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Dielectronic recombination of berylliumlike Xe^{50+} ions: Measurement and theoretical calculations

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Synopsis Absolute rate coefficients for dielectronic recombination (DR) of Be-like $^{136}Xe^{50+}$ have been measured at the heavy-ion storage ring ESR. The experimental results are compared with relativistic distorted-wave calculations employing the multiconfiguration Dirac-Fock method. Based on the DR measurements, multiple intra-L-shell excitation energies were determined.

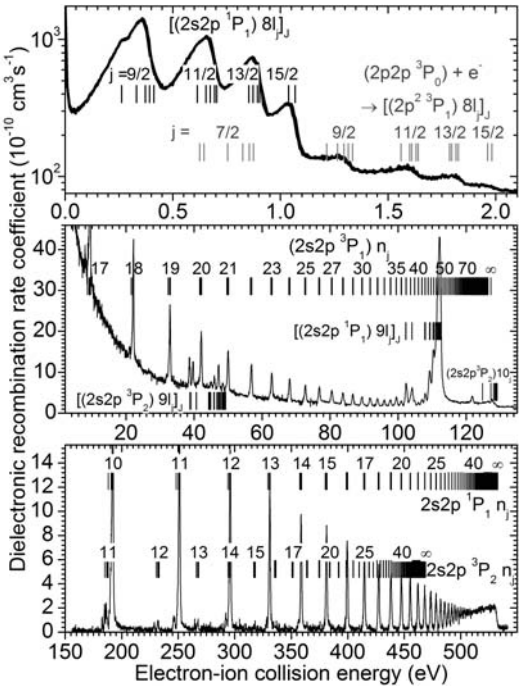

Figure 1. Measured $^{136}Xe^{50+}$-DR spectrum (black line) and calculated DR resonance positions (black and gray vertical bars for the initial $2s^2\ ^1S_0$ and $2s2p\ ^3P_0$ states, respectively) using core excitation energies from [1] and Rydberg electron binding energies. For principal quantum numbers $n \leq 9$ Rydberg binding energies were determined by using the Los Alamos atomic physics program package [2]. States with $n \geq 10$ were assumed to be hydrogenlike with Dirac binding energies.

Absolute DR-rate coefficients of Be-like $^{136}Xe^{50+}$ have been measured at the experimental storage ring (ESR). The experimental center-of-mass energy range (0–540 eV) covers all resonances associated with the $2s^2+e^- \rightarrow (2s2p_{j'}\, nl_j)_J$ DR processes (figure 1). For the predominant $(2s2p_{1/2}\ ^3P_1)\, n$ and $(2s2p_{3/2}\ ^1P_1)\, n$ DR-resonance series the strengths and energies of isolated DR-resonance groups have been determined for principal quantum numbers n up to 34. In addition to the prominent ground-state DR, also resonances associated with metastable $^{136}Xe^{50+}$ $(2s2p\ ^3P_0)$ parent ions were observed at energies between 1.2 and 2.2 eV [3]. By extrapolating DR resonance positions to $n \rightarrow \infty$, the $2s^2\ ^1S_0 - 2s2p_{1/2}\ ^3P_1$, $2s2p_{3/2}\ ^3P_2$, $2s2p_{3/2}\ ^1P_1$ and $2s2p_{1/2}\ ^3P_0 - 2p_{1/2}2p_{3/2}\ ^3P_1$ excitation energies were determined with relative accuracies of the order of 10^{-4}. In addition to our experimental measurements we have performed relativistic distorted-wave calculations employing the multiconfiguration Dirac-Fock (MCDF) method [4].

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