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Title**: Supersolid phases in a realistic three-dimensional spin model**

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Supersolid phases, in which a superfluid component coexists with conventional crystalline long range order, have recently attracted a great deal of attention in the context of both solid helium and quantum spin systems. Motivated by recent experiments on 2H-AgNiO2, we study the magnetic phase diagram of a realistic three-dimensional spin model with single-ion anisotropy and competing interactions on a layered triangular lattice, using classical Monte Carlo simulation techniques, complemented by spin-wave calculations. For parameters relevant to experiment, we find a cascade of different phases as a function of magnetic field, including three phases which are supersolids in the sense of Liu and Fisher. One of these phases is continuously connected with the collinear ground state of AgNiO2, and is accessible at relatively low values of magnetic field. The nature of this low-field transition, and the possibility of observing this new supersolid phase in AgNiO2, are discussed.