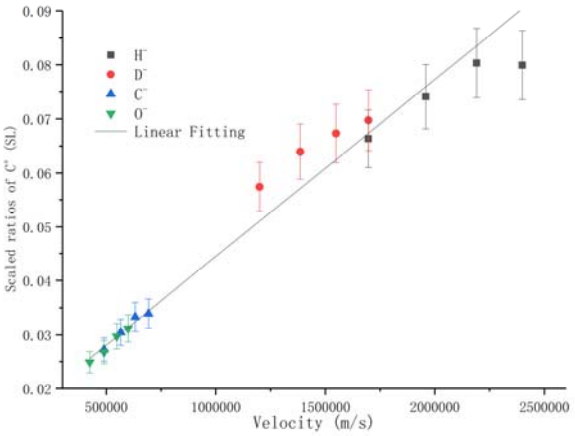
Scaling law investigation on dissioation ratios in negative-ion and gas collisions

G Guo, D Wang, Z Zhao and X Zhang *

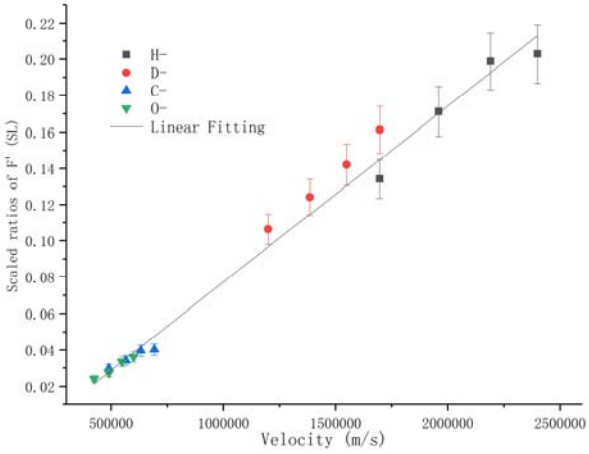
Institute of Modern Physics, Department of Nuclear and Technology, Fudan University, Shanghai 200433, China
Key Laboratory of Nuclear Physics and Ion-Beam Application, Fudan University, Shanghai 200433, China

Synopsis The relative dissociation ratios of N_2O, CF_4, and SF_6 are measured under 15-30keV H^-, D^-, C^- and O^- impact. The recoil ions are detected and recorded by a time of flight mass spectrometer, in coincidence with detection of scattered projectiles. The ratios of atomic ions produced from targets can be scaled by nuclear charges of negative ions and their impact velocities. The ratios divided by Z or $Z^{1/3}$ or $Z^{2/3}$ all change linearly with v. Moreover, compared with the center atoms in the target molecule, dissociation of the outer atoms show more dependence on nuclear charges of negative ions.

We have studied the relative dissociation ratios of N_2O, CF_4, SF_6 under 15-30 keV H^-, C^-, O^- impact [1-3]. It is found out that more data are needed to try to establish scaling laws, if there are any, of the dissociation ratios. In order to partial fill in the data blank, we choose deuterium, one isotope of hydrogen. A D^- beam is produced and guided to impact on the three molecules mentioned above, and new data are analyzed in the similar way as before. Then, the results for D^- are then combined with the previous results for H^-, C^-, O^-, to make a more comprehensive data base and empirical scaling laws are established [4].



$$\frac{\sigma_{C^+}}{\sqrt[3]{Z^2}} \approx 0.033 \times \left(\frac{v}{10^6} + 0.36\right)$$



$$\frac{\sigma_{F^+}}{Z} \approx 0.097 \times \left(\frac{v}{10^6} - 0.20\right)$$

Figure 1. The scaling results are shown for CF_4 in Single-electron-Loss process under negative ions impact.

References

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* E-mail: zhangxm@fudan.edu.cn