

# Dissociation dynamics of nitrous oxide upon the impact of fast electrons and highly charged ions studied by a newly built 3-D focusing recoil ion momentum spectrometer

Arnab Khan<sup>1</sup>, Lokesh C. Tribedi and Deepankar Misra<sup>2</sup>

Department of Nuclear and Atomic Physics

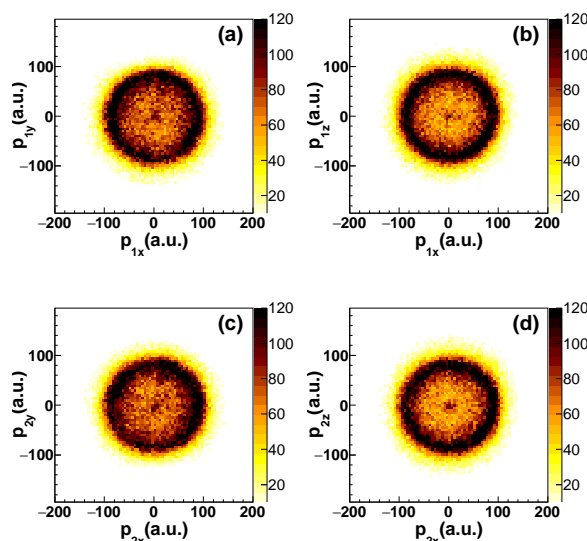
Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Mumbai 400005, India

**Synopsis** Ionization and dissociation dynamics of  $\text{N}_2\text{O}$  has been studied upon the impact of fast electrons and highly charged ions using a two-stage 3-D focusing recoil ion momentum spectrometer. The kinematics of several fragmentation channels are studied by three-dimensional momentum imaging of fragments detected in coincidence. We observe the presence of both concerted and sequential breakup channels in the decay of  $\text{N}_2\text{O}^{3+}$  molecular ion.

Dissociation dynamics of nitrous oxide ( $\text{N}_2\text{O}$ ) upon the impact of fast keV energy electrons and keV to MeV energy highly charged ions is studied. When one or more electrons are removed from a neutral molecule a molecular ion is formed. Depending on the amount of energy deposited several states of molecular ions can be populated. The decay products in a molecular breakup carry the information of transient molecular ions. The complete momenta and kinetic energy release (KER) distributions of the fragmentation of doubly and triply charged molecular ions have been deduced and compared with previous experimental as well as theoretical studies [1, 2, 3, 4]. Several studies are available on symmetrical molecule like  $\text{CO}_2$  and asymmetric molecule like  $\text{OCS}$ . However, relatively less number of studies are available for the asymmetric, linear, tri-atomic molecule  $\text{N}_2\text{O}$ . Unlike  $\text{OCS}$ , where all three atoms are different  $\text{N}_2\text{O}$  has two N atoms which can be labeled as central ( $\text{N}_c$ ) and terminal ( $\text{N}_t$ ). Assignment of these two nitrogen atoms as central and terminal is difficult. However, under certain special conditions a partial assignment can be done.

The present experiments have been performed using a commercially available electron gun and an ECR based ion accelerator facility at TIFR, Mumbai. A newly built recoil ion momentum spectrometer [5] has been used to perform the experiments. It has been observed that  $\text{N}_2\text{O}^{2+}$  fragments mainly via two processes, namely, de-nitrogenation and de-oxygenation. It is also observed that de-nitrogenation is more probable than de-oxygenation. Figure 1. shows momentum distributions of fragmentation of  $\text{N}_2\text{O}^{2+}$  into  $\text{O}^+$  and  $\text{N}_2^+$ . Along with this it is

also seen that de-nitrogenation happens through the decay of a metastable state. Similarly we have also studied fragmentation  $\text{N}_2\text{O}^{3+}$ . It has been observed that the precursor ion decays via concerted and sequential processes.



**Figure 1.** Momentum distributions for fragmentation of  $\text{N}_2\text{O}^{2+}$  into  $\text{O}^+$  and  $\text{N}_2^+$  (de-oxygenation). (a)  $p_x$  vs  $p_y$ , (b)  $p_x$  vs  $p_z$  for  $\text{O}^+$  ions and (c)  $p_x$  vs  $p_y$ , (d)  $p_x$  vs  $p_z$  for  $\text{N}_2^+$  ions.

## References

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<sup>1</sup>E-mail: [arnab.khan@tifr.res.in](mailto:arnab.khan@tifr.res.in)

<sup>2</sup>E-mail: [dmisra@tifr.res.in](mailto:dmisra@tifr.res.in)

