0@ucl.ac.uk

Heavy Neutral Leptons (HNLs) are a popular extension of the Standard Model to explain the lightness of neutrino masses and the matter-antimatter asymmetry through leptogenesis. Future direct searches, such as fixed target setups like DUNE, and neutrinoless double beta decay are both expected to probe the regime of active-sterile neutrino mixing in a standard Seesaw scenario of neutrino mass generation for HNL masses around 1 GeV. We analyze the complementarity between future direct searches and neutrinoless double beta decay to probe the nature of HNLs, i.e., whether they Majorana or Quasi-Dirac states, and CP-violating phases in the sterile neutrino sector. Following an analytic discussion of the complementarity, we implement a generic fixed target experiment modelling DUNE. We perform a statistical study in how a combined observation of HNLs in direct searches and neutrinoless double beta decay can probe the nature of sterile neutrinos.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Phenomenology

Gong Show Talks / 6

Spectral Reconstruction in NRQCD using the Backus-Gilbert Method

Author: Ben Page[1]

Co-authors: Chris Allton [1]; Seyong Kim [2]

[1] *Swansea University*

[2] *Sejong University*

Corresponding Author: benjaminpage.acer@gmail.com

Reconstructing the spectrum of QCD in the non-relativistic regime involves the inversion of a Laplace transform. For noisy lattice data, this process is numerically unstable and requires treatment to avoid the emergence of infinitely many spectra. One such treatment is the Backus-Gilbert method, originally applied to seismic wave data, now deployed in the reconstruction of heavy bottomonium meson spectra. We then conclude with a discussion of properties of the Laplace transform and how they may be manipulated to improve the resolution of the reconstruction.

Type of presentation:

5 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Lattice QCD

Full Length Talks / 7

Cauchy Slice Holography

Authors: Aron Wall[1]; Rifath Khan[1]; Goncalo Araujo-Regado[1]

[1] *University of Cambridge*

In the Canonical theory of Quantum Gravity (CQG), states are given by the superposition of geometries on a Cauchy slice, called the Wheeler-DeWitt (WDW) states. On the other hand, the Holographic principle states that quantum gravity in d+1 spacetime dimensions is the same as a quantum field theory in d spacetime dimensions. In this talk, I will briefly review both of these and will explain how to reformulate CQG as a holographic theory by defining a new holographic dictionary that maps any state of the boundary field theory to a bulk WDW state. This dictionary is an isomorphism between the Hilbert space of CQG and holographic CFT. This also reformulates the holographic principle in a way that the dual field theory now lives on Cauchy slices of the bulk, hence applicable to dS and flat spacetimes too. I will then explain why this is a manifestly background independent theory of "effective"quantum gravity. Time permitting, I will also discuss UV completion of quantum gravity, emergence of classical spacetime from WDW states and its possible implications for the black hole information paradox and holographic cosmology. Based on work with Goncalo Araujo-Regado and Aron C. Wall: arXiv:2204.00591.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Black Holes, Gravity

Please select the most relevant category:

Holography

Full Length Talks / 8

Zero-damped Modes and Nearly Extremal Horizons

Author: Jason Joykutty[1]

[1] *University of Cambridge*

Quasinormal modes are the gravitational wave analogue to the overtones heard after striking a bell. They dominate the signal observed during the ringdown phase after a dynamical event and are characterised by complex frequencies, which encode oscillation and exponential decay in time. As horizons become extremal, various computations (both analytic and numerical) have shown that in many cases, there exists a sequence of frequencies which become purely oscillatory in the limit and which cluster on a line in the complex plane. These are zero-damped modes and are conjectured to exist generically for nearly extremal horizons. In this talk, we shall discuss results that can be obtained toward resolving this question; for example, one can show that these modes do arise for the conformal Klein-Gordon equation on a class of spherically symmetric black hole spacetimes.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Black holes

Full Length Talks / **9**

The DGLAP-SMEFT interplay

Authors: Luca Mantani[1]; Manuel Morales[2]; Maria Ubiali[1]

[1] *University of Cambridge*

[2] *DAMTP, University of Cambridge*

Corresponding Author: manu.morales.alvarado@gmail.com

The DGLAP equations describe how parton distribution functions evolve between different energy scales. In this talk, we will discuss how potential effects of new physics, parametrised in terms of higher dimensional operators in the Standard Model Effective Field Theory, could affect these equations. We assess the importance of the dimensionality of the operators and the role that it plays in the calculation of the DGLAP splitting functions in the collinear limit.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Beyond the Standard Model

Full Length Talks / 10

Pure Spinor Super Yang Mills at \alpha'^3

Author: Callum Hunter[1]

Co-author: Carlos Mafra [2]

[1] *University of Southampton*

[2] *University of Southampton*

Corresponding Author: c.l.hunter@soton.ac.uk

In this talk I will present the toolbox used in Pure Spinor Super Yang-Mills in 10 dimensions. The Pure Spinor formalism greatly simplifies the computation of string scattering amplitudes and by extension, the calculation of amplitudes in the SYM theory. In the talk I will briefly introduce the fundamentals of Pure Spinor superstring theory and its related BRST operator, which is fundamental to the simplicity of the formalism. After I introduce the Non-Linear field equations and their perturbiner solutions and discuss n-point tree-level amplitudes in the theory. I will present some new results on \alpha' deformations to SYM using the surprisingly simple Pure Spinor BRST operator. Finding these deformations becomes a question of finding operators within the BRST cohomology, something that is easily automated.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Strings

Full Length Talks / 11

On Graviton non-Gaussianities in the Effective Field Theory of Inflation

Author: Ayngaran Thavanesan[1]

[1] *University of Cambridge*

In cosmology we measure correlation functions (cosmological correlators) which we can trace back to the boundary at the end of inflation. In the spirit of the S-matrix in flat space and holography in AdS, the cosmological bootstrap allows us to compute these boundary observables by sidestepping cumbersome Lagrangians, and instead using dS isometries and fundamental principles with no explicit reference to time evolution, i.e. "bootstrapping time". Recently, progress has been made on

bootstrapping correlators in the case where dS boosts are broken, to make more phenomenologically relevant observational predictions. In this talk I will explain how we can use locality and unitarity to bootstrap the graviton three-point function within the Effective Field Theory of Inflation (EFToI). I will first present the full class of operators that contribute to the on-shell two- and three-point functions of gravitons, and show how our analysis also captures graviton bispectra with a perturbative correction to the graviton two-point function.

Based on:
https://link.springer.com/article/10.1007/JHEP10(2022)154

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Cosmology

Full Length Talks / 12

Higher-spin symmetry in asymptotically flat space-time

Author: Simon Pekar[1]

[1] *University of Mons*

We present an algebra of generators of symmetry for massless higher-spin particles in asymptotically Minkowski space with dimension D ≥ 3, and show that it admits an extension to an algebra of asymptotic symmetries, similar to the generalized BMS algebra. We discuss its relevance for the asymptotic symmetries of Fronsdal fields and its implications for flat holography

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Gravity

Full Length Talks / 13

How to find the Feynman Rules from any scalar-tensor theory and not cry in the process

Author: Sergio Sevillano Muñoz[1]

[1] *University of Nottingham*

The ability to represent perturbative expansions of interacting quantum field theories in terms of simple diagrammatic rules has revolutionised calculations in particle physics. However, in the case of extended theories of gravity, deriving this set of rules requires linearization of gravity, perturbation of the scalar fields and multiple field redefinitions, making this process very time-consuming and model dependent. In this talk, I will motivate and present FeynMG, a Mathematica extension of FeynRules that automatizes this calculation, allowing for the application of quantum field theory techniques to scalar-tensor theories.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Phenomenology/Beyond the Standard Model

Please select the most relevant category:

Cosmology

Full Length Talks / 14

Flavour symmetries and Standard Model tests in B->DD decays

Author: Jonathan Davies[1]

[1] *University of Manchester (GB)*

The discrepancy between the Baryon Asymmetry of the Universe and its Standard Model (SM) prediction implies the existence of physics beyond the SM, which must include further sources of CP violation. Generically, physics beyond the SM comes with O(1) weak phases. LHCb has recently made several CP asymmetry measurements for B->DD decays. For such non-leptonic modes, a lack of knowledge of long-distance strong interaction contributions means these are challenging to predict. We use QCD's approximate SU(3)-flavour symmetry, systematically including breaking effects, to assess the consistency of current data with the SM and to predict yet unmeasured CP asymmetries.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Phenomenology

Poster Session and Dinner / **16**

Flavour symmetries and Standard Model tests in B->DD decays

Author: Jonathan Davies[1]

[1] *University of Manchester (GB)*

The discrepancy between observations, and Standard Model (SM) predictions of the Baryon Asymmetry of the Universe implies the existence of physics beyond the SM, which must include further sources of CP violation- in general with O(1) phases. LHCb has recently made several CP asymmetry measurements for B->DD decays. For such non-leptonic modes, lack of knowledge of long-distance strong interaction contributions mean these are challenging to predict. We use QCD's approximate SU(3)-flavor symmetry, systematically including breaking effects, to assess the consistency of current data with the SM and to predict yet unmeasured CP asymmetries.

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

N/A (poster presentation)

Other categories::

Please select the most relevant category:

Phenomenology

Full Length Talks / **17**

The complexity of cosmic large-scale structure encoded in a single wavefunction

Author: Alex Gough[1]

[1] *Newcastle University*

On large scales, the dark matter distribution can be treated as a perfect fluid. On small scales, gravitationally bound structures form through nonlinear clustering. Capturing the resulting cascade of multiple fluid streams in 6d phase space is challenging. We approximate the time evolution of this complex phase-space dynamics using a wavefunction, in the spirit of the quantum-classical correspondence. This method is a tool both for modelling the phase-space dynamics of cold dark matter in position-space, and is the fundamental description of ultralight dark matter candidates such as axions. In a simple dynamical model for the evolution of this dark matter wavefunction, I will demonstrate how the rapid oscillations from wave interference automatically encode information beyond perfect fluid models and how the classical streams are recovered from "unweaving" the interference. This description, together with connections to optical caustics and diffraction integrals, presents rich universal features that can unlock new ways of modelling and probing both wavelike and cold dark matter on the scales of the cosmic web.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Cosmology

Full Length Talks / 18

Pushforwards through the Scattering Equations

Author: Jonah Stalknecht[1]

[1] *University of Hertfordshire*

In the past decade, the *CHY formalism* and *positive geometries* have arisen as interesting new ways to think about scattering amplitudes in certain theories. The former allows for scattering amplitudes to be calculated by summing over the solutions to a set of rational equations (the *scattering equations*), whereas the latter allows for scattering amplitudes to be calculated as the canonical form of certain geometric objects that live in the kinematic space (such as *amplituhedra*).

Although their development has been largely distinct, it has recently become clear that there is a direct connection between the two. This connection is facilitated by calculating *pushforwards* through the scattering equations. To further investigate this remarkable connection, in [2206.14196] we develop tools to calculate these pushforwards using techniques from algebraic geometry. In this talk I will give an introduction to the connection between positive geometry and scattering equations, and explain how these pushforwards can be calculated without having to solve the scattering equations explicitly.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Amplitudes

Full Length Talks / **19**

Five loop analysis of stable fixed points in QCD

Author: Robert Mason[None]

We examine the phase plane of perturbative QCD involving a coupling constant and gauge parameter.We explore the fixed points in different schemes and with different gauge fixing terms in order to investigate the physical structure of the theory through recourse to scheme and gauge independence. Particularly the quark mass anomalous dimension and critical slope are considered at both the Bank-Zaks and Infra-Red stable fixed points of pQCD in a variety of kinematic and non-kinematic schemes as well as linear and non-linear gauge fixing to all avialable loop orders.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

QCD

Full Length Talks / **20**

Regge pole description of scattering by dirty black holes

Author: Shiqian Hu[1]

[1] *King's College London*

We study the problem of plane monochromatic scalar waves impinging upon a Schwarzschild dirty black hole and show that dirty black hole spacetimes may exhibit various critical effects for geometrical optics. We provide the complex angular momentum representation of the differential scattering cross section and examine the role of the different Regge pole branches. The role of the critical effects, i.e., orbiting, glory, grazing and rainbow scattering, and their impact on the differential scattering cross-section is introduced.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Black holes

Full Length Talks / **21**

Wilson loops for 5d and 3d conformal linear quivers

Authors: Ali Fatemiabhari[1]; Carlos Nunez[1]

[1] *Swansea University*

The study of supersymmetric and conformal field theories in diverse dimensions and classification of Type II or M-theory backgrounds with AdS_{d+1} factors as their holographic duals in d dimensions is of substantial interest. In this talk, we focus on the case of conformal and supersymmetric linear quiver field theories in three and five dimensions preserving eight Poincare supercharges. We are mainly interested in Wilson loops as they can be computed exactly in SUSY gauge theories. Within the electrostatic formulation of holographic duals to conformal balanced quivers in five and three dimensions, we mention the expressions for Wilson loops in antisymmetric representations. In the case of three-dimensional quivers, we present a relation between Wilson loops in an 'electric'and the 'magnetic/mirror'descriptions.
This talk is based on arXiv:2209.07536

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Holography

Full Length Talks / **22**

A dynamical formulation of ghost-free massive gravity

Author: Jan Kożuszek[1]

[1] *Imperial College London*

The ghost-free massive gravity theory of de Rham, Gabadadze and Tolley (dRGT) has attracted a lot of attention since its formulation over a decade ago. Many studies have looked at its consequences for cosmology, and explored various limits in which the theory simplifies. However, until now few attempts have been made at numerically simulating its full non-linear equations, as an explicit dynamical formulation, analogous to the ADM formulation of GR, was not known.

In this talk, based on work with de Rham, Tolley and Wiseman, I will briefly introduce the history and nuances of the formulation of massive gravity. I will then outline a dynamical formulation for the minimal and next-to-minimal dRGT models with a flat reference metric, explicitly identifying the phase-space variables, their associated momenta, as well as the evolution and constraint equations. I will go over the construction of initial data, which, like in GR, must still obey the Hamiltonian and momentum constraints. Finally, the techniques developed will be applied to perform numerical spherically symmetric gravitational collapse of scalar field matter for the minimal model, finding generically that this model breaks down before any large curvatures can appear.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Gravity

Poster Session and Dinner / **23**

New descriptions of VBS and VBF processes with High Energy Jets

Authors: Conor Elrick[1]; Jeremy Paltrinieri[1]

[1] *University of Edinburgh*

Corresponding Author: conor.elrick@ed.ac.uk

High Energy Jets (HEJ) is a resummation framework designed to include contributions from high energy logarithms in □ /□2⊥ to all orders in perturbation theory. These logs can become significant at the LHC and future colliders, and are significantly enhanced by the requirement of a large dijet invariant mass or large rapidity separation common in VBF/VBS cuts.

I will present a poster giving a general overview of the HEJ formalism at leading logarithm, followed by a discussion on recent developments included as part of the upcoming code release. In particular, I will discuss predictions for the QCD $\alpha_s^2\alpha_w^2$ contribution to same-sign □□+≥2 jets vector boson scattering [arXiv:2107.06818] and for inclusive Higgs + 1 jet production [arXiv:2210.10671].

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

No

Are you happy for your talk to be recorded?:

N/A (poster presentation)

Other categories::

Please select the most relevant category:

Phenomenology

Full Length Talks / **24**

High Energy Jets (HEJ) applied to Higgs plus jets processes

Author: Jeremy Paltrinieri[1]

Co-authors: Conor Elrick [1]; Hitham Hassan [2]

[1] *University of Edinburgh*

[2] *Durham University (1st year PhD student)*

Corresponding Author: jeremy.paltrinieri@ed.ac.uk

In order to further study the coupling of the Higgs boson to vector bosons at the LHC, experimentalists use Vector Boson Fusion (VBF) cuts of large invariant mass between jets to isolate the relevant production mode. While this is efficient in suppressing the QCD background, it has the drawback of enhancing high-energy large logarithms effects to all orders in the strong coupling which must be resummed, resulting in a suppression of the cross-section compared to fixed-order at large Δy_{12} or large m_{jj}.

In this talk, I will outline the HEJ framework and present recent studies of $H+ \geq 1j$ and $H+ \geq 2j$ processes which highlight how numerically significant these logarithms are at LHC energies, and thus in future colliders.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Phenomenology

Full Length Talks / **25**

A covering map description for AdS3/CFT2

Author: Nathan McStay[1]

[1] *University of Cambridge*

It has recently been argued by Gaberdiel, Gopakumar et al. that type IIB string theory on $AdS_3 \times S^3 \times \mathbb{T}^4$ in the tensionless limit is exactly dual to the symmetric orbifold CFT $\mathrm{Sym}^N(\mathbb{T}^4)$ in the large N limit. One fascinating feature of this duality is that it is rendered manifest by a localisation of the physical correlators of tensionless strings to points in moduli space where a covering map exists, mapping the worldsheet to the boundary. In this talk, I will present my own argument for this localisation and demonstrate that it arises from the presence of a particular weight 3 gauge symmetry in the theory. This will allow us to extend the results in the literature to show that the localisation holds even for correlators containing non-highest weight states.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Strings

Full Length Talks / 26

Non-Gaussianity from preheating of non-minimally coupled inflaton

Author: Pulkit Ghoderao[1]

[1] *Imperial College London*

Full non-linear simulations of massless preheating model have revealed a large non-Gaussianity can be generated. We study a more observationally viable model consisting of inflaton non-minimally coupled to gravity that decays into a massless scalar spectator during preheating.

Including the scale-dependence of Hubble rate places tight constraints on the 'cosmic variance', the values which the mean spectator field value can take. A negligible cosmic variance forces mean close to zero, and symmetry of many inflation potentials around zero dictates leading order non-perturbative treatment shall fail. Thus, we calculate sub-leading order term in the non-perturbative delta N formalism. As this calculation also needs to be performed keeping in mind the scale dependence, we show a scale-invariant way of solving momentum integrals is insufficient to yield the correct non-Gaussianity from preheating.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Cosmology

Gong Show Talks / **27**

Higher-spin asymptotic symmetry algebra

Author: Simon Pekar[1]

[1] *University of Mons*

We present an extension of the (generalized) BMS algebra containing asymptotic symmetry generators of higher-spin fields.

Type of presentation:

5 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Gravity

Poster Session and Dinner / **28**

Scheme Dependence in pQCD at the Four Loop Level

Author: Robert Mason[None]

We consider measurable quantities calculated in massless perturbative QCD in a variety of schemes, including the symmetric momentum subtraction schemes, up to the four-loop level in order to investigate scheme dependence in the perturbative series as a theory lab. Appropriate error values should be attached to estimates of physical results which can be done by asserting that renormalization group invariance is true to order in truncation. Scheme invariance is investigated as a measure of error using measurements to calculate $\alpha_{\overline{\text{MS}}}(M_Z)$ from different schemes as a point of comparison for the results.

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

N/A (poster presentation)

Other categories::

Please select the most relevant category:

QCD

Full Length Talks / **29**

The Axion-Higgs portal

Authors: Martin Bauer[1]; Guillaume Rostagni[2]; Jonas Spinner[3]

[1] *IPPP Durham*

[2] *IPPP, Durham University*

[3] *Heidelberg University*

Corresponding Author: jonas.spinner@gmx.de

We present the Axion-Higgs portal, the unique dimension six operator that respects both a Z2 symmetry and the typical shift symmetry of an axion. Due to the Z2 symmetry, the axion is stable for all masses and serves as a natural DM candidate. We derive experimental constraints and the regions where the observed amount of DM can be produced and compare them in the parameter space. Throughout the talk, we compare the Axion-Higgs portal with the Higgs portal and axion models without the Z2 symmetry, being its closest neighbours in the space of models for BSM physics.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Beyond the Standard Model

Gong Show Talks / **30**

Astrophysics Searches for Oscillations in the Axiverse

Author: James Maxwell[1]

[1] *Durham University*

String compactification can give rise to a large spectrum of pseudo-scalar, axion like particles (ALPs). These ALPs will generally have different masses and so, akin to neutrinos, may oscillate among their flavour states. By considering the large distance scales present in astrophysical scenarios, the phenomenological implications of this behaviour can be investigated. The excessive transparency of the universe to blazar photons hints at the existence of a spectrum of ALPs. Through a numerical study we are able to place limits on the cardinality of this spectrum. We consider ALPs with a stringy mass distribution and anarchical standard model couplings.

Type of presentation:

5 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Astroparticle

Gong Show Talks / 31

Atom interferometry for fundamental physics

Author: John Carlton[1]

[1] *King's College London*

Atom interferometry is an exciting new technology employing quantum sensors to make precision measurements in key tests of fundamental physics. Upcoming terrestrial long-baseline experiments such as AION and MAGIS will access new parameter spaces in searches for dark matter and gravitational waves, including sensitivity to the mid-band frequency range between LIGO and LISA. The talk will give a very brief overview of the physical principles behind atom interferometry and how it can be used to probe ultra-light dark matter.

Type of presentation:

5 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Phenomenology

Full Length Talks / 32

Sensitivity of Future Tritium Decay Experiments to New Physics

Authors: Frank Deppisch[1]; James Canning[2]; Wenna Pei[3]

[1] *UCL*

[2] *UCL HEP*

[3] *University College London*

Corresponding Authors: james.canning.20@ucl.ac.uk, f.deppisch@ucl.ac.uk

The β-decay of tritium is the most promising approach to measure the absolute masses of active light neutrinos in the laboratory and in a model-independent fashion. The development of Cyclotron Radiation Emission Spectroscopy techniques and the use of atomic tritium has the potential to improve the current limits by an order of magnitude in future tritium experiments. In this paper, we analyse the potential sensitivity of such future searches to keV-mass sterile neutrinos and exotic interactions of either the active or sterile neutrinos. We calculate the relevant decay distributions in both energy and angle of the emitted electron with respect to a potential polarisation of the tritium; we include interference with the Standard Model case as well as incorporating relevant final state corrections for atomic tritium. We present projected sensitivities on the active-sterile neutrino mixing and effective operator scales of exotic currents, demonstrating the potential to probe New Physics in tritium experiments.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Phenomenology

Full Length Talks / 33

Can Primordial Black Hole Clusters Evade Microlensing Constraints?

Author: Matthew Gorton[1]

[1] *University of Nottingham*

Stellar microlensing strongly constrains the fraction of dark matter in compact objects, such as primordial black holes (PBHs). However, PBHs are expected to form clusters, and it has been argued that these constraints are therefore weakened or evaded. I will present a plausible PBH cluster model for the most commonly-studied PBH formation mechanism: the collapse of large curvature perturbations generated by inflation. I will then discuss the impact of these PBH clusters on stellar microlensing constraints.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Primordial Back Holes

Please select the most relevant category:

Astroparticle

Full Length Talks / 34

Improved Antenna Subtraction at NNLO

Authors: Oscar Braun-White[1]; Nigel Glover[2]; Christian Preuss[3]

[1] *IPPP Durham University*

[2] *IPPP, Durham University*

[3] *ETH Zürich*

Corresponding Author: oscar.r.braun-white@durham.ac.uk

The antenna subtraction method has been successfully applied to a wide range of next-to-next-to-leading order in α_s (NNLO) processes relevant for the Large Hadron Collider. We summarise how the antenna subtraction method works at NLO and NNLO and identify the current drawbacks in the scheme. In particular, the tree-level four-particle antennae, X_4^0, extracted from known colour-ordered matrix elements do not have consistent patterns in unresolved singular structure. We show that it is possible to construct similar antennae with more uniform features directly out of the unresolved limits required. It is hoped that the application of these improved Antennae will be more straightforward and efficient, such that the antenna subtraction scheme is less process-dependent. Finally, we match the integration of the antennae over the unresolved phase space to the previous incarnation, serving as an independent check on our results.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

No

Other categories::

Please select the most relevant category:

QCD

Full Length Talks / **35**

Non-Linear Solutions and the Double Copy

Author: Kymani Armstrong-Williams[1]

Co-authors: Christopher White [1]; Sam Wikeley [2]

[1] *Queen Mary University of London*

[2] *Queen Mary University of London*

The double copy relates scattering amplitudes in quantum gravity as the square for those in non-abelian gauge theories. This property has been extended to relate position space solutions in classical physics in biadjoint scalar, gauge and gravity theories. So far, no strongly coupled examples of the double copy in four dimensions have been found, and previous attempts based on exact non-linear solutions of biadjoint theory in Lorentzian signature have proved unfruitful. Instead, we search for solutions in Euclidean signature, which could be relatable to Yang-Mills or gravitational instantons. We show that non-linear spherically symmetric power-like Euclidean solutions are non-existent in four spacetime dimensions. The reason why this is the case turns out to involve the Eguchi-Hanson instanton.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Gravity

Poster Session and Dinner / **36**

Double Copy: Turning Electricity into Black Holes

Author: Kymani Armstrong-Williams[1]

[1] *Queen Mary University of London*

An open problem in theoretical physics is to combine all four of the fundamental forces of nature into one singular theory. Problematically, gravity has proven difficult to reconcile with the other forces. Recently, relationships between scattering amplitudes in non-abelian gauge theories and theories of quantum gravity have led to the discovery of a relation known as the double copy. The double copy relates scattering amplitudes in quantum gravity as the square for those in non-abelian gauge theories. This property has been extended to relate solutions in classical electromagnetism with those in general relativity, via a theory known as the classical double copy.

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

N/A (poster presentation)

Other categories::

Please select the most relevant category:

Gravity

Full Length Talks / **37**

The density of states method, Yang-Mills theories and first order phase transitions

Author: David Mason[1]

[1] *University of Swansea*

Phase transitions in gauge theories carry important information about the non-perturbative underlying dynamics. For instance, first-order phase transitions in the early universe generate a primordial gravitational wave background whose intensity can in principle be determined with lattice simulations. However, metastable dynamics at first order phase transitions make precise determination of relevant observables difficult, often leading to large uncontrolled numerical errors. In this talk, I will discuss the first order deconfinement transition in the strong Yang-Mills sector of the standard model using the logarithmic linear relaxation method on the lattice. This method provides a determination of the density of states of the system with exponential error suppression while avoiding the metastability problems. From this, the micro-canonical information can be analysed and thermodynamic observables can be reconstructed with a controlled error.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Lattice QCD

Gong Show Talks / **38**

Quantum vortices and black hole superradiance

Author: Ansh Gupta[1]

[1] *King's College London*

Vortices in quantum fluids have discrete charges associated with their circulations. Higher charged quantum vortices have dynamical instabilities which arise from superradiant bound states inside the vortex core, resulting in vortex splitting. Remarkably, the rotational superradiance we expect to see around rotating black holes has the same physics behind it, allowing us to explore the analogy between black holes and draining quantum vortices even further.

Type of presentation:

5 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Black holes

Full Length Talks / **39**

Flavonstrahlung in the B3 – L2 Z′ Model at Current and Future Colliders

Author: Eetu Loisa[1]

[1] *University of Cambridge*

The $B_3 - L_2$ Z' model may explain some gross features of the fermion mass spectrum as well as $b \to s\ell\ell$ anomalies. A TeV-scale physical scalar field associated with gauged $U(1)_{B_3-L_2}$ spontaneous symmetry breaking, the flavon field ϑ, affects Higgs phenomenology via mixing. In this talk, I will discuss the collider phenomenology of the flavon field. Higgs data are used to place bounds upon parameter space. I then examine "flavonstrahlung" ($Z'^* \to Z'\vartheta$ production) at colliders as a means to directly produce and discover flavon particles, providing direct empirical evidence tying it to $U(1)_{B_3-L_2}$ symmetry breaking. A 100 TeV FCC-hh or a 10 TeV muon collider would have high sensitivity to flavonstrahlung, whereas the HL-LHC can observe it only if the flavon charge is larger than unity.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Please select the most relevant category:

Beyond the Standard Model

Full Length Talks / 40

Information recovery in JT gravity

Author: Neil Talwar[1]

[1] *Swansea university*

I will discuss the information recovery problem for an object thrown into a black hole in JT gravity using the quantum extremal surface prescription. In particular, I will show how to reproduce the Hayden-Preskill decoding criterion but with some refinements, which include the effect of the backreaction of the infalling object.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

quantum gravity, quantum information

Please select the most relevant category:

Holography

Full Length Talks / 41

Accelerating black holes in 2+1 dimensions

Authors: Andrew Scoins[1]; Gabriel Arenas-Henriquez[1]; Ruth Gregory[2]

[1] *Durham University*

[2] *Kings College London*

Corresponding Author: gabriel.arenas-henriquez@durham.ac.uk

We study the C-metric in 2+1 dimensions ab initio. We find three classes of geometry, which we interpret by studying holographically their physical parameters. From these, we construct stationary, accelerating point particles; one-parameter extensions of the BTZ family resembling an accelerating black hole; and find new solutions including a novel accelerating "BTZ geometry"not continuously connected to the BTZ black hole as well as some black funnel solutions.

Type of presentation:

20 minute talk

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Yes

Other categories::

Gravity / Holography

Please select the most relevant category:

Black holes

Poster Session and Dinner / **42**

EFT Wavefunction Coefficients in de Sitter

Author: Connor Armstrong[1]

[1] *Durham University*

The Cosmological Scattering Equations lead to a natural formulation of EFT wavefunction coefficients in de Sitter written in terms of conformal generators in the future boundary. The corresponding integrands can be assembled from simple building blocks (including mass deformations and curvature corrections) leading to a double copy prescription. We can also analyse the operator form of the wavefunction coefficients in the soft limit, letting us link EFT soft theorems with Lagrangian symmetries beyond flat space

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

N/A (poster presentation)

Other categories::

Please select the most relevant category:

Amplitudes

Poster Session and Dinner / **43**

Electroweak input schemes in the SMEFT

Author: Tommy Smith[1]

[1] *IPPP*

The electroweak input scheme is a key choice in any phenomenological calculation. The replacement of the Lagrangians bare parameters in favour of differing physical inputs can notably change the results obtained through perturbation theory. In the SM, the effects on the convergence of the perturbative series, are well understood. However, the SMEFT has additional considerations,

with differing input schemes introducing different Wilson Coefficients at LO and NLO. This all adds to the complexity of the multi faceted problem of choosing an electroweak input scheme in the SMEFT.

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

Other categories::

Please select the most relevant category:

Phenomenology

Poster Session and Dinner / **44**

Using Helicity to Distinguish Dark Matter Models at Lepton Colliders

Author: Sofie Erner[1]

Co-author: Martin Baur

[1] *PhD student at IPPP at Durham University*

Corresponding Author: sofie.n.erner@durham.ac.uk

Dark Matter has eluded us for decades and continues to do so. Current lepton colliders are currently being used to set exclusion limits on coupling constants and masses of various dark matter models, but many models would have either identical or too close to distinguish signals in a detector. There is hence a need for methods/observables to separate the signals. We look into whether measuring the helicity of the photon in e^+e^- processes with a single outgoing photon plus missing energy, can be used to distinguish two dark matter models: Dark Photon and Axion-Like-Particles (ALPs). It was found that for the limitations of the Belle II detector, the SM background is close to 50% independent of $\cos\theta_\gamma$. This means that any alteration to this, either in total left-right photon helicity asymmetry or $\cos\theta_\gamma$-dependence can be used as a beyond-standard-model (BSM) signal.

Type of presentation:

Poster

Would you be interested in receiving feedback on your presentation?:

Yes

Are you happy for your talk to be recorded?:

N/A (poster presentation)

Other categories::

Please select the most relevant category:

Beyond the Standard Model