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The effects of superhigh magnetic fields on equation of state of a neutron stars

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Based on our previous work, we deduce a general formula for pressure of degenerate and relativistic electrons, P_e, which is suitable for superhigh magnetic fields, discuss the quantization of Landau levels of electrons, and consider the quantum electrodynamic(QED) effects on the equations of states (EOSs) for different matter systems. The main conclusions are as follows: P_e is related to the magnetic field B, matter density ρ, and electron fraction Y_e; the stronger the magnetic field, the higher the electron pressure becomes; the high electron pressure could be caused by high Fermi energy of electrons in a superhigh magnetic field; compared with a common radio pulsar, a magnetar could be a more compact oblate spheroid-like deformed neutron star due to the anisotropic total pressure; and an increase in the maximum mass of a magnetar is expected because of the positive contribution of the magnetic field energy to the EOS of the star.

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