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Dipolar spinor condensate: a novel magnetic anisotropic superfluid

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Dipolar interactions play crucial roles in quantum magnetism. Recent experimental breakthrough of a chromium condensate (with ground state magnetic dipole moment as large as 6 Bohr magneton) rekindles great interest in dipolar effects in atomic Bose-Einstein condensates. Here we focus on the ground state structure of a dipolar spin-1 condensate. We show that the interplay between the short-range isotropic collisional interactions and the long-range anisotropic dipolar interactions gives rise to an extremely rich phase diagram, characterized by intricate spontaneous magnetic ordering and spin textures. These textures arise as a result of the dipolar-induced coupling between the spin and orbital degrees of freedom. The tunability of the effective dipolar interaction in atomic gases provides a new set of control knobs on condensates, and access to different magnetic phases can be achieved by modifying the trapping geometry. The feasibility of observing these dipolar-induced phases in alkali spinor condensates is analyzed.