Fermilab Intensity Fellowship, August 2013 - August 2014
Final Report: Thomas Strauss

When I applied for my Intensity Fellowship, I planned an extended stay at Fermilab to work on the MicroBooNE experiment; to install and develop a UV laser calibration system for the detector.

After my arrival at Fermilab, I had ample opportunity to work on the MicroBooNE experiment, here my daily interaction with Dr. Jennifer Raaf on the Assembly of the detector is worth mentioning. Together with the technician team of John Voirin and the help of Fermilab Post-Docs like Sarah Lockwitz and Ben Carls we assembled the MicroBooNE detector.

During the time, I had also the chance to work with graduate student Benjamin J.P. Jones from MIT on the design of a LED flasher system, where the support of the Fermilab technical staff, explicitly John Voirin and Gary Markiewicz for the mechanical part of the system, and Linda Bagby and Sten Hansen for the electrical components were valuable without comparison.

The detector construction and the LED flasher system could not have been possible without my presence at Fermilab, due to heavy face-to-face work involved in designing the system and the physical labor required to build a detector. The work resulted in various internal notes, a paper describing the system is in progress to be published in the early stages of 2015:

MicroBooNE internal note: The photomultiplier tube calibration system of the MicroBooNE experiment, B.J.P. Jones, Z. Moss, T.Strauss, http://microboone-docdb.fnal.gov/cgi-bin/ShowDocument?docid=3896
MicroBooNE internal note: Proposal to install a PMT Flasher system in MicroBooNE, B. J.P. Jones, T. Strauss

My initial project of the UV laser calibration system progressed very well during my stay, many of the developments required communication back and forth between the engineers at my home university, and the team at Fermilab, to find the best place for the system and integrate it with very well into the infrastructure of the experiment:

A steerable UV laser system for the calibration of liquid argon time projection chambers A. Ereditato, et al., JINST (2014) T11007
MicroBooNE internal note: Prototype of a cryogenic UV laser feed-through with a moveable mirror system to allow a hemispherical steering of the laser, T. Strauss, et al.

The personal support of Fermilab scientists like Geralyn Zeller, Bruce Baller and Catherine James helped me to integrate into the scientific culture of the laboratory.

The help of the administrative staff personal Stephanie Schuler and Julie

Saviano was invaluable, especially when organizing my trip to participate in the MicroBooNE reconstruction software workshop to Yale University, which was funded with the travel money allocated to my intensity frontier fellowship.

Fermilab profited during my stay from the experience in the liquid argon detector technology. From the transfer of knowledge we were able to improve the detector such that it become a better experiment, with added reliability in the presences of large electric fields, as is the custom for a time projection chamber.

Measurements performed at LHEP Bern with high voltages in liquid argon showed a potential problem with the high voltage system with the MicroBooNE TPC. The used components were found to be unreliable in case of high voltage breakdowns, a condition that was not anticipated with previous knowledge. Once discovered a large team of students and Post-Docs worked tireless to find a solution, which lead to several publications as example:

Breakdown voltage of metal-oxide resistors in liquid argon, L.F. Bagby, et al., JINST 9 (2014) T11004
Testing of High Voltage Surge Protection Devices for Use in Liquid Argon TPC Detectors, J. Asaadi, et al., JINST 9 P09002 (2014)
MicroBooNE internal note: Breakdown voltage of metal-oxide resistors in liquid argon, L.F. Bagby, et al
MicroBooNE internal note: Report on Surge Protection Devices and Their Suitability for Cryogenic Over-voltage protection, J. Asaadi, et al.,

The work at Fermilab allowed me to participate in several workshops and meetings, which lead to several proceedings, one of them being a review of the neutrino physics in the process of the P5 community planning process in the US:

Neutrinos, A. de Gouva, et al.,
Liquid Argon Time Projection Chamber research and development in the United States, B. Baller, *et al.,* JINST 9 (2014) T05005
High Voltage in Noble Liquids for High Energy Phyiscs, E. Bernard, et al., JINST 9 (2014) T08004
LAR1-ND: Testing Neutrino Anomalies with multiple LArTPC detectors at Fermilab, C.Adams, et al., White paper, eprint arXiv:1309.7987 (2013)

During my stay at Fermilab the Intensity Frontier Fellowship allowed me to participate in the following Conferences and give presentations at various meetings:

- 2nd LArTPC (Liquid Argon Time Projection Chamber Detector) R&D Workshop, Fermilab, USA 08.07. – 09.07.2014
- Intensity Frontier Seminar, Fermilab, USA 13.03.2014

- All experiments meeting, Fermilab, USA 10.02.2014
- High Voltage in Noble Liquids Workshop, Fermilab, USA 08.11. - 09.11.2013

My presences at Fermilab allowed me to collaborate with scientists from many different universities, that all come together at this unique place where the support from the resident scientist allows a unique atmosphere where scientific ideas are developed and discussed, and the progress in sciences advances daily in a measurable pace.