Anomalous Hysteretic Behavior in a System of Dipolar Bose Gases

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We study quantum phase transitions of dipolar bosons loaded into triangular optical lattices. We analyze hysteresis properties of the system by applying a large-size cluster mean-field approximation to the corresponding hardcore Bose-Hubbard model. The long-range nature of dipole-dipole interaction gives rise to a rich ground-state phase diagram, containing superfluid (SF) phase, solid (Sol) phase, and the coexistence of them, the so-called supersolid (SS) phase. We find that the transition between the SF phase and the other phases is always first-order (discontinuous) except for the particle-hole symmetry point. In conventional first-order transitions, the transition between the two phases occurs bidirectionally along a hysteresis loop. In contrast, we find that in the present case the quantum melting transition from the Sol (or SS) to SF phase occurs *unidirectionally* along a hysteresis curve, which does not form a standard loop structure.[1]

[1]D. Yamamoto, I. Danshita, and C. A. R. Sá de Melo, arXiv:1102.1317.