Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Cold Chemistry

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Cold chemistry is the investigation of interactions of atoms and molecules at near-absolute-zero temperatures, few-Kelvin to milli-Kelvin range. Cold conditions enable the study of chemical reactions with full control over the reaction parameters. Colliding particles at these temperatures reveals quantum nature of interaction between any atoms or molecules; quantum effects such as resonances become observable and lead to sharp increase in collision cross section. Such unambiguous identification of resonances enables subtle features on the underlying potential energy surfaces to be probed, enabling us to get the first look at what exactly happens during a chemical reaction. Cold chemistry is also important for the understanding the rich gas phase chemistry occurring at the interstellar medium and the upper atmosphere, where reactions are expected to proceed through quantum mechanisms, unlike at room temperatures. Therefore, such experimental measurements enable the accuracy of high-level theoretical calculations to be assessed and the validity of such models of chemical reactivity to be tested. In the talk, I will show the results of a recent experiment, where a merged beam method is used in combination with velocity map imaging technique to probe the dynamics of He* – D2 collisions in the range 1.0 to 50.0 K experimentally. In our studies, we distinguish between two mechanisms of formation of resonances by comparing the elastic and Penning ionisation cross sections (this work has been recently published in Nat. Chem., 13, 94, 2021). In this work we show two different resonances – shape and orbiting in the interaction of He* and D2. Our results show resonances at 2.0, 4.0 and 8.0 K in the elastic scattering cross section whereas only the 2.0 K resonance is visible in the Penning ionisation spectra. Shape resonances appear as sharp peaks in both processes whereas orbiting resonances only appear in the elastic cross section since the probability of finding particles at short separation, where ionisation takes place, is small. In this work, we report the first experimental identification of these two mechanisms.

Wednesday, Aug 24th 2022

04:00 PM (Tea/Coffee at 3:45 PM)

Auditorium, TIFR-H