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Universal Scattering with Ultracold Polar Molecules in Optical Potentials[1] ALEXANDER PETROV, Temple University, NRC "Kurchatov Institute" PNPI, Gatchina, Division of Quantum Mechanics, St.Petersburg State University, Russia, HUI LI, Temple University, CONSTANTINOS MAKRIDES, Joint Quantum Institute, MING LI, SVETLANA KOTOCHIGOVA, Temple University
— Interactions between atoms and molecules are controlled by their attractive long-range van-der-Waals potentials as well as their short-range exchange and repulsive potentials. Here, we determine the ultracold inelastic and elastic scattering rate coefficients for a large class of polar molecules in their lowest vibrational state with their constituent atoms using universal scattering theory. Universal scattering is solely determined by the van-der-Waals, dispersion interaction, which in turn is defined by the dynamic polarizability of the atom and molecule as a function of imaginary frequency. We examine two different approaches to calculate the dynamic polarizability: 1) a *perturbation-theory-based* method that uses relativistic potentials and transition dipole moments, and 2) a non-relativistic *coupled cluster polarization propagator* method. We evaluate the strengths and weaknesses of these methods. Finally, we compare our inelastic rates coefficients with experimental measurements and exact quantum-mechanical calculations, where available. Our goal is to provide a better understanding of the limits of the universal scattering model at ultra-low temperatures and, in particular, the degree to which short-range potentials are important.

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