UK- QFT meeting, Monday, March 30

Imperial College London,
Huxley Building, 342

talks will be 30 min plus 10 min question/discussion time

10:00 - 10:40	Daniel Litim: From asymptotic freedom to asymptotic safety
10:40 - 11:20	Anupam Mazumdar: Construction of singularity free and ghost free gravity
11:20 - 11:40	coffee break
11:40 - 12:20	Carlos Tamarit: Higgs valleys, stability and inflation
12:20 - 13:00	Jean Alexandre: Dynamical mechanism for ultra-light scalar dark matter
13:00 - 14:30	lunch break
14:30 - 15:10	Tim Morris: Background independent exact renormalization group for conformally reduced gravity
15:10 - 15:50	Daniel Burns: Matter Quantum Corrections to the Graviton Self-Energy and the Newtonian Potential
15:50 - 16:10	coffee break
16:10 - 16:50	Tommi Markannen: RG running in the presence of background curvature
16:50 - 17:30	Peter Millington: Radiative effects in decay of metastable vacua: a Green's function approach
17:30 - 18:10	Leron Borsten: On the symmetries of "Yang-Mills squared"
18:10 - 18:30	Final discussion

Abstracts:

Jean Alexandre (KCL)
Dynamical mechanism for ultra-light scalar Dark Matter

Assuming a double-well bare potential for a self-interacting scalar field, with the Higgs vacuum expectation value, I shown that non-perturbative quantum corrections naturally lead to non-interacting ultra-light particles of mass about 10^{-23}eV, if these non-perturbative effects occur at a time consistent with the Electroweak phase transition. This mechanism could be relevant in the context of Bose Einstein Condensate studies for the description of cold Dark Matter.

Leron Borsten (Dublin Institute for Advanced Studies)
On the symmetries of "Yang-Mills squared"

There is a long and varied history relating gravity to Yang-Mills theory, with a variety of approaches: from gauging spacetime symmetries to the more recent applications of the holographic principle. Here, instead, we appeal to the idea of “gravity as the square of Yang-Mills” by tensoring left and right multiplets with arbitrary non-Abelian gauge groups GL and GR. Squaring Yang-Mills theories is a recurring theme in attempts to understand the quantum theory of gravity and appears in several different forms. In the context of scattering amplitudes the Bern-Carrasco-Johansson colour/kinematic duality has led to the remarkable conjecture that all loop (super)gravity amplitudes can be written as the "double copy" of (super) Yang-Mills amplitudes. These advances motive the question: to what extent can a quantum theory of gravity be understood in terms of Yang-Mills squared? We begin to address this puzzle, starting with the local and global symmetries of (super)gravity and (super) Yang-Mills theories. Local: By regarding gravity as the convolution of left and right Yang-Mills theories together with a "spectator" scalar field in the biadjoint representation of GL x GR, we derive in linearized approximation, the gravitational symmetries of general covariance, p-form gauge invariance, local Lorentz invariance, and local supersymmetry from the flat space Yang-Mills symmetries of local gauge invariance and global super-Poincaré symmetry. Global: We give a unified description of D = 3 super-Yang-Mills theory with N = 1, 2, 4, and 8 supersymmeties in terms of the four division algebras: reals (R), complexes (C), quaternions (H) and octonions (O). Tensoring left and right super-Yang-Mills multiplets with N = 1, 2, 4, 8 we obtain a Freudenthal magic square RR, CR, CC, HR, HC, HH, OR, OC, OH, OO description of D = 3 supergravity with N = 2, 3, 4, 5, 6, 8, 9, 10, 12, 16.

Daniel Burns (Manchester)
Matter Quantum Corrections to the Graviton Self-Energy and the Newtonian Potential

The mechanism which keeps the graviton massless beyond the tree level has, thus far, not been adequately elucidated. In this talk, I will present the calculation of matter quantum effects on the graviton self energy on a Minkowski background, with a view to determining whether the graviton remains massless with the inclusion of these quantum corrections. To this end, I will derive a low-energy theorem which directly relates the radiative corrections of the cosmological constant to those of the graviton mass to all orders in perturbation theory, and use this theorem to demonstrate that the graviton remains massless with a suitable renormalization of the cosmological constant. I will show this explicitly within an Abelian Higgs model with minimal coupling to gravity at the one-loop level. I shall also present results regarding the matter quantum corrections to the Newtonian potential and show that the correction exhibits an exponential fall-off dependence on the distance r, once the non-relativistic limit with respect to the non-zero loop mass is carefully considered.

Daniel Litim (University of Sussex)
From asymptotic freedom to asymptotic safety

Asymptotic freedom plays a central role in the construction of the Standard Model and its extensions. In this talk we study the ultraviolet behaviour of four-dimensional quantum field theories involving non-abelian gauge fields, fermions and scalars in a regime where asymptotic freedom is absent. We explain when, and how, the three types of fields cooperate to develop exact, fully interacting ultraviolet fixed points - even without supersymmetry. We discuss the significance of the result for e.g. particle phenomenology, model building, and in view of the asymptotic safety conjecture for gravity.

Tommi Markkanen (Imperial College)
RG running in the presence of background curvature

A well-known fact of quantum field theory is that it introduces a scale dependence for the fundamental parameters of the theory, i.e., running. However, often it is neglected that in the presence of gravity the curvature of space is also a form of energy contributing to the running. In this talk I will show how this works in practice via two important examples: electroweak vacuum stability and the cosmological constant.

Anupam Mazumdar (Lancaster University)
Construction of Singularity free and Ghost free gravity

I will construct singularity free and ghost free theory of gravity in 4 dimensions. I will briefly discuss classical and quantum aspects including one loop and 2 loops.

Peter Millington (TU Munich)
Radiative effects in decay of metastable vacua: a Green's function approach

We introduce a Green's function method for handling radiative effects on the decay of metastable vacua. In the context of phi-4 theory, we are able to calculate analytically both the functional determinant of the quadratic fluctuations about the soliton configuration as well as the first correction to the soliton configuration itself. The latter is made feasible by employing the thin-wall approximation and treating the bubble wall in the planar limit. In so doing, the problem of tunnelling in radiatively generated potentials may be reduced to one of solving one-dimensional ordinary differential equations and integrals.

Tim Morris (Southampton University)
Background independent exact renormalization group for conformally reduced gravity

Within the conformally reduced gravity model, where the metric is parametrised by a function f(phi) of the conformal factor phi, we keep dependence on both the background and fluctuation fields, to local potential approximation and derivative-squared approximation respectively. Although the standard renormalization group (RG) scale is inherently background dependent, by utilising transformations that follow from combining the flow equations with the modified split Ward identity, we show that there exists a unique background independent notion of RG scale. The resulting RG flow equations are then not only explicitly background independent along the entire RG flow but also explicitly independent of the form of f.

Carlos Tamarit (IPPP Durham)
Higgs valleys, stability and inflation

Mexican hat potentials can support inflation while satisfying Planck and BICEP's bounds on the tensor-to-scalar ratio. When a singlet getting a large vacuum expectation value is coupled to the Higgs, such Mexican hat potentials can be realized along valleys that extend into large values of the Higgs field. Inflation can thus start far in the Higgs direction and end while the fields are rolling parallel to it. We revisit stability conditions to conclude that in general such valleys cannot be stabilized by threshold effects, and stabilization can be either achieved with a top mass m_t<=172.1 GeV or in models with an additional scalar that does not get a VEV. Although no fine-tuning of the top mass is needed for successful models with large excursions in the Higgs direction, we also show that inflation can start in false Higgs vacua arising for appropriately tuned values of m_t.