Educational Programs in the US with ATLAS Data

R. Michael Barnett
Lawrence Berkeley National Laboratory, 1Cyclotron Road, Berkeley, CA 94720, USA
Barnett@LBL.gov

Abstract. *Student event analysis programs can be and have been used in two distinct ways. The first is via Masterclasses, where physicists can guide the students directly. This will be described by others at this workshop. The second way is via programs such as the QuarkNet educational project in the U.S., where the teachers are "trained" by physicists, and the teachers involve students in a classroom setting. I will describe the QuarkNet project. The ATLAS Experiment has developed several student event analysis programs including the HYPATIA and MINERVA programs. Here I will describe the AMELIA program developed in the U.S. at the Lawrence Berkeley National Laboratory. AMELIA is an acronym for ATLAS Multimedia Educational Lab for Interactive Analysis. It is an educational computer program that focuses on particle physics processes in the ATLAS Experiment, allowing students and other users to decode the collision events that unfold after the head-on collisions of protons at the Large Hadron Collider. It makes use of a real-time 3D-visualization engine (like a computer game engine), using the best aspects of technical animation by allowing users to control 3D representations of collision events and to manipulate 3D models of the detector and see how particles are detected as they pass through. Users can rotate, zoom and select virtual pieces of the ATLAS detector and events (not unlike techniques in some computer games). The challenge for students is to find actual events that may carry signatures for new discoveries. A simple example of possible research would be to study examples of simulated ATLAS events showing new physics events (such as Higgs bosons) along with Standard Model physics such as Z bosons. Understanding these collision events will require using ones knowledge of energy, momentum, magnetism, kinematics, etc. Students are guided to learn the patterns of the events, so they can separate events representing new physics from other classes of events (Standard Model "backgrounds"). They then apply what they have learned to a larger sample of simulated and real events. The QuarkNet educational project is a long-term, research-based teacher professional development program in the United States jointly funded by the National Science Foundation and the US Department of Energy. Since 1999, QuarkNet has established centers at universities (and national laboratories) conducting research in particle physics across the United States. Mentor physicists and physics teachers collaborate to bring cutting-edge physics to high school classrooms. QuarkNet offers research experiences for teachers and students, teacher workshops and sustained follow-on support. Through these activities, teachers enhance their knowledge and understanding of scientific research and transfer this experience to their classrooms, engaging students in both the substance and processes of contemporary physics research. Teachers may receive academic credit for their participation. QuarkNet programs are designed and conducted according to "best practices" described in the National Research Council National Science Education Standards report (1995). Originally, QuarkNet established centers led by physicists participating in the CDF and DØ experiments at Fermilab's Tevatron collider and the ATLAS and CMS experiments at the Large Hadron Collider (LHC) at CERN in Geneva, Switzerland. It has expanded to include centers with participation in other particle physics experiments that are broadly representative of the field. QuarkNet teachers provide opportunities for students to increase their scientific proficiency, especially in particle physics. Their students show evidence that they understand how scientific knowledge is developed and engage in scientific practices and discourse. Through involvement in the project, QuarkNet teachers become more professional.*