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Mass splitting of vector meson and spontaneous spin polarization under rotation

We study the effect of the rotation on the masses of scalar meson as well as vector meson in the framework of 2-flavor Nambu–Jona-Lasinio model. Applying the random phase approximation, the meson mass is calculated numerically. It is found that the behavior of scalar and pseudoscalar meson masses under the angular velocity ω is similar to that at finite chemical potential, both relied on the behavior of constituent quark mass and reflect the property related to the chiral symmetry. However, masses of vector meson ρ have a profounder relation with rotation. It turns out that at low temperature and small chemical potential, the mass for spin component $s_z = 0, \pm 1$ of vector meson under rotation shows very simple mass splitting relation $m_\rho^{s_z}(\omega) = m_\rho(\omega = 0) - \omega s_z$, similar to the Zeeman splitting of charged meson under magnetic fields. Especially it is noticed that the mass of spin component $s_z = 1$ vector meson ρ decreases linearly with ω and reaches zero at $\omega_c = m_\rho(\omega = 0)$, this indicates the system will develop $s_z = 1$ vector meson condensation and the system will be spontaneously spin polarized under rotation.

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