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Transport properties of rotating quark matter

Measurements of global spin polarization of hyperons and mesons in non-central heavy ion collisions reveal a promising signature of non-zero net angular momentum in the locally thermalized medium of quark-gluon plasma. This motivates a detailed understanding of the thermodynamic and transport properties of quark matter in a rotating frame. Rotation breaks translational symmetry in a system and anisotropies its thermodynamic quantities, potentially disrupting the thermalization requirement at high angular velocity. Along with thermodynamic variables, rotation disrupts the isotropy of transport coefficients in the same way as an external magnetic field does. In this work, we calculate anisotropic components of transport coefficients by considering angular velocity ($\vec{\Omega}$) as an independent degree of freedom in the rotating frame. As a result, shear and bulk viscosity breaks up into five independent components and electrical conductivity breaks up into three independent components. We calculate the transport coefficients by solving the Boltzmann transport equation (BTE) using kinetic theory formalism. With the modified equation of motion in the rotating frame, the force term in the BTE naturally gives rise to Coriolis, centrifugal, and many other fictitious forces. We solve the BTE for the leading order terms in $\vec{\Omega}$. We employ a two-flavor Nambu-Jona—Lasinio model to estimate the transport coefficients, with the modified Lagrangian taking care of the equation of motion in a rotating frame and including a spinorial connection. As a first estimate, we choose a fixed coupling constant, due to which chiral condensate melts down with rotation and the transportation increases.

Authors: DWIBEDI, ASHUTOSH (IIT Bhilai); Dr SAHU, Dushmanta (nstituto de Ciencias Nucleares, Universidad Nacional Aut´onoma de M´exico); DEY, Jayanta (BLTP, JINR); Mr GOSWAMI, Kangkan (IIT Indore); Dr SAHOO, Raghunath (IIT Indore); Prof. GHOSH, Sabyasachi (IIT Bhilai)

Presenter: DEY, Jayanta (BLTP, JINR)