

QuarkNet Staff Monthly Report Activities of September 2020

The staff meet remotely every Tuesday to discuss QuarkNet matters in general and every Wednesday to discuss technical issues. In addition, staff reports the following activities:

QuarkNet Educational Discussions (QED) – In August, staff launched a biweekly series of Wednesday evening Zoom chats for QuarkNet teachers to talk about teaching in the new environment of the 2020 academic year. These meetings continued on September 9 and 21 with an average of about 12 teachers from various centers.

Staff Meeting – Shane, Deborah, Mark, Adam, Jeremy, Spencer, and Ken met online for three hours on September 24 in the first of a series of such videoconferences this autumn to cover issues they would normally discuss in the in-person meetings they have lacked in 2020. They talked about projected work and initiatives for the 2020–21 academic year as well as how to better address diversity issues.

Centers

Purdue University and Purdue University Northwest – Ken met with Purdue University lead teacher/mentor Marla Glover and Purdue University Northwest mentor Neeti Parashar on Zoom on September 29 to discuss the Hoosier Association of Science Teachers, Inc. (HASTI) virtual meeting scheduled for February. They agreed to make a joint presentation about QuarkNet in Indiana as well as to encourage teachers in their respective centers to submit their own talks.

University of Illinois at Chicago – A major rewrite of an Eclipse article for the *Physics Teacher* was undertaken. Mark held virtual meetings with graduate Tamar (now at UIUC) and lead teacher Nate on September 6, 23, and 30 to finalize the analysis and responses to reviewers' questions. They checked all results, created new measures, and calculated an upper limit on muon production from the sun. Also, the *Physics Teacher* accepted a paper on the MUSE project written by students.

University of Notre Dame – Notre Dame weekly teacher meetings began on September 14. Ken participated as the group discussed coping with their various teaching situations, as each school district has their own policies regarding the pandemic. They also discussed attending and presenting at Indiana AAPT (INAAAPT) and Hoosier Association of Science Teachers, Inc. (HASTI) virtual meetings in September and February, respectively. Jeremy Wegner presented a lab developed during the Notre Dame summer workshop, and Ken, with teacher Rebekah Randall, talked about STEP UP at virtual INAAAPT on September 26.

University of Washington – Mentor Shih-Chieh Hsu does a CMS masterclass with incoming physics undergraduates each year in September. Ken met Shih-Chieh on Zoom on September 4 to discuss the changes to the CMS masterclasses and then, one week later, Fermilab physicist Allison Hall and Ken connected with Shih-Chieh and the students for a masterclass videoconference.

Cosmic Ray Studies

Statistics from e-Lab: There were 576 cosmic ray uploads and 13 cosmic ray plots from August 28 to September 22. Mark provided help desk assistance for teachers on the following cosmic ray topics: replacement of CRMD components; investigating CRMD light leaks; and resetting teacher passwords. Mark continues to collect muon speed data with DAQ 6674 located in his home, recalibrating the barometer for use in rate studies. Edit and Mark continue to investigate and repair errors found in the e-Lab. They searched for future-dated upload files and wrote an admin tool that executes monthly; discussed changes to Lifetime software trigger logic; corrected metadata

information on gate widths in shower module file searches; discussed data needs for a possible pyramid tracker data format; tested and certified a semi-log plot in Lifetime; and collected pure decay samples for new Lifetime debugging.

LHC Physics

The LHC and Neutrino fellows have adopted an approach to the World Wide Data Day (W2D2) measurements suggested by Jeremy Wegner's initial exploration of the data: students will measure direction angle PHI of muons in dimuon events as well as the opening angle between the two muon tracks; both measurements are in the plane transverse to the LHC beamline. Ken also developed an explanation of the opening angle measurement for teachers. An rZ projection was developed for the relatively static ATLAS event display; Tom McCauley will work on one for iSpy, but this will take about a year given that iSpy is dynamic and more complicated. We may then switch to PHI and THETA measurements in 2021. W2D2 is on November 12 and how to proceed for next year will depend, in part, on the response to the new measurement this year.

Neutrino Physics

Shane interviewed Sowjanya Gollapinni from the MicroBooNE experiment on September 4 for the Friday Flyer and discussed future changes to the Fellows program and future QuarkNet neutrino activities.

Fellows

The LHC and Neutrino fellows had scheduled bi-weekly meetings on September 1, 15, and 29. A large part of their discussions were about International Masterclasses and World Wide Data Day. The fellows tested the proposed PHI and delta-PHI measurement described above and had an ad-hoc meeting on September 22 to discuss the results of the test. We adopted the measurement on their recommendation. The LHC and Neutrino fellows also discussed overall plans for 2020–21, Dark Matter Day, and neutrino physics efforts.

Data Activities Portfolio

Deborah is working with Ken and Shane to develop new activities to support the neutrino workshop. *Making Tracks I* (introduction to cloud chambers) and *Making Tracks II* (introduction to bubble chambers) are completed and posted. Under development is *Particle Transformations* which is an introduction to Feynman diagrams and rules for particle decays. *Particle Transformations* is a response to a request by BNL-SB lead teacher Gillian Winters. Deborah is working with Shane to develop screencasts to support teacher virtual use of certain activities. The pilot screencast is for the *Z Mass* activity. Joe Kozminski of Lewis University contacted Ken in August about finding coding projects for two of his undergraduates that could work with QuarkNet. Joe and Ken assembled a small ad-hoc group consisting of Adam LaMee, Jeremy Wegner, Tom McCauley, Joel Griffith, Joe, Ken, and the two students to discuss what might be done. They met on September 1 and September 10 on Zoom and agreed that one student would refine the VPython code to enhance the online version of Rolling with Rutherford while another would work on Google Colab projects.

Increasing Diversity

Deborah worked with a team of STEP UP ambassadors to host a social hour based on the research about underrepresented minorities. The event was well attended, and teachers stayed well past the official end of the session to continue the discussion. Deborah and Shane also participated in their respective regional STEP UP meeting. The teachers shared links with important information on teaching underrepresented students.

Broader Impacts

International Collaborations – Ken had several international videoconferences this month. He met Uta Bilow of TU Dresden twice to discuss plans for International Masterclasses and produce the first IMC circular. Uta and Ken also met online with several IPPOG members and two young Ukrainian physicists to discuss bringing masterclasses to that country and again with IPPOG members on September 28 for the IPPOG website Steering Group meeting.

On September 22, members of the staff plus Cosmic fellow Dan Kallenberg and LHC-Neutrino fellow Joel Klammer had a videoconference with Tohoku University physicist Kazuo Tanaka, who leads the TanQ cosmic ray outreach and education program in Japan, physicists Ming-Chung Chu of Chinese University of Hong Kong and CM Kuo of Central University in Taiwan, and Argentine educator Ana Prieto. The topic was collaboration on cosmic ray studies, especially with the inexpensive MIT Cosmic Watch detector. Dr. Tanaka also showed the OSECHI detector developed at KEK that fits three scintillators with SiPMs and an arduino-based DAQ into a bento box. They developed plans to work together and meet again in October.

AAPT – Deborah, chair of the Committee on Contemporary Physics (CoCP), coordinated with Marla, vice-chair of CoCP, on session and workshop submissions for upcoming meetings. Deborah, Shane, Ken, and Spencer worked on plans for AAPT Winter Meeting 2020.