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Subatomic fluid spintronics - Global hyperon polarization in heavy ion collisions measured by STAR[1]

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In 1915, Barnett et al found that rotation of a metal cylinder can induce a magnetization in the object. This remains a rare example of a coupling between macroscopic mechanical rotation and quantum spin (though this was not the paradigm of the day). Just last year (2016), Takahashi et al discovered the first polarization of electrons induced by mechanical vorticity induced by viscous effects in a fluid; they thus heralded the new field of "fluid spintronics." In 2000, first collisions at Brookhaven National Lab's Relativistic Heavy Ion Collider (RHIC) led to the surprising discovery that the deconfined quark-gluon plasma (QGP) is best described as a "nearly perfect fluid." These fluid properties remain the focus of intense study, and are providing insights into the Strong force in the non-perturbative regime. However, fundamental features of the fluid– including its vorticity– are largely unexplored. I will discuss recent measurements by the STAR Collaboration at RHIC, on the spin alignment, or polarization, of Lambda hyperons with the angular momentum of the collision. I will argue that a RHIC collision generates the subatomic analog of Takahashi's observation, the vorticity generated by initial viscous forces and maintained by subsequent low viscosity. These measurements allow an estimate of both the vorticity of the QGP and the magnetic field in which it evolves. Both of these quantities far surpass any known system in the universe. Furthermore, knowledge of both is crucial to recent studies that may reveal the onset of chiral symmetry restoration in QCD.

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