Neutrino IF Group Meeting

Afternoon Session 6 notes by Gavin S. Davies

New Experiments to refute/verify OPERA results on neutrino speeds

Speaker: Michael Schmitt, Northwestern University

OPERA Δt too short with respect to speed of light. Ignore theoretical considerations: Needs to be tested experimentally. The concept uses a traditional pion-decay beam. Compare dt of ν and μ in same detector, a laser synced to proton. Considers beam similar to current NuMI beam to compare TOF of the neutrinos to that of the relativistic muons. Collect four kinds of signals: laser pulses, neutrinos from pion decays, muons from pion decays and the special 'dual events' - muon and neutrino from same single pion decay interact in detector. Showed PYTHIA simulations of the ideal scenario in a feasibility study. Details in the slides. If 10 ps is achieved, decay tunnel can be shortened but if we have a 10 km tunnel, then 50 ps is good enough.

Questions:

Bob Tschirhart points out that there is a Fast-timing pico-second collaboration at Argonne that should talk to. Less than 10 ps is achievable.

Mary Bishai points out that CERN are going to repeat experiment with 4 ns widows.

Ben Jones: How do you know which muon to tag with which neutrino? Probability of them occurring in the same 8 ns bucket is very small.

?: For every detected muon, how many neutrinos? 10^{13}. For every spill you are swamped by many muons and need a fine-grained detector. Bob Tschirhart points out that absorber optimisation will help here.

Searching for New Particles Beyond the Standard Model by proton Bremsstrahlung

Speaker: William Louis, LANL

Neutrino experiments are useful for new particle searches due to a large number of POT ($> 10^{21}$), located large distance from target so backgrounds from ν interactions are low. Exotic "brem-ed" particle flux is collimated around incoming proton beam and decays in center of detector - assuming on-axis beam. Paraphoton is one such example of an exotic produced via Bremsstrahlung or rather "beam-strahlung". Its cross-section is forward-peaked along beam direction. Project X would provide 10x the current beam intensity, allowing for searches with very high sensitivity for new scalar and vector boson production via proton Bremsstrahlung. Intensity improves when coupled with a dedicated beam dump.

Questions:

Bob Tschirhart: What is the motivation for using protons? Model-dependent collimation is better with protons than electrons and all background decreases as $1/r^2$.

Andre De Gouvea points out that there is a subgroup dedicated to paraphotons

in the IF workshop.

Searching for Sterile Neutrinos with a Radioactive Source at Daya Bay
Karsten Heeger, University of Wisconsin

Daya Bay is a China-US reactor experiment designed to measure θ_{13}. Use an anti-neutrino ^{144}Ce radioactive source to search for sterile neutrinos. The source would be placed in the water pool that surrounds the 4 detectors in the Far Hall. Possible to probe baselines of 1.5 to 8 m with an anti-neutrino energy range of 1.8 - 3 MeV, observing a signal of 30 k - 40 k inverse beta-decay interactions per year. After the θ_{13} measurement has been made propose to then test for sterile neutrino oscillations with mass > 1 eV.
Questions:
William Louis: Will you be able to keep anti-neutrino running when put source in? It is advantageous to use Far Detector for this experiment but could do it in Near Hall. Assume will take place after the θ_{13} measurement.
Andre De Gouvea: What are the backgrounds you are wary of? The nice feature of this experiment is that the source is placed in the water pools which act as shielding to gammas and neutrons, as well as a providing cooling. Logistics and infrastructure already in place.

A Proposal for BooNE - MiniBooNE in 30 seconds
Geoffrey Mills, LANL

Outlined lessons learned from MiniBooNE and gave a synopsis of BooNE. All future experiments should work hard to get the intensity they hope for! MiniBooNE proposal was a 3 yr run but in reality was 9 years. Systematic errors are difficult in a wide-band neutrino beam. It pays to have two identical detectors. BooNE would be 1 - 2 year experiment (at current rate) with two-detectors, placing an identical MiniBooNE detector 200 m from proton target location at FNAL. Existing MiniBooNE detector is 541 m from target. Measure muon-neutrino disappearance to $< 10^{-1}$ in the reactor anomalies region of interest.

Alternative Oscillation Models
Teppei Katori, MIT

In the neutrino Standard Model (νSM) assume neutrino mass as phase and mass mixing matrix elements as an amplitude of oscillations in a model dependent diagram. Presented how things look for model independent neutrino oscillation data which is the function of neutrino energy and baseline. Much more sparse than model-dependent diagram. The Puma model (Diaz and Kostelecky, PLB700(2011)25) has only 3 parameters and perfectly describes all neutrino oscillation signals including the MiniBooNE low energy excess.
Teppei will give the Fermilab Wine & Cheese seminar on November 11th - "Test of Lorentz and CPT Violation with MiniBooNE excesses".