POST-COLLISIONAL RESCATTERING OF AUTOIONIZATION ELECTRONS

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In the past few years, great attention of investigators has been attracted to the post-collision interaction (PCI) effects in autoionization as well as Auger process in the kinematical region, where the relative velocity of a scattered ion and an autoionization (Auger) electron is close to zero. In this region PCI results in the so-called Coulomb focusing of the autoionizing electrons[1] and an anomalous feature on the low-energy tail of resonance in autoionization[2] and Auger process[3], respectively. This structure has been attributed to the autoionization electron rescattering in the attractive Coulomb field of the receding ion[4].

In this work, we examine in details the origin of this structure within the quantum-mechanical model[5] using the final-state wave function with corrected asymptotic behavior. The angle-dependent spectral intensity at a given electron energy can be written as

$$I(E,\theta) = |A_0 + A_{sc}|^2, \qquad (1)$$

where A_0 is the amplitude excluding the rescattering effects. A_{sc} is the rescattering amplitude.

To demonstrate the rescattering effects we have calculated the shape of the $(2s^2)^1S$-autoionization resonance of helium excited by 10 and 50 keV protons for emission angles between 0 and 10^0. Fig. 1 shows the result of our calculation at 50 keV proton energy and 2^0 emission angle: curve 1 is the total calculation according to Eq. (1), curves 2 and 3 represent the separate contributions from the amplitudes A_0 and A_{sc}, respectively. It is seen that the pronounced shoulder appearing on the low-energy tail of the the line is not a substantially interference effect; the shoulder and the main part of the peak correspond to the scattered and unscattered autoionization electrons, respectively.

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References

1. J.K. Swenson et al.// Phys. Rev. Lett. 1989. v.63. p.35.

2. J.K. Swenson et al.// Phys. Rev. Lett. 1991. v.66. p.417.

3. L. Sarkadi et al.// J. Phys.B. 1991. v.24. p.1655.

4. Sh.D. Kunikeev and V.S. Senashenko// Pis. Zh. Tech. Fiz. 1988. v.14. p.1181.

5. Sh.D. Kunikeev and V.S. Senashenko// submitted to Zh. Eksp. Teor. Fiz. 1996.

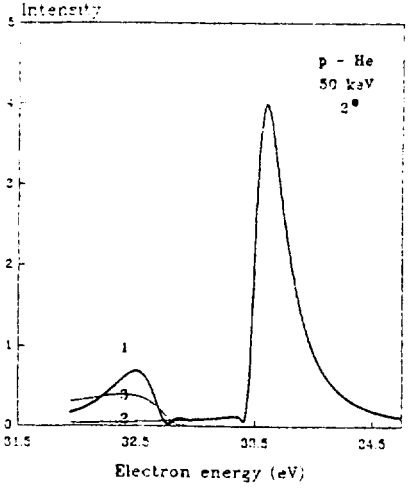

Figure 1: Energy spectrum of the $(2s^2)^1S$-autoionization resonance of helium excited by 50 keV protons at 2^0 emission angle. For notations see text