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Quantum localization of particles with dipolar tunnelling in three-dimensional lattices of finite size[1] JOSHUA T. CANTIN, TIANRUI XU, ROMAN V. KREMS, Univ of British Columbia — It is generally assumed that quantum particles with dipolar long-range hopping do not undergo Anderson localization in 3D disordered lattices. However, this is valid only for lattices of infinite size. The delocalization of particles with long-range hopping occurs through resonant couplings between sites with the same on-site energy. As the lattice size grows, the energy for each lattice site within a finite volume has a non-zero probability to be equal to the energy of a site outside this volume. The number of such resonances diverges with the system size. If the lattice size is finite, the number of resonances is finite and may not be sufficiently large to cause delocalization. This raises the question: can quantum transport be suppressed by reducing the size of the system? To answer this, we compute the localization-diffusion phase diagram for a quantum particle with dipolar long-range hopping in a finite-size three-dimensional lattice with diagonal and off-diagonal disorder. We characterize the diffusion-localization transition as a function of the system size and the amount of diagonal and off-diagonal disorder. Our calculations show that the diffusion-localization transition could be detected using excitations of polar molecules in an optical lattice as probe particles.

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