

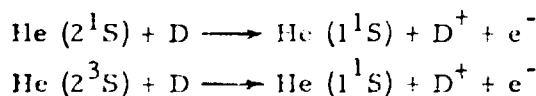
VELOCITY DEPENDENCE OF THE PENNING IONIZATION OF
D ATOMS BY He (2^1S) AND He (2^3S) ATOMS

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A time-of-flight technique has been developed for the study of the velocity dependence of the cross section for Penning ionization of D atoms by metastable He atoms :



The same apparatus as in Ref. 1 (study of $\text{He}^* + \text{Ar}$ interaction) is used. The D atoms are produced in a r. f. discharge operating at 260 MHz; the atoms are then slowed down by passing them through a small cylinder at the room temperature. The degree of dissociation of D_2 molecules measured in the experiment is roughly 70-80%. The D atom beam enters the interaction chamber; Penning ions produced by the collisions of He (2^1S) or He (2^3S) with D atoms are mass-analyzed and counted.

In the case of a short gate function and a slowly varying cross section, the ratio of the ion signal to the metastable signal $N_{IP}^+ (\tau) / N^* (\tau)$ for the same flight path is given by : $\sigma_{\text{eff}} (\tau) + \sum_p (-1)^p \frac{\epsilon_{IP}}{p} \approx \sigma_{\text{eff}} (\tau) / 1/$.

σ_{eff} is the effective cross section given by $\sigma_{\text{eff}} (v) = \int_0^\infty \frac{v_\lambda}{v} g (v_\lambda) \sigma (v_\lambda) dv_\lambda$ where $\vec{v}_\lambda = \vec{v} - \vec{v}_e$ is the relative velocity and $g (v_\lambda)$ is the density distribution of the D atom velocities.

The velocity dependence of the penning ionization cross section of D atoms by He(2^1S) is shown in Fig. 1.

Also, the first results show that penning ionization cross section for the reaction He(2^1S) + D is much larger than the cross section for He (2^3S) + D. This result for the ratio of the cross sections is in better agreement with the theoretical predictions of Cohen and Lane /2/ than with the predictions of Fujii and al. /3/.

- A. Pesnelle, G. Watel and C. Manus - J. Chem. Phys. to be published.
 /2/ J.S. Cohen and N.F. Lane - J. Phys. B 6, L113 (1973).
 /3/ H. Fujii, H. Nakamura and M. Mori - J. Phys. Soc. Japan 29, 1030 (1970).

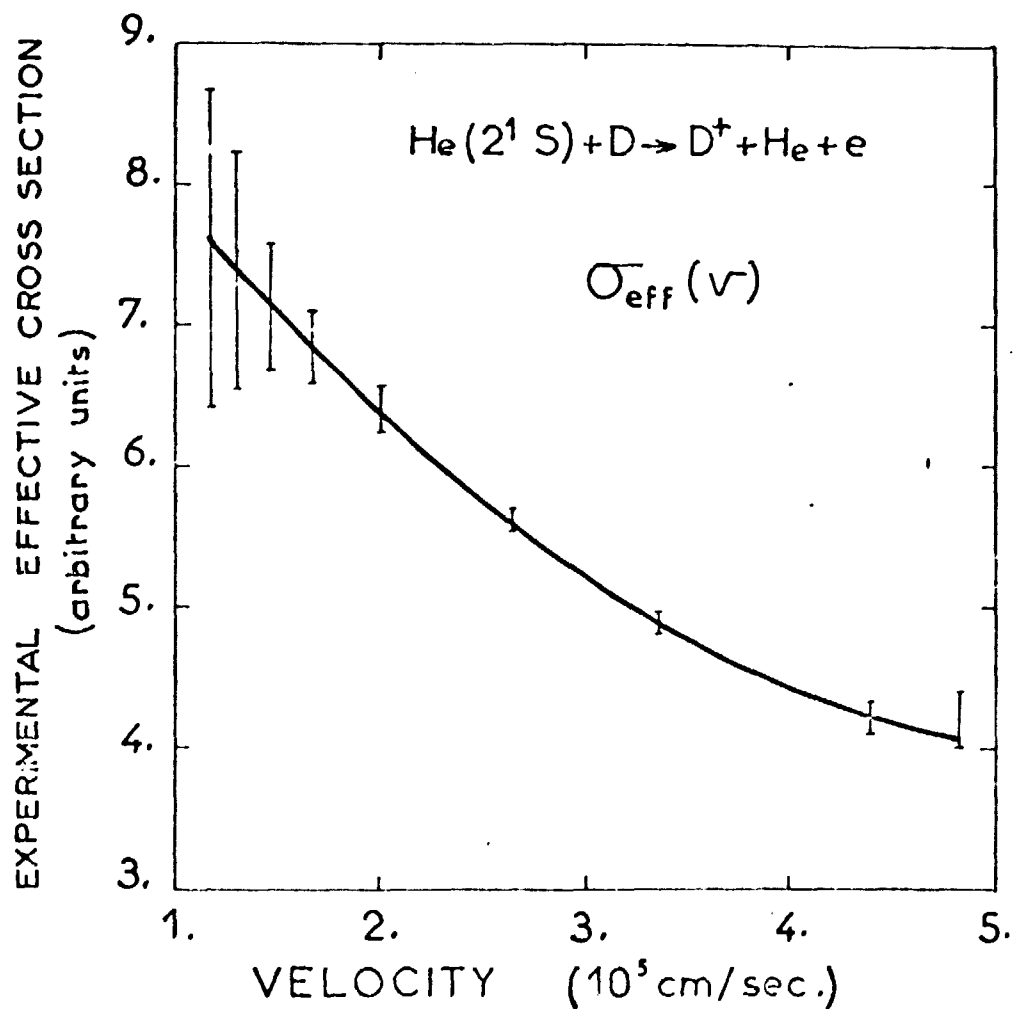


Fig. 1 : Effective Penning ionization cross section for He(2¹S) + D interaction, v is the velocity of He* atoms. — present experimental $\sigma_{\text{eff}}(v)$ cross section : a smooth curve has been drawn through about 200 points ; typical error bars are shown.