# Inner-Shell Photoionization: $Ar^+(2p)$

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## INTRODUCTION

The study of photoionization of ionized matter is of fundamental importance as a critical test of theoretical models. It is of importance also for the astrophysical community, as space is filled primarily with ionized matter, and photons as well, thus their interactions must be understood. For example, information about the universe reaches us in the form of light, which has passed through vast regions of space; this information must be interpreted in terms of the interaction of the photons with the ionized matter in space, of which there are very few studies to date.

The present abstract reports on recent results obtained on *inner-shell* photoionization of $Ar^+$ ions, i.e., interactions of photons with 2p electrons in $Ar^+$. This is part of an ongoing series of measurements of photoionization of singly charged ions using beamline 10.0.1.2: the photon-ion beamline at the Advanced Light Source. The novel aspect of the experiment reported is that an inner-shell electron is ionized rather than valence electrons as in our previous experiments, which results in both single and double ionization of the $Ar^+$ ion.

## EXPERIMENT

The experimental method is the same as has been described in other reports, e.g., Covington et al in this Compendium. The difference is that photon energies in the range 255-275 eV were used rather than photons at lower energies as reported in Covington et al, to allow excitation of inner-shell electrons in the ion. This required use of the third grating in the monochromator on beamline 10, and thus lower photon fluxes than in previous experiments. However, adequate count rates were obtained.

Creation of a vacancy in the L shell of $Ar^+$ leads to the possibility of producing $Ar^{3+}$ as well as $Ar^{2+}$ ions, thus the observation of both double and single ionization of $Ar^+$ ions. This is our first study of double ionization of an ion.

We have recently calibrated the efficiency of the ion-counting system on the beamline for doubly charged ions, thus we are able to place single-ionization cross sections on an absolute basis. We have not yet calibrated the efficiency of the ion-counting system for triply charged ions; however, we expect that it will be greater than for doubly charged ions. We thus cannot at present compare the relative magnitudes of the results for single and double ionization, only their energy dependence and spectral features.

## RESULTS

Preliminary results obtained for single and double ionization of $Ar^+$ ions in the energy range in which a vacancy is produced in the L shell are shown in Fig 1.

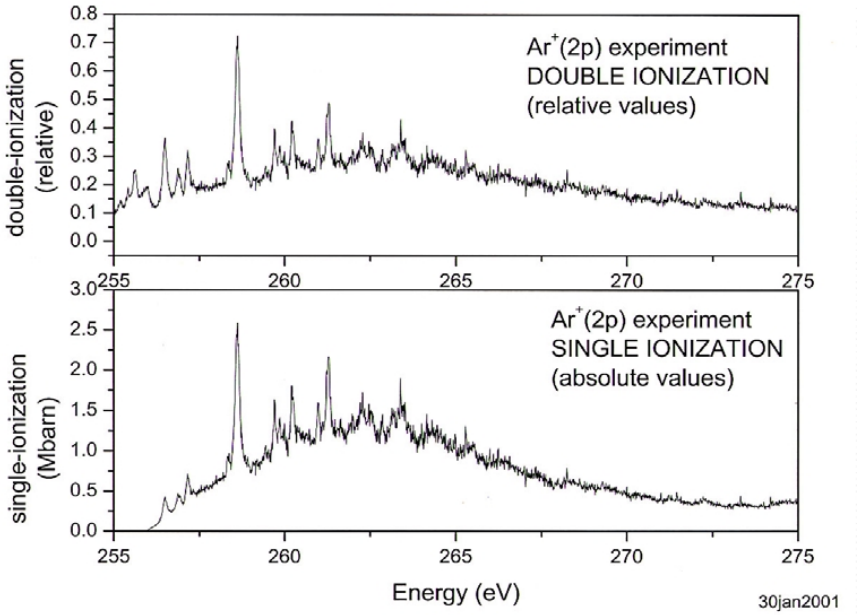


Figure 1. Cross section for single and double ionization of $Ar^+$ ions with production of an L-shell vacancy. Absolute cross sections are shown for single ionization; relative values are shown for double ionization. Values for single and double ionization therefore cannot be compared at present.

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