Shashank Shalgar

Research statement

Present work and future directions: My current work includes phenomenology with supernova neutrinos, and trying to study the sensitivity of collective neutrino oscillations to transition magnetic moment for Majorana neutrino. I am currently working on the collective neutrino oscillations with three flavors and multi-angle calculations of supernova neutrino oscillations. A preprint that discusses the effect of transition magnetic moments on three flavor oscillations is expected to be released very soon. I am also working towards including multi-angle effects. This is a computationally challenging problem that requires proficiency in parallel computing.

My research interest is primarily in neutrino and beyond Standard Model collider phenomenology. The hope is, that neutrino physics might offer us a window into the elusive high energy regime, not accessible by current collider technologies. I am interested in the phenomenology of atmospheric neutrino as it offers a sensitivity to a wide range of parameters with a free neutrino source. I have written a user friendly code with Graphical User Interface (GUI) in an attempt to make neutrino oscillations accessible to undergraduate students (http://mac.softpedia.com/get/Math-Scientific/Neutrino-Oscillation-Toolkit.shtml).

In the future, I plan on continuing to work on LHC phenomenology of beyond standard model physics and would also like to expand my research efforts into model building and phenomenology related to dark matter.

List of Publications:

- Measurement of mass hierarchy with atmospheric neutrinos (with Raj Gandhi, Pomita Ghoshal, Srubabati Goswami, Poonam Mehta, S Uma Sankar) [**arXiv:0707.1723**]:

  We performed a detailed study of the determination of the neutrino mass hierarchy with a magnetized iron calorimeter type of detector. In order to make the study as realistic as possible we took into account in detail the energy and angular smearing, as well as the uncertainty in the known neutrino oscillation parameters.

- Implications of Higgs discovery in the MSSM Golden region (with Ian Low)[**arXiv:0901.0266**]:

  We studied the implication of a light stop with a large stop mixing in the MSSM. In this region of parameter space, the Higgs mass and the Higgs to gamma-gamma branching ratio can be used to constraint the stop sector to a very good accuracy.

- Atmospheric tau neutrinos in multi-kiloton Liquid Argon detector (with Janet Conrad, André de Gouvêa, and Joshua Spitz)[**arXiv:1008.2984**]:

  A large Liquid Argon detector (100 kt-yr exposure) can be used to isolate around 30 tau neutrino events using simple kinematic cuts, using atmospheric neutrinos as the source. We showed that this data would be enough to perform a flux averaged cross section measurement.

- Parametrising Majorana Neutrino couplings in Higgs sector (with André de Gouvêa and Wei-Chih Huang)[**arXiv1007.3664**]:

  We studied the parametrisation of Yukawa couplings for Majorana neutrinos. We showed that the Yukawa couplings can be parametrised in terms of neutrino mixing parameters, including active-sterile mixing parameters, and discussed the physical parameter range of the neutrino mixing parameters.

- Effect of Transition Magnetic Moments on Collective Supernova Neutrino Oscillations (with André de Gouvêa)[**arXiv:1207.0516**]:

  The "switch on" effect seen in collective oscillations for θ_{13} is also present for transition magnetic moments of Majorana neutrinos. We found that collective neutrino oscillation is the only known phenomenon for which transition magnetic moments of the order predicted by the standard model can have a significant impact.