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Spin-orbital dynamics in a system of polar molecules[1] SERGEY SYZRANOV, Univ of Colorado - Boulder, MICHAEL WALL, JILA, NIST, and Physics Department, Univ of Colorado - Boulder, VICTOR GURARIE, Univ of Colorado - Boulder, ANA MARIA REY, JILA, NIST, and Physics Department, Univ of Colorado - Boulder — We consider the dynamics of a two-dimensional system of ultracold polar molecules weakly perturbed from a stationary state. We demonstrate that dipole-dipole interactions in such a system generate chiral excitations with a non-trivial Berry phase 2π. These excitations, which we call *chirons*, resemble low-energy quasiparticles in bilayer graphene and emerge regardless of the quantum statistics and for arbitrary ratios of kinetic to interaction energies. Chirons manifest themselves in the dynamics of the spin density profile, spin currents, and spin coherences, even for molecules pinned in a deep optical lattice. We derive the kinetic equation that describes chiron dynamics and calculate the distributions of physical observables for experimentally realisable initial conditions.

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Sergey Syzranov
Univ of Colorado - Boulder

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