

Dielectronic recombination of lithiumlike Xe^{51+} ions: Storage ring experiment and theoretical calculations

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Synopsis Absolute rate coefficients for dielectronic recombination (DR) of Li-like $^{136}\text{Xe}^{51+}$ 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 the $2s-2p_{1/2}$ and $2s-2p_{3/2}$ excitation energies in Li-like Xe^{51+} were determined with a relative accuracy of ~ 400 ppm.

Absolute rate coefficients for dielectronic recombination (DR) of Li-like $^{136}\text{Xe}^{51+}$ have been measured by employing the electron-ion merged-beams technique at the experimental storage ring (ESR) at GSI in Darmstadt, Germany. The present DR measurement closes the gap between measurements for lighter Li-like ions at TSR [1] and earlier results of heavy Li-like ions [2].

The investigated center-of-mass energy range 0 – 505 eV covers all $^{136}\text{Xe}^{50+}(2p_{1/2} nl_j)_J$ and $^{136}\text{Xe}^{50+}(2p_{3/2} nl_j)_J$ DR resonances associated with $2s-2p$ excitations. Strengths and energies of isolated $(2p_{1/2} n)$ and $(2p_{3/2} n)$ DR-resonance groups have been determined for principal quantum numbers n up to 43 and 36, respectively.

In addition to our experimental measurements we have performed relativistic distorted-wave calculations employing the multiconfiguration Dirac-Fock (MCDF) method. Figure 1 shows a comparison of measured DR-rate coefficients and corresponding theoretical results – taking into account the experimental electron velocity distribution – for the $^{136}\text{Xe}^{51+}(2s)+e^- \rightarrow ^{136}\text{Xe}^{50+}(2p_{3/2} 9l_j)_J$ -DR resonance group.

We find excellent agreement between experimental and theoretical resonance structures. By extrapolating measured DR-resonance positions to $n \rightarrow \infty$ the $2s-2p_{1/2}$ and $2s-2p_{3/2}$ excitation energies were determined. These results are compared with calculations (e.g. [3]) and results from beam-foil-spectroscopy [4, 5].

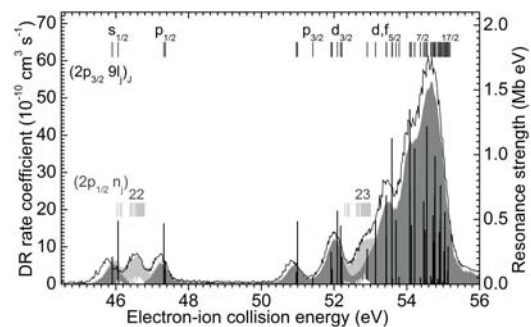


Figure 1. Small part of the measured $^{136}\text{Xe}^{51+}$ -DR spectrum (black solid line) in the energy range of the $\text{Xe}^{51+}(2s) + e^- \rightarrow \text{Xe}^{50+}(2p_{3/2} 9l_j)_J$ resonance group. Results of MCDF-calculations, convoluted with the experimental electron velocity distribution and shifted by -0.29 eV and -0.4 eV are shown as dark and light shaded curves for the $(2p_{3/2} 9l_j)_J$ and $(2p_{1/2} nl_j)_J$ resonances, respectively. Corresponding resonance strengths are given by black and white vertical lines, respectively while shifted energies are indicated by dark grey and light grey vertical bars, respectively.

References

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