

# Low Energy Resonances in CO - *para*-H<sub>2</sub> Inelastic Collisions

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In this presentation we will present results on the study of inelastic collisions between CO and *para*-H<sub>2</sub>, at collision energies approaching the cold regime. These results will be compared with quantum mechanical calculations.

The CO ( $j = 0$ ) + H<sub>2</sub> ( $j = 0$ ) → CO ( $j = 1$ ) + H<sub>2</sub> ( $j = 0$ ) 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<sub>2</sub> beams were characterized using resonance-enhanced multiphoton ionization time-of-flight spectrometry. The lowest collision energy reached was 3.3 cm<sup>-1</sup>, which is below the threshold of the ( $j = 0 \rightarrow 1$ ) rotational transition in CO at 3.85 cm<sup>-1</sup>. 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<sub>2</sub> *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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