Dipolar Gases in Curved Geometries

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We have been investigating quantum gases with dipole-dipole interactions in curved potential landscapes, either by investigating a two dimensional infinite plane with curvature or a shell-like trapping potential.

Dipole-dipole interactions between polarized particles are long-range and anisotropic since the dipolar interaction potential is given by

$$U_{dd} = \frac{\mu_0 \mu^2}{4\pi} \frac{1 - 3\cos^2\theta}{r^3},$$

where μ is the magnetic moment, r the distance between particles and θ the angle between the polarization direction and the line connecting the particles.

Such combination, of dipole interactions and curved geometries creates interesting possibilities concerning the ground state of quantum gases, computed via the Gross-Pitaevskii equation, their low-lying excitation and also on the dynamics of solitons and vortices. In this work we summarize our current results and findings in the ground state of a dipolar quantum gas in a tunable shell geometry.