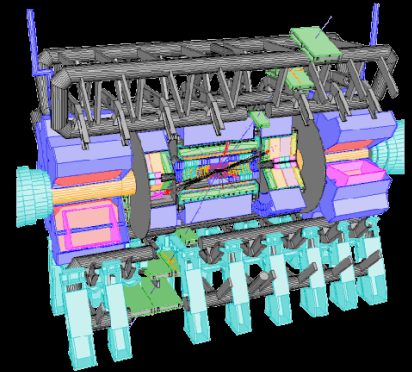


# CU Physics Department Colloquium

Monday, February 6, 2012 4:10 PM 428 Pupin Hall

## Studying hot, dense QCD matter with the ATLAS experiment at the LHC

Heavy ion physics has entered a very exciting period, where experiments are now taking data at two high energy collider facilities: the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory, and the Large Hadron Collider (LHC) at CERN. Results from gold-gold collisions at RHIC have shown that collisions of heavy nuclei at ultra-relativistic energies create an evanescent drop of a nearly-perfect fluid with an energy density at least 60 times more dense than a proton, and reaching temperatures of several trillion Kelvin. Even more striking, this matter is found to lead to a strong energy loss of quarks and gluons that traverse it, observed in the phenomenon of "jet quenching", although the precise mechanism of this is not yet understood. To extend these studies to even higher temperatures and densities, a broad program of measurements using lead-lead collisions is underway at the LHC. This talk will primarily describe measurements performed using up to  $9 \mu\text{b}^{-1}$  of lead-lead collision data at a nucleon-nucleon center-of-mass energy of 2.76 GeV, collected by the ATLAS Detector during November and December 2010. Results on inclusive charged particle multiplicities and elliptic flow are used to study the global features of the collisions as a function of centrality, pseudorapidity and transverse momentum. Higher order Fourier coefficients will also be shown to assess the importance of more complicated event-wise geometric fluctuations. The study of the microscopic properties of the system will be addressed with high momentum probes. Measurements of muons provide access to W and Z bosons, which are potentially sensitive to modifications of the nuclear PDFs, as well as heavy flavor. Charged particle spectra, particularly at high  $p_T$ , are sensitive to the overall suppression of jets and their modified fragmentation. Finally, jet rates, asymmetries and fragmentation properties offer a more direct look at the physics of jet quenching than has been available previously.



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