2017 Annual QuarkNet report for Syracuse University

Center name: Syracuse University, 6th year in QuarkNet.
Participants: 10 teachers from local area high schools + ~50 high school students for Masterclass
Program description: CMS e-Lab + Solar eclipse cosmic ray flux study
Mentors: Prof. Steven Blusk, Prof. Matt Rudolph

In March, the Syracuse University group was pleased to host two days of LHCb MasterClasses, which enabled about 50 high school students from four different schools to learn about particle physics and the Large Hadron Collider. The four high schools were: Cicero-North Syracuse, Vernon-Verona-Sherrill, Weedsport, and Fayetteville Manlius. Students spent the morning attending presentations by Profs. Steven Blusk and Matthew Rudolph on particle physics and the LHC, and working on an activity using LHCb data in the afternoon (see Fig 1 below). Feedback from teachers indicated the students enjoyed the day's events.

Fig. 1 Students working on the LHCb masterclass activity at Syracuse Univ. computing lab.

On Aug 21-23, we also hosted a Quarknet workshop. We had 9 teachers participate, of which 3 were "first timers". The participating teachers were: Chris Cox (Paul V. Moore), Mike Madden (Canandaigua Academy), Stephanie MetzMiller (Webster-Schroeder), Anne Huntress (South Lewis Central), Steve Dunckel (Oneida), Patricia Madigan (Cicero-North Syracuse), Richard Heffernan (Phoenix), Justin Shute and Alexa Perry (Fayetteville-Manlius). We were also delighted to have Shane Wood from Quarknet at the event. The first day was dedicated to activities related to the Aug. 21 solar eclipse. In addition to a presentation on the celestial mechanics, the history of solar eclipse events and the viewing, we set up a cosmic ray detector the morning of the eclipse, to measure the muon flux before, during and after the eclipse. Prof. Blusk also gave a presentation that specifically addressed questions posed in advance by the teachers.

On Tuesday and Wednesday, the focus was on the CMS e-Lab activity, led by Shane Wood. Prof. Rudolph gave a presentation on how the CMS detector works, and focused in on how we turn digits of data into the physically meaningful quantities, as used in the e–Lab. Profs. Blusk and Rudolph were on hand to answer questions, and provide background information. The culmination of the CMS e-Lab activity entailed teachers making posters that posed research questions, and used the data to try and answer those questions. Two of the teachers expressed interest in creating a poster based on the eclipse data taken two days earlier, and Shane agreed. Figure 2 shows the two teachers presenting their findings for the muon flux as a function of time, which showed

about a 10% drop in the cosmic ray flux during the time of the eclipse (note the dip in figure, about 2/3 of the way along the horizontal axis (time)).

The full three-day program, along with the presentations given, can be found at: https://quarknet.i2u2.org/content/2017-cms-e-lab-workshop-syracuse.

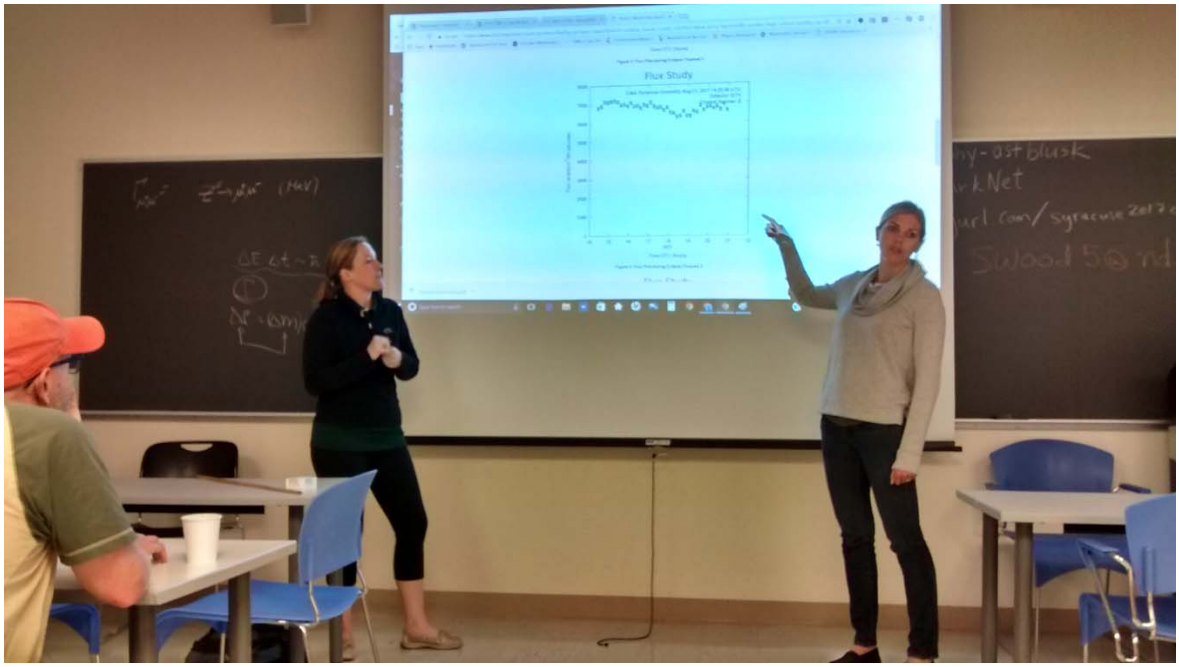

Fig 2: Alexa Perry (left) and Stephanie MetzMiller (right) showing their findings of the cosmic ray intensity around the time of the solar eclipse. A dip in the flux at the time of the eclipse is seen.

During the summer, we also were delighted to have two high school students (Josh Owens and Liam Meisner), and one high school teacher (Justin Shute) join us for a summer research internship experience. All three worked on projects related to the Upstream Tracker, a large silicon detector that will be installed in LHCb during the Phase I upgrade in 2019-2020. Josh and Justin worked on the so-called “end-of-stave mounts”. These components are precisely machined and assembled plates that mechanically connect the silicon “staves” to the frame, and provide for precise positioning of the stave. Liam worked on using our Flash SmartScope to measure the quality of various components being built for the stave.

Fig 3: (Left) Justin Shute and Josh Owens working on end-of-stave mounts for the UT detector. (Right) Liam Meisner measuring the quality of the bending of the cooling tubes that will be embedded in the UT staves.