Proposed Research Plan for Intensity Frontier Fellowship

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I have started working on Mu2e in 2010 after having worked in the KLOE/KLOE-2 experiments where, besides other roles, I was the database and calibration expert of the calorimeter system. In 2014, I assumed the role of L3 manager of the crystals for the Mu2e calorimeter and I have started working on the technical choice of crystals, on their radiation hardness and on the test of their optical and mechanical parameters. Moreover, I am developing the calorimeter production database. Up to now, the work has been centered in Italy since most of the test for prototyping, pre-production and module-0 construction has been carried out there. However, the next years, especially 2018-2019, are of crucial importance for the test of the crystal components, thus requiring an increase of my presence at Fermilab. Indeed, the production calorimeter phase will start at the beginning of 2018 and will be continuous for 1.5 years. Measurements will be carried out at the SiDET facility in Fermilab, therefore I am applying to the Intensity Frontier to have a support for a one year stay at Fermilab without interruptions beginning sometime in mid-2018.

Since the test of crystal components will take just a fraction of my time, I plan to dedicate a large part of my research activity for collaboration related work, which will greatly benefit from regular discussions and interactions with experts present at FNAL. The main activities I would like to focus on are:

1. **Simulation study of in-situ calibration tools for the calorimeter system**

   This consists of simulation of events that can be used online during data taking, to determine and monitor the calorimeter energy and timing calibration offsets as well as the related resolutions. My plan is to do this in three steps: a) using off-spill cosmic ray events, b) using on-spill in situ Decay-In-Orbit (DIO) events and c) integrating the software in the reconstruction program. As a first step, cosmics will be used to develop iterative procedures for a first level calibration of time offsets and energy response for each crystal. DIO events will then be used to cross-calibrate calorimeter cells and set the energy scale and the timing between tracker and calorimeter systems.

2. **Production and calibration database**

   The Mu2e database is developed in collaboration with the Fermilab Scientific Computing Division, thus requiring a continuous interaction with FNAL DB experts. The design of the production database for the Mu2e calorimeter has being completed for crystals. This work is being extended to other detector components, such as photo-sensors and front-end electronics and will be completed in the next months. The calorimeter DB design have then to be extended to the calibration database. I plan to develop the scheme of the tables needed for the calorimeter and to develop a GUI program to easily display the results of calibration procedures. This will be extremely important for the detector commissioning phase, allowing to compare and monitor the calibration constants along the time.