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On chiral instability in quark-gluon plasma

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We study the chiral-imbalance and the Weibel instabilities in presence of the quantum anomaly using the Berry-curvature modified kinetic equation. We argue that in many realistic situations, e.g. relativistic heavy-ion collisions, both the instabilities can occur simultaneously. The Weibel instability depends on the momentum anisotropy parameter ξ and the angle (θ_n) between the propagation vector and the anisotropy direction. It has maximum growth rate at $\theta_n=0$ while $\theta_n=\pi/2$ corresponds to a damping. On the other hand the pure chiral-imbalance instability occurs in an isotropic plasma and depends on difference between the chiral chemical potentials of right and left-handed particles. It is shown that when $\theta_n=0$, only for a very small values of the anisotropic parameter $\xi\sim\xi_c$, growth rates of the both instabilities are comparable. For the cases $\xi_c<\xi\ll 1$, $\xi\approx 1$ or $\xi\geq 1$ at $\theta_n=0$, the Weibel modes dominate over the chiral-imbalance instability if $\mu_5/T\leq 1$. However, when $\mu_5/T\geq 1$, it is possible to have dominance of the chiral-imbalance modes at certain values of θ_n for an arbitrary ξ. We also calculate the coefficient of shear viscosity generated by
the instability. Further we discuss consequences of our results for heavy-ion collisions.

Collaboration

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