nuSTORM

Neutrinos from STORed Muons

The results from LSND and MiniBooNE, along with the recent papers indicating a possible reactor neutrino flux anomaly, give tantalizing hints of new physics. Models beyond the νSM have been developed to explain these results and involve one or more additional neutrinos that are non-interacting or "sterile." Sterile neutrinos—fermions that are uncharged under the SU(3) $\times$ SU(2) $\times$ U(1) gauge group—arise naturally in many extensions of the Standard Model and even where they are not an integral part of a model, they can usually be accommodated easily. Neutrino beams produced from the decay of muons in a racetrack-like decay ring provide a powerful way to study this new physics. The nuSTORM facility [1] (see Fig. 1) and a magnetized iron far detector can perform neutrino oscillation searches at short baseline with unprecedented precision while making efficient use of existing infrastructure on the Fermilab site. Monte Carlo simulations assuming a total exposure of 10^{21} 60 GeV protons on target indicate that this experimental approach can provide 10σ confirmation or rejection of the LSND/MinBooNE results (see Fig. 2). The contours in Fig.2 show preliminary results from our multivariate boosted-decision-tree (BDT) analysis. The BDT analysis outperforms the cuts-based analysis used for the data shown in our Letter of Intent [1]. In Fig. 2 we also show the 99% C.L. "Evidence" from a global fit to LSND + MiniBooNE + Gallium experiments + the reactor anomaly [2-4] and the 99% C.L. appearance contours from ν_e and ν_e-bar appearance data. In addition, the facility can be used to make neutrino interaction cross section measurements important to the next generation of long-baseline neutrino oscillation experiments and, in general, add significantly to the study of neutrino interactions. For example, at a near detector hall located approximately 50m from the end of the decay ring straight, a 1T fiducial mass detector would register roughly 40,000 ν_e CC interactions for the above exposure. The unique ν beam available at the nuSTORM facility has the potential to be transformational in our approach to ν interaction physics, offering a *"ν light source"* to physicists from a number of disciplines. Finally, it is possible to produce a low-momentum (200-500 MeV/c) intense ($\approx 10^{10}$ μ in a 1 μs pulse) muon beam (simultaneously while running the neutrino program) for future investigations into muon ionization cooling or other studies for future ultra-high intensity muon accelerator facilities.

Figure 1 Schematic layout of nuSTORM on Fermilab site.

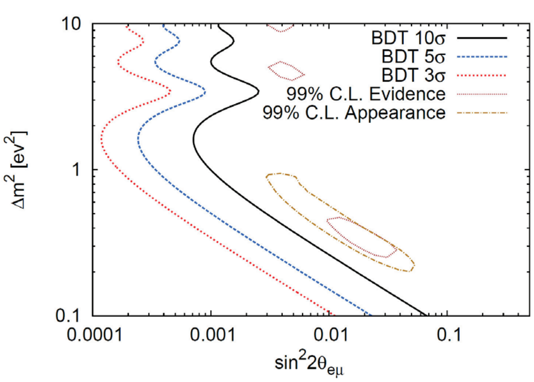

Figure 2 Exclusion limits for nuSTORM.

[1] Kyberd, P. *et. al*, nuSTORM: Neutrinos from STORed Muons, arXiv:1206.0294.
[2] J. Kopp, M. Maltoni, and T. Schwetz, "Are there sterile neutrinos at the eV scale?," Phys.Rev.Lett. 107 (2011) 091801, arXiv:1103.4570 [hep-ph].
[3] K. Abazajian, M. Acero, S. Agarwalla, A. Aguilar-Arevalo, C. Albright, et al., "Light Sterile Neutrinos: A White Paper," arXiv:1204.5379 [hep-ph].
[4] J. Kopp, P. Machado, M. Maltoni, and T. Schwetz, Work in progress.