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Few-electron systems in a quantum dot in a magnetic field: Wigner phase and broken-symmetry spin-singlet state

ABSTRACT. The nature of the ground state of a few-electron system in a parabolic two-dimensional (2D) quantum dot (QD) is theoretically investigated on the basis of a variational many-body approach within a second quantized formulation. The resulting analytical expressions lead to various phase transitions: maximum density droplet, Wigner phase, etc., in a broad range of magnetic fields. It is observed that in the case of relatively strong QD confinement and weak magnetic fields, a rotationally symmetric spin-singlet state is the ground state of the system. However, in a strong magnetic field and for the same QD confinement, a broken-symmetry spin-singlet state appears to be energetically favoured over the symmetric spin-singlet state. The method developed is generalized for the investigation of possible novel phases for electron-hole interacting systems.

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