UK-QFT VIII

Report of Contributions

Contribution ID: **3** Type: **not specified**

Welcome

Thursday, 28 November 2019 10:10 (5 minutes)

Presenter: ALEXANDRE, Jean (King's College London)

Session Classification: Registration, Coffee and Welcome

Contribution ID: **4** Type: **Talk**

Quantum fields as sensors for fundamental physics

Thursday, 28 November 2019 15:30 (30 minutes)

Quantum sensors that are used to measure gravitational fields and detect dark energy typically use single particle interferometric techniques that are limited by the time of flight in the interferometer arm. In this talk I will present a new detection method that uses quantum resonances and the sensitivity of collective excitations (phonons) to gravitational fields. When phonons in a Bose-Einstein condensate are initially prepared in a squeezed state, spacetime distortions can create additional excitations through parametric amplification. This effect can be used to detect gravitational waves at high frequencies. We have also developed a phonon based scheme to estimate spacetime parameters, miniaturize devices to measure gravitational fields and gradients and set further constrains on dark energy models.

Primary author: Prof. FUENTES, Ivette (University of Nottingham)

Presenter: Prof. FUENTES, Ivette (University of Nottingham)

Session Classification: Session 3

Contribution ID: **5** Type: **Talk**

Fermions and the spontaneous breaking of scale invariance

Thursday, 28 November 2019 14:45 (30 minutes)

We present the first example of the Bardeen-Moshe-Bander phenomenon in a purely fermionic relativistic quantum field theory. In this talk I will give an overview of the phenomenon, in which a scale invariant theory may nonetheless have massive excitations due to strong coupling effects, before explaining how this situation arises in a purely fermionic field theory: a less symmetric version of the well studied Gross-Neveu model in three dimensions. I will conclude by discussing the relation of this fermionic effect to the original phenomenon in scalar field theories, and connections to certain "bosonisation"dualities.

Primary author: CRESSWELL-HOGG, Charlie (University of Sussex)

Presenter: CRESSWELL-HOGG, Charlie (University of Sussex)

Session Classification: Session 2

Contribution ID: **6** Type: **Talk**

Integrating the path integral

Thursday, 28 November 2019 13:45 (30 minutes)

The path integral gives a very useful framework for understanding quantum mechanics, but actually evaluating it can be tricky. We shall review some recent progress on a method to perform the integration of the real-time path path integral using Picard-Lefschetz techniques.

Primary author: Dr SAFFIN, Paul (University of Nottingham)

Presenter: Dr SAFFIN, Paul (University of Nottingham)

Session Classification: Session 2

Contribution ID: **7** Type: **Talk**

Constraining the inflationary field content

Thursday, 28 November 2019 11:15 (30 minutes)

Understanding the laws of inflation can shed light on the processes that govern physics at very high energy scales, beyond current experimental limits. In particular, the characterisation and detection of primordial gravitational waves produced during inflation can be an excellent test for the particle content of the very early universe. We consider an Effective Field Theory of inflation where tensor perturbations are sourced already at linear order. We show how this set-up supports a sufficient production of primordial gravitational waves to make the signal detectable at interferometer scales. We complement theoretical consistency checks on the model with stringent observational bounds on its parameter space stemming from CMB measurements, LIGO and Big Bang Nucleosynthesis bounds, as well as constraints from Primordial Black Holes production and UltraCompact MiniHalos.

Primary author: IACCONI, Laura (ICG, University of Portsmouth)

Presenter: IACCONI, Laura (ICG, University of Portsmouth)

Session Classification: Session 1

Contribution ID: **8** Type: **Talk**

Free energy dependence on spatial geometry for (2+1)-dimensional QFTs

Thursday, 28 November 2019 16:00 (30 minutes)

We consider (2+1)d-QFT at finite temperature on a product of time with a static spatial geometry. Generically, free energy of QFTs on curved spacetime can be very difficult to calculate even for free field theories. For perturbations of flat space we show that free energy difference goes quadratically with perturbation amplitude and may be computed from the linear response of the stress tensor. As an illustration we compute it from holographic duality finding that for strongly coupled CFT at any temperature, and for any perturbation, the free energy decreases. Similar behaviour was also found for free scalars and fermions, and for unitary CFTs at zero temperature from heat kernel method. Similarity between two vastly different regimes of QFT is also commented. This suggesting that (2+1)d-QFT may generally energetically favour a curved spatial geometry. We also treat the deformation in a large wavelength deformation relative to the thermal scale. Then the free energy variation is determined by a curvature correction to the stress tensor and for these theories is negative for small curvature deformations of flat space.

Primary author: Mr CHEAMSAWAT, Krai (Imperial College London)

Presenter: Mr CHEAMSAWAT, Krai (Imperial College London)

Session Classification: Session 3

Contribution ID: **9** Type: **Talk**

The continuum limit of perturbative quantum gravity

Thursday, 28 November 2019 10:15 (30 minutes)

We show that quantum gravity does exist as a genuine perturbative quantum field theory (i.e. is renormalizable), with all the correct properties one would expect of such a theory: unitarity, locality, microcausality etc. However it has many novel features not seen in other quantum field theories.
Although it is perturbative in couplings it is non-perturbative in Planck's constant, and the natural direction of RG flow depends on the sector. In the high cutoff (continuum) limit the theory is governed by infinite number of such underlying couplings conjugate to interactions that violate diffeomorphism invariance. In the low cutoff regime, diffeomorphism invariance and the standard form of the amplitudes are recovered, the latter parametrised by just two effective couplings, Newton's constant and the cosmological constant. These effective couplings also determine the values of all the couplings to higher dimension operators that in the perturbatively non-renormalizable effective quantum gravity approach would have to be introduced as separate parameters.

Primary author: Prof. MORRIS, Tim (University of Southampton)

Presenter: Prof. MORRIS, Tim (University of Southampton)

Session Classification: Session 1

Contribution ID: **10** Type: **Talk**

Production of ’t Hooft-Polyakov monopoles from strong magnetic fields

Thursday, 28 November 2019 16:30 (30 minutes)

The production rate of monopoles from strong magnetic fields at high temperatures is determined by an unstable ‘sphaleron’ field configuration. In this talk I will present the results of a study of this sphaleron in the $SU(2)$ Georgi-Glashow model using lattice techniques. I will show how the sphaleron solution changes as the magnetic field strength is increased, and discuss the implications of our results for the production of solitonic monopoles in physical situations such as heavy-ion collisions.

Primary author: Mr HO, David (Imperial College London)

Presenter: Mr HO, David (Imperial College London)

Session Classification: Session 3

Contribution ID: **11** Type: **Talk**

Grand covariance in quantum gravity

Thursday, 28 November 2019 10:45 (30 minutes)

The laws of physics should not depend on how we choose to describe them, and we should not be able to change the physical predictions of our theory just by changing notation. However, this is exactly what happens in the standard formulation of quantum field theories. The effective action receives different quantum corrections depending on how we parametrise our fields. Even Feynman diagrams, a fundamental building block for QFT calculations, yield results that depend on the definition of the fields we choose to work with. In this talk I will rectify these problems by introducing the notion of grand covariance, in which the quantum fields are treated as coordinates on a manifold, known as the grand field space. Field redefinitions are then simply diffeomorphisms of this manifold and thus we can impose reparametrisation invariance using well-known techniques from differential geometry. I show how we can apply this formalism to scalar-tensor theories of quantum gravity. This talk is based on arXiv:1910.06661.

Primary author: FINN, Kieran (University of Manchester)

Presenter: FINN, Kieran (University of Manchester)

Session Classification: Session 1

Contribution ID: **12** Type: **Talk**

Field-space geometry of cosmological attractors

Thursday, 28 November 2019 11:45 (30 minutes)

In this talk, I will discuss the geometry of attractor theories in a cosmological context, showing that theories which feature poles act as unions of multiple canonical models. This means that poles demarcate different field-space domains which may drastically differ in their phenomenology. Usually, studies of attractor theories are confined within the poles; however, moving beyond the poles can be an invaluable tool in identifying novel robust and well-motivated models. As a concrete example, the scalar field responsible for the early-time acceleration of the Universe may reach the boundary of the field-space manifold when outside the poles, indicating that a boundary condition must be imposed in order to determine its late-time behaviour. If the evolution of the field is arrested before this happens, we find that quintessence can be achieved without a potential offset, which is an example of a new model with desirable features. Turning to multifield models with singular kinetic terms, I show that poles generalise straightforwardly to singular curves, acting as "model walls" between distinct pole-free inflationary models. I demonstrate that in this case, the evolution of isocurvature perturbations can be sensitive to where the non-canonical field begins its trajectory. This has far-reaching implications for the initial conditions of attractor theories, since it implies that we must make a fundamental choice as to which domain we impose initial conditions on the fields.

Primary author: Dr KARAMITSOS, Sotirios (University of Manchester)

Presenter: Dr KARAMITSOS, Sotirios (University of Manchester)

Session Classification: Session 1

Contribution ID: **14** Type: **Talk**

Integrable sigma models and RG flow

Thursday, 28 November 2019 14:15 (30 minutes)

It is often conjectured that integrable 2d sigma models should be renormalizable (with only finitely many running couplings). After introducing integrability and sigma models, I will explain the intuition behind this conjecture. Although there is no general proof, it has been checked in various non-trivial examples at the leading 1-loop order. I will present recent work where we ask the question of what happens beyond 1-loop. In the examples of the lambda- and eta-deformed sigma models, we find that the conjecture is true beyond 1-loop if the sigma model target space geometries are supplemented with particular quantum corrections. Alternatively we may formulate the lambda-deformation as a sigma model on a "tripled" target space, where extra symmetries become manifest and the theory is renormalizable without corrections.

Primary author: LEVINE, Nat (Imperial College London)

Presenter: LEVINE, Nat (Imperial College London)

Session Classification: Session 2