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Many-Body Dynamics of Repulsively Bound Pairs of Particles in a Periodic Potential DAVID PETROSYAN, Institute of Electronic Structure & Laser, FORTH, 71110 Heraklion, Crete, Greece, BERND SCHMIDT, JAMES R. ANGLIN, MICHAEL FLEISCHHAUER, Fachbereich Physik, Technische Universitaet Kaiserslautern, 67663 Kaiserslautern — Recently, Winkler *et al.* [Nature 441, 853 (2006)] have observed repulsively bound atom pairs in an optical lattice. In a tight-binding periodic potential described by the Bose-Hubbard model, when the on-site repulsion between the particles exceeds their inter-site tunneling rate, such "dimers" are well localized at single sites and are stable over the time scale on which the energy dissipation is negligible. We derive an effective many-body Hamiltonian for a lattice loaded with dimers only, and discuss its implications for the dynamics of the system. We show that strong on-site repulsion and nearest-neighbor attraction favor clusters of dimers with minimum surface area and uniform, commensurate filling, representing thus incompressible "droplets" of a lattice liquid.

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