Supersolid Phases of Dipolar and Spin-Orbit Coupled Bosons in Optical Lattices

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Following a quick review of the existence of supersolid and melted supersolid phases (hexatic superfluids) in two-dimensional continuum dipolar boson systems [1], the emergence of supersolid phases of dipolar and spin-orbit coupled bosons in optical lattices is discussed. For dipolar systems, it is shown that the ground state phase diagram is very sensitive to the direction of an externally applied field with respect to the normal to the plane of a two-dimensional square optical lattice, and that supersolids are stabilized by dipolar interactions [2]. It is found that the phase diagram, at high filling factors, is very rich with various supersolid (e.g., checkerboard and striped) phases emerging out of superfluid regions [2]. For spin-orbit coupled systems in two-dimensional square optical lattices, it is shown that the competition between the optical lattice period and the spin-orbit coupling length – along with spin hybridization induced by a Rabi coupling and local interparticle interactions – create a rich variety of quantum phases including uniform and phase separated superfluids and supersolids [3]. Finally, it is shown that Devil’s staircases of supersolid phases exist, when the spin-orbit coupling momentum transfer is not aligned with the principal axis of the square lattice [4].


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