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

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Synopsis  The relative dissociation ratios of N$_2$O, 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$_2$O, 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].

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![Figure 1. The scaling results are shown for CF$_4$ in Single-electron-Loss process under negative ions impact.](image)

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\frac{\sigma^+_{F^+}}{Z} \approx 0.097 \times \left(\frac{v}{10^6}\right) + 0.20
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References

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