# THE PHYSICS OF IONIZED GASES

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# EXCITATION CROSS SECTIONS FOR XENON ATOM BY ELECTRON IMPACT

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The knowledge of the exact integral excitation cross section values of atoms and molecules by electron impact is relevant for the understending of many processes in discharge and plasma and laser media. These cross sections are of special interest in the intermediate electron energy range where new channels open in the scattering process. These values might also serve as a good test for validity of theoretical calculations.

Relative differential cross sectins (DCS) for elastic and inelastic electron scattering on xenon atom have been obtained by the electron spectrometer briefly described earlier[1]. Crossed electron beam - atom beam technique has been utilized. Inelastic DCS have been determined at 15, 20, 30 and 80 eV impact energies and in 5° to 150° angular range.

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Relative elastic DCS were put on the absolute scale by normalization to the DCS by Register et al.[2] at particular angle. Extrapolating to 0° following Wagenaar et al.[3] and to 180° scattering angles integral cross sectins for elastic scattering were obtained. These values with associated error bars are presented in Fig.1 (open squares □ ). In the same figure total cross sections by Nickel et al.[4] (solid curve with open circles —○— ) and the sum of partial ionization cross sections by Stephan and Märk[5] (dashed curve with open triangles —·—△— ) are presented.

Experimental elastic to inelastic intensity ratios were used to put relative DCS[6] for the excitation of specific atomic state on the absolute scale[7]. Integral cross sections for the excitation of particular state were obtained by extrapolating DCS to 0° and 180° angles and integrating over full solid angle. These values are presented in Fig.1 for the excitation of the $6s[3/2]^o_2$ (crosses × ), $6s[3/2]^o_1$ (asterisks ✳), $6s'[1/2]^o_0$ (full triangles ▲ ), $5d[7/2]^o_3$ (full squares ■ ) and $5d[3/2]^o_1$ (full circles ● ).

Integral excitation cross sections for the transitions in which dipole selection rules are obayed (✳& ● ) increase similar as the ionization cross section. On the contrary, when selection rules are not obayed, excitation cross sections have maximum at treshold energies and decrease with electron impact energy.

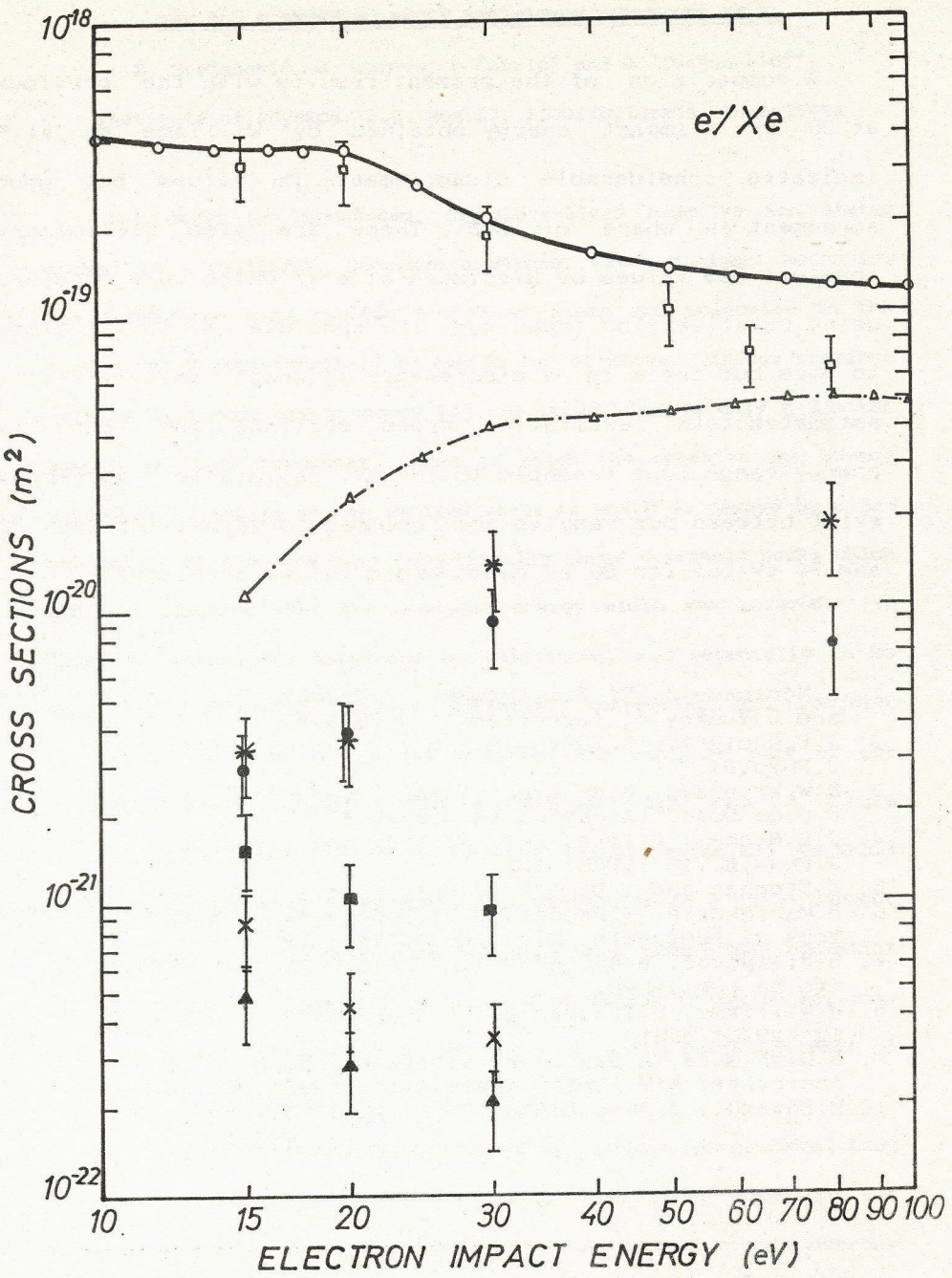
$10^{-18}$
$10^{-19}$
$10^{-20}$
$10^{-21}$
$10^{-22}$
$e^-/Xe$
CROSS SECTIONS ($m^2$)
10
15
20
30
40
50
60
70
80
90
100
ELECTRON IMPACT ENERGY (eV)

Fig. 1

A comparision of the present results with the previous at 20 eV impact energy obtained by Williams et al.[8] indicates considerable disagreement in values but good agreement in shape of DCS. There are also preliminary absolute DCS values by Nishimura et al.[9] which were obtained using relative flow technique. The absolute values are close to ours but there is a discrepancy in shape. Hayashi[10] has estimated total excitation cross sections for xenon in energy range from treshold to $10^4$ eV. Satisfactory agreement exist between our results and recommended values for 15, 20 and 30 eV but for 80 eV recommended values are lower.


1. B.Marinković, Cz.Szmytkowski, V.Pejčev, D.Filipović and L.Vušković, (accepted in J.Phys.B)
2. D.F.Register, L.Vušković and S.Trajmar, (accepted in J.Phys.B)
3. R.W.Wagenaar, A.de Boer, T.van Tubergen, J.Los and F.J.de Heer, (accepted in J.Phys.B)
4. J.C.Nickel, K.Imre, D.F.Register and S.Trajmar, J.Phys.B.,16 (1985) 125
5. K.Stephan and T.D.Märk, J.Chem.Phys., 81 (1984) 3116
6. B.Marinković, V.Pejčev, D.Filipović and L.Vušković, Book of Abstracts, XIII ICPEAC (Berlin, 1983), p.85.
7. D.Filipović, B.Marinković, V.Pejčev and L.Vušković, (to be published)
8. W.Williams, S.Trajmar and A.Kuppermann, J.Chem.Phys., 62 (1975) 3031
9. H.Nishimura, A.Danjo and T.Matsuda, Book of Abstracts, XIV ICPEAC (Palo Alto, 1985), p.108.
10. M.Hayashi, J.Phys.D:Appl.Phys.,16 (1983) 581