CROSSED BEAMS MEASUREMENTS OF ELECTRON-IMPACT IONIZATION OF MULTIPLY-CHARGED IONS

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The ORNL electron-ion crossed beams experiment was employed during this period to determine absolute cross sections for electron-impact ionization of the Li-like ions B^{2+} and C^{3+}. The measurements[4] for direct ionization of B^{2+} are in very good agreement with several recent theoretical predictions[4,5] as well as the measurements of Hofmann *et al.*[6] but are about 15% higher than the previous ORNL measurements.[7] The present experimental data (see figure below) for the direct ionization of C^{3+}, however, lie about 25% below the most recent theoretical predictions[8] while agreeing very well with the previous experimental results.[6,9] Our investigation into the discrepancy between experimental and theoretical cross sections for direct ionization of Li-like ions will continue with Be^{+}, where the discrepancy is largest at about 30%.

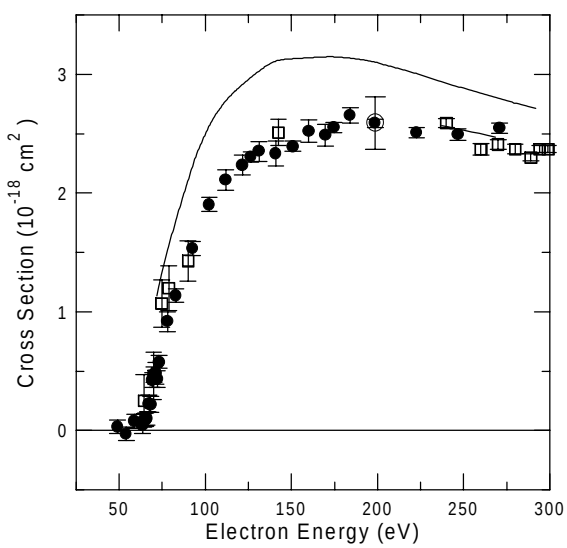

Fig. 1. Cross sections for electron-impact ionization of C^{3+} as a function of center-of-mass energy. The circles are the present measurements with 67% confidence level relative uncertainties. Also shown are the previous measurements of Ref. 9 (squares) and Ref. 6 (lower solid curve) and the calculations of Ref. 8 (upper solid curve).

In support of the ORNL/JILA merged electron-ion beams energy-loss (MEIBEL) experiment on the excitation of the Be-like ions C^{2+}, N^{3+}, and O^{4+}, the electron-impact ionization cross sections were measured above and below the ground-state threshold for these ions. Although the measurements are in agreement with previous experiments[10] and indicate a significant fraction of metastables in the Be-like ion beams, the existing theoretical cross sections are not accurate enough to reliably determine the fraction. A beam attenuation method is being developed as an alternate determination of metastable fractions in order to provide more direct comparison between measured and calculated ionization cross sections.

The electron-ion crossed beams apparatus was also used to continue investigations on electron-impact dissociation of hydrocarbon molecular ions. A

colutron ion source has been installed on the beamline and tested by benchmark ionization measurements for N^+ and He^+. Preliminary measurements on the dissociation of CD^+ producing C^+ demonstrated that the cross section below 10 eV depended strongly on the operating conditions of the colutron source, suggesting the presence of electronically and vibrationally excited molecular ions in the beam. Work continues to optimize both the ion source and the electron gun for investigating dissociation near the dissociative excitation threshold.

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