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Complex scattering length trends for rotationally-excited molecules in ultracold collisions with He[1] BENHUI YANG, JEFF NOLTE, P. STANCIL, R. FORREY, N. BALAKRISHNAN — The study of atom-molecule collisions in the ultracold regime has attracted substantial attention in recent years with an interdisciplinary impact on physics, chemistry, and quantum computation. These two-body collisions are governed by s-wave scattering with inelastic quenching processes becoming important for high internal excitation. In this work, quantum close-coupling scattering calculations are performed for rotationally-excited linear molecules (H_2, HD, CO, O_2, and CO_2) and non-linear molecules (H_2O, NH_3, and CH_4) due to collisions with He. The results are given in terms of the ratio of the imaginary part of the scattering length β to the real part α which give measures of inelastic and elastic probabilities, respectively. For linear molecules, the ratio β/α generally increases with decreasing rotational constant. Conversely, $\beta/\alpha \sim 0.1$ for all of the considered non-linear molecules, nearly independent of rotational excitation. Such a large ratio, indicating significant quenching, suggests that these non-linear molecules would not be good candidates for cooling and trapping experiments.

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