

Columbia University

Department of Physics Colloquium



“The first one femtometer/c “

Ultra-relativistic nucleus-nucleus collisions at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC) create a unique state of matter called quark gluon plasma (QGP) that exists only at temperatures in excess of 10^{12} degrees Kelvin. The quark gluon plasma is observed to be the most ideal fluid ever created in the laboratory. That result admits a number of parallels between the evolution of the quark gluon plasma in heavy ion collisions and the evolution of the early universe -- thus, the choice of the title of this colloquium in analogy with Steven Weinberg's famous book "The first three minutes". In particular, recent measurements by ATLAS probe the evolution of quantum fluctuations in the initial state of lead-lead collisions through rapid thermalization and subsequent hydrodynamic evolution of the plasma. Similar to the way quantum fluctuations in the early universe are imprinted onto the cosmic microwave background, the quantum fluctuations in the initial state of nuclear collisions are imprinted on the angular distribution of final-state particles. Results and implications of measurements of the analog of the CMB power spectrum in lead-lead collisions will be presented and discussed. In addition, early results of measurements in proton-nucleus collisions that directly probe the physics of the initial state and the first fm/c in lead-lead collisions will be presented.



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