

QuarkNet Staff Monthly Report
Activities of January and February 2023

The staff meet remotely every Tuesday to discuss QuarkNet matters in general and every Wednesday to discuss technical issues. Several staff members and consultants worked together to recruit eight QuarkNet teachers to participate in CERN Summer Programs from calling for applications on January 19 to final selections on February 14. The QuarkNet Educational Discussions (QED) group met on February 8 on Zoom. The QuarkNet Request for Proposals was sent out in early February. About half of the centers have submitted responses, and they were sent award letters. In addition, the staff reports the following activities:

Centers

Brookhaven National Laboratory/University at Stony Brook – Kathy Race and Ken met on January 26 with mentors Ketevi Assamagan and Dmitiri Tsybychev and lead teachers Gillian Winters and Susan Wetzler to work together on their Center Feedback form and gain insights on how the BNL/SB center can move forward.

Catholic University of America – Ken visited Paul Koziel at Bullis School, Gerson Perreira at Washington-Liberty High School, Kelley Parent at Yorktown High School, and Nadia Robles at Swanson Middle School, February 15-17. Bullis is in Potomac, Maryland and the other schools are in Arlington, Virginia. Ken observed classes and discussed pedagogy within the teachers; he also helped Kelly Parent with her cosmic ray detector (together, they discovered a light leak). Ken discussed center plans over dinner with mentors Angela McRae and Katryna Andrusik, including a May masterclass, choosing new lead teachers, and the summer workshop.

Kansas State University – Edit identified and fixed a time discrepancy between e-Lab RvsP plots and unix time which was originally discovered by Martin Shaffer. Dave and Mark helped Sundara to develop a GPS cabling plan. Dave and Mark helped several other teachers with GPS cabling and PyEQUIP installation. Mark communicated with Jim Deane about a cosmic ray agenda for their upcoming Orientation meeting.

University of California at Irvine – Shane met via Zoom on January 6 with Pedro Ochoa-Ricoux to discuss plans for 2023 center activities. Shane and Neutrino fellow Mike Plucinski met on Zoom with Pedro again on February 28 to discuss specific plans for the NOvA masterclass that will take place on March 25.

University of Illinois Chicago and Chicago State University – Moon Shadow data collection continues at four sites. Staff developed an improved normalization technique and implemented new analysis procedures at an analysis meeting attended by eight students, three teachers and Mark was held at Ida Crown Jewish Academy on January 8. In an emergency, Edit rebooted the server at Notre Dame and modified scripts so that e-Lab was available during the Sunday workshop. Mark held a further analysis meeting with nine students and two teachers at New Trier High School on February 12.

University of Minnesota – Shane met with mentor Greg Pawloski and Neutrino fellow Mike Plucinski on Zoom on February 23 to continue planning the latest pilot of the NOvA Masterclass, which will take place on March 11.

University of Notre Dame – Ken participated in Monday teacher meetings on January 23 and February 27. Much of the discussion was on plans for and then a report on participation in the public exhibit Science Alive at the St. Joseph County Library on February 11. In the latter meeting, they also talked about summer plans and research projects. Ken visited Canterbury High School in Fort Wayne to help Rebekah Randall and her students set up their cosmic ray detector. On February 22,

Ken visited Notre Dame cosmologist Quynh Lan Nguyen to discuss ideas for her contributions to QuarkNet. On the same day, Ken went to St. Joseph High School in South Bend to prepare students to analyze masterclass data at home. Students from three Indiana schools came to Notre Dame on February 28 for a CMS masterclass. Ken and LHC fellow Jeremy Wegner hosted the event. Engineer Dan Ruggiero explained research work in the QuarkNet facility to the students.

University of Washington – Dave and Mark assisted a Seattle-area student to commission CRMD readout on a new computer; Seattle participated in International Muon Week.

University of Wisconsin – Mark discussed the re-energized center with Mentor Jim Madsen. Mark and Dave helped Jeff Paradis from Milwaukee obtain a new CRMD and provided training at the Lederman Science Center on February 9, in time for Jeff to participate in International Muon Week.

Cosmic Ray Studies

During January and February there were 1176 cosmic ray uploads and 56 cosmic ray plots. An Analysis report finds 6009 analysis days run during the same period. The number of days each analysis was run are 54 Flux, 20 Lifetime, 6 Advanced Lifetime, 10 Performance, 20 Shower, and 9 Time-of-Flight. Mark provided help desk assistance for teachers on the following cosmic ray topics: GPS cabling, identifying bad cables, SiLab installation, EQUIP and Java setup, DAQ 5000 debugging, running PyEQUIP on PCs and Macs, upload failures, calculating consistent rates for International Muon week, introduction to CRMDs, muography, detector commissioning for IMW, plateauing, and additions to PyEQUIP readme instructions.

Edit and Mark met weekly via Zoom to solve EQUIP and PyEQUIP issues and continue e-Lab and other software development.

Mark contacted mentors whose teachers have uploaded data in the last year, to encourage participation in International Muon Week, February 13-24. He posted announcements to the Friday Flyer, e-Lab, and the cre-labusers listserv. Cosmic fellow Jeff Rodriguez released the registration page and instructions. Mark provided help with detector setups via email and during zoom sessions with several non-US participants. Also, Mark calculated acceptance correction factors for those participating with non-QuarkNet cosmic ray detectors. Thirty-one sites from eight countries participated, including 17 QuarkNet teachers. Jeff led an email discussion of changing flux rates due to a storm in the Midwest; sites in Minnesota, Indiana, and Ohio participated. He is currently compiling 1-page summaries as well as a 3D global map of the average rate at each IMW site.

Mark maintained the Fermi DAQs weekly: 6119 collecting single muon upward-muon search data; and 6148 collecting large shower array data. Their recent failures to collect data was fixed using an additional terminal window running caffeinate, as well as requiring the drives to not be shut down after the display darkens. Mark has returned both to WIFI. DAQ 6410 has been used to debug PyEQUIP and to collect data for International Muon Week. Mark also collected Moon Shadow data with DAQ 6674 in Geneva.

Dave and Mark set up a detector and Cosmic Watch demonstration for the Ad Board meeting on January 28. Mark wrote a sidebar on QuarkNet high school experiments to accompany Don Lincoln's article on Muography to be published in *The Physics Teacher* in April.

The Fellows' new bimonthly CRMD Support Zoom series to prepare for International Muon Week was launched January 18. Fellows met via zoom on January 11 and February 15. They discussed the following topics: International Muon Week participation, action items from Fellows Camp, CRMD bimonthly support zoom sessions, Cosmic Watch activities draft, cloud chambers, and materials purchased via mini-grants for Fellows. Nicole Preisser volunteered to help test Edit's new PyEQUIP installation for Raspberry Pi.

Mark calculated the pt kick a cosmic ray receives from the Earth's magnetic field (assuming a dipole field) and found it more consistent with predictions from the Tibet group than with those from MINOS.

LHC Physics

Ken hosted CMS Question Time on Zoom for International Masterclasses participants on February 8.

The LHC fellows met with Ken on Zoom on January 5 and February 2. They organized for masterclass orientations, moderation of Fermilab masterclass videoconferences, and their own masterclasses. They also discussed adding a masterclass quiz to the videoconferences as well as future CMS masterclass development.

Neutrino Physics

Spencer and Shane hosted MINERvA Question Time on Zoom for participants in International Masterclasses on February 14.

The Neutrino fellows met on January 17 and February 18 on Zoom to prepare for upcoming masterclasses. The University of Minnesota will run a second pilot NOvA masterclass on March 11. Most of the Neutrino fellows will be in Minnesota to provide feedback and improve documentation of the measurement. Also, a NOvA masterclass pilot will take place at UC Irvine and at SURF later this spring.

International Masterclasses

Shane, Spencer, and Ken recruited and organized moderators for Fermilab masterclass videoconferences and made a schedule of videoconferences during February.

Shane facilitated a MINERvA masterclass orientation on Zoom on February 23 with teachers and leaders from the Colorado State University and the Black Hills/SURF centers.

The following Fermilab masterclass videoconferences were held in February:

- February 25 (ATLAS) - Universidade Lisboa, moderated by Ken, Shane and two physicists.
- February 25 (CMS) - Uramita, Colombia, moderated by Ken, Shane and two physicists.
- February 28 (CMS) - Notre Dame and Puebla, Mexico, moderated by Shane and two physicists.

Coding

IRIS-HEP Principal investigators requested a budget justification and text to include collaboration with QuarkNet on Coding for teachers and students. Adam, Mitch, and Ken consulted, and Mitch prepared the final result for transmission to IRIS-HEP.

Data Activities Portfolio

Deborah, Ken and Shane met on several Thursdays in January and February. Deborah continued work with Danelix Cordero from the University of Puerto Rico center to translate activities into Spanish. *Top Quark Mass* and *Calculating Z Mass* have been translated and posted.

Broader Impacts

AAPT Winter Meeting 2023 – Shane attended the AAPT Winter Meeting 2023 in Portland Oregon on January 14-16 where he gave a talk on Neutrino Masterclasses, co-led a Neutrino Masterclasses Workshop along with Neutrino Fellow Mike Pluciski, attended sessions, and networked with QuarkNet mentors, fellows and teachers. Shane became the vice-chair of the Committee on Contemporary Physics at the conclusion of this meeting.

Cosmic Rays at Pyramid - Mark meets biweekly with Pyramid collaborators. Also, he is working with our local Congressman's office to explore possible help from the Coast Guard in transporting the final detector to Mexico. Mark is designing prototype event displays with advice from Tom McCauley and Edit.

Hoosier Area Science Teachers Inc. (HASTI) – On February 13, Marla Glover and Ken gave a presentation about QuarkNet in Indiana at the 2023 meeting in Indianapolis

International Collaborations – Uta Bilow and Ken met on Zoom on January 17 to discuss the ramp-up for International Masterclasses. Also, Ken met with Japanese collaborators Kazuo Tanaka and Miki Ohtsuka on Zoom on February 10 to discuss the Cosmic Watch project and masterclasses. Ken accepted an invitation to join the International Organizing Committee of the African Conference on Fundamental and Applied Physics (ACP) 2023 to be held in George, South Africa. Physicist Esmeralda Yitamben met Ken on Zoom on February 24 to discuss ways to improve the offerings for high school learners in the ASP 2024.

Outreach at AAPT Winter Meeting 2023 – Shane and Marla Glover brought QuarkNet activities to physics classrooms in South Eugene High School, Eugene, OR. This visit continues a tradition of QuarkNet staff and fellows working with students at schools near the in-person Winter AAPT Meeting location that started in 2019.

Outreach Efforts in the Los Angeles Area – Shane met on Zoom with Israel Hernandez and Paula Marillo from the STEM Academy of Boyle Heights to plan science classroom visits there in late March.

STEAM Efforts – Shane met with Agnes Chavez via Zoom on January 18 to discuss QuarkNet STEAM efforts in New Mexico in 2023.