Shaping UV Physics Beyond the Standard Model

Sunday 12 July 2015 - Wednesday 15 July 2015

IPPP, Durham University

Book of Abstracts

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Alberto Mariotti: UV symmetries for neutral naturalness

Summary:

I will introduce the symmetry principle at the base of the concept of neutral naturalness. I will review the basic realization of such mechanism in the Standard Model, that is the Twin Higgs, showing the details of the protection of the Higgs mass.
I will then discuss how to provide a UV completion of such model and its possible generalizations, where the symmetry protecting the Higgs mass can emerge from a larger symmetry group.

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Arrival: Van Mildert College, Durham University, Mill Hill Lane, Durham DH1 3LH

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Astrid Eichhorn

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Carlos Nunez: Aspects of Gauge-Strings Duality

Summary:

I will discuss the duality between gauge fields and strings.
Various examples of interest for this audience will be presented: flows between conformal theories (including flows across dimensions) and flows between conformal theories and confining ones. The case of 'walking' dynamics will also be discussed.

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Daniel Litim: UV fixed points from BSM to gravity

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Francesco Sannino: UV conformality and pheno implications

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Fred Jegerlehner: The SM as a low-energy effective theory: what is triggering the Higgs mechanism and inflation?

Summary:

The Higgs has been discovered to have a very peculiar mass value, which, depending on some technical details in calculating MSbar parameters in terms of physical ones, allows the Standard Model to work up to the Planck scale. This requires the Higgs potential to remain stable. If so, it turns out that the bare Higgs mass square changes sign at some value below the Planck scale. Assuming that the SM is a low energy effective theory of some cutoff system residing at the Planck scale, the bare parameters are the ones relevant at very high energies as they existed in the early universe after the Big Bang. The change of sign of the bare Higgs mass square triggers the Higgs mechanism. The broken phase characterized by a non-vanishing Higgs vacuum expectation value is realized below the Higgs transition temperature, while in the very early universe the SM is in the symmetric phase, characterized by a large quadratically cutoff-enhanced mass term, which helps to trigger inflation. In fact there is also a large calculable quartically enhanced positive cosmological constant, which gives additional support for the Higgs to be the Inflaton. Detailed calculations show that Higgs inflation actually works and agree with patterns known from CMB data. The cosmological constant surprisingly also exhibits a zero close to the Higgs transition point. At the zeros the quadratically and quartically enhanced contributions vanish and renormalized parameters of the broken phase match with the bare parameters relevant in the high energy phase of inflation and which grow power like as the energy increases. Possible consequences of such a scenario for Baryogenesis are briefly mentioned.

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Ian Jack: The a theorem in various dimensions

Summary:

Zamolodchikov's c-theorem showed how flows of couplings under renormalisation in two-dimensional quantum field theories are constrained by a gradient flow equation with a positive definite "metric", leading to a "c-function" monotonically increasing with energy. The a-theorem is the extension of this result to four dimensions; in fact it is now well-established that similar results hold, at least perturbatively, in all even dimensions. In this talk we discuss the possibility of an exact a-function in 4-d supersymmetric gauge theories; and also present "experimental" evidence for an a-function in three-dimensional theories.

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Ivo Sachs: On scale- versus Weyl- versus conformal invariance

Summary:

We discuss the precise conditions for which scale invariance implies conformal invariance in a four-dimensional, relativistic quantum field theory.

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Jegerlehner: The SM as a low-energy effective theory: what is triggering the Higgs mechanism and inflation?

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Michael Spannowsky: Higgs phenomenology and implications on UV physics

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Roberto Percacci: Towards asymptotic safety of gravity

Summary:

I will review recent work on the existence of a nontrivial gravitational fixed point.

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Stephan Huber: UV scale invariance: challenges in cosmology

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Steve Abel: on mediation of scale breaking

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Valentin Khoze: Novel unitarity problems in the UV? Scattering processes at 100 TeV

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Witold Skiba: Scale Invariance and the Hierarchy Problem

Summary:

I wil discuss the hierarchy problem in theories where the Standard Model is embedded in scale-invariant theories at large energies. I will argue that the Higgs mass is sensitive to the scale at which the Standard Model running of the couplings gives way to scale-invariant behavior.