Extensions of the Standard Model at the LHC and the flavor factories: scalar sector and lepton flavor violation

Research Project / Research Group Description:
The LHCpheno group at IFIC has a long standing international projection in the field of the phenomenology of particle physics, in particular in the development and study of effective field theories in the study of flavor physics and the improvement of techniques for perturbative Quantum Chromodynamics (QCD).

Our group has, at present, three permanent staff, three postdoctoral researchers and eight PhD students. In the last five years, we have directed 7 doctoral theses and 15 master theses. The enormous activity of the group reflects in an excellent record of publications with more than 60 scientific articles in international journals (in the last five years).

Our group is funded three-yearly by the corresponding calls of the present Ministerio de Economía, Industria y Competitividad of the Spanish Government. We have a record of successive awards of these grants since 1998. In addition, we participate, as a group of excellence, in the grants PROMETEO II by Generalitat Valenciana since its start in 2008.

Job position description:
The proposed work subject is aimed to fulfill the content of a PhD thesis in Physics, namely by the University of Valencia. The project has been designed for a student that has a good knowledge of Quantum Field Theory, both concepts and tools, and its application to particle physics.

After the discovery of the neutrino mixing, and hence their mass, it is clear that the lepton flavor is violated in the neutral sector. There is no apparent reason why this should not occur also with charged leptons, though, at present, there is no experimental evidence of it. Known extensions of the scalar sector of the Standard Model could provide the dynamics for such processes. Hence the work project is divided into two steps: i) Study of scalar extensions of the Standard Model, such as the ones driven, for instance, by compositeness, in order to find out their features providing lepton flavor violation in the charged sector; ii) application of those models to the study of muon-tau conversion in the presence of nuclei. Although muon-electron conversion in nuclei has been thoroughly studied following its dedicated search in experiments like the past SINDRUM II and foreseen COMET and Mu2E, the case of muon-tau conversion (m N ® t N) in the presence of nuclei has a very short record of studies, namely because the difficult experimental task needed (though proposals in the past have been put forward). However, it is the violation of lepton flavor in the tau sector the one that, presumably, could be more intense if due to scalar extensions of the Standard Model. We intend to settle this aspect by analyzing these processes. Together with the studies of tau decays in the flavor factories, a global frame could emerge singularizing the third family of leptons as suggested by the recent “anomalies” observed in B decays by LHCb.

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Research project/Research Group website
http://twiki.ific.uv.es/twiki/bin/view/LHCpheno/LHCPhenoHome

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