Strongly coupled QCD matter: very hot and very cool

Prof. Barbara Jacak

Department of Physics, University of California

Quantum Chromodynamics predicts a transition from normal hadronic matter to a phase where the quarks and gluons are no longer bound together and instead move freely through the medium. This quark gluon plasma is now produced regularly in collisions of heavy nuclei at very high energy at both the Relativistic Heavy Ion Collider (RHIC) in the U.S. and at the LHC in Europe. Experiments have already provided some key information about the phase diagram of QCD.

Quark gluon plasma exhibits remarkable properties. Its vanishingly small shear viscosity to entropy density ratio means that it flows essentially without internal friction, making it one of the most “perfect” liquids known. It is also very opaque to transiting particles, though the mechanism for this is not yet understood. The similarities to strongly coupled or correlated systems in ultra-cold atoms and condensed matter are striking, and have inspired novel theoretical descriptions growing out of string theory. Nevertheless, it remains a big mystery how this plasma emerges from cold, dense gluonic matter deep inside nuclei. I will discuss how we might solve this mystery.