

Deformation of the Fermi Surface

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In the presence of isotropic interactions, the Fermi surface of an ultracold Fermi gas is spherical. Introducing anisotropic and long-range dipole-dipole interaction (DDI) to the system deforms the Fermi surface to an ellipsoid, as was experimentally observed in a degenerate dipolar Fermi gas of erbium atoms [1]. The deformation is caused by the interplay between the strong magnetic DDI and the Pauli exclusion principle. It was also observed that the atomic cloud follows the rotation of the dipoles when the direction of the external magnetic field is changed, keeping the major axis always parallel to the direction of the maximum attraction of the DDI. Here we present a generalization of the previous Hartree-Fock mean-field theory [2, 3], where the magnetic field was assumed to be parallel to one of the harmonic trap axes. We now extend our calculations for an arbitrary orientation of the magnetic field. In order to obtain the ground state and analyze the resulting deformation of the Fermi surface, we minimize the total energy of the system, which enables us to determine its Thomas-Fermi radii and momenta. These analytical and numerical calculations are in agreement with observations from the Innsbruck experiment [1] and are relevant for understanding similar ongoing experiments with ultracold fermionic dipolar atoms.

REFERENCES

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