Intensity Frontier Fellowship Final Report

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I. Overview

The proposal for my Intensity Frontier (IF) Fellowship, which was held in 2017, described a number of R&D items that would ultimately lead to the establishment of a successful production program for the Mu2e Tracker at Rice University, my institution at the time. While the majority of these items, which are summarized below, were successfully carried out in the awarded year, the death of my advisor, Marjorie Corcoran, changed the details and context of the Tracking Group's research goals. While the implications have been numerous and far reaching, those that most directly affected the activities described herein are (1) my having become a Fermilab employee in the Spring of 2017 and thus technically ineligible to continue as an IF Fellow thereafter, and (2) the transfer of responsibilities from Rice University to the University Of Minnesota. Although I received funds from the IF Fellowship for only the first three months of 2018, those funds helped support research activities throughout the year and have greatly contributed towards the establishment of a tracker production program at The University of Minnesota, where I currently reside.

II. Fellowship Activities

A. Tracking Hardware

The first major achievement in 2017 was the completion of the first demonstrably vacuum-ready prototype for the Mu2e Tracker, Panel 2.5, which is shown in Figure 1. Our success was possible in part from the IF Fellowship because, by allowing me to stay at Fermilab, it facilitated my close collaboration with the L2 manager of the tracker, Aseet Mukherjee, and the deputy manager, Robert Wagner, at a time when the tracking group was critically low on on-site collaborators. The importance of Panel 2.5's success was that it provided the first proof of principle for the tracker's baseline design, as well as a platform for optimization. In my IFF proposal, a number of goals relating to the completion of Panel 2.5 were set and are listed below. All goals have been completed, excluding the one listed last, which is now in its final stages.

- Complete and test Panel V2.5
  - Finalize the wire and straw installation method.
  - Finalize the straw tensioning apparatus and procedure.
  - Finalize the heating method for epoxy curing.
  - Prepare the Large Vacuum Vessel with gas and electronic feed-throughs for panel testing.
  - Develop an optical method of monitoring straw tension through the resonance frequency.

With the experience gained from the above activities, I moved to Minneapolis to establish a panel production program at the University of Minnesota, where I have trained two graduate students and five undergraduates. In addition, we have worked on a number of student R&D projects, many of which are continuations of secondary projects that began during my IFF sponsored time at Fermilab.

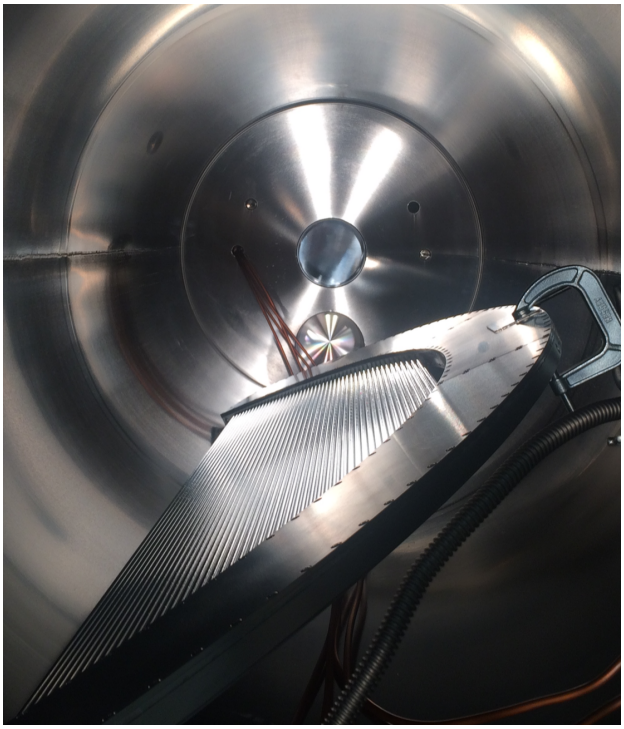

Figure 1: A picture of Panel 2.5 being prepared for testing in a vacuum chamber.

B. Tracking Software

In my IFF proposal, I identified a number of ingredients, all of which pertained to the physical modeling of the detector, that needed to be incorporated into the tracking algorithm for accurate simulation and reconstruction. While the software's physics models of the tracker will continue to be improved over the next few years, I have begun by building a more accurate model of the ion drift velocity and magnetic corrections thereon. These models have been implemented in a version of the Mu2e software at LBNL, and they will be merged in the standard software at Fermilab shortly.