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Positron and electron impact multiple-ionization of rare gases

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Synopsis We present a theoretical treatment of the multiple-ionization by light projectiles, which is valid in an extended energy range (from near threshold to the keV region). It covers the direct ionization and the post-collisional electron emission, and takes into account charge and mass effects: projectile trajectory, finite momentum transferred, energy threshold. Our results for positron and electron-impact on Ne, Ar, Kr and Xe, are compared with a detailed compilation of experimental data of multiple and of total ionization cross sections. These values and previous ones for antiproton and proton-impact let us to present an extended picture of the particle-antiparticle multiple-ionization.

Electron and positron impact ionization is a very active field [1-3]. In this work we aim to describe the multiple ionization (MI) by light projectiles in an extended energy range by employing the continuum distorted-wave eikonal initial state approximation [4]. As this model is valid for heavy projectiles, we introduced corrections to account for the finite momentum transferred, the non-linear trajectory and the minimum energy [5]. The thresholds, calculated considering the mean kinetic energy of the outgoing electrons, describe reasonably well the experimental appearance energies from single to sextuple ionization [6]. Within the independent particle model, the MI is a multinomial combination of independent ionization probabilities of the different subshells [7-8]. We introduce the energy thresholds and the post-collisional branching ratios in the multinomial expression.

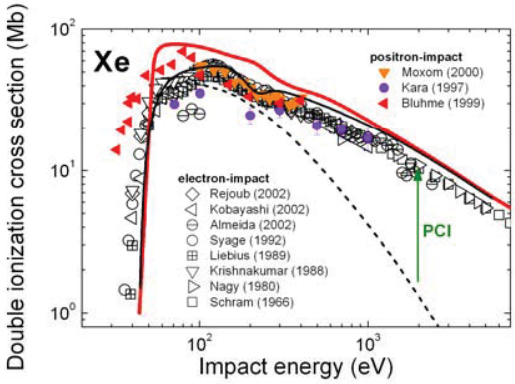

Figure 1. Double ionization cross section of Xe by impact of positron (thick-red line) and electron (thin black line). The dashed line indicates the direct ionization.

In figure 1 we display positron and electron results for the double-ionization of Xe, together with the experimental data available. The description of the experimental energy threshold is good. Note that for Xe, above 0.2 keV the Auger-type post-collisional ionization (PCI) is important. In figure 2 we display the total (or gross) ionization cross section of Xe by positron and electron-impact. Our positron results are above the electron ones around the maximum, in agreement with the data [9-10].

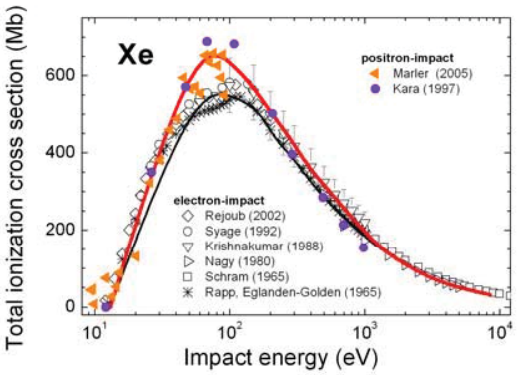

Figure 2. Total ionization cross sections by positron and electron impact. Notation, as in figure 1.

References

[1] Shevelko V and Tawara H 1998, *Atomic Multielectron Processes* (Berlin: Springer-Verlag)
[2] Laricchia G *et al* 2013, *Experimental Aspects of Ionization Studies by Positron and Positronium Impact* (Cambridge University Press)
[3] Chiari L and Zecca A 2014, Eur. Phys. J. D **68**, 297
[4] Fainstein P D *et al* 1988, J. Phys. B **21** 287
[5] Montanari C C *et al* 2014l, J. Phys. B **47** 105203
[6] Montanari C C and Miraglia J E 2015, Proceedings HCI 2014, J. Phys. Conf. Series, in press
[7] Cavalcanti E G *et al* 2002, J. Phys. B **35** 3937
[8] Spranger T and Kirchner T 2004, J. Phys. B **37** 4159
[9] Kara V *et al* 1997, J. Phys. B **30** 3933
[10] Marler J P *et al* 2005, Phys. Rev. A 71, 022701

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