Ph.D Thesis Abstrack

"n quest of doubly charged Higgs bosons at low and high energies"

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The primary hypothesis on which the Thesis relies is the existence of additional scalar particles other than the Higgs boson discovered in 2012 at LHC. Finding other scalar particles would have a conspicuous effect on the future development of particle physics.

I consider the Higgs Triplet Model (`HTM`) not restricted by the custodial symmetry and the Minimal Left-Right Symmetric Model (`MLRSM`). The models include scalar triplets with different complexity of scalar potentials and, due to experimental restrictions, completely different scales of non-standard triplet vacuum expectation values. In both models, a doubly charged Higgs boson $H^{\pm\pm}$ can acquire a mass of hundreds of gigaelectronvolts, which can be probed at HL-LHC, future e^+e^-, and hadron colliders. Notably, $H^{\pm\pm}$ particles are connected with different neutrino mass generation mechanisms, seesaw type-I in case of `MLRSM`, and seesaw type-II in case of `HTM`. Thus, collider's $H^{\pm\pm}$ discovery signals can help to understand neutrinos' properties.

I consider $H^{\pm\pm}$ production and decay in e^+e^- and pp colliders, including possible clean four charged lepton signals without missing energy in the final state. The signals are compared with the Standard Model background predictions. In signal estimates, I take into account a comprehensive set of constraints on the parameters of both models coming from neutrino oscillations, LHC, e^+e^- and low-energy lepton flavour violating data.

I show that the discovery of the $H^{\pm\pm}$ leptonic signals over the SM background in two models is possible and for which parameters there is a chance to discriminate between the models when four leptons are identified in the final state.