Preface

During my Ph.D. course, under the guidance of Riccardo Barbieri and Andrea Romanino, I began working on fascinating subjects at the intersection of High Energy Physics, Neutrino Physics, Astrophysics and Cosmology. I partecipated in several collaborations which led to a number of published papers. In this Thesis, I present a extended collection of the work and the results which focus on sterile neutrinos, both in the form of a conventional 4D extra state and in the form of an infinite tower of additional states motivated by Extra Dimensions. With Guido Marandella, Alessandro Strumia and Francesco Vissani in [1], we completed a thorough analysis of the (4D) sterile neutrino effects in solar, reactor, atmospheric and short-/long-base line experiments, as well as in Supernovæ and in the Early Universe. The last two topics are included in this Thesis. Previously, with Giacomo Cacciapaglia, Lin Yin and Andrea Romanino [2] we revisited the bounds on neutrinos in Extra Dimensions set by Supernovæ and by Cosmology. In [3], we extended the study to include the mixing with extra dimensional fields of all neutrino flavors and we addressed the interesting modified supernova phenomenology.

Besides these works, during my Ph.D. course I studied further issues connected with extra dimensional field theories. In [4] and [5], in collaboration with Giacomo Cacciapaglia and Giampaolo Cristadoro, I computed two relevant observables in the framework of the theory proposed by R. Barbieri, L. Hall and Y. Nomura, an extension of the Standard Model to five dimensions endowed with a supersymmetric structure. In [4] we found that the production rate of the Higgs boson via gluon fusion (which is the main channel at a hadron collider) is significantly suppressed, due to cancellations among the additional (Kaluza-Klein) states of the theory. In [5] we showed that the theory is compatible with the precision measurements of muon anomalous magnetic moment, by explicitly computing all the relevant additional contributions to such a quantity and finding them small.

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