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Dipole Condensations in Tilted Bose-Hubbard Chains

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We study the quantum phase diagram of a Bose-Hubbard chain whose dynamics conserves both boson number and boson dipole moment, a situation that can arise in strongly tilted optical lattices. With DMRG simulations, we show that the conservation of the dipole moment has a dramatic effect on the phase diagram. In particular, various types of incompressible dipolar condensate phases arise in the thermodynamic limit. In finite-sized systems, however, it may be possible to stabilize a 'Bose-Einstein insulator': an exotic compressible phase that is insulating, despite the absence of a charge gap. We also suggest a cold atom experiment that may identify these exotic phases.

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