Rutgers 2019 Annual QuarkNet Program Report

This was the 19th year for the Rutgers University QuarkNet Center. Personnel participating in the Center include lead teachers Daniel Kaplan and Frank Cappuccio along with Rutgers faculty members, Eva Halkiadakis, Amit Lath and Steve Schnetzer, staff member Dave Maiullo and Rutgers students. All actively participate in the summer teacher/student research program.

This year, we hosted our 12th QuarkNet-sponsored, summer research program for high school students. The goal of this program is to expose enthusiastic high school students to ongoing research in cosmology and particle physics, topics that are often sadly lacking in the high school curriculum. This year we inaugurated a new component on quantum computing that was highly successful. With essentially no prior knowledge, after two weeks, the students were able to code their own quantum computing algorithms and run them on a quantum computer at IBM. In addition to lectures and informal discussion sessions with Rutgers faculty, students get hands-on hardware experience building and taking data with cosmic ray detectors and using them to obtain high precision measurements of the muon lifetime and the speed of light. They also analyze actual CMS data to search for particles such as the Z and Higgs bosons and in the process learn about aspects of relativity such as 4-vectors and invariant mass. Alumni of the program value it highly and have sent letters and emails of support including to the Rutgers University President.

Each summer, we hold an evening public event during the two-week program that is attended by high school students along with their teachers, parents and the general public. This past summer the evening program was a lecture by Prof. Timothy Koeth of the University of Maryland on the German effort to build a nuclear reactor during World War II. Prof. Koeth's research into this important piece of physics history was highlighted in a cover story in Physics Today.

Our center also works closely with the New Jersey Chapter of the American Association of Physics Teachers. This year we held a one-day workshop shop attended by fifteen teachers. The focus of the workshop was on describing the content and activities of the summer program to them and assisting them in transferring the material to their classrooms. During the workshop, students in the summer program describe and show the teachers what they have learned and done in the program. This year groups of students gave the teachers a lesson on quantum computing. Both the teachers and we were very impressed, even amazed, at the level of the students' understanding and their ability to clearly describe it to the teachers.

Mentor: Steve Schnetzer