PHYSICAL AND TECHNO-LOGICAL SCIENCES

Elementary Particle Physics Group

Vilnius University

Keywords: *particle physics, theory, CERN LHC, neutrinos, seesaw mechanism, Weyl spinor formalism, two Higgs doublet models*

Research group activities

- Analyzing (and understanding) the Grimus-Neufeld model (a two Higgs doublet and fermionic singlet seesaw extension of the Standard Model of particle physics) for signatures that can be searched for at the LHC.
- Calculating the possible stable configurations of protons and neutrons from the understanding of their interaction.

Proposal

Better understanding of nature in its smallest parts.

The group works with the current understanding of nature in its smallest parts and participates in the attempt to solve the riddles of nature. This enterprise of humankind started with the ancient Greek philosopher Demokritus, but it made huge progress only with the discovery of radioactivity and the subsequent search for the smallest building blocks of nature. Today the best known Laboratories working on these questions are CERN (Switzerland/ France), FermiLab (USA), Gran Sasso (Italy), Kamiokande (Japan), GSI Darmstadt (Germany), etc. But all the experiments need also the input from theorists – and there we come in together with our theory colleagues from the whole world.

The smallest building blocks of nature are the fundamental fermions: the quarks and the leptons. Although the quarks seem mysterious, quite a lot is known about their properties and their abilities to form the boundstates that we can observe in the detectors. The charged leptons, with their lightest member, the electron, are even better known, but the neutral ones, the neutrinos are very hard to detect even today. Consequently, only very little is known about them.

The fundamental fermions interact via gauge bosons. The photon, the particle of light, the most well known gauge boson, produces effects that we understand as electro-magnetism. The theory that describes all these particles and their interactions most accurately is to our understanding the Standard Model of particle physics. This Standard Model needs the Higgs mechanism. The particle predicted by the Higgs mechanis, the Higgs boson, was finally discovered in 2014. Not all of its properties have been measured yet, nor could the possibility be excluded, that more Higgs bosons exist.

Specifically: We want to offer a model that can connect the Higgs sector with the neutrino sector. This model should be simple enough that predictions for future measurements (at LHC in CERN or at neutrino experiments) can be tested.

Meet our team

Team members

Dr. **Thomas Gajdosik**

Dr. **Andrius Juodagalvis**

Dr. **Darius Jurčiukonis**

PhD students

Simonas Draukšas

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Research outcomes

Most recent publications

- **T. Gajdosik, A. Juodagalvis, D. Jurčiukonis and T. Sabonis,** Constraints on the Higgs Sector from Radiative Mass Generation of Neutrinos, Acta Phys. Polon. B 46 (2015) 11, 2323. doi:10.5506/APhysPolB.46.2323
- **V. Dūdėnas and T. Gajdosik,** Feynman Rules for Weyl Spinors with Mixed Dirac and Majorana Mass Terms, Lith. J. Phys. 56, 149–163 (2016). doi:10.3952/physics.v56i3.3364

Resources

We have access to the high performance open access computing center “HPC-Sauletekis”, a cluster with 2000 computing cores.

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