Vortex in a Bose-Einstein condensate with dipole-dipole interactions

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Introduction

Dipole-dipole interactions are both long-range and anisotropic and hence a crucial effect on the ground state wave functions in weak BECs. A useful DEC (Dipolar) BEC was studied by Harrison et al. (2001). Here, we study the effects of dipole-dipole interactions upon the internal properties of a BEC. It will turn out that these effects depend on the shape and boundary of the BEC.

Do attractive bosons condense? - the role of interactions

\[ \Phi_0(r) = \sum_{i} \frac{\mu_i^2}{4\pi\epsilon_0 r_i} \left( \frac{2}{r_i} - \frac{1}{r_i^3} \right) \]

\[ \text{where} \quad r_i = \left| \mathbf{r} - \mathbf{r}_i \right| \]

\[ \mu_i \] is the magnetic dipole moment of the i-th atom.

Exact solution to hydrodynamic waves for a diatomic molecule with electrostatics

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Ways of adding angular momentum to a trapped BEC

Centre of mass motion at constant frequency: \( \omega = \frac{\hbar}{\\text{mass}} \)

Dipole-Dipole Interactions

Chirality BEC in Stuttgart: Nov 2004


Vortex in a dipolar BEC

Dipole Dipole interactions can be achieved either by using the linear Darwin's function in spherical vortices or by integrating over ellipsoids (D. Green). On the characterization of Kohn and interior reflection of dipolar of variable density. Trans. Comb. Phil. Soc. Vol. 42, Part 1, 1924

Controlling dipole-dipole interactions by rapidly rotating the external field


Vortex in a dipolar BEC: results

Controlled short range interactions: Feedback scattering resonance in chromism

Conclusions

Collisionless hydrodynamics of a superfluid at T=0

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Future work: fragmentation in dipolar BECs

Conclusion

Quantum phase transition in interactions become not positive, i.e. quasilinear different behavior under rotation depending upon whether the interactions are positive or negative.