

Experimental Studies of the Energy Dependence of State-Selective Non-Dissociative Single Electron Capture in He^{2+} on H_2 Collisions

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The Cold Target Recoil Ion Momentum Spectroscopy (COLTRIMS) technique has been used to investigate non-dissociative state-selective one electron capture processes in $\text{He}^{2+} + \text{H}_2$ collisions in the intermediate impact energy range 120 keV – 700 keV. The experimental measurements were performed at the Van de Graaff accelerator facility of the University of Jordan.

By contrast with photon spectroscopic studies of the same collision system, the COLTRIMS measurements have the advantage of being able to directly measure capture to the ground state ($n=1$) of the projectile ion. The measurements showed that capture to the ground state essentially dominates the collective capture to the excited states ($n \geq 2$) over the entire impact energy range.

The measurements are found to be in gross disagreement with classical trajectory Monte-Carlo (CTMC) model calculations [1] over the entire impact energy range. The measurements demonstrate that comparisons with cross sections extracted from photon emission may lead to erroneous conclusions. The experimental results call for the development of more accurate theoretical models for the description of the important $\text{He}^{2+} + \text{H}_2$ collision system.

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[1] L. Meng, R. E. Olson, H. O. Folkerts, and R. Hoekstra, J. Phys. B **27**, 2269-2276 (1994).