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Anomalous large low-energy elastic cross sections for electron scattering from the CF₃ radical

J. R. Brunton^{*}, L. R. Hargreaves^{*1}, M. J. Brunger^{*2}, S. J. Buckman[†], G. García[§],
F. Blanco[†], O. Zatsarinny[^], K. Bartschat[^], C. Winstead[#], and V. McKoy[#]

^{*}ARC Centre for Antimatter-Matter Studies, School of Chemical and Physical Sciences,
Flinders University, Adelaide, Australia

[†]ARC Centre for Antimatter-Matter Studies, Research School of Physics and Engineering,
Australian National University, Canberra, Australia

[§]Instituto de Física Fundamental, Consejo Superior de Investigaciones Científicas, Madrid, Spain

[†]Departamento de Física Atómica, Molecular y Nuclear, Universidad Complutense de Madrid, Madrid, Spain

[^]Department of Physics and Astronomy, Drake University, Des Moines, Iowa, USA

[#]A. A. Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California, USA

Synopsis We present measured absolute cross sections for elastic electron scattering from the CF₃ radical over the incident energy range of 7–50 eV and scattering angles between 20° and 135°. The results are compared to theoretical predictions from SMC, IAM-SCAR, and R-matrix calculations.

Absolute electron collision cross sections with fluorocarbon radicals are required for important modeling processes. These include plasma etching of semiconductors, laser and gas discharge physics, and atmospheric physics [1].

Here we detail our method for producing multi-species supersonic gas jets containing CF₃ radicals, along with the process we use for extracting the elastic CF₃ cross section component from the measured data [2]. We present absolute angle-differential and integral elastic electron scattering cross sections for the CF₃ radical for impact energies ranging from 7–50 eV, with the measured DCSs covering an angular range 20°–135°. These cross sections represent the first measurements utilising open-shell non-linear radicals produced *in situ* as a target.

Our experimental cross sections are compared with the available theoretical predictions, including results obtained with the UK R-matrix method [1], along with our current Schwinger Multichannel (SMC) computations and our Independent Atom Model results, which incorporated a correction using the screening additivity rule (IAM-SCAR) [3]. Further details of both our SMC and IAM-SCAR models will be presented separately at this conference.

For electron impact energies between 25–50 eV, the level of agreement between the present measurements and the available calculations is reasonable. For lower impact energies, however, we observed anomalously large cross sections, far in excess of those predicted by any of the theories (see Fig. 1). These mismatched magnitudes might be a result of an inadequate treatment of polarization in the calculations, and

further studies of these cross sections are underway. Results of these studies will be reported on separately at this conference.

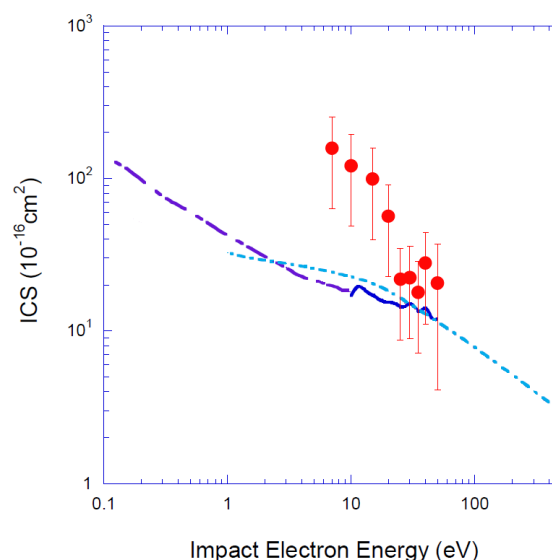


Figure 1. CF₃ Elastic ICS (10^{-16}cm^2): present measurements (\bullet); the SMC (—) and IAM-SCAR (---) results; and an R-Matrix (—) study of [1].

References

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- [2] Hargreaves L R, Brunton J R, Brunger M J, *et al.* 2010 *Plasma Sources. Sci. Technol.*, **19** 065021
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¹ E-mail: lhargreaves@fullerton.edu

² E-mail: michael.brunger@flinders.edu.au