Double-electron-capture processes in low- and intermediate-energy Th^{90+}-$Ru^{42+}(1s^2)$ collisions

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Synopsis Double-electron-capture (DEC) processes in the Th^{90+}-$Ru^{42+}(1s^2)$ collisions are studied for a wide energy collision region from 0.5 to 50 MeV/u. The total cross sections as well as impact parameter dependencies of various DEC processes are obtained. Our study demonstrates a very significant role of the relativistic effects, which become crucial in the low-energy regime.

Heavy-ion collisions play a very important role in investigations of the relativistic quantum dynamics of electrons in presence of strong electromagnetic fields [1]. A special interest is attracted to resonance processes, which can be very sensitive to relativistic and quantum electrodynamic effects.

In the present work we theoretically study double-electron-capture (DEC) processes in the Th^{90+}-$Ru^{42+}(1s^2)$ collisions, where the ground state of ruthenium and $n = 2$ states of thorium are in a resonance. The calculations are performed for a wide energy collision region ranging from 0.5 to 50 MeV/u. A semiclassical atomic Dirac-Fock-Sturm orbital coupled-channel method within an independent particle model is used [2, 3]. The total and state-selective DEC cross sections as well as the impact parameter dependencies are evaluated. A few examples are presented in Figs. 1-2. Special attention is paid to investigation of the relativistic effects, which role is very significant and becomes crucial in the the low-energy regime.

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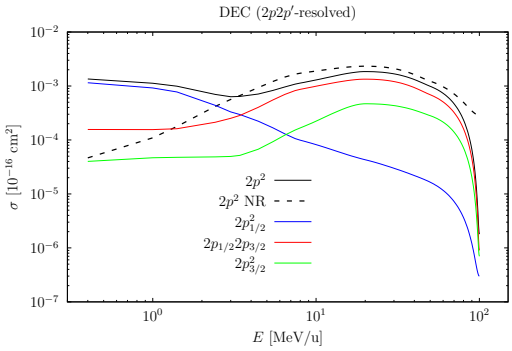

Figure 1. $2p2p'$-selective DEC cross sections for electron capture to the Th^{88+} ion. The non-relativistic results are marked NR.

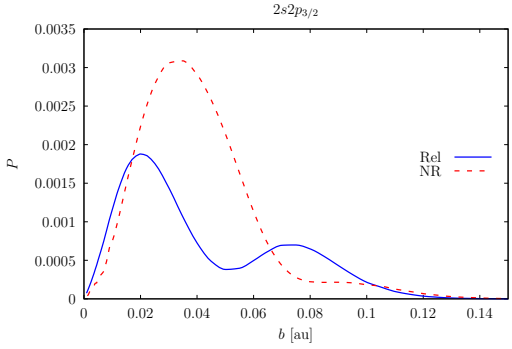

Figure 2. $2s2p_{3/2}$ DEC probabilities weighted by the impact parameter for the Th^{90+}-$Ru^{42+}(1s^2)$ @ 50 MeV/u collisions as functions of the impact parameter. The relativistic results ("Rel") and non-relativistic ones ("NR") are presented.

References

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