CU Physics Department Colloquium

Monday, December 13, 2010 4:10 PM 428 Pupin Hall

First Direct Observations of Jet Quenching(?) by the ATLAS Experiment in Lead-Lead Collisions at the LHC

On November 6, 2010 the Large Hadron Collider (LHC) started colliding lead nuclei at a nucleon-nucleon center of mass energy of 2.76 TeV. Such collisions are expected to create strongly interacting matter at temperatures in excess of 500 MeV (> 1012 degrees K) -- the highest temperatures ever created in the laboratory. At such high temperatures, strongly interacting matter is predicted to be in a novel state called a strongly interacting quark-gluon plasma (sQGP), in which quarks and gluons normally "confined" within the volume of a proton become "deconfined" over a much larger nuclear volume. The ATLAS detector at the LHC was constructed primarily to study high-energy proton-proton collisions. It turns out however to be also an ideal instrument for studying sQGP properties in nuclear collisions because its highly segmented calorimeters provide excellent detection and measurement of "jets" of particles in very complex high multiplicity environments. On November 26, 2010 ATLAS reported the first observation of large imbalances in transverse momenta of pairs of "jets" produced in the lead collisions. Unlike in proton-proton collisions, pairs of back to back jets in nuclear collisions are found to be highly momentum unbalanced in the plane transverse to the incoming beams. The observation suggests that the hot sQGP created in the lead-lead collision can change significantly the energy of one or both jet partons before they fragment into jets of pions, kaons and other particles. Such "quenching" of quarks and gluons was theoretically predicted nearly two decades ago. Results from the Relativistic Heavy Ion Collider have indirectly demonstrated jet quenching through the suppressed yield of high-energy fragments of jets. If the jet quenching interpretation is ultimately confirmed, the recent ATLAS measurements would represent its first direct observation via full calorimetric jet reconstruction.

Hosted by
Miklos Gyulassy

Brian Cole
Columbia University