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# Chiral symmetry for an accelerated and rotated observer

In the relativistic heavy ion collision experiment, there exist a large acceleration and rapid rotation in the non-central collision which can be considered as a system with acceleration and rotation. According to the Hawking-Unruh effect, the accelerated observer sees himself in a system with Unruh temperature $T/2\pi$. And the color glass condensate picture predicts that in heavy ion collision the particle under a strong color-electric field with strength $E \sim Q_s^2/g$ ($Q_S$ is the saturation scale, and g is the strong coupling) which will provide a typical acceleration $a \sim Q_s \sim 1GeV$ such that the Unruh temperature $T \sim 200MeV$ which is large than the pseudo-critical temperature for QCD phase transition. It means that the Unruh effect may play an important role in QCD phase transition. The chiral symmetry breaking and restore for an accelerating observer have been discuss in the past study. As the QGP is the most vortical fluid, QCD matter under rotation has attracted many attentions. In this work we study the chiral symmetry for an observer under both acceleration and rotation.

We study the chiral condensate as observed by an accelerating and rotating observer using field theory in general spacetime. We develop the formalism to calculate the chiral condensate using the Nambu-Jona-Lasinio model in accelerating and rotating frame. We solve the gap equation and obtain the chiral condensate as a function of proper acceleration and angular velocity. We also defined a critical acceleration $a_c$ where the chiral symmetry restore. As one of our main results, $a_c$ as a function of rotation angular velocity $\omega$ was obtained. And we also study the constituent quark mass and neutral pion condensate in the case with the presence of $a \cdot \omega$. Like the case in parallel electromagnetic field, we observe a chiral rotation form the $\sigma$-direction toward the $\pi$-direction.

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