Angular momentum of small molecules: quasiparticles and topology

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I will present our recent findings on small molecules kicked by laser pulses. First, I will describe a technique that allows to probe highly excited molecular states in the presence of an environment, such as superfluid 4He, and a corresponding theory based on angulon quasiparticles that is capable of describing such states, in good agreement with experiment.

Second, I will show how that even the simplest of existing molecules - closed-shell diatomics not interacting with one another - host topological charges when driven by periodic far-off-resonant laser pulses. A periodically kicked molecular rotor can be mapped onto a "crystalline" lattice in angular momentum space. This allows to define quasimomenta and the band structure in the Floquet representation, by analogy with the Bloch waves of solid-state physics. In such a momentum space we predict the occurrence of Dirac cones with topological charges, protected by reflection and time-reversal symmetry. These Dirac cones -- and the corresponding edge states -- are broadly tunable by adjusting the laser strength and can be observed in present-day experiments by measuring molecular alignment and populations of rotational levels. This paves the way to study controllable topological physics in gas-phase experiments with small molecules as well as to classify dynamical molecular states by their topological invariants.