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QED calculation of cross section for resonant electron scattering on H-like ions

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Synopsis Cross section for resonant electron scattering on H-like ions is calculated within the framework of QED. The Auger electron emission is investigated.

Process of electron scattering on H-like ions is considered. The initial state is given by incident electron $e(\epsilon)$ with energy (ϵ) and one-electron ion being in the ground state $(1s)$. If energy of the initial state is close to energies of the double excited states $((n'l', nl)$, where the principal quantum numbers $n', n \geq 2$; l', l denote the orbital momenta), the cross section shows resonances. These double excited states are autoionizing states. The resonances in the cross section are explained by Auger electron emission. The process of resonant electron scattering on H-like ions is investigated experimentally and theoretically [1].

Calculation of cross section for the resonant electron scattering within the framework of quantum electrodynamics (QED) is presented. The line-profile approach (LPA) [2, 3] was employed for calculation of the cross section. The LPA was generalized for description of systems with electrons from the continuous Dirac spectrum. In the present research the initial and final states contain electron from the continuum. One of the advantages of the LPA is a developed technique for calculation of interelectron interaction corrections with high accuracy. Some corrections such as one-photon exchange can be taken into account in all orders of the QED perturbation theory. The emission of Auger electrons is determined by the electron correlation, accordingly, the interelectron interaction corrections become very important.

Calculation of the total cross section and the differential (at the $\theta = 180^\circ$ scattering angle in the center-of-mass frame) cross section for the resonant electron scattering on H-like ions is performed. The results of calculations for a wide range of nuclei $(8 \leq Z \leq 92)$ are presented. The one-photon exchange corrections are taken into account for electrons with the principal quantum number $n \leq 3$ in all orders of the QED perturbation theory. The two-photon exchange corrections and the radiative one-electron corrections (self-energy and vacuum polarization) are also considered for the mentioned set of electrons.

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