Low Energy Resonances in CO - *para*-H_2 Inelastic Collisions

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In this presentation we will present results on the study of inelastic collisions between CO and *para*-H_2, at collision energies approaching the cold regime. These results will be compared with quantum mechanical calculations.

The CO (j = 0) + H_2 (j = 0) $\rightarrow$ CO (j = 1) + H_2 (j = 0) process is of particular importance in astrophysics. Theoretical calculations predict that this system is dominated by quantum effects called resonances [1]. These resonances can only be revealed at very low energies, and their experimental observation provides a test for the theoretical models.

Experiments were performed using a crossed molecular beam apparatus, combining a variable beam intersection angle and cryogenically cooled fast-pulsed valves [2]. The CO and H_2 beams were characterized using resonance-enhanced multiphoton ionization time-of-flight spectrometry. The lowest collision energy reached was 3.3 cm^{-1}, which is below the threshold of the (j = 0 $\rightarrow$ 1) rotational transition in CO at 3.85 cm^{-1}. The experimental excitation function shows a sharp rise at threshold followed by successive waves, evidencing the underlying resonance structures. This is the first observation of scattering resonances in an inelastic process [3].

In parallel, quantum mechanical scattering calculations were performed using the CO-H_2 *ab initio* potential energy surface determined by Jankowski and Szalewicz [4]. Comparison between the experimental and theoretical excitation function shows that agreement depends critically on the details of the surface that is used to perform the scattering calculations.

References

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