PHOTODETACHMENT OF K$^-$

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A comprehensive eigenchannel R-matrix study of K$^-$ photodetachment is presented over the energy region from the K(5s) threshold to the K(7p) threshold. Present results are compared with prior theoretical and experimental studies. The calculated K(5s) partial cross section between the K(6p) and K(5f) thresholds are in good agreement with the recent relative measurements of Kiyan *et al.*[1]. However, theoretical analyses reveal a different structure underlying the observed resonances, compared with the one obtained by fitting measured partial cross section to a resonance profile formula. A complete list of energies and widths for the predicted ^{1}P^o resonances in the energy region studied is provided. Using the standard projection operator method, all ^{1}P^o resonances in the energy region studied are analyzed and their corresponding doubly excited states are identified.

Detailed theoretical analyses provide insight into the underlying structure and dynamics of K$^-$. Comparing current results and prior studies on He$^-$ and other alkali negative ions, one observes that, as the alkali negative ions become heavier, the approximate symmetry of pure three-body systems breaks down. In stead, the spectra is dominated by complicated channel coupling. The asymptotic behavior of electron-atom interaction plays an important, but not decisive, role in the structure of negative ions. Recently, a semiclassical model based on a single-channel induced dipole potential has been used to derive formulas describing resonance positions[2] and widths[3]. However, the common occurrence of channel coupling in negative alkali ions certainly limited the applicability of these formula. Besides, without theoretical input, it is impossible to distinguish resonances from different series when more than one series overlap. Therefore, a pure induced dipole potential is not sufficient to describe the structure and dynamics of negative ions. One has to take into account effects due to electron correlation in the region close to the nucleus and channel coupling.

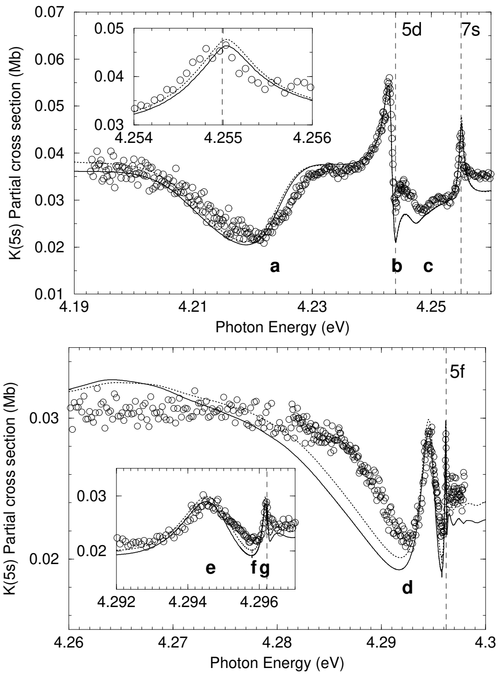

Figure 1. Partial cross section for the process K$^- + \gamma \rightarrow$ K(5s) $+ e^-$ in the photon energy range from 4.19 eV to 4.26 eV. Curves: present results in dipole velocity (solid) and dipole length (dotted) approximations. Circles: relative experimental measurement of Kiyan *et al.*[1] normalized to the theoretical predictions. The inset shows a normalized comparison between theory and experiment near the K (7s) threshold. The vertical dashed lines indicate the locations of the thresholds.

References

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