Sujet de stage de Master 1

Service de *Physique de l'Univers, Champs et Gravitation*

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Compactifications in higher-dimensional gravity: Kaluza-Klein and beyond (I. Basile)

General Relativity has proven to be one of the most reliable and revolutionary theories in physics. Its beautiful geometric underpinnings led many to wonder whether other fundamental interactions could be incorporated in a similar framework. While this is the case to a certain extent, from the point of view of principal bundles and Einstein-Cartan theory, it was found long ago that General Relativity in higher dimensions can encode some aspects of other fundamental interactions. This remarkable idea, famously studied by Kaluza and Klein around a century ago, underlies the mechanism of compactifications – solutions to the field equations where spacetime contains extra dimensions that are wrapped up, or "compactified", hidden from the observer. After reviewing the original efforts of Kaluza and Klein, whereby a hidden circle gives rise to Maxwell electrodynamics and a scalar field, we will look at more general cases. Confronted with the general problem of moduli stabilization, we will look at a specific model that arises from string theory, where the compactification turns out to be a more complicated fibration over an interval.

The aim of this internship is:

- To acquire familiarity with widespread and active areas of research in modern high-energy theoretical physics;
- To acquire technical fluidity in computations involving fields of various types, coupled non-linearly, and working in general spacetime dimension.

Prerequisites: concepts acquired in General Relativity (MAB1) and Electrodynamics.

Some useful references are:

[1] J. M. Overduin and P. S. Wesson, "Kaluza-Klein gravity", Phys. Rept. 283, 303–380 (1997), arXiv:gr-qc/9805018.

[2] M. J. Duff, "Kaluza-Klein theory in perspective", in The Oskar Klein Centenary Symposium (Oct. 1994), pp. 22–35, arXiv:hep-th/9410046.

[3] E. Dudas and J. Mourad, "Brane solutions in strings with broken supersymmetry and dilaton tadpoles", Phys. Lett. B486, 172–178 (2000), arXiv:hep-th/0004165 [hep-th].