01 Sep 2015

Low-energy (E_0 = 65 eV) Electron-Impact Ionization of Neon: Internormalized Triple-Differentical Cross Sections in 3D Kinematics

XueGuang Ren

Sadek M. Amami

Oleg I. Zatsarinny

Thomas Pfluger

et. al. For a complete list of authors, see https://scholarsmine.mst.edu/phys_facwork/1515

Recommended Citation

X. Ren and S. M. Amami and O. I. Zatsarinny and T. Pfluger and M. Weyland and W. Y. Baek and H. Rabus and K. Bartschat and D. H. Madison and A. Dorn, "Low-energy (E_0 = 65 eV) Electron-Impact Ionization of Neon: Internormalized Triple-Differentical Cross Sections in 3D Kinematics," *Journal of Physics: Conference Series*, vol. 635, no. 5, Institute of Physics - IOP Publishing, Sep 2015.
The definitive version is available at https://doi.org/10.1088/1742-6596/635/5/052021

Low-energy ($E_0 = 65$ eV) electron-impact ionization of neon: Internormalized triple-differentical cross sections in 3D kinematics

XueGuang Ren[*‡1], **Sadek Amami**[§], **Oleg Zatsarinny**[†], **Thomas Pflüger**[*‡], **Marvin Weyland**[*‡], **Woon Yong Baek**[*], **Hans Rabus**[*], **Klaus Bartschat**[†], **Don Madison**[§], **Alexander Dorn**[‡]

[*] Physikalisch-Technische Bundesanstalt, 38116 Braunschweig, Germany
[‡] Max-Planck-Institute for Nuclear Physics, 69117 Heidelberg, Germany
[§] Physics Department, Missouri University of Science and Technology, Rolla, Missouri 65409, USA
[†] Department of Physics and Astronomy, Drake University, Des Moines, Iowa 50311, USA

Synopsis We present a combined experimental and theoretical study on the low-energy ($E_0 = 65$ eV) electron-impact ionization of neon. The experimental data are compared to predictions from a hybrid second-order distorted-wave Born plus R-matrix approach (DWB2-RM), the distorted-wave Born approximation with inclusion of post-collision interaction (DWBA-PCI), a three-body distorted-wave approach (3DW), and a B-spline R-matrix (BSR) with pseudostates approach. Excellent agreement is found between experiment and the 3DW and BSR theories. The importance of PCI effects is clearly visible in this low-energy electron-impact ionization process.

The electron-impact ionization dynamics have now been well understood for simple systems such as atomic hydrogen and helium [1, 2, 3]. Recent studies for the ionization of neon by 100 eV electron-impact showed an unprecedented agreement between experiment and BSR predictions [4]. The physical effects of PCI as well as electron exchange and charge-cloud polarization in the projectile-target interaction are expected to become even more pronounced with decreasing projectile energy. Here, we investigate the low-energy ($E_0 = 65$ eV) electron-impact ionization of neon to thoroughly test state-of-the-art theoretical approaches.

The experimental data were measured using a reaction microscope [5, 6], which can cover nearly the entire 4π solid angle for the secondary electron emission. The measured cross sections are internormalized across all different scattering angles (θ_1) and ejected energies (E_2), which provide a thorough test ground for theory. As one example, the (e, 2e) triple-differential cross sections (TDCS) for $\theta_1 = -12.5°$ and $E_2 = 2$ eV are presented in Figure 1 for the scattering plane and the full-perpendicular plane. The experimental data are compared to various theoretical predictions from the 3DW, BSR, DWB2-RM, DWBA-PCI models. Excellent agreement is found between experiment and the 3DW and BSR theories. Significant discrepancies between DWB2-RM and experiment are observed near the projectile forward direction, while the DWBA-PCI model provides a clear improvement over the DWB2-RM calculations in this angular range. This indicates that PCI effects play a very important role in the low-energy ionization process studied here [7]. More results, including three-dimensional (3D) presentations of the TDCS, will be shown at the conference.

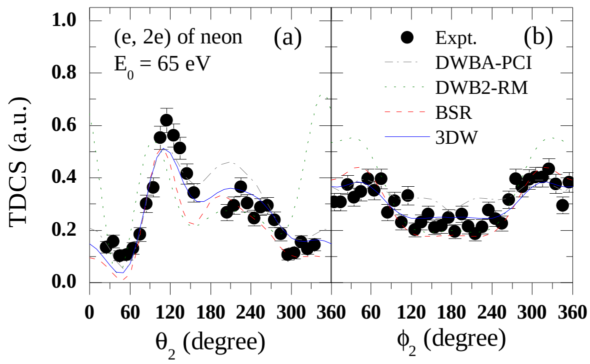

Figure 1. TDCS for the ionization of Ne ($2p$) presented as a function of the secondary electron (e_2) emission angle at $\theta_1 = -12.5°$ and $E_2 = 2$ eV. (a): TDCS in the scattering plane; (b): TDCS in the plane perpendicular to the incident beam direction.

References

[1] T. N. Resigno *et al* 1999 *Science* **286** 2474
[2] X. Ren *et al* 2011 *Phys. Rev. A* **83** 052711
[3] O. Zatsarinny *et al* 2011 *Phys. Rev. Lett.* **107** 023203
[4] T. Pflüger *et al* 2013 *Phys. Rev. Lett.* **110** 153202
[5] J. Ullrich *et al* 2003 *Rep. Prog. Phys.* **66** 1463
[6] X. Ren *et al* 2014 *J. Chem. Phys.* **141** 134314
[7] X. Ren *et al* 2015 *Phys. Rev. A* **91** 032707

[1] E-mail: xue.g.ren@ptb.de