Calculations of dielectronic recombination of Li-Like Ar^{15+} and Xe^{51+} ions

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Synopsis The Δn=0 dielectronic recombination of Li-like Ar^{15+} and Xe^{51+} ions were studied using the flexible atomic code, in which the relativistic configuration interaction (RCI) method was employed. For the higher Rydberg resonance states close to the series limits ($n\rightarrow\infty$), the resonance energies and strengths are obtained by extrapolation based on quantum defect theory. The theoretical rate coefficients are in good agreement with the measurements for Ar^{15+} ions at the CSRm and for Xe^{51+} ions at the ESR.

Dielectronic recombination (DR) of Li-like ions has attracted much interest both in experimental and theoretical studies due to its significance in modeling astrophysics and fusion plasmas, and in testing atomic structure and collision theories in recent years. In this report, we performed a detailed calculations for the Δn=0 transitions of Li-like low-Z Ar^{15+} and medium-Z Xe^{51+} ions, and obtained the DR rate coefficients by using the Flexible Atomic Code (FAC) based on the relativistic configuration interaction method [1]. The resonance positions and strengths for the $(2p_{1/2,3/2}nl_j)_J$ (n=10-17) doubly excited states of Ar^{14+} ions are calculated systematically. For the higher Rydberg resonances with n>17 close to thresholds, the resonances are obtained by extrapolation in combination with quantum defect theory (QDT). Our calculated rate coefficients (black line) are illustrated in Figure 1 and compared with the experimental results at the heavy ion storage ring CSRm at IMP [2].

For the DR process of medium-Z Li-like Xe^{51+} ions, all DR resonances associated with the two Rydberg resonance series $(2p_{1/2}nl_j)_J$ (n=18-32) and $(2p_{3/2}n'l_j)_J$ (n'=9-27) were considered in the calculations. The contributions from higher Rydberg resonances with n>32 and n'>27 throughout to thresholds are obtained by extrapolation based on QDT. Figure 2 pictures the calculated DR spectrum (black line) for the $(2p_{3/2}9l_j)_J$ resonance manifolds compared with the recent experimental results at the ESR [3]. It is showed that the FAC calculations for both Li-like Ar^{15+} and Xe^{51+} ions are in good agreements with corresponding experiments.

This work was partially supported by the NSFC (Grant Nos. 11320101003, 91336102, U1331122, U1530142, U1332206). and the Young Teachers Scientific Research Ability Promotion Plan of Northwest Normal University (NWNU-LKQN-15-3).

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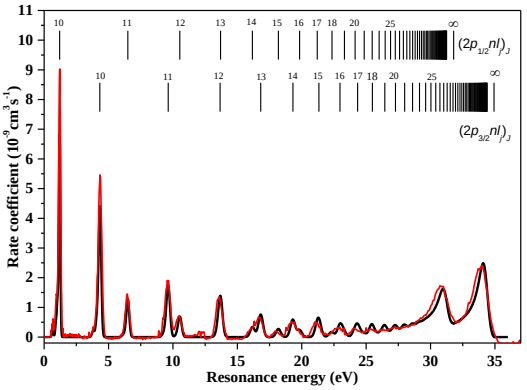

Figure 1. Comparison of the theoretical (black line) and experimental (red line) rate coefficients for Ar^{15+} ions. The theoretical rates are cut off at n_{cut}=75. The rate coefficients are obtained from the theoretical resonance strengths convoluted with the electron beam temperatures (40 meV/k_B transverse and 0.8 meV/k_B longitudinal).

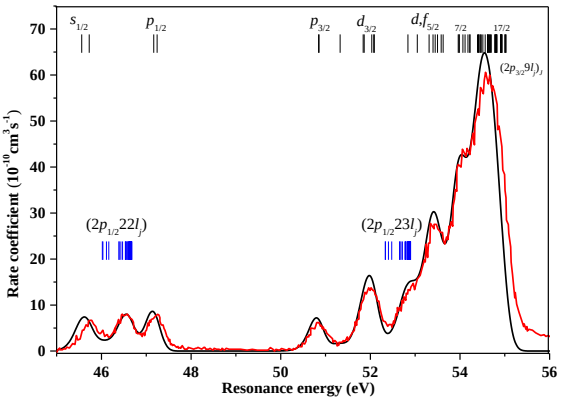

Figure 2. Comparison of the theoretical (black line) and experimental (red line) rate coefficients for Xe^{51+} DR spectrum in the energy range of the $2s+e\rightarrow(2p_{3/2}9l_j)_J$. Totally 64 individual resonances are included for the $(2p_{3/2}9l_j)_J$ manifold, which are blended by $(2p_{1/2}nl_j)_J$ with n =22 and 23.

References

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