Energy Gain Comparison of Single Electron Capture From Atomic and Molecular Hydrogen By Ar^{8+}

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We have used our HTRIMS (hydrogen target recoil ion momentum spectroscopy) to study single electron capture from atomic and molecular hydrogen targets by Ar^{8+} ions at projectile velocities of $0.2, 0.5$ and 0.75 a.u. The Ar^{8+} ion beam was provided by the KSU-CRYEBIS facility. We have built an atomic hydrogen source similar to that described in [1]. This source consists of a discharge tube in a microwave cavity operating at 2.45 GHz. Our dissociation fraction at the collision region (which is about 20 cm from the discharge region) was about 30%. This dissociation fraction allowed us to conduct both atomic and molecular hydrogen target experiments simultaneously.

The method we have used is similar to COLTRIMS [2], even though our target was not cold. The thermal momentum spread of the H gas was 1.83 a.u. along the jet direction. Due to skimmer collimation before entering the chamber, the spread along the ion beam was less than 0.2 a.u. We have calculated the energy gain (or Q value) from:

$$Q = -p_{\|} v_p - {v_p}^2/2$$

where $p_{\|}$ is the recoil momentum component along the ion beam and v_p is the projectile velocity. We observed that for projectile velocities of 0.75 and 0.5 a.u. we get a reaction window distributed between $n = 5$ and $n = 6$ levels of Ar^{7+} for an atomic hydrogen target, as suspected from the classical over-barrier-model. Figure 1 shows the Q value distribution for $v = 0.75$ a.u. case. However, for the $v = 0.2$ a.u. case we see that the reaction window shifts to $n = 6$ and $n = 7$ levels.

We will show further detail on these results as well as the molecular target results and a comparison of the two.

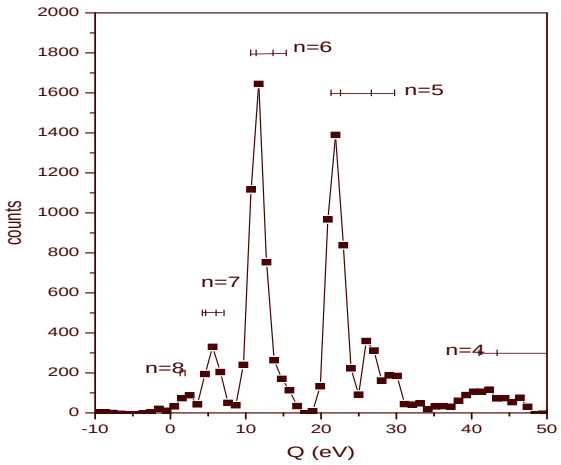

Fig. 1. Energy Gain spectra for Ar^{8+} on H for projectile velocity of 0.75 a.u.

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References

[1] Paolini and Khakoo, Rev. Sci. Inst. 69, 3132 (1998)

[2] see for example, J. Ullrich et al. J.Phys.B. Topical Review B30, 2917, (1997)