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Heavy-Fermion Instability in Double-Degenerate Plasmas

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In this work we study the propagations of normal frequency modes for quantum hydrodynamic (QHD) waves in the linear limit and introduce a new kind of instability in a double-degenerate plasma. Three different regimes, namely, low, intermediate and high magnetic field strengths are considered which span the applicability of the work to a wide variety of environments. Distinct behavior is observed for different regimes, for instance, in the laboratory-scale field regime no frequency-mode instability occurs unlike those of intermediate and high magnetic-field strength regimes. It is also found that the instability of this kind is due to the heavy-fermions which appear below a critical effective-mass parameter ($\mu_{cr}=\sqrt{3}$) and that the responses of the two (lower and upper frequency) modes to fractional effective-mass change in different effective-mass parameter ranges (below and above the critical value) are quite opposite to each other. It is shown that, the heavy-fermion instability due to extremely high magnetic field such as that encountered for a neutron-star crust can lead to confinement of stable propagations in both lower and upper frequency modes to the magnetic poles. Current study can have important implications for linear wave dynamics in both laboratory and astrophysical environments possessing high magnetic fields.

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