Ba atomų $5p^5n_1l_1n_2l_2n_3l_3$ *LSJ* būsenų sužadinimo elektronais funkcijos

The electron-impact excitation functions of the $5p^5n_1l_1n_2l_2n_3l_3$ *LSJ* states in Ba atom

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Recently we have performed the detailed spectroscopic classification of the $5p^5n_1l_1n_2l_2n_3l_3$ *LSJ* autoionizing states (AIS) in barium by measuring the ejected-electron spectra in a broad electron-impact energy range and by calculating their excitation cross section, energies and decay rates [1]. The electron spectra were measured at incident and ejected-electron energy resolutions of 0.2 eV and 0.07 eV, respectively. The calculations of the cross sections were performed in distorted wave approximation by using relativistic radial wavefunctions obtained in the standard Dirac-Fock-Slater method. The Flexible Atomic Code [2] and quantum numbers *jjJ* of the relativistic coupling scheme of angular momenta were used. Transformation from the *jjJ* to *LSJ* coupling scheme of angular momenta was performed by using the computer program [3]. A number of configurations used in the superposition to take into acount correlation effects both in the initial and final states was 10198.

In the present work, the obtained in [1] set of data on intensities of ejected-electron lines was used to obtain the electron-impact excitation cross sections for a number of the states from different autoionizing configurations.

In figure 1, the experimental cross sections for the $5d6s^2\ ^3P_1$, $5d^2(^3P)(^4P)6s\ ^3P_1$ and $5d(^3P)6s(^2P)7s\ ^3P_1$ dipole-allowed AIS are compared with calculated ones in an impact energy range from excitation thresholds up to 600 eV. Although the reliability of the present calculations is not large at low impact energies, nevertheless they also confirm the observed strong resonance excitation of all states considered in the present study.

Comparing the cross sections shows that the ratio between resonance and potential scattering varies noticeably along the $5p^6$ energy level spectrum. As can be seen, the resonance excitation is the dominant process for $5d6s^2\ ^3P_1$ state at 15.81 eV, which is the lowest dipole-allowed $5p^6$-core excited AIS in Ba atoms. With increasing the excitation energy of the states the efficiency of potential excitation increases and becomes stronger for the states lying in the middle of the $5p^6$ spectrum (see in figure 1 the cross section for $5d^2(^3P)(^4P)6s\ ^3P_1$ state) and dominant for the high-lying states ($5d(^3P)6s(^2P)7s\ ^3P_1$). Since mixing and correlation effects play a major role in 5p-core electron-impact excited Ba atoms and are especially strong for high-lying states, the observed regularity is quite unexpected. Our preliminary data on the excitation cross sections for dipole-forbidden AIS ($J\neq1$) from similar configurations show that the resonance excitation dominates for all states regardless of their excitation energy.

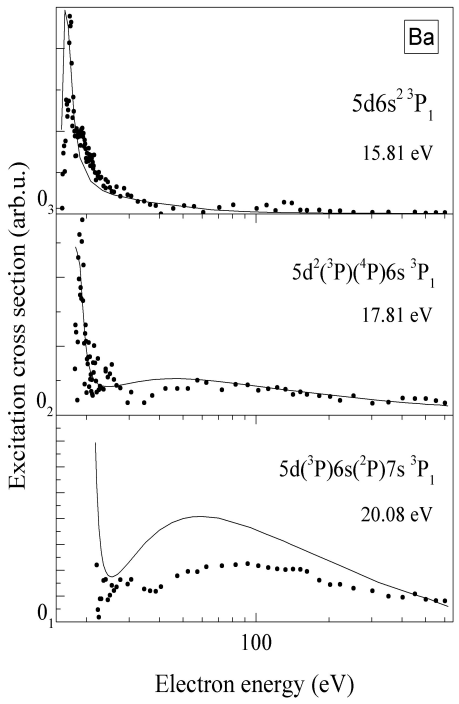

Figure 1. Ejected-electron excitation functions for the $5p^5n_1l_1n_2l_2n_3l_3$ *LSJ* autoionizing states in barium. Solid curves represent the present calculations.

Keywords: atomic theory, experiment, energy levels, electron-impact excitation.

References

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