ELECTRONIC EXCITATION OF CO BY POSITRON IMPACT

Euclimar P. da Silva*, Márcio T. do N. Varella and Marco A. P. Lima†

*Departamento de Física, Universidade Federal do Ceará, 60455-760 Fortaleza, Ceará, Brazil
†Instituto de Física Gleb Wataghin, Universidade Estadual de Campinas (UNICAMP), 13083-970 Campinas, São Paulo, Brazil

The development of high resolution ($\Delta E \sim 25$ meV FWHM) beam of positrons using the highly efficient buffer–gas positron accumulation technique (modified Penning-Malmberg trap) has opened up a new era in the study of positron physics [1, 2, 3]. The bright low–energy monochromatic positron beam allows experimentalists to perform highly sophisticated scattering experiments where measurements of state–resolved absolute cross sections for electronic or vibrational excitations are possible.

We report in this conference differential and integral cross sections for the electronic excitation of carbon monoxide CO by positron impact. The calculations were carried out with the Schwinger multichannel method (SMC), and the formal aspects of this approach are discussed in detail elsewhere [4, 5]. In these calculations, we included six–channel, namely the excited A $^1\Pi$, I $^1\Sigma^-$ and D $^1\Delta$ states, and the ground state X $^1\Sigma^+$. We expected to find a resonant feature in the excitation cross section of the A $^1\Pi$ state, consistent with the experimental $a\ ^1\Pi_g$ excitation cross section of the isoelectronic nitrogen molecule [2]. Our *ab initio* e^+–CO scattering calculation did not reproduce the conpicuous resonant-like structure, being consistent with previous e^+–N_2 scattering calculations [6, 7]. It could be claimed that present calculation do not take nuclear motion and the positronium formation channel into account. The scattering amplitudes were improved by combining the SMC approach ($l \leq 2$) with the first Born approximation (FBA) ($l \geq 3$) for the A $^1\Pi$ and D $^1\Delta$ states. The I $^1\Sigma^-$ state was calculated only with the SMC approach ($l \leq 5$) since the FBA does not contribute to the SMC.

In Fig. 1, we present integral excitation cross sections to the A $^1\Pi$ state and his partial cross sections.

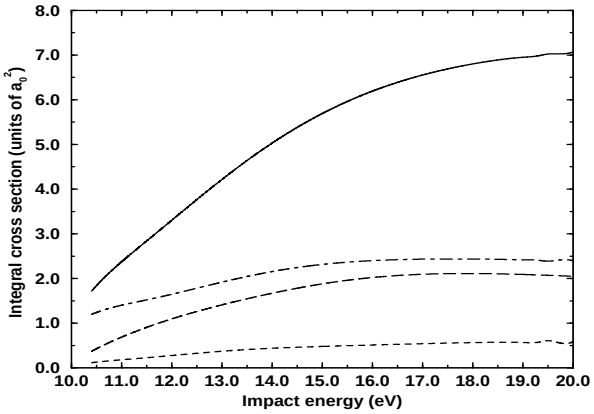

Fig. 1. Integral cross section for the electronic excitation to the A $^1\Pi$ state of CO by positron impact. Solid line: Total cross section (summed over all symmetries). Also shown are the partial cross sections. Short dashed line: $^2\Sigma$ symmetry; dot–dashed line: $^2\Pi$ symmetry; long dashed line: $^2\Delta$ symmetry.

References

[1] S. J. Gilbert, J. P. Sullivan, R. Greaves and C. M. Surko, Nucl. Instrum. Meth. Phys. Res. B **171**, 81 (2000).
[2] J. P. Sullivan, J. P. Marler, S. J. Gilbert, S. J. Buckman and C. M. Surko, Phys. Rev. Lett. **87**, 073201 (2001).
[3] J. P. Sullivan, S. J. Gilbert and C. M. Surko, Phys. Rev. Lett. **86**, 1494 (2001).
[4] J. S. E. Germano and M. A. P. Lima, Phys. Rev. A **47**, 3976 (1993).
[5] E. P. da Silva, J. S. E. Germano, and M. A. P. Lima, Phys. Rev. A **49**, R1527 (1994); *ibid.* Phys. Rev. Lett. **77**, 1028 (1996).
[6] P. Chaudhuri, M. T. do N. Varella, C. R. C. de Carvalho, and M. A. P. Lima, Nucl. Instrum. Meth. Phys. Res. B **221**, 69 (2004); *ibid.* Phys. Rev. A **69**, 042703 (2004).
[7] T. N. Rescigno, private communication (2003).