Grimus-Neufeld modelio naujienos

News from the Grimus-Neufeld model

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The Grimus-Neufeld model (GN) [1] combines both mechanisms of neutrino mass generation, the seesaw mechanism [2] and the radiative generation of masses [1], and extends the Standard Model (SM) of particle physics in a minimal way by adding only a single Majorana fermion and one Higgs doublet.

Though the GN was proposed 30 years ago, not much was published about the model, apart from the contributions of our group [3], with the renormalization of neutrino masses [4] and the inclusion [5] into the automated programs SPheno [6] or FlexibleSUSY [7] as the last published step. The first result of the doctoral research of Simonas Draukšas is a new scheme to define mass counterterms for fermions [8]. The latest findings of Vytautas Dūdėnas analyse the needed counterterms for the scalar sector of a model with spontaneously broken gauge symmetry and study their gauge dependence [9].

In the research of his postdoc project Vytautas Dūdėnas spotted an overlooked area in the parameter space of the GN model that inspires us to a new direction in the active research. With lowering the seesaw scale below the electro weak scale the model still seems to allow a phenomenologically observed neutrino sector, meaning that one can find model parameters that give the observed [10] neutrino mass differences and mixing angles. Vytautas research already shows hints, that the reproduction of the neutrino data does not really restrict the parameter space of the Higgs sector: nearly any general Two Higgs Doublet model can serve as the Higgs sector of the GN.

The Grimus-Lavoura approximation (GLA) [11] seems to work, although the assumption that the Majorana mass is much larger than the scalar masses of the theory is inverted. Simas Jankauskas will check this question as his task for the bachelor thesis. In principle GLA is an essential ingredient in the model, as when this approximation is applicable, the model cannot be reduced to the cases of either only seesaw or only radiative masses. Only in the mixed case the model offers a new viewpoint for the interpretation of the experimental data.

The new mass range for the heavy neutrino, which is in the language of neutrino physics a sterile neutrino, opens the question whether this neutrino can be a Dark Matter candidate and if it has any influence in early cosmology. Aurimas Vitkus works on this question for his Master thesis.

In the context of the stability of radiative corrections, which is embedded in the full renormalisation of the model, the low fermioninc scale gives hopes, that the fine tuning of the Higgs potential parameters can be avoided. Although fine tuning is mostly an argument about the aesthetics of the theory, it gives the feedback, that there should be probably a better, more efficient parametrisation of the model, if the values of the bare parameters look unnatural. This aspect connects again to Vytautas last publication [9]. Zooming out of the details, one can look at the general behaviour of the Grimus-Neufeld model and analyse it in the context of the renormalisation group. This is the task of Rokas Garbačauskas for his Master thesis.

Reikšminiai žodžiai: neutrinos, seesaw mechanism, radiative masses

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