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THE UNIVERSITY of WISCONSIN MADISON

Department of Physics Colloquium

Friday, January 22, 2010 • 4:00 P.M. • 2241 Chamberlin Hall

cookies & coffee served at 3:30 p.m

Quark-Gluon Plasma in QCD, at RHIC and LHC, and in String Theory

Krishna Rajagopal

MIT

Host: Ramsey-Musolf

The realization that the high temperature phase of QCD is quark-gluon plasma, with properties qualitatively distinct from those of the hadronic phase whose quasi-particles make up the matter in the everyday world around us, goes back more than 30 years. Over that time, we have gained reliable insight into the thermodynamics of quark-gluon plasma, and we have understood much about its dynamics in the high temperature limit where it becomes weakly coupled. However, in the last five years experimental discoveries at the Relativistic Heavy Ion Collider have taught us that, at least at temperatures within a factor of two of that at which hadrons ionize, the dynamics of quark-gluon plasma is closer to the ideal liquid limit than to the ideal gas limit. These experimental data demand a theoretical understanding of the dynamics of strongly coupled quark-gluon plasma. Such calculations in QCD itself are in their infancy, but string theory provides us with robust tools for exactly this purpose, applicable to the quark-gluon plasmas of many QCD-like theories. I will describe some of the many new insights into the properties of strongly coupled plasma obtained recently from these calculations in which difficult quark-gluon plasma questions are mapped onto easy gravity questions, and look ahead toward the expected interplay between these calculations and heavy ion collision experiments at the LHC.