Photoionization of Ne^+ ions and Ne atoms near the K edge

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Synopsis Absolute cross sections for photoprocesses near the K edge of Ne^+ ions and neutral Ne atoms have been determined at resolving powers up to 27000 facilitating the precise determination of natural widths of the most prominent resonances as well as the associated transition probabilities and branching ratios.

Single, double and triple photoionization of Ne^+ ions and electron production associated with single-photon absorption by a neutral Ne atom have been investigated [1]. Absolute cross sections were measured for Ne^+ employing the **P**hoton-**I**on Spectrometer at **PE**TRA III (PIPE) [2]. Electron emission from neutral Ne in a gas cell was monitored as a function of photon energy. By normalizing the electron-emission spectrum, fine-structure photoabsorption cross sections for Ne atoms were determined. Photon energies for the experiments with Ne^+ ions were between 840 and 930 eV covering the range from the lowest-energy resonances, which are associated with excitation of one single K-shell electron, up to double excitations involving one K- and one L-shell electron, well beyond the K-shell ionization threshold. Photoionization of neutral Ne was investigated at the K edge in the energy range from 863.6 to 870.8 eV. The associated electron production cross section is shown in Fig. 1.

Photon energy bandwidths ΔE were between 32 and 500 meV. Resolving powers up to $E/\Delta E \approx$ 27000 were achieved facilitating the precise determination of natural line widths of the most prominent lines associated with K-vacancy levels [3] in Ne and Ne^+. The uncertainty of the energy scale is estimated to be 0.2 eV. From the data obtained for Ne^+ ions, transition probabilities and branching ratios could be determined for the decay of K-vacancy levels including the fluorescence yield of Ne K_α radiation. For comparison with existing theoretical calculations, astrophysically relevant photoabsorption cross sections were inferred for Ne^+ by summing the measured and inferred partial ionization channels. The experiments revealed the presence of complex Auger-decay mechanisms. The ejection of three electrons from the lowest K-shell-excited $Ne^+(1s2s^22p^6\ ^2S_{1/2})$ level, for example, requires cooperative interaction of at least four electrons.

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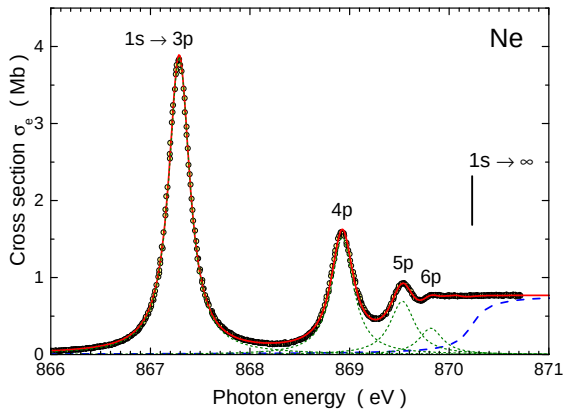

Figure 1. Cross section for the production of electrons subsequent to absorption of a single photon by a neutral neon atom with promotion of a K-shell electron to either $1s2s^22p^6np\ ^1P$ autoionizing levels with $n = 3,4,5,6,\ldots$ or to the continuum. The dotted and dashed lines represent individual contributions to the cross section.

References

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