Abstract Submitted
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Cold and ultracold dipole-dipole collisions[1] CATHERINE NEWELL, MICHAEL CAVAGNERO, VLADIMIR ROUDNEV, University of Kentucky, JOHN BOHN, JILA and University of Colorado — Elastic collisions of ideal oriented dipoles are calculated using a variety of techniques appropriate to different cold and ultracold regimes of temperature. The elastic scattering cross section for two electric dipoles with moment $\vec{\mu}$ in an electric field $\vec{E}$ is obtained in the semi-classical Eikonal approximation, giving an exact result, $(4\pi\mu^2/v)[1-(\hat{k}_i\cdot\hat{E})^2]$, where $\vec{k}_i = m\vec{v}$ is the incident relative momentum. This result is expected to apply to collisions at temperatures above a few μK, encompassing recent experiments in the trapping and cooling of polar molecular gases. The Eikonal calculation contrasts sharply with the Born approximation which predicts an energy-independent cross section scaling as μ^4 and which should be applicable at lower temperatures. A separate analysis of the threshold ultracold region is also presented. Numerical close-coupling results connect these various approximation methods, and demonstrate that the crossover between semi-classical and perturbative regimes occurs at the characteristic dipole energy scale, $E_0 = \hbar^6/m^3\mu^4$.

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