Calculation of electron scattering on silver

Keegan McNamara*[1], Dmitry V. Fursa*[2], and Igor Bray*

* Department of Physics, Curtin University, WA 6845 Perth, Australia

Synopsis We report on the application of the relativistic convergent close-coupling method to electron scattering from silver. Differential and integrated cross sections are presented for elastic scattering and excitation to the $4d^{10}5p$, $4d^{10}6s$, $4d^{10}6p$, $4d^{10}5d$, $4d^{10}7s$, and combined $4d^{10}7p$, $4d^{10}6d$, and $4d^{10}4f$ states for incident electron energies in the range 0 - 500 eV.

A detailed analysis of elastic and inelastic scattering of electrons from silver is of significant interest for applications in astrophysics, laser techniques, and atomic frequency standards. A series of experiments conducted by Tošić et al. [1, 2, 3] study the angle-differential and integrated cross sections for elastic electron scattering, as well as electron impact excitation to the $(4d^{10}5p)^2P_{1/2}$ and $(4d^{10}5p)^2P_{3/2}$ states, which cannot be experimentally resolved, and compare with relativistic distorted-wave (RDW) calculations.

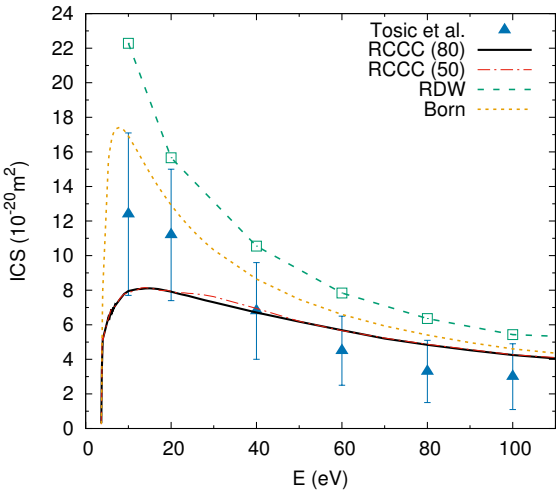

Figure 1. Integrated cross sections for electron scattering from the $(4d^{10}5p)^2P_{1/2,3/2}$ states of silver. Experimental results and RDW calculations are due to Tošić et al. [2]

We extend previous application of the Relativistic Convergent Close Coupling (RCCC) method to silver [4] to calculate differential and integrated cross sections for electron scattering from various states of silver. We model the silver atom as a single electron above a frozen [Kr]$4d^{10}$ core. Empirical one- and two-electron polarisation potentials have been used to obtain the best representation of the target state energies and the optical oscillator strengths (OOS). We test convergence of our calculations in the energy range 0-500 eV using two target states models, one consisting of 22 bound states and 28 continuum states, and the other extending the number of continuum states to 58.

[1]E-mail: Keegan.McNamara@student.curtin.edu.au
[2]E-mail: D.Fursa@curtin.edu.au

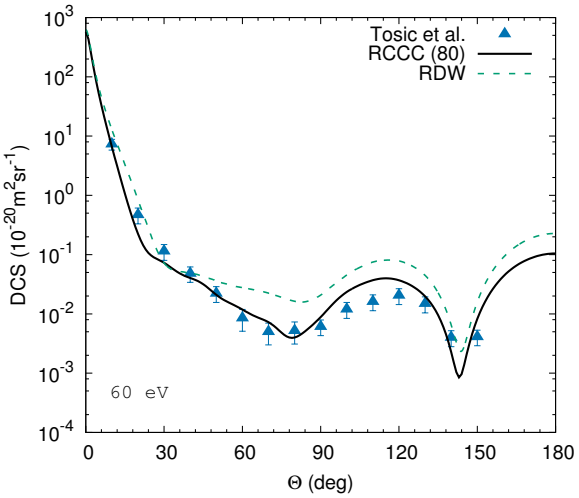

Figure 2. Differential cross sections for electron scattering from the $(4d^{10}5p)^2P_{1/2,3/2}$ states of silver at 60 eV. Experimental results and RDW calculations are due to Tošić et al. [2]

We find that our results converge for all incident electron energies, and thus present the RCCC results and, where available, compare with experiment for elastic scattering and excitation of the $4d^{10}5p$, $4d^{10}6s$, $4d^{10}6p$, $4d^{10}5d$, $4d^{10}7s$, and combined $4d^{10}7p$, $4d^{10}6d$, and $4d^{10}4f$ states. As an example of our results we present in Figs. 1 and 2 integrated and differential cross sections for scattering from the $(4d^{10}5p)^2P_{1/2,3/2}$ states. In addition to the cross sections we will present Stokes parameters for the $(4d^{10}5p)^2P_{3/2}$ state and elastic spin asymmetries.

References

[1] S. D. Tošić, V. Pejčev, D. Sĕvić, R. P. McEachran, A. D. Stauffer, and B. P. Marinkovič, 2011 *Nucl. Instrum. Methods Phys. Res. Sect. B* **279**, 53

[2] S. D. Tošić, V. Pejčev, D. Sĕvić, R. P. McEachran, A. D. Stauffer, and B. P. Marinkovič, 2015 *Phys. Rev. A* **91**, 052703

[3] S. D. Tošić, V. I. Kelemen, D. Sĕvić, V. Pejčev, D. M. Filipović, E.Yu. Remeta, and B. P. Marinkovič, 2009 *Nucl. Instrum. Methods Phys. Res. Sect. B* **267**, 283

[4] C.J. Bostock, D. V. Fursa, and I. Bray 2013 *Phys. Rev. A* **88**, 062707