DOE Award: DE-SC0011803 DREXEL UNIVERSITY

Project Title: NEUTRINO PHYSICS AT DREXEL

PI:

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Key to participants:

CL: Charles Lane, PI

MD: Michelle Dolinski, co-I

RN: Russell Neilson

Accomplishments over past budget period:

- DUNE/LBNF (CL): Institutional Representative on the DUNE IB. Built, tested and distributed 'gated PMT bases' for use with Stopping Muon Detector prototypes in the FNAL NuMI beam muon alcoves. Designed, built, deployed and operated new 'water Cherenkov' based Stopping Muon Detector prototypes in the NuMI muon alcove #2. Observed peculiar beam-related PMT/base post-beam-pulse exponential behavior, which is to be the focus of further beam tests.
- PROSPECT (CL): Simulation of neutron-activated gamma calibration sources for energy calibrations in the region of the 'reactor neutrino spectral anomaly'.
- PROSPECT (RN): Design and testing of laser calibration system for stability and linearity measurements.
- PROSPECT (MD): Analysis of calibration data from the P50 prototype counter, toward improved analysis techniques and optimization of calibration sources and techniques. Responsible for slow-control system. Institutional representative on the PROSPECT Collaboration Board.

Accomplishments over grant period:

- DUNE/LBNF (CL): design, prototyping, testing of a 'gated PMT base', to prevent PMT saturation during the FNAL beam pulse and efficient detection of subsequent decays of muons stopped in small detectors in the NuMI muon alcove. There were several stages of bench-testing to result in fast turn-on (<200ns) characteristics, with stable post turn-on gain and efficiency.
- PROSPECT(MD,RN,CL): joined in the initial stages of design, simulation, site-selection, and proposal for the PROSPECT short baseline neutrino experiment, now focusing on calibration analysis and simulation.
- NuLAT (CL): involvement in the design and proposal stages of NuLAT (an innovative new design for a short-baseline neutrino experiment), investigated the possible deployment at the Hope Creek power reactor for initial testing purposes, but decided to focus efforts on PROSPECT.

Student Mentoring

- Dr. Jonathan Insler, postdoctoral fellow, working on PROSPECT and DUNE
- Dr. Yung-Ruey Yen, postdoctoral fellow, working on PROSPECT
- Kelley Commeford, graduate student (PROSPECT)
- Tyler Rehak, graduate student (DUNE)
- Brian Goddard, undergraduate student (PROSPECT)
- Jeremy Gaison, undergraduate student (PROSPECT)
- Cuong Tranh, undergraduate student (PROSPECT and DUNE)
- Tristan Winick, undergraduate student (DUNE)
- Ruyuan Li, undergraduate student (PROSPECT)

The postdoctoral fellows have been attending and presenting at a number of significant conferences, including Neutrino 2016 and the Lake Louise conference. In addition, postdoctoral fellows and graduate students are presenting their work at collaboration meetings.

Undergraduate students at Drexel have two major forms of involvement with experiments: 6 month periods of full-time employment in the Drexel co-op program, which allows them to be heavily involved in every aspect of an experiment. In the above list, Goddard, Gaison, Tranh and Winick have all worked as co-op students. In addition, undergraduate seniors have a year long research project the culminates in a Senior Theses. All of the above-mentioned undergraduates (with the exception of Cuong Tranh, who is not yet a senior) have completed Senior projects in areas of experimental neutrino physics, either related to DUNE or PROSPECT. Most of the undergraduates, particularly the co-op students, have participated in collaboration meetings.

PROSPECT publications/talks/posters:

1) Sterile at reactors: PROSPECT; PoS NOW2016 (2017) 032.

2) Searching for Sterile Neutrinos with the PROSPECT Detector; PoS ICHEP2016 (2016) 956.

3) Precision Measurement of the Reactor Antineutrino Spectrum with PROSPECT; PoS ICHEP2016 (2016) 950.

4) Design of the PROSPECT Experiment; PoS ICHEP2016 (2016) 938.

5) Neutrino experiments at nuclear reactors; PoS FPCP2016 (2017) 037.

6) The PROSPECT Physics Program; arXiv:1512.02202 [physics.ins-det].

10.1088/0954-3899/43/11/113001. J.Phys. G43 (2016) no.11, 113001.

7) Sensitivity and Discovery Potential of the PROSPECT Experiment; arXiv:1511.00177 [physics.ins-det].

8) Development of PROSPECT detectors for precision antineutrino studies; arXiv:1510.09082 [physics.ins-det].

9) Light Collection and Pulse-Shape Discrimination in Elongated Scintillator Cells for the PROSPECT Reactor Antineutrino Experiment; arXiv:1508.06575 [physics.ins-det].

10.1088/1748-0221/10/11/P11004. JINST 10 (2015) no.11, P11004.

10) Background Radiation Measurements at High Power Research Reactors; arXiv:1506.03547 [physics.ins-det]. 10.1016/j.nima.2015.10.023. Nucl.Instrum.Meth. A806 (2016) 401-419.

11) PROSPECT – A precision oscillation and spectrum experiment; arXiv:1501.00194 [physics.ins-det].

10.1016/j.nuclphysbps.2015.06.031. Nucl.Part.Phys.Proc. 265-266 (2015) 123-125.

12) PROSPECT - A Precision Reactor Oscillation and Spectrum Experiment at Short Baselines; arXiv:1309.7647 [physics.ins-det].

DUNE publications/talks/posters:

1) Design of the LBNF Beamline; FERMILAB-CONF-17-022-AD

2) The Single-Phase ProtoDUNE Technical Design Report; arXiv:1706.07081 [physics.ins-det].

3) Automated Reconstruction, Signal Processing and Particle Identification in DUNE; PoS ICHEP2016 (2016) 183.

4) Deep Underground Neutrino Experiment; 10.1142/9789813224568_0003.

5) Developing Detectors for Scintillation Light in Liquid Argon for DUNE; Submitted to: Proceedings of Science.

6) DUNE Strategy for Controlling Systematic Uncertainties; 10.7566/JPSCP.12.010012. JPS Conf.Proc. 12 (2016) 010012.

7) A pressurized argon gas TPC as DUNE near detector; arXiv:1610.07803 [physics.ins-det].

8) Experiment Simulation Configurations Used in DUNE CDR; arXiv:1606.09550 [physics.ins-det].

9) An Experimental Program in Neutrinos, Nucleon Decay and Astroparticle Physics Enabled by the Fermilab Long-Baseline Neutrino Facility; PoS EPS-HEP2015 (2015) 041.

10) DUNE Physics; FERMILAB-CONF-15-611-ND

11) Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) : Volume 3: Long-Baseline Neutrino Facility for DUNE June 24, 2015; arXiv:1601.05823 [physics.ins-det].

12) Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) : Volume 1: The LBNF and DUNE Projects; arXiv:1601.05471 [physics.ins-det].

13) Underground physics with DUNE; arXiv:1601.03496 [physics.ins-det].

10.1088/1742-6596/718/6/062032. J.Phys.Conf.Ser. 718 (2016) no.6, 062032.

14) Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) : Volume 4 The DUNE Detectors at LBNF; arXiv:1601.02984 [physics.ins-det].

15) Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) : Volume 2: The Physics Program for DUNE at LBNF; arXiv:1512.06148 [physics.ins-det].