

Observation Of Resonances In Penning Ionization Reactions At Sub-Kelvin Temperatures In Merged Beams

A. B. Henson, S. Gersten, Y. Shagam, J. Narevicius, E. Narevicius

*Department of Chemical Physics, Weizmann Institute of Science, Rehovot, Israel.
alon.henson@weizmann.ac.il*

The field of chemical interactions in the cold regime, below 1 K, is filled with theoretical calculations and predictions. Yet experimental results have been lacking thus far, due to an inability to control the collisional velocities of neutral reactants. One approach that has been explored extensively in the past two decades is the use of external fields to decelerate the mean transverse velocity of a supersonic beam. In that vein we have designed and built a magnetic decelerator that is more than two orders of magnitude better than previous state-of-the-art systems [1,2]. However, we have recently used a new approach and successfully implemented a conceptually simple merged beam apparatus that has enabled us to perform measurements of the Penning ionization reaction of molecular Hydrogen and Argon with metastable Helium from energies corresponding to several kelvin down to 10 millikelvin [3]. We observe sharp changes in the reaction rate brought about by the emergence of quantum behavior at these energy scales. We expect our method to enable the much anticipated study of many chemical reactions in this energy range.

[1] E. Lavert-Ofir, L. David, A. B. Henson, S. Gersten, J. Narevicius and E. Narevicius, *Phys. Chem. Chem. Phys.*, **13**, 18948 (2011)

[2] E. Lavert-Ofir, S. Gersten, A. B. Henson, I. Shani, L. David, J. Narevicius, E. Narevicius, *New Journal of Physics* **13**, 103030 (2011)

[3] A. B. Henson, S. Gersten, Y. Shagam, J. Narevicius, E. Narevicius, *Science*, **338** (6104): 234-238 (2012)