COLLISIONAL ENERGY DEPENDENCE STUDY FOR ELASTIC SCATTERING OF QUASI-FREE ELECTRONS FROM $B^{3+}(1s^2)$ IONS

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Electron scattering from highly charged ions with just a few electrons, such as H-like and He-like ions, offers some of the simplest testing grounds of atomic structure and collision theory. Direct electron-ion collisions performed in ion storage ring experiments provided high precision total cross section measurements for the formation of He-like and Li-like doubly-excited states [1]. However, measurements of angle-differential electron-ion scattering cross sections, which probe the delicate interference between the short range scattering potential due to the electronic structure of the ion and the long range Coulomb potential due to the ion's charge, are still very scarce. Large angle scattering is of particular interest, since it is much more sensitive to correlation, exchange, bound-state resonances and interference effects [2], and therefore much more challenging to be experimentally investigated and accurately modelled.

Here, we present large angle (180°) absolute double differential cross section (DDCS) measurements for quasi-free elastic electron scattering from the $B^{3+}(1s^2)$ ground state. The DDCS spectra, including both non-resonant and resonant contributions were studied as a function of the collision energy. An example of a typical DDCS spectrum is shown in Fig. 1. We overcame the problem of metastable mixed-state He-like beams by using a technique to obtain practically metastable-free B^{3+} beams [3]. The emphasis in the study is given to the resonant $1s2lnl'$ series of the doubly excited states, as they correspond to similar total cross section dielectronic recombination measurements. State-of-the-art R-matrix scattering calculations were utilized within the electron scattering model, showing an excellent overall agreement with the measurements.

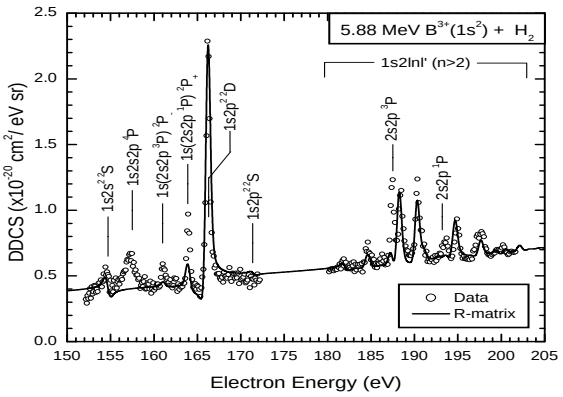

Fig. 1. The $B^{2+}(1s2lnl')$ doubly-excited states, which are formed by resonant transfer excitation and de-excited via Auger decay back to the $B^{3+}(1s^2)$ ground state, are seen to be superimposed on the broad continuum of the binary encounter peak. The ^4P and ^3P peaks are formed by capture and excitation, respectively, from the small ($< 5\%$) $1s2s\ ^3S$ metastable state of the ion beam. The small ^1P peak is formed by excitation from the ground state. R-matrix elastic scattering calculations, shown by the solid line, are seen to be in excellent overall agreement with the measurement.

References

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