

APR12-2011-000143

Abstract for an Invited Paper  
for the APR12 Meeting of  
the American Physical Society

**What's up with neutrinos? (...and what can we do about it?)**

ROBERT SVOBODA, UC Davis

We now know that neutrinos have some very fundamental differences with other particles of the Standard Model. Firstly, except for the photon they are the only electrically neutral stable particle we know exists for sure (could dark matter be another?). This leads to the curious fact that there are two possible forms for the neutrino that both solve the Dirac equation and are Lorentz invariant. Which form is the real neutrino and how might this affect our view of the nature of mass itself? In addition, we now know that neutrinos have a non-zero mass via the phenomenon of neutrino oscillations – essentially quantum interferometry over macroscopic distance scales of hundreds of kilometers. This type of measurement is made possible only by the fact that neutrino interaction eigenstates are profoundly different than the mass eigenstates, the nature of which is not really understood at a fundamental level. As if this was not enough, “sterile” and “superluminal” neutrinos are now being seriously discussed based on recent experimental indications. This presentation gives an up-to-date summary of what we know about neutrinos, how we know it, and what the current experimental issues are. In addition, it will cover how new accelerator-based experiments will address some of the most outstanding questions, while at the same time allow us to begin to exploit more fully the neutrino as a probe in other areas of science and technology.