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Alignment of the excited states and angular distribution of subsequent decay following the radiative electron capture into lithium-like ions*

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Synopsis The radiative electron capture into highly charged lithium-like U^{89+} ions is studied in the framework of the density matrix, based on Dirac's equation. Emphasis is placed on the population of $1s^22s2p_{3/2}$ J=1,2 excited states, as well as the angular distribution and polarization of subsequent characteristic photon emissions (included E1 and M2 transition).

Collisions of highly charged, heavy ions with atoms and free electrons have been studied intensively both at ion storage rings and at electron beam ion traps. In these collision studies, special interest has been devoted to the production of excited ionic states and on the measurement of their subsequent radiative decay. Indeed, the analysis of the bound-state transitions in high-Z ions plays a key role in our understanding of electron-electron and electron-photon interactions in the presence of strong fields, including important information about the relativistic and quantum electrodynamics effects in few-electron systems [1].

At high energies, the radiative electron capture (REC) is known as ones of the dominant processes for medium- and high-Z ions at storage rings. In this charge transfer process, a (quasi) free electron from either the (electron) cooler or some rest gas is captured into a bound state of the ion under the simultaneous emission of a photon. A great advantage of angle-resolved x-ray studies is that they are often much more sensitive to the magnetic and retardation effects than the analysis of the total (i.e., integrated over the angles) rates [2].

In this contribution, the REC into highly charged lithium-like U^{89+} ions is studied in the framework of the density matrix, based on Dirac's equation [3]. Detailed computations have first been carried out for the total and angle-differential cross sections (i.e. the angular distribution of the REC photon) of L-REC into the ground state $1s^22s^2$ J=0 and the low-lying excited state $1s^22s2p$ J=1,2 of final beryllium-like ion. Emphasis is placed on the population of $1s^22s2p_{3/2}$ J=1,2 excited states, as well as the angular distribution and polarization of subsequent characteristic photon emissions (included E1 and M2 transition). Strong angular anisotropy and linear polarization characteristics were found, and the possibility of observations from the experiment were also analyzed and discussed.

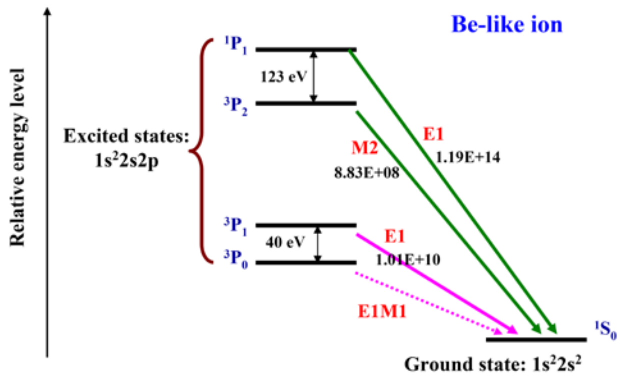

Figure 1. The relative energy level and main decay channel of beryllium-like U^{88+} ions.

References

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