T 18: Neutrinophysik (Theorie)

Zeit: Freitag 14:00–15:45 Raum: Peterhof-HS 4

T 18.1 Fr 14:00 Peterhof-HS 4

Quark-Lepton Complementarity from Discrete Flavor Symmetries — •Florian Plentinger, Gerhart Seidl, and Walter Winter — Institut für Theoretische Physik und Astrophysik, Universität Würzburg, D-97074 Würzburg, Germany

We present numerous simple models for fermion masses realizing quark-lepton complementarity, i.e., the solar mixing angle θ_{12} obeys the sum-rule $\theta_{12}+\theta_C \approx \pi/4$, where θ_C is the Cabbibo angle. As flavor symmetries, we use products of cyclic groups. The fermion mass hierarchies are generated by higher-dimension operators via the Froggatt-Nielsen mechanism. Neutrino masses emerge exclusively from the usual type-I seesaw mechanism. We focus on solutions that can naturally give close to tri-bimaximal lepton mixing with a very small reactor angle $\theta_{13} \ll \theta_C$. Hierarchical fermion mass ratios and the mixing angles are predicted as powers of a single parameter of the order of θ_C. These models are rather general in the sense that large mixings can come from the charged leptons and/or neutrinos. Moreover, in the neutrino sector, both left- and right-handed neutrinos can mix maximally. This could be the result of quark-lepton unification in grand unified theories.

T 18.2 Fr 14:15 Peterhof-HS 4

Dihedral Flavour Symmetries with conserved subgroups — •Alexander Blum, Claudia Hagedorn, Andreas Hohenegger, and Manfred Lindner — Max-Planck-Institut für Kernphysik, Heidelberg

We perform a systematic study of dihedral groups used as flavor symmetry. The key feature here is the fact that we do not allow the dihedral groups to be broken in an arbitrary way, but in all cases some (non-trivial) subgroup has to be preserved. In this way we arrive at only five possible (Dirac) mass matrix structures which can arise, if we require that the matrix has to have a non-vanishing determinant and that at least two of the three generations of left-handed (conjugate) fermions are placed into an irreducible two-dimensional representation of the flavor group. Furthermore, we comment on possible forms of Majorana mass matrices. As a first application we find a way to express the Cabibbo angle, i.e. the CKM matrix element $|V_{us}|$, in terms of group theory quantities only, the group index n, the representation index j and the index $m_{u,d}$ of the different preserved subgroups in the up and down quark sector: $|V_{us}| = |\cos(\pi(m_u - m_d)j/n)|$ which is $|\cos(3\pi/7)| = 0.2225$ for $n = 7, j = 1, m_u = 3$ and $m_d = 0$. We prove that two successful models which lead to maximal atmospheric mixing and vanishing θ_{13} in the lepton sector are based on the fact that the flavor symmetry is broken in the charged lepton, Dirac neutrino and Majorana neutrino sector down to different preserved subgroups whose mismatch results in the prediction of these mixing angles.

T 18.3 Fr 14:30 Peterhof-HS 4

A Simple Baryon Triality Model for Neutrino Masses — •Jong Soo Kim, Marc Thormeier, and Herbi Dreiner — Physikalisches Institut der Universität Bonn

We make a simple ansatz for the supersymmetric lepton-number violating Yukawa couplings, by relating them to the corresponding Higgs Yukawa couplings. This reduces the free B_3 parameters from 36 to 6. We fit these parameters to solve the solar and atmospheric neutrino anomalies in terms of neutrino oscillations. The resulting couplings are consistent with the stringent low-energy bounds. We investigate the resulting LHC collider signals for a stau LSP scenario.

T 18.4 Fr 14:45 Peterhof-HS 4

Nuclear aspects of neutrino energy reconstruction in current oscillation experiments — •Tina Leitner[1], Oliver Buss[1], Ulrich Mosel[1], and Luis Alvarez-Ruso[2] — [1]Institut für Theoretische Physik, Universität Gießen — [2]Departamento de Física Teórica and IFIC, Universidad de Valencia - CSIC, Spain

There is an extensive experimental effort aiming at a precise determination of neutrino oscillation parameters. A critical quantity is the neutrino energy which can not be measured directly but has to be reconstructed from observables. A good knowledge of neutrino-nucleus interactions is thus necessary to minimize the systematic uncertainties in neutrino fluxes, backgrounds and detector responses. A reliable reconstruction has to account for in-medium modifications. We find that in particular final-state interactions inside the target nucleus modify considerably the distributions through rescattering, charge-exchange and absorption. These effects can be simulated with our coupled channel GiBUU transport model where the neutrino first interacts with a bound nucleon producing secondary particles which are then transported out of the nucleus. We consider, besides Fermi motion and Pauli blocking, full in-medium kinematics, mean-field potentials and in-medium spectral functions. In this contribution, we compare the reconstructed quantities obtained within our model to the ones obtained by the current experiments like MiniBooNE, which mostly rely on simple two-body kinematics. We then discuss how these uncertainties influence not only the cross section measurements but also the oscillation results. Supported by DFG.

T 18.5 Fr 15:00 Peterhof-HS 4

New physics effects in future oscillation experiments — •Toshihiko Ota — Uni Wuerzburg

Neutrino oscillation experiments enter the phase of precision measurements. The high statistics and precision of forthcoming experiments are effective not only for the determination of the standard oscillation parameters, but also for the discovery of the physics beyond the standard model. In this talk, we study the performance of near future experiments (reactor and superbeam neutrino experiments) and also neutrino factory type experiments in the presence of such new physics effects, using the method of non-standard interactions (NSIs). These provide a convenient, model-independent way of parameterizing a wide class of new physics scenarios.

T 18.6 Fr 15:15 Peterhof-HS 4

Effects of Lightest Neutrino Mass in Leptogenesis — Emiliano Molinaro[1,2], Serguey Petcov[1,2], •Tetsuo Shindou[3], and Yasutaka Takanishi[1,2] — [1]SISSA, Trieste, Italy — [2]INFN sezione di Trieste, Trieste, Italy — [3]DESY Theory Group, Hamburg, Germany

The effects of the lightest neutrino mass in “flavoured” leptogenesis are investigated in the case when the CP-violation necessary for the generation of the baryon asymmetry of the Universe is due exclusively to the Dirac and/or Majorana phases in the neutrino mixing matrix U. The type I see-saw scenario with three heavy right-handed Majorana neutrinos having hierarchical spectrum is considered. The “orthogonal” parametrisation of the matrix of neutrino Yukawa couplings, which involves a complex orthogonal matrix R, is employed. Results for light neutrino mass spectrum with normal and inverted ordering (hierarchy) are obtained. It is shown, in particular, that if the matrix R is real and CP-conserving and the lightest neutrino mass m_3 in the case of inverted hierarchical spectrum lies the interval $5 \times 10^{-4}\mathrm{eV} < m_3 < 7 \times 10^{-3}\mathrm{eV}$, the predicted baryon asymmetry can be larger by a factor of arround 100 than the asymmetry corresponding to negligible $m_3 \sim 0$. As consequence, we can have successful thermal leptogenesis for $5 \times 10^{-6}\mathrm{eV} < m_3 < 5 \times 10^{-2}\mathrm{eV}$ even if R is real and the only source of CP-violation in leptogenesis is the Majorana and/or Dirac phase(s) in U.

T 18.7 Fr 15:30 Peterhof-HS 4

Leptogenesis in an inhomogeneous Universe — •Alexander Kartavtsev[1], Emanuel Paschos[2], and Denis Besak[3] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117, Heidelberg — [2]Universitat Dortmund, Otto-Hahn str. 4, 44221, Dortmund — [3]Universität Bielefeld, 33501, Bielefeld

Baryogenesis via Leptogenesis is one of the most attractive scenarios able to explain the observed baryon asymmetry of the Universe. Since the early Universe was to a very good approximation homogeneous and isotropic, it is common to neglect the primeval inhomogeneities. Nevertheless, since the primeval perturbations were of utmost importance for the subsequent formation of large scale structures, it is of interest to investigate how they affected the generation of the lepton and baryon asymmetries.

We have derived an integrated gauge-invariant form of the Boltzmann equations useful for analysis of development of the lepton asymmetry in an inhomogeneous Universe. Using the method of steepest descent an approximate analytical solution of the Boltzmann equations has been derived. We have calculated Fourier components of perturbations of the efficiency of leptogenesis which is of potential interest for theoretical analysis of the CMB spectrum. We have also related

the efficiency to the covariantly defined perturbations of energy and particle number density and found that the efficiency is smaller in the regions of higher energy and particle number density.