Research Highlight: Holography of the QGP Reynolds number

Work of Professor Brett MCINNES

The Relativistic Heavy Ion Collider (RHIC) is a large facility at the Brookhaven National Laboratory (BNL) in Upton, New York. It collides not elementary particles but rather entire atomic nuclei. It is famed for running the first experiments in which the constituents of familiar particles such protons and neutrons, that is, quarks, have been liberated, giving rise to a new form of matter, the Quark-Gluon Plasma [1]. This plasma has many surprising properties: for example, despite being extremely hot (with temperatures in the trillions of degrees), it behaves like a fluid rather than like a gas. Perturbative techniques have not succeeded in describing this behaviour. One (still rather speculative) way of doing so uses string theory to allow techniques from black hole theory to be brought to bear on this problem. In the work of Professor Brett McInnes [2], a specific kind of black hole is studied, and its properties are used to study a particular fluid-dynamical parameter describing the Quark-Gluon Plasma, namely its *Reynolds number* (denoted Re), which quantifies a measure of the viscosity of the plasma. This model puts an upper bound on Re for plasmas resulting from head-on heavy-ion collisions at a given temperature; this upper bound is in very good agreement with the observational lower bound from the RHIC. Thus a combination of theoretical work and experimental observations allows one to give an estimate of this important parameter.

References

[1] Thomas Schaefer, Derek Teaney, Nearly Perfect Fluidity: From Cold Atomic Gases to Hot Quark Gluon Plasmas, Rept.Prog.Phys.72:126001, 2009, arXiv: 0904.3107 [hep-ph]

[2] Brett McInnes, Holography of the QGP Reynolds Number, Nucl.Phys. B921 (2017) 39, arXiv: 1702.02276 [hep-th]