

Doping and Probing the Original Liquid: Opportunities and Challenges from Heavy Ion Collisions

Heavy ion collisions at RHIC and the LHC recreate droplets of the matter that filled the microseconds old universe. These experiments have shown that this stuff, conventionally called quark-gluon plasma (QGP), is the hottest, and most liquid, liquid phase of matter that we know of.

And, it was the earliest complex matter to form in the history of the universe. After a look back at these discoveries I will focus on the central questions that they are posing today and look at the challenges and opportunities ahead as we strive to answer them in the coming decade. Questions that I will pose, but that cannot yet be answered, include: How does QGP work? How does its liquidness emerge from its simple microscopic dynamics? Using the probes that we have at our disposal, how can we best “look under the hood”? What is the smallest possible droplet of QGP that behaves hydrodynamically? How does QGP form in heavy ion collisions? (One thing we know is that the answer is different than in cosmology, because heavy ion collisions are lumpy and rapid.) What is the phase diagram of doped QGP? Can we see the quantum aspects of QGP?