

Annual Report 2022

University at Buffalo QuarkNet Center Mentors: Profs. Ia Iashvili and Avto Kharchilava

University at Buffalo (UB, SUNY) has joined QuarkNet in early 2006. Mentors of the group are UB experimental High Energy Physicists (HEP), Profs. Ia Iashvili and Avto Kharchilava. Every year, the group sponsors at least two activities: Spring Masterclass, and Summer teacher Workshop. The former in recent years takes place in Nichols High school, where our lead teacher, Mr. Larry Hiller, teaches science courses. Second UB lead teacher, Mr. David McClary, teaches at North Tonawanda High School. Both lead teachers have been with the UB QuarkNet center since its inception.

The UB center has organized the most recent in-person CMS Masterclass on April 2nd, 2022 in Nichols High School. Four students participated – two boys from Nichols High School (teacher Mr. Larry Hiller) and two girls from Cuba-Rushford Central School (teacher Mr. Thomas Kenyon). Mentors first gave introductory talks on HEP and research at LHC/CMS. Second part of the Masterclass was dedicated to detailed instructions on the CMS data analysis using event display and associated tools. Students analyzed $Z \rightarrow ee/\mu\mu$, $W \rightarrow ev/\mu\nu$ event candidates using iSpy event display. At the end of the data analysis session, students compared and combined results to measure relative fraction of Z events compared to W events, ratio of W^+ over W^- , and to check lepton universality in these events. Students also “discovered” the Higgs boson, J/Ψ and Υ resonances in 2(4)-lepton mass distributions histogram. Finally, students shared their findings with other participating QuarkNet centers (Quito and Seattle) through a videoconferencing, and discussed results with a moderator based at Fermilab. One of the UB center teachers, Mr. Orlando Buria from West Seneca Christian School, also attended the Masterclass.

UB Summer 2022 QuarkNet Workshop took place during August 22-24 at UB Physics Department. We had four participating teachers: Mr. David McClary (North Tonawanda High School), Mr. Orlando Buria (West Seneca Christian School), Mr. Thomas Kenyon (Cuba-Rushford Central School) and Mr. Joel May (North Tonawanda High School). Mr. Kenneth Cecire (QuarkNet National Staff) and Mr. Jeremy Wegner (QuarkNet teacher from Indiana) have visited the center to help with the Workshop activities. The theme of the first day of the Workshop was “Higgs @10”. The activities included look at the “Data Activities Portfolio”, “Shuffling the Particle Deck”, a tutorial for “The Road to Discovery” and presentation by the mentor on “Higgs Discovery at CMS/LHC”. The 2nd and 3rd days of the Workshop were dedicated to coding using the Jupyter notebook and Python APIs. In particular, teachers worked

on velocity graphs, projectile in Air, Muon mass and other notebooks. At the end of the Workshop, we held dedicated discussions to brainstorm on how to implement these activities in the classroom curriculum.

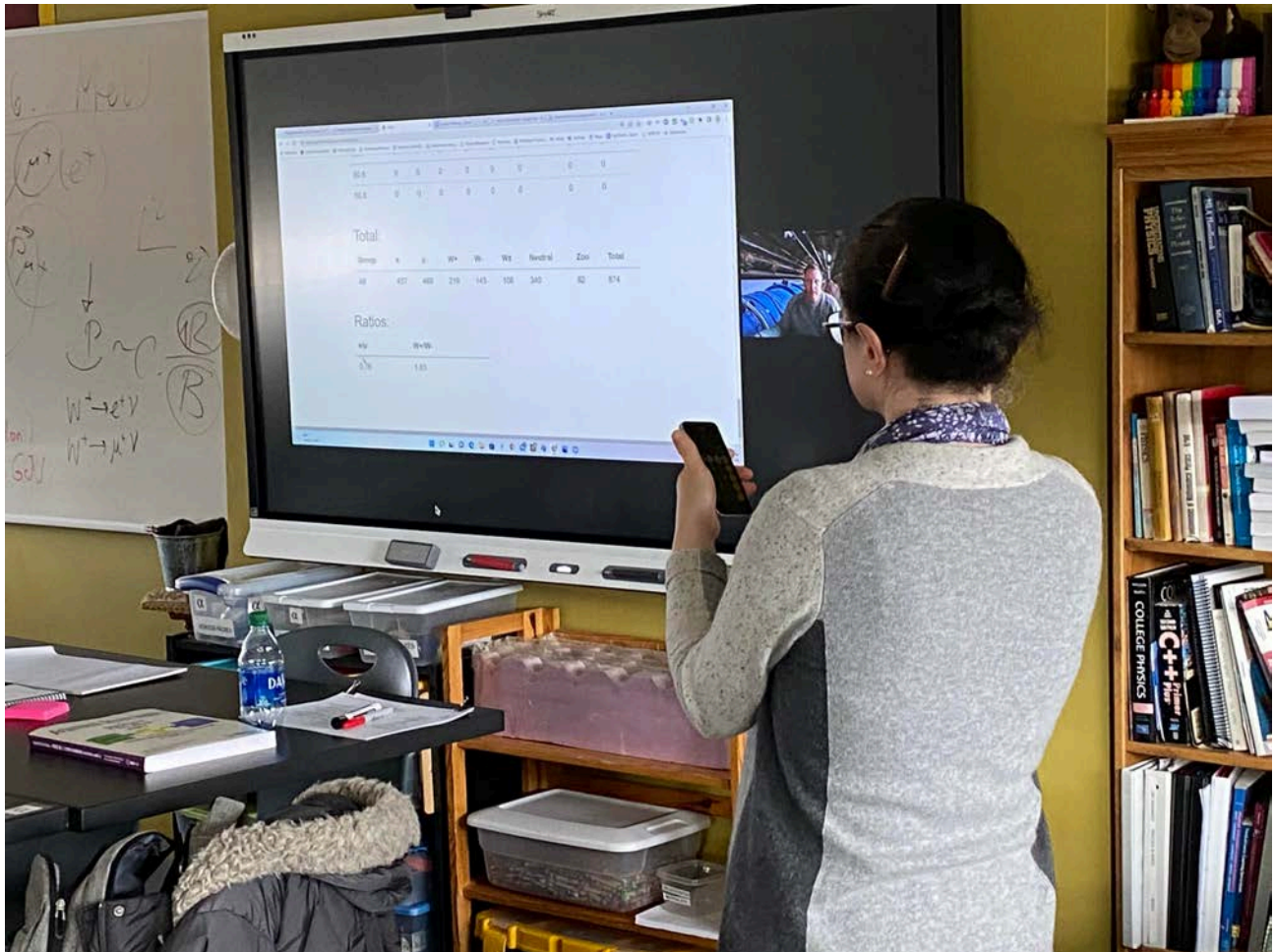


Photo: QuarkNet Masterclass at Nichols High School, 04/01/2022. UB center mentor giving instructions on CMS data analysis.



Photo: QuarkNet Masterclass at Nichols High School, 04/01/2022. Nichols High School students analyzing the CMS/LHC data.



Photo: Summer 22 QuarkNet Workshop at the UB Physics Department, 08/22-08/24/22. The Workshop participants analyzing mass histograms produced with Jupyter Notebook and using CMS open data.