2019-2020 Boston QuarkNet Center Annual Report

**December 10, 2019**

 Attendance was a little thin at our fall meeting this year, but George Odell, Jon Kelley, Tim Fitzgibbon, and Mike Wadness joined Rick Dower at the Roxbury Latin Physics Lab for a convivial evening. During the conversation period, Mike informed us that Medford High School was eliminating their Physics First requirement for freshmen due to difficulty in finding and retaining adequate physics teachers. That circumstance served as a prelude to Mike’s presentation on the STEP UP Physics program designed to increase the gender diversity in the physics undergraduate population. Although women comprise nearly half the students taking physics in high school in the USA, they are only about 20% of those who go on to complete physics bachelor’s degrees. If each US high school generated one more physics graduate, the country would achieve gender parity. Mike introduced us to interesting biographical materials and simple plans for two lessons during the school year that could be used to encourage more women to consider physics in college. More information can be found at STEPUPphysics.org or contact Mike, who is an Ambassador for the program

 After Mike’s presentation, we examined some of the materials available in the Data Activities segment of the QuarkNet.org website. The site contains several activities that can be used or adapted for physics classes including activities related to randomness and radioactivity and activities showing the application of conservation of momentum and energy in a particle physics context.

 Finally, we noted that the date for our Particle Physics Masterclass in the spring at Northeastern University has been set for Saturday March 28, 2020. Our winter meeting will include, among other things, preparations for the Masterclass. The meeting was set for 5:00 pm Tuesday February 11, 2020 in the Roxbury Latin Physics Lab. Mark your calendars now!

**February 25, 2020**

  We held our winter meeting last night at our usual gathering place in the Roxbury Latin School Physics Lab thanks to the hospitality of Robert Moore. Robert was joined by Amanda Harnden, Mike Wadness, Jamison Smith, Tim Fitzgibbon, Jon Kelley, and Rick Dower for an evening that began (after snacks) with Mike’s presentation of new features of the iSpy software that will be used by the students at next month’s Particle Physics Masterclass at Northeastern to examine and classify CMS events. There will be a greater variety of 4-lepton events included in the data sets this year. The CIMA software in which to enter event data for analysis has also been updated, and Mike showed the new features of that program. Mike will be expecting to hear from teachers who want to bring students to the Masterclass soon. We have space for about 30 students. During Mike’s presentation we had a call-in from Ken Cecire, our QuarkNet headquarters contact. Ken wanted to make sure that all was going well and that Mike was not leading us astray. (Of course, that would never happen!)

 Subsequent to his presentation Mike asked teachers if they had taken the opportunity to engage their students in one or both of the STEPUP for Physics lessons that he described to the group in December. The response was generally – YES. Mike noted that he found it helpful early in the conversations to ask students to write, anonymously on paper, an incident of gender bias that they or a friend has experienced. He then shuffles the responses (or takes them to a different section of students) and reads them for discussion to raise student awareness of the issue. That activity has proved very enlightening for students.

 During the last half of the meeting teachers worked through the beginning of an exercise that Rick had prepared in which Newtonian analysis is applied to recent observations of the Cygnus X-1 binary system. The analysis shows how the evidence was obtained that caused Stephen Hawking in 1990 to concede losing his 1974 bet with Kip Thorne. Hawking had bet that the Cyg X-1 source was not a black hole. The evidence shows that Cyg X-1 is a 14.8 solar mass black hole in orbit with a 19.2 solar mass blue supergiant star (HDE226868).

In mid-March 2020 the COVID-19 pandemic caused Massachusetts and other states to go into lockdown, and on-person gatherings at schools were prohibited. We had to cancel our Particle Physics Masterclass planned at Northeastern University for March 28.

Teachers were too busy working to conduct online classes through the end of the school year to consider holding our usual May meeting. But QuarkNet quickly adapted and organized a series of online webinars for teachers: QuarkNet Wednesday Webinars (QW2). Rick Dower led off the series on May 5 with a Zoom webinar on the history of neutrino experiments and discoveries. Later in May, Rick worked online via Zoom with Paul Sedita and Jeremy Wegner to construct a two-day online QuarkNet Neutrino Workshop for teachers. Much of the structure was adapted from the in-person Neutrino Workshop held by our Boston group at Roxbury Latin School in 2019. The online workshop was successfully tried out with teacher members of the Kansas State University QuarkNet center in late June.

Our switch to online interaction continued through the summer. Dr. Allison Hall at Fermilab conducted a series of six weekly online talks (Summer Session for Teachers – SST) about the Standard Model of Particle Physics. The Boston Summer Workshop consisted of a series of six 1.5 hour Zoom sessions hosted by Rick Dower and attended by six teachers, as their summer schedules allowed, to discuss SST homework and review related topics.

We have all experienced the convenience of online interaction which avoids transportation time and traffic jams, but we regret that it limits the camaraderie associated with in-person gatherings.

Rick Dower, Boston QuarkNet Center