A.3.10. Ion-Rydberg Atom Collisions: Energy Transfer in Charge Exchange-- *B.D. DePaola, C. W. Fehrenbach, and S. L. Lundeen**

Charge transfer collisions between an ion of charge q and a highly excited atom having principal quantum number n occur with quite large cross sections, approximately $qn^4a_0^2$ for sufficiently low collision velocity. Such collisions are believed to result in a narrow distribution of final states, with the captured electron being bound by approximately the same energy as in the original excited atom. No satisfactory quantum mechanical calculations exist for this process, the most satisfying treatment being CTMC calculations. On the other hand, CTMC is not expected to be valid at very low velocities, and may not accurately predict final n and l distributions on the projectile following charge capture. In order to more severely test theoretical models in ion-Rydberg collisions, it is therefore desirable to make measurements which are differential in as many parameters as possible, including initial and final n and l. In the case of charge transfer cross sections, we have extended previous measurements [Publication #19] to include collisions with multiply charged ions, having $q = 1 – 4$. For these investigations, final l quantum numbers were not resolved, however the distribution of initial target n was expanded to include $n_t = 7 – 18$. Using the same RESIS technique [Publication #19] to unambiguously identify the final n_p of the projectile, the focus of this study was to concentrate on the relationship between n_t and n_p, over a range of collision velocities (v = 0.031, 0.057 and 0.100 a.u.) and charge states. In general, the data show a clear resonance in the capture cross section to a particular energy state as the binding energy of the Rydberg target is varied. The resonance position differs significantly from the predictions of the classical over-barrier model, and its width becomes very small (0.025 eV) at the lowest velocities studied. This work is presented in Publication #24. It was part of the Ph.D. thesis work of D. Fisher of Colorado State University.

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