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Anomalous-Magnetic-Moment Effects in the EoS of a Magnetized Fermion System

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We investigate the effects of the anomalous magnetic moment (AMM) in the EoS of a fermion system in the presence of a magnetic field. In the region of intermediate to large magnetic fields the AMM is found from the one-loop fermion self-energy. In contrast to the weak-field AMM found by Schwinger, in the intermediate-to-large magnetic field region, the AMM depends on the Landau level and decreases with it. We introduce this Landau level-dependent AMM in the effective Lagrangian used for the calculation of the energy and pressures of the system. We plot the medium parallel and perpendicular pressures versus the magnetic field considering the found AMM, the Schwinger AMM, or no AMM at all. The results clearly show the inconsistency of assuming the validity of the Schwinger AMM beyond the very weak field region ($eB \geq 0.1e$ Bc). The curves for the EoS, pressures and magnetization at different fields give rise to the well-known de Haas van Alphen oscillations, associated to the change in the number of Landau Levels (ALL) contributing at different fields.

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