Caleb Fangmeier

Relevant Experience

During my years both as an undergraduate and graduate student I worked on projects that have given me skills and experience relevant to this position. Here, I will present them in roughly chronological order from early projects undertaken as a student worker through ongoing work as a postdoc.

Beginning in 2010, I worked in the fledgling UNL Silicon lab under the guidance of Prof. Aaron Dominguez. From then until my graduation in 2013, I worked on a variety of projects related to the CMS experiment. The first of which was using Arduino micro-controllers to study the performance of "Precon" temperature/humidity sensors which were being considered for environmental monitoring within the CMS detector. Temperature and Humidity were varied by employing a Peltier cooling device and a dry air supply. Following this work, I designed and implemented an exploratory data visualization tool for understanding the performance of the CMS pixel detector. This tool, PixelGUI, was implemented in C++ within the ROOT framework. The tool was utilized by scientists at multiple institutions, including the Paul Scherrer Institute (PSI) in Villigen, Switzerland, and was presented at the PIRE conference in Lawrence, KS in 2010. Following this, I spent several weeks during the summer of 2011 at PSI as part of the PIRE program. My project during the stay involved measuring the relative charge collection efficiency of the pixel detector as a function of particle impact points within the pixel, looking specifically for features resulting from certain structures in the pixel design. I also studied the pixel detector's hit resolution by examining how the pixel hits would merge for narrowly separated particle trajectories. This involved writing software that could process many gigabytes of data and produce meaningful visualizations.

Outside of Physics, I also contributed to projects related to my other major area of study: Computer Science. Foremost of these was my participation in the Design Studio program in the Raikes School. This was a two-semester program where I worked with a team of five other students to produce a valuable software product for a partnering business or organization. My group's charge was to develop an algorithm to examine the company's extensive catalog of products and split them into groups of similar products based on their names and text descriptions. The algorithm employed natural language processing and machine learning to successfully accomplish this task. I was awarded the Design Studio "Rock Star" award for my contributions to the project.

After finishing my BS, I elected to remain at UNL to pursue a Ph.D. During graduate school, I completed several projects for the CMS experiment. First, I led the effort to produce a robust software framework, implemented in LabVIEW and C++, that could be deployed on a robotic

228 N 12th St – Lincoln, NE
+1 (402) 768 1358 • *caleb@fangmeier.tech*
www.fangmeier.tech • *cfangmeier*

gantry system used for CMS FPIX module assembly. This software reduced, relative to the previous implementation, the time to construct each module and the amount of expert knowledge needed to operate the gantry. This same software is currently being augmented to be used in the production of the next generation of particle detector modules for the HL-LHC. I have traveled to partnering institutions to both deploy the software on their machines as well as train local personnel on how to use it.

As service work in the CMS collaboration, I helped improve the offline reconstruction of electrons. Specifically, I worked on improving the algorithm which matches energy deposits in the electromagnetic calorimeter with hits in the innermost layers of the silicon tracker. These pairs compose the seeds of electron candidates that are further developed in subsequent steps in the reconstruction. My work consisted of developing metrics to measure the matching algorithm's performance, create custom configurations within the CMSSW framework to modify the algorithm, and present results at regular meetings of the Egamma POG of CMS.

I also designed a telescope to be used for characterizing the next generation of silicon pixel detectors. The design incorporated several silicon strip detectors to precisely measure the trajectory of individual charged particles as they pass through both the telescope and the device-under-test. Design work included interfacing with legacy hardware, RF electronics, PCB design, and FPGA firmware development. Finally, I contributed to the measurement of the production cross section of four top quarks using data collected at CMS from 2016-2018. My contributions included studies of alternative signal region definitions and generation of simulated datasets for interpreting the primary result in the context of BSM models.

During my short time as a postdoc, I have contributed to multiple ongoing projects. The gantry system that was used during the FPIX module production was relocated to Catholic University, and I have since helped with the selection and acquisition of components to build a replacement gantry system. To improve upon the previous gantry system, I designed a "hub box" to reduce wiring complexity and the likelihood of accidental disconnects. The box was well received by other gantry sites, who have requested hub boxes for their own setups. I have also designed both mechanical and thermal mockup components for the CMS MTD project to test thermal cooling capacity and mechanical jig based assembly precision. I have been able to leverage my experience in circuit, and especially PCB, design to facilitate this work. Finally, I have helped train and mentor students to help them become more effective researchers, both in terms of technical skills and in terms of research best-practices including good record keeping and high-quality communication.

228 N 12th St – Lincoln, NE
+1 (402) 768 1358 • *caleb@fangmeier.tech*
www.fangmeier.tech • *cfangmeier*