T 21: Astroteilchenphysik, Kosmologie / Neutrinophysik (Theorie)

Convenor: Thomas Schwetz-Mangold, Patrick Huber

Zeit: Dienstag 16:45–19:00 Raum: VG 3.101

T 21.1 Di 16:45 VG 3.101

Light Neutralino in the MSSM: a playground for dark matter, flavor physics and collider experiments — Lorenzo Calibbi[1], •Toshihiko Ota[1], and Yasutaka Takanishi[2] — [1]Max-Planck-Institut fuer Physik, Muenchen, Germany — [2]Technische Universitaet Muenchen, Muenchen, Germany

We investigate the constraints to the light neutralino dark matter scenario in the minimal supersymmetric standard model from available experimental observations such as decays of B and K meson, relic dark matter abundance, and the search for neutralino and Higgs production at colliders. We find that two regions of the MSSM parameter space fulfill all the constraints: a fine-tuned strip with large tan beta where the lightest neutralino can be as light as 8 GeV, and a low tan beta region providing a neutralino mass larger than 16 GeV. The large tan beta strip, which can be compatible with recently reported signals from direct detection experiments, can be fully tested by means of low-energy observables and, in particular, by $B_s \to \mu\mu$ and Higgs bosons searches at the LHC within the upcoming months. We include the update on the latest LHC results.

T 21.2 Di 17:00 VG 3.101

Alternatives to WIMP dark matter — •carlos yaguna — Institute for Theoretical Physics, Westfälische Wilhelms-University Münster, Wilhelm-Klemm-Str. 9, 48149 Münster Germany

Currently, there is no evidence that dark matter is actually composed of WIMPs so it is important to consider viable alternatives to this scenario. In this talk, I will examine two alternative frameworks that have been recently proposed. They both allow to account for the dark matter but give rise to a very different phenomenology. The viable parameter space and the detection signatures of dark matter, in particular, are strongly modified. Some implications of these alternative frameworks will be discussed.

T 21.3 Di 17:15 VG 3.101

B-L Breaking as the Origin of the Hot Early Universe — Wilfried Buchmüller, •Valerie Domcke, and Kai Schmitz — Deutsches Elektronen-Synchrotron (DESY), Notkestraße 85, 22607 Hamburg

The decays of heavy Majorana neutrinos and their superpartners shortly after inflation simultaneously give rise to three crucial ingredients for the hot early universe: (1) the entropy inherent to the thermal radiation that dominates the overall energy density, (2) the matter-antimatter asymmetry and (3) dark matter. For characteristic neutrino parameters baryogenesis can be accomplished by means of nonthermal leptogenesis. At the same time the reheating temperature is controlled by the neutrino lifetime in such a way that thermal production of the gravitino, which we assume to be the lightest superparticle, automatically yields the observed amount of dark matter. This connection between the neutrino sector and supergravity results in constraints on superparticle masses in terms of neutrino masses and vice versa. In the scenario presented here, the initial heavy Majorana (s)neutrino abundance is produced in the course of tachyonic preheating associated with spontaneous B - L breaking in the early universe. This model is sensitive to the light neutrino masses and the supersymmetry mass spectrum and can hence be tested by colliders and in cosmological observations.

T 21.4 Di 17:30 VG 3.101

Nonequilibrium approach to $|\Delta L| = 2$ scattering processes in leptogenesis — •Tibor Frossard[1], Mathias Garny[2], Andreas Hohenegger[3], Alexander Kartavtsev[1], and David Mitrouskas[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [3]Ecole Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland

In the baryogenesis-via-leptogenesis scenario the lepton asymmetry produced by the decay of the heavy Majorana neutrinos is partially washed out by the inverse decay and $\Delta L = 2$ scattering processes. In the canonical approach amplitudes of these processes are computed in vacuum and used in the Boltzmann equation which describes the time evolution of the asymmetry. The resulting equation suffers from the so-called double-counting problem and neglects the medium effects. A consistent description of the asymmetry generation in the early Universe can be achieved using methods of nonequilibrium QFT. Starting from first principles we derive a Boltzmann-like equation for the lepton number which includes the decay, inverse decay and $\Delta L = 2$ scattering processes. The obtained equation takes into account the medium effects, incorporates quantum statistical factors and is free of the double-counting problem.

T 21.5 Di 17:45 VG 3.101

Direct Detection of Dark Matter in Radiative Seesaw Model — •Daniel Schmidt[1], Thomas Schwetz[1], and Takashi Toma[2] — [1]Max-Planck-Institut fuer Kernphysik, Heidelberg — [2]Institute for Theoretical Physics, Kanazawa University, Japan

In the radiative seesaw model proposed by Ma, we assume that the lightest right-handed neutrino is the Dark Matter candidate and almost degenerated with the second lightest right-handed neutrino. Thus, elastic Dark Matter-nucleus scattering is suppressed. Inelastic scattering is induced by a lepton-loop coupled to the photon. Effectively, there are charge-charge, dipole-charge and dipole-dipole interactions. We present the event rate of the model and compare it with existing data. Moreover, monochromatic photons from the decay of the excited Dark Matter state are discussed.

T 21.6 Di 18:00 VG 3.101

Constraining neutrinoless double beta decay — •Luis Dorame[1], Davide Meloni[2], Stefano Morisi[1], Eduardo Peinado[1], and Jose Valle[1] — [1]Instituto de física corpuscular, CSIC-Universidad de Valencia, Valencia, Spain — [2]Dipartamento di fisica "E. Amaldi", Universitá degli studi Roma tre, Roma, Italy

A class of discrete flavor-symmetry-based models predicts constrained neutrino mass matrix schemes that lead to specific neutrino mass sum-rules (MSR). We show how these theories may constrain the absolute scale of neutrino mass, leading in most of the cases to a lower bound on the neutrinoless double beta decay effective amplitude.

T 21.7 Di 18:15 VG 3.101

Sterile Neutrinos for Warm Dark Matter and the Reactor Anomaly in Flavor Symmetry Models — •James Barry, Werner Rodejohann, and He Zhang — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The existence of light active neutrino masses requires new physics beyond the Standard Model, with current theoretical prejudice favouring the introduction of heavy right-handed (sterile) neutrinos: the seesaw mechanism. However, there are a number of recent experimental hints, both from oscillation physics and cosmological parameter fits, that point towards the existence of light sterile neutrinos in the eV mass range. In addition, keV-scale sterile neutrinos are a prime candidate for Warm Dark Matter, whose existence could solve some of the problems of the Cold Dark Matter paradigm by reducing the number of Dwarf satellite galaxies or smoothing cusps in Dark Matter halos.

We examine the feasibility of incorporating sterile neutrinos of different mass scales into type I seesaw neutrino mass models (and effective models) with flavour symmetries, in particular a model based on the tetrahedral group A_4 augmented with a Froggatt-Nielsen U(1) symmetry. Higher order seesaw terms and higher-dimensional effective operators are discussed in detail, and the phenomenological consequences for both active and active-sterile neutrino mixing as well as for neutrinoless double beta decay ($0\nu\beta\beta$) are presented. Light sterile neutrinos induce deviations from the zeroth order tri-bimaximal mixing, and can have a significant influence on the effective mass in $0\nu\beta\beta$.

T 21.8 Di 18:30 VG 3.101

Natural Vacuum Alignment from Group Theory: The Minimal Case — •Martin Holthausen[1] and Michael A. Schmidt[2] — [1]Max-Planck Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]ARC Centre of Excellence for Particle Physics at the Terascale, School of Physics, The University of Melbourne, Victoria 3010, Australia

Discrete flavour symmetries have been proven successful in explaining the leptonic flavour structure. To account for the observed mixing pattern, the flavour symmetry has to be broken to different subgroups in the charged and neutral lepton sector. This, however, poses a problem as cross-couplings via non-trivial contractions in the scalar potential force the group to break to the same subgroup. We present a solution to this problem by extending the flavour group in such a way that it preserves the flavour structure, but leads to an 'accidental' symmetry in the flavon potential.

We have searched for symmetry groups up to order 1000, which forbid all dangerous cross-couplings and extend one of the interesting groups A_4, T_7, S_4, T' or $\Delta(27)$. We have found a number of candidate groups and present a model based on one of the smallest extension of A_4, namely $Q_8 \rtimes A_4$. We show that the most general non-supersymmetric potential allows for the correct vacuum alignment. We investigate the effects of higher dimensional operators on the vacuum configuration and mixing angles, and give a see-saw-like UV completion. Finally, we discuss the supersymmetrization of the model and present the Mathematica package `Discrete`.

T 21.9 Di 18:45 VG 3.101

Beyond the SM $\boldsymbol{\Delta L = 2}$ Operators and Neutrinoless Double Beta Decay — •Dominik Neuenfeld, Michael Dürr, and Manfred Lindner — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Neutrinoless double beta decay is a lepton number violating process ($\Delta L = 2$) whose observation would prove that neutrinos are Majorana particles, i.e. their own antiparticles. The simplest realisation of this process (mediation by light massive Majorana neutrinos) may however interfere with other lepton number violating operators. Therefore, the possibility to reliably extract neutrino parameters from the experimental results may be affected by this interplay. We discuss the effects of various beyond the SM $\Delta L = 2$ processes at higher scales on the measurement of the effective Majorana mass and their implications on different parameters in the neutrino sector.