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Quantum collapse in ground-state Fermi-Dirac-Landau plasmas

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It is revealed that in a relativistically degenerate dense highly-magnetized electron-ion plasma the effective quantum-potential due to the total quantum-force acting on fermions may cancel-out causing a quantum transverse collapse in the ground-state Fermi-Dirac-Landau (GSFDL) plasma. The condition for the plasma transverse collapse is found to be restricted to the minimum relativistic degeneracy parameter and minimum impressed magnetic field strength values satisfied for many superdense astrophysical objects such as white dwarfs and neutron stars. In such plasmas, the magnetization pressure is shown to cancel the lateral electron degeneracy pressure counteracting the existing gravitational pressure. Furthermore, using the Sagdeev pseudopotential method in the framework of quantum magnetohydrodynamics (QMHD) model including spin magnetization it is confirmed that the quantum pressure due to spin-orbit polarization and the electron relativistic degeneracy has significant effects on the existence criteria and the propagation of localized magnetosonic density excitations in GSFDL plasmas. Current findings can have important implications for the density excitations mechanism and gravitational collapse of the highly magnetized astrophysical relativistically dense objects such as white-dwarfs, neutron stars, magnetars and pulsars.

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