HEP-QFT Lecce

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1. Research Interests

The group in 2016 has been composed of 1 permanent staff member (C.C.), two former graduate students (A.C. and C.M), one former postdoc now Assistant Professor in India (P.B.), one visiting professor (P.H.F.) and one master student (M.M. M.). The activity has been part of the HEP-QFT general INFN line of research on fundamental interactions (iniziativa specifica INFN High Energy Physics and Quantum Field Theory) and of the MIUR FIS 02/A2 section. Fundamental aspects of quantum field theory (QFT) are investigated together with other various aspects of physics beyond the Standard Model and Cosmology.

1.1. Conformal theories

In the area of QFT we have been involved in 2016 in the study of multi-point correlators relevant for the analysis of gravitational perturbations in conformal theories and in their non-conformal extensions. This activity has been performed with the goal of comparing exact non perturbative solutions of the conformal Ward identities - for correlators involving three stress energy tensors (TTT) - with the perturbative ones discussed by us in previous works. At the same time, the goal of the recent investigations has been to specialize several studies in $D = 4$ spacetime dimensions to $D = 3$. These studies are important for the analysis of gravitational perturbations in the early universe and for their comparison with the current data on the cosmic microwave background at recombination time. Perturbative analysis at 2-loop level (with Delle Rose and Skenderis (Rutherford Lab/Southampton)) of the TT correlator have been used in the study of a holographic model of our universe which is perturbative in its pre-inflationary phase [1]. The reconstructions method of the exact solutions for the TTT correlator, recently presented by Bzowski, McFadden and Skenderis [2] has been compared (in a study with M. M. Maglio and E. Mottola of Los Alamos) with the prediction for the same correlator coming from the nonlocal conformal anomaly action (also known as Riegert's action), as a test of its consistency. Such effective action is expected to play a role in the emission of gravitational waves.

1.2. Dilatons composite scalars and physics beyond the Standard Model at the LHC

In the context of physics beyond the Standard Model, our activity our long-term analysis of possible embeddings of the Standard Model into a conformal theory has been concentrated on the dynamics of a possible composite Higgs/dilaton [3] and on supersymmetric models with an extended scalar sector with a triplet Higggs [4] (see also [5]). Specifically, in both cases we have investigated the compatibility of these scenarios with the current LHC data. In [3] we have presented a bound on the conformal scale in a general conformal extension of the Standard Model. Other activity is centered on the analysis of Frampton's 331 extension of the Standard Model, together with its proponent (P.H.F.), with Antonio Costantini, Gennaro Corcella of INFN at LNF, and C.C. (work in preparation). Our interest is in the signature of the gauge bosons of the model, termed "bileptons", see [6]. Large simulations of the Standard Model background around a specific signature of such doubly charged gauge bosons are expected to provide important clues on their detection.
Due to important theoretical constraints on the couplings, the model can be confirmed or excluded by collider data in the near future. Other related analysis involve the study of quiver gauge theories [7], the study of their quasi-conformal behaviour, and the embedding of Stuckelberg axions in larger Grand Unified Theories (P.H. Frampton and C.C.) with gauge group E_6.
The study of the stability of the potential in abelian extensions of the Standard Model has been pursued together with L. Delle Rose of Rutherford Lab, Carlo Marzo (now at Tallin University) [8], and with E. Accomando, J. Fiaschi and S. Moretti at the University of Southampton in the UK [9].

In this context it has been shown that the inclusion of large Yukawa couplings in the renormalization group equations, to account for the light neutrino masses ina typical seesaw scenario, and the inclusion of a simple extra Z prime, generates a far more complex pattern of stability than previously expected.

References

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