Structure formation in chiral magnetohydrodynamics: Effect of background magnetic field

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Anomalous transports due to quantum anomalies have been theoretically predicted. In a system with a chirally imbalanced medium and a magnetic field, the so-called chiral magnetic effect (CME) that induces a current along the magnetic field is expected to appear, such as in electroweak plasmas in the early Universe and in quark-gluon plasmas in heavy-ion collisions. The macroscopic dynamics of a charged medium, on the other hand, is controlled by magnetohydrodynamics (MHD). In order to investigate the linkage between microscopic CME and macroscopic motion of the charged and chirally imbalanced medium, chiral MHD has recently been proposed [Yamamoto, 2016; Rogachevskii, et al., 2017]. Its properties, however, are not fully clarified though several theoretical and simulation studies have been carried out so far. In this study, we investigate the effect of the background magnetic field on the chiral plasma instability (CPI) driven by the chiral term in the induction equation using two-dimensional chiral MHD simulations. The results show that finer magnetic structures than those in CPI without the background magnetic field are formed.

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