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Robust Supersolidity in the V_1-V_2 Extended Bose-Hubbard Model NICOLE GREENE, JEDEDIAH PIXLEY, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park — Motivated by ultra-cold atomic gases with long-range interactions in an optical lattice we study the effects of the next-nearest neighbor interaction on the extended Bose-Hubbard model on a square lattice. Using the variational Gutzwiller approach with a four-site unit cell we determine the ground state phase diagrams as a function of the model parameters. We focus on the interplay of each interaction between the nearest neighbor (V_1), the next-nearest neighbor (V_2), and the onsite repulsion (U). We find various super-solid phases that can be described by one of the ordering wavevectors (π, 0), (0, π), and (π, π). In the limits $V_1, V_2 <$U and $V_1, V_2 >$U we find phases reminiscent of the limit $V_2 = 0$ but with a richer super solid structure. For $V_1 <$U $<V_2$ we find a qualitatively new super solid phase that is quite stable and occupies a large region of the phase diagram. For sufficiently strong interactions we find various Mott and charge density wave (CDW) insulating phases that can be understood in the classical limit (i.e. no inter-site tunneling). We characterize the nature of each quantum phase transition between Mott/CDW to super-solid to superfluid at the mean field level.

Jedediah Pixley
Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park

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