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Novel transport phenomena with chirality, vorticity and magnetic field

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By colliding heavy ions at high energies, physicists are able to "break up" nuclear particles like protons and neutrons and create a hot "subatomic soup", the quark-gluon plasma (QGP). In recent years, there have been significant interests and progress on the spin degrees of freedom in the QGP fluid. In particular, novel transport phenomena arise from the nontrivial interplay between quark spin and chirality with extremely strong vorticity and magnetic field in heavy ion collisions. In this talk, a number of fascinating examples will be briefly surveyed. The first is the global polarization of particle spin from fluid rotation, demonstrating "fluid spintronics" on the subatomic scale. The second is the anomalous transport phenomenon known as the Chiral Magnetic Effect (CME) that has been enthusiastically studied not only in the "subatomic swirls" but also in Dirac and Well semimetals as well as in atomic, astrophysical and cosmological systems. The talk would also give a more detailed discussion on the ongoing efforts to search for the CME in heavy ion collisions. The pertinent progress in phenomenological modelings with the recently developed tool of Anomalous-Viscous Fluid Dynamics (AVFD) framework will also be presented. We end this talk with an outlook into the potential opportunity of discovery in the isobaric collision experiment.

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