Theoretical study on the angular distribution of Auger electron emission from highly charged Be-like ions *

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Synopsis The electron-impact excitation of highly charged Be-like ions is studied in the framework of the density matrix, based on Dirac's equation. Emphasis is placed on the population of $1s2s^22p_{3/2}\ ^3P_2$ inner-shell excited states, as well as the influence of the magnetic interactions on the angular distribution of subsequent Auger electron emissions.

An atomic autoionizing state created by a beam of electron is aligned in the direction of the incident beam if the total angular momentum of the excited state is greater than 1/2. The alignment results from the fact that the excitation cross section has different values for different projections of the total angular momentum of the ion on the beam direction and independent of the sign [1]. The alignment of the ions can be revealed by studying its subsequent decay by ejection of the Auger electrons and characteristic x-ray emission [2].

In this work, the influence of the Breit interaction typically appears as a relativistic correction to the Coulomb repulsion acting among the electrons, on the alignment (*i.e.* the population of the magnetic sublevels) and the angular distribution of electron emission from the excited state have been investigated systematically. Figure 1 shows the angular distribution for the electron emission of the $1s2s^22p_{3/2}\ ^3P_2 - 1s^22s\ ^2S_{1/2}$ autoionization of beryllium-like ions with projectile energies E_e = 2.0u, 4.0u, and 5.0u, following the electron-impact excitation from their $1s^22s^2\ ^1S_0$ ground state. Results are shown in the rest frame of three beryllium-like projectiles with charges Z = 54, 74 and 92 and in two approximations. Angular distributions with only the Coulomb repulsion incorporated into the Auger amplitudes (blue dashed lines, C only) are compared with those where the complete *e–e* interaction is taken into account (black solid lines, C+B). A rather strong interference between the Coulomb and the magnetic terms in the *e–e* interaction arises especially at low projectile energies, and gives rise to a double-peak structure in the angular distributions as well as to a 10% reduction of the electron yield in the forward direction if the nuclear charge of the projectiles is increased from Z = 54 to 92.

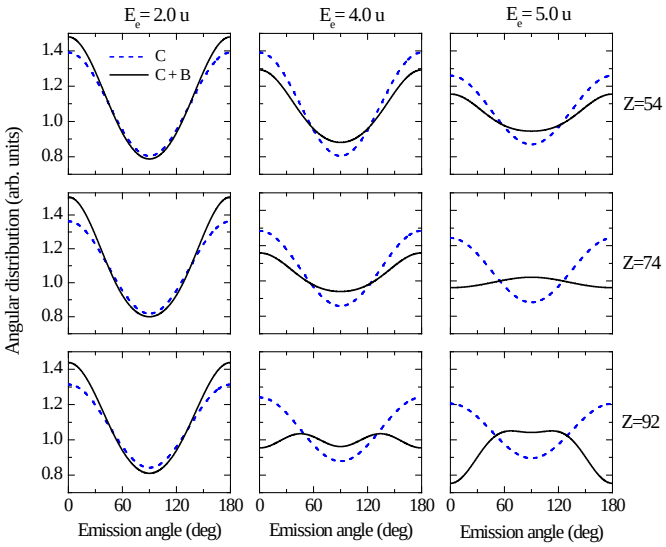

Fig.1. The angular distribution for the electron emission of the $1s2s^22p_{3/2}\ ^3P_2 - 1s^22s\ ^2S_{1/2}$ autoionization of beryllium-like ions with projectile energies E_e = 2.0u, 4.0u, and 5.0u, following the electron-impact excitation from their $1s^22s^2\ ^1S_0$ ground state.

References

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