§18. Dependence of Radiative Stabilization on Projectile Charge State after Double Electron Transfer in Slow, Highly Charged Ion — Molecule Collisions

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In low energy collisions of highly charged ions (HCI) with atoms/molecules the electron transfer is the dominant reaction channel. In such collisions, several target electrons can be transferred into multiply excited Rydberg levels of HCI [1]. The stabilization processes of the multiply excited Rydberg states (the ejection of electron(s), Auger decay, or/and the emission of photon(s), radiative decay) occurring in the projectile ions are very important, for example, for studying the composition of plasmas in astrophysical objects or for the plasma diagnostics in thermonuclear plasmas.

In this paper, we investigate the dependence of the radiative stabilization (P_{rad}) of high Rydberg states, defined as ratios of radiative transition rates to total (radiative + Auger decay) rates, after double electron transfer processes on the charge state of the projectile in 1.5q keV I^{q+} ($8 \leq q \leq 26$) - CO collisions. It is found that the radiative stabilization probabilities increase as the charge of the projectile ions increases and does not depend on the target state (whether the target is atomic or molecular) (see Fig.1). To explain the observed features, a model in which, at the present collision energy, the transfer of two electrons occurs dominantly into the highest possible orbital momentum states *l* for a given level n is proposed. Based upon the model the theoretical radiative and autoionization decay rates have been calculated for the modified transferred Rydberg levels (n_1, n_2) which differ either only by unity ($\Delta n_1 = 1$ and $\Delta n_2 = -1$) from or the same as those predicted by the extended classical over-barrier model. As in these calculations only the autoionization decay channels with the highest probabilities are considered, the calculated P_{rad} should correspond to the minimum value (Fig.2).

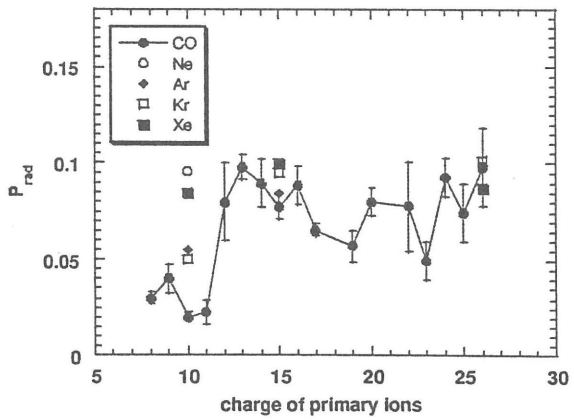

Figure 1. The measured P_{rad} as a function of the projectile charge state for the $I^{(q-2)+**}$ ions after two electron transfer from CO (●) and rare gas targets (Ne - ○, Ar - ◆ Kr - □, Xe - ■).

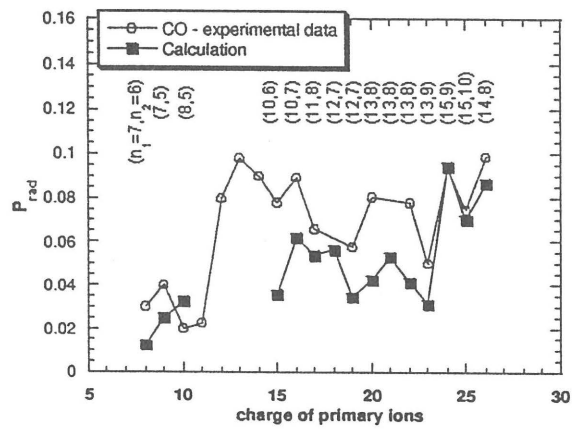

Figure 2. A comparison of the measured and the calculated P_{rad} for the modified transferred levels (n_1,n_2). The principal quantum numbers for two transferred electrons (n_1,n_2) are shown in the figure.

Reference

[1] R. Ali, C.L. Cocke, M.L.A. Raphaelian and M. Stöckli, Phys. Rev. A 49, 3586 (1994).