

MERGED-BEAMS MEASUREMENTS OF ELECTRON-IMPACT EXCITATION OF MULTIPLY-CHARGED IONS

M. E. Bannister, Y.-S. Chung,¹ N. Djurić,² G. H. Dunn,² A.C.H. Smith,³
B. Wallbank,⁴ O. Voitke,² and S. Zhou²

The ORNL/JILA merged electron-ion beams energy loss (MEIBEL) apparatus was used during this period for collaborative measurements of cross sections for electron-impact excitation of multiply-charged ions at the ORNL ECR Multicharged Ion Research Facility. The $2s^2\ ^1S - 2s2p\ ^1P$ transition was investigated^{5,6} for the Li-like ions B^{2+} and C^{3+} and the absolute total cross sections measured were found to be in good agreement with theoretical predictions made with the close-coupling approach. The results for C^{3+} were also in good agreement with the previous crossed-beams fluorescence measurements of Taylor *et al.*⁷ but only fair agreement with the more recent measurements of Savin *et al.*⁸

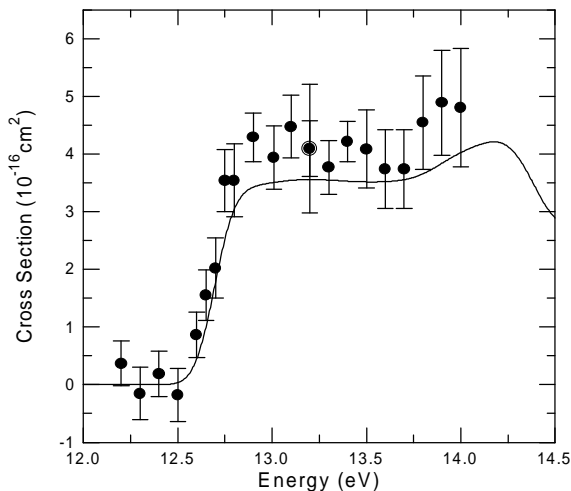


Fig. 1. Cross sections for electron-impact excitation of the $2s^2\ ^1S - 2s2p\ ^1P$ transition in C^{2+} as a function of the center-of-mass energy. The points are the experimental data with 90% confidence level relative uncertainties; the solid curve is a close-coupling R-matrix calculation.

Several transitions, allowed as well as forbidden, were measured⁹ for the Be-like ions C^{2+} , N^{3+} , and O^{4+} including transitions from the metastable $2s2p\ ^3P$ levels of C^{2+} and O^{4+} . Using the metastable fractions of Be-like ions extracted from an ECR ion source measured by Brazuk *et al.*,¹⁰ satisfactory agreement was found between our experimental results and theoretical cross sections calculated with the close-coupling R-matrix approach⁹ for the allowed transitions. The close-coupling theory also did a reasonable job of predicting our measurements for the forbidden transitions $2s^2\ ^1S - 2s2p\ ^3P$ and $2s2p\ ^3P - 2s2p\ ^1P$ in C^{2+} and O^{4+} , although these close-lying transitions cannot be separated by the MEIBEL technique. We measured a resonance feature just above threshold for the $2s2p\ ^3P - 2s2p\ ^1P$ transition in C^{2+} which was not predicted by theory. The MEIBEL experiment will continue to investigate transitions in multiply-charged ions that can serve as benchmarks for refining the close-coupling theory relied upon heavily for production of excitation cross sections required in the study of laboratory and astrophysical plasmas.

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1. Chungnam National University, Daejeon, South Korea.
 2. JILA, Boulder, CO.
 3. University College London, London, UK.
 4. St. Francis Xavier University, Antigonish, Nova Scotia, Canada.
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