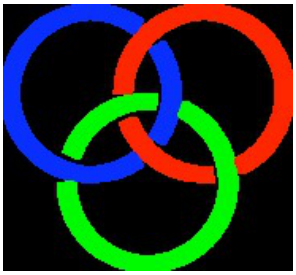

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Stability of Bright, Vortex-Bright, and Gap Solitons in a Dipolar Bose-Einstein Condensate

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We study the formation and dynamics of bright, vortex-bright, and gap solitons in a dipolar Bose-Einstein condensate (BEC). The bright and vortex-bright solitons are considered in a cigar-shaped dipolar BEC for large repulsive atomic interactions, while no solitons can appear in a BEC of atoms without dipolar moment. Phase diagram showing the region of stability of these solitons is obtained. We also study the dynamics of breathing oscillation of these solitons as well as the collision dynamics of two solitons at large velocities. Two solitons placed side-by-side at rest coalesce to form a stable bound soliton molecule due to dipolar attraction.

The gap solitons can appear and are considered in both disk- and cigar-shaped dipolar BEC with weak atomic attraction and repulsion. The gap solitons are localized, in the lowest band gap, by three orthogonal optical lattice (OL) potentials. The onedimensional version of these solitons of experimental interest
confined by an OL along the dipole moment direction and harmonic traps in transverse directions are also considered. Dynamics of (i) breathing oscillation of a gap soliton and (ii) dragging of a gap soliton by a moving lattice along axial direction demonstrates the stability of the solitons.

We use both time-dependent variational analysis and numerical solution of the mean-field Gross-Pitaevskii equation in this study

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