T 20: Neutrinophysik (Theorie)

Convenor: Walter Winter

Zeit: Dienstag 16:45–18:45 Raum: WIL-B122

T 20.1 Di 16:45 WIL-B122

Lepton number and lepton flavour violation in left-right symmetric theories — •James Barry — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Neutrinoless double beta decay is a lepton number violating process, which, if observed, would prove that neutrinos are Majorana particles. New physics beyond the standard model is required to make the process observable, and there are several different theoretical frameworks that could provide the necessary operators. In the left-right symmetric model there are a number of contributions, either from right-handed neutrinos or Higgs triplets, with the rate for double beta decay linked to neutrino mass. In this context we investigate the different double beta decay amplitudes in different regions of the seesaw parameter space, i.e., with either type I, type II or type I+II seesaw, paying particular attention to the relevant constraints from lepton flavour violation and collider searches. In addition, we discuss the observability of the inverse process $e^- e^- \to W_L^- W_R^-$ at a linear collider.

T 20.2 Di 17:00 WIL-B122

Neutrinoless Double Beta Decay and Lepton Number Violating New Physics — •Michael Duerr, Manfred Lindner, and Dominik Neuenfeld — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Neutrinoless double beta decay is a very promising experimental test for lepton number violation. The exchange of light Majorana neutrinos is the simplest realization of this decay, but other physics beyond the Standard Model may also mediate neutrinoless double beta decay. We will discuss the interplay of different mechanisms and the influence such an interplay has on the extraction of parameters of the neutrino sector from experimental results.

T 20.3 Di 17:15 WIL-B122

Non unitarity and radiative corrections in Type I See-Saw — •Juri Smirnov, Alexander Kartavtzev, and Manfred Lindner — Max Planck für Kernphysik, Heidelberg, Deutschland

Since the discovery of neutrino oscillations it is beyond any doubt that the standard model has to be extended to accommodate neutrino mass terms. One popular option is to introduce singlet neutral fermions, which can have Majorana mass and allow furthermore a Dirac mass term with the active neutrinos. We study a model in which the neutral fermions are of the order of TeV scale and can considerably mix to the active flavors. This has on the one hand an impact on the active neutrino-mixing-matrix, which is now non-unitary. Furthermore, the heavy states can propagate in loops and thus contribute to gauge boson self-energies, what has influence on the electroweak precision observables. We find a regime in which the tree level effects of non-unitarity are in an interplay with the radiative effects which leads to interesting phenomenological results.

T 20.4 Di 17:30 WIL-B122

Neutrino Mixing from SUSY breaking — •Wolfgang G. Hollik and Ulrich Nierste — Karlsruher Institut f. Technologie (TTP)

The origin of lepton flavour mixing may or may not depend on hidden flavour symmetries. In a theory with an additional source of flavour mixing, like in the MSSM with righthanded neutrinos, those can radiatively spoil the tree-level contributions from the mass matrices. Without the assumption of non-minimal flavour violation, the corrections to neutrino mixing get significantly enhanced for quasi-degenerate neutrino masses. However, this class of radiative corrections is quite general and not committed to SUSY theories.

T 20.5 Di 17:45 WIL-B122

Multicomponent Dark Matter and Light Sterile Neutrinos — •Julian Heeck and He Zhang — Max-Planck-Institut für Kernphysik, Heidelberg

Generating small sterile neutrino masses via the same seesaw mechanism that suppresses active neutrino masses requires a specific structure in the neutral fermion mass matrix. We present a model where this structure is enforced by a new U(1)' gauge symmetry, spontaneously broken at the TeV scale. In order not to spoil the neutrino structure, the additional fermions necessary for anomaly cancellations need to carry exotic charges, and turn out to form multicomponent cold dark matter. The active-sterile mixing then connects the new particles and the Standard Model – opening a new portal in addition to the usual Higgs- and kinetic-mixing portals – which leads to dark matter annihilation almost exclusively into neutrinos.

T 20.6 Di 18:00 WIL-B122

Decay of neutrinos from cosmological sources and prospects of observation at neutrino telescopes — •Mauricio Bustamante, Philipp Baerwald, and Walter Winter — Institut für Theoretische Physik und Astrophysik, Universität Würzburg, 97074 Würzburg, Germany

We explore the possibility that ultra-high energy neutrinos produced at cosmological sources decay during their propagation. By solving a redshift-dependent decay equation, we find important conceptual differences compared to more rudimentary treatments of neutrino decay. Notably, we find that the maximum travel distance is bounded by the Hubble length, so that the common notion that longer neutrino lifetimes can be probed by using more distant sources is valid only for redshifts below ~ 1. Using a sophisticated calculation of the neutrino flux from gamma-ray bursts, we discuss the effects of decay on the neutrino spectra and flavor ratios. If ν_1 is stable, as implied by the observation of SN 1987A, and if ν_2 and ν_3 have lifetimes much shorter than their current bounds, then the expected ν_μ flux at PeV energies, where IceCube is most sensitive, is reduced in approximately one order of magnitude, while the ν_e flux is only slightly affected. This suggests that it is possible that no muon tracks from gamma-ray burst neutrinos will be found in the experiment, and that only cascade measurements will have to be used to reliably study high-energy astrophysical neutrinos. As a result, the two cascade events recently detected by IceCube at PeV energies might not be accompanied by muon tracks of comparable energies.

T 20.7 Di 18:15 WIL-B122

High energy proton proton interactions in AGN and the resulting neutrino fluxes — •Isaac Saba[1], Julia Tjus[2], and Francis Halzen[3] — [1]Ruhr-Universität Bochum, Fakultät für Physik & Astronomie, Theoretische Physik I, D-44780 Bochum, Germany — [2]Ruhr-Universität Bochum, Fakultät für Physik & Astronomie, Theoretische Physik I, D-44780 Bochum, Germany — [3]Department of Physics, University of Wisconsin, Madison, WI-53706, USA

The cosmic ray (CR) flux beyond the knee ($E > 10^{15}$ eV) is believed to be extragalactic origin. **A**ctive **g**alactic **n**uclei (AGN) are considered to satisfy physical conditions, i.e. large magnetic fields and high luminosities, to accelerate particles to the observed energies. Particles are assumed to be accelerated near to the accretion disk and in the plasma jets, produced due to conservation of angular momentum, to the highest energies, where they interact with each other and produce pions, which-decay among others-in neutrinos. The high energy neutrinos leave their origin, without any significant interaction with matter. In this talk we present our results for the target densities n_{H} for inelastic proton-proton interactions and focus on 32 FRI galaxies with given radio luminosities. For Centaurus A (Cen A) and Messier 87 (M87) we use Fermi observations to calculate the $\gamma-$flux, the neutrino flux and the resulting target density. The detection of these neutrinos will help to find information about acceleration processes in the source.

T 20.8 Di 18:30 WIL-B122

Interaction of neutral particles with strong laser fields — •Sebastian Meuren, Christoph H. Keitel, and Antonino Di Piazza — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg

Since the invention of the laser in the 1960s the experimentally available field strengths have continuously increased. The current peak intensity record is $2 \times 10^{22}\,\mathrm{W/cm^2}$ and next generation facilities such as ELI, HiPER and XCELS plan to reach even intensities of the order of $10^{24}\,\mathrm{W/cm^2}$ [1]. Thus, modern laser facilities are a clean source for very strong external electromagnetic fields and promise new and interesting high-energy physics experiments. In particular, strong laser fields could be used to test non-linear effects in quantum field theory.

In [2] we have investigated how radiative corrections modify the coupling of a charged particle inside a strong plane-wave electromagnetic background field. However, a charged particle couples already at tree level to electromagnetic radiation. Therefore, we have now analyzed how the coupling between neutral particles and radiation is affected by a very strong plane-wave electromagnetic background field, when loop corrections are taken into account. In particular, the case of neutrinos is discussed [3].

[1] Di Piazza, et al., Rev. Mod. Phys. **84**, 1177–1228 (2012)
[2] S. Meuren and A. Di Piazza, Phys. Rev. Lett. **107**, 260401 (2011)
[3] S. Meuren, C. H. Keitel and A. Di Piazza, in preparation.