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L-shell x-ray production cross sections of Ag, In and Sn by positron impact

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Synopsis The L-shell x-ray production cross sections of Ag, In and Sn by positron impact in the energy range between 5 and 30 keV have been calculated using the three-body classical trajectory Monte Carlo method and the binary encounter model. We have found that the classical treatment of the present collision systems describes reasonably well the cross sections measured recently.

Ionization by positron impact has been extensively studied both theoretically and experimentally in recent decades. In most cases noble gas atoms were used as the target. For designing new experiments, such as production of antimatter, ionization cross sections for many other atoms are also necessary. Recently, improvements in experimental techniques have enabled the determination of inner shell x-ray production cross sections by positron impact [1].

The classical treatment of various collision problems has been quite successful for the calculation of the ionization cross sections. In particular the classical trajectory Monte Carlo (CTMC) method is widely used. It is a non-perturbative method and hence all the interactions between colliding particles can be taken into account exactly within the framework of the classical dynamics. It has been shown that the CTMC method can be also applied for light projectile impacts. In this work we also applied the binary encounter approximation (BEA) for the study of the collisions between positrons and free atoms. In both cases we used the frozen charge state model and the Slater-rule for the determination of the static nuclear charge of electrons bound to the L-shells of the target nucleus. The present calculations were performed solving the non-relativistic equations.

Figure 1 shows the L-shell x-ray production cross sections of Ag, In and Sn as a function of the positron impact from the threshold energy up to 30 keV. In the present cases, a very large number of classical trajectories were computed because the total cross sections decrease dramatically with decreasing incident projectile energies. At low impact energies, 20 million histories were calculated, while at 25 and 30 MeV impact energy, 2 million classical trajectories were evaluated. The results of our present CTMC calculations are very close to that of the experimental data. This fact suggests that the classical treatment of the present collision systems can be described accurately using the independent particle approximation.

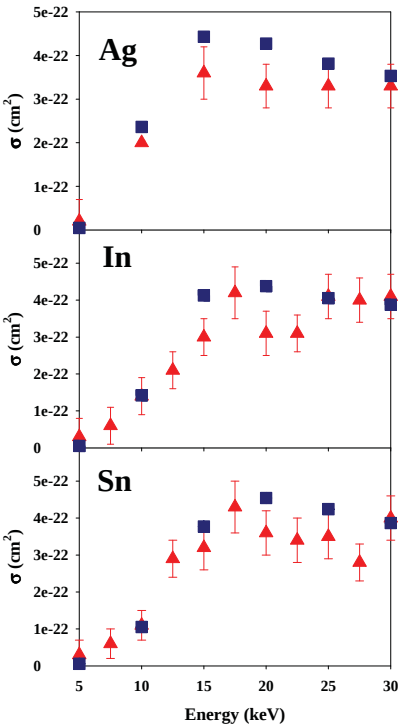

Figure 1. L-shell x-ray production cross sections of Ag, In and Sn by positron impact. Trinagles: experiment [1], squares: present CTMC results.

Acknowledgements

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References

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