Absolute triple-differential cross sections for Ne(2*p*) and Ar(3*p*)

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Synopsis In this work, we have proposed a new high-order distorted wave Born approximation model using the continuous distorted-waves expansion. Within this model, we have calculated the absolute triple differential cross section for single ionization of Ar(3*p*) at an impact energy of 195 eV and Ne(2*p*) at an impact energy of 599.6 eV. Both the second-order and third-order effects are considered in the present calculations, and the third-order distorted wave Born approximation model (DWBA3) is reported for the first time. Compared with experimental data and other theoretical results, we found the high-order interaction between the two outgoing electrons plays a critical role for the magnitude of absolute triple-differential cross sections of (e, 2e) reaction at intermediate energies.

To our knowledge, recently a derivative of nonperturbative close-coupling method, the B-spline R-matrix approach (BSR), was formulated by Zatsarinny *et al*. Comparing to other theoretical models, the success of BSR method is the accurate calculations of the TDCS for the single ionization of Ne(2*p*) at 100 eV, where a good agreement with experiments was found for such complex targets at low energies. This model, however, fails to predict absolute (e,2e) cross sections for Ar(3*p*)[1], for which considerable discrepancies with experimental data were observed, in particular at large scattering angles. This was interpreted by the fact of the limitation of computational resources, since more complex is the target, more pseudostates will be required in the calculations.

To further evaluate the accurate absolute TDCS for the (e, 2e) reaction of complex atom with the present computer facility, an approximate model with all the complex interactions described reasonably can be developed. As a first test, a new and reliable high-order DWBA model for (e, 2e) reaction at intermediate energy is proposed in this work. Due to the ionized cross sections larger than excited cross sections in this energy region, the bound states of target were neglected and the continuous distorted-wave was used to expand the Green's function. The absolute TDCS for single ionization of Ar(3*p*) and Ne(2*p*) at intermediate energy are calculated by present second order DWBA model (DWBA2). To obtain the more accurate results and examine the convergence of Born approximation in Ar(3*p*) (e, 2e) reaction, third-order DWBA model (DWBA3) has also been derived in this work. Our results are presented in Fig. 1 and Fig. 2 for Ne(2*p*) and Ar(3*p*) respectively.

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Excellent agreements have been achieved in comparison with the available measurements, which illustrates that high-order interactions between the two outgoing electrons indeed play a critical role in the intermediate energy (e, 2e) reaction, especially for the magnitude of TDCS.

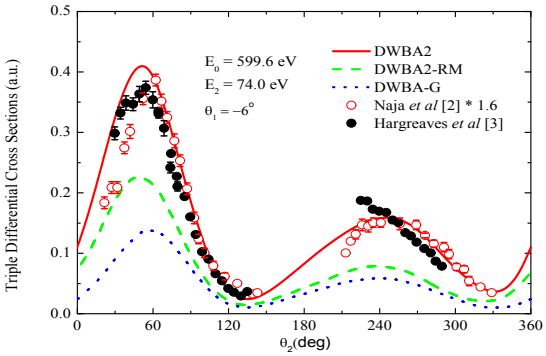

Figure 1. Absolute triple-differential cross sections for Ne(2*p*) in coplanar asymmetric geometry.

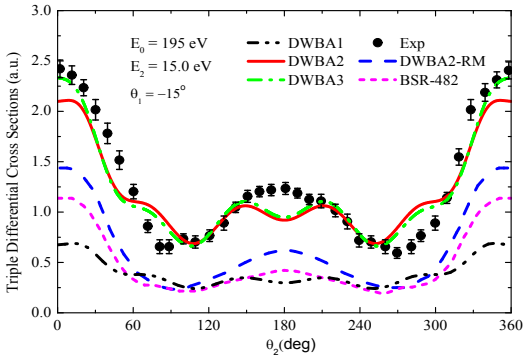

Figure 2. Absolute triple-differential cross sections for Ar(3*p*) in the perpendicular plane.

References

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