Angular distributions in two body breakup of OCS^{q+} ions

Herendra Kumar[*1], **Pragya Bhatt**[¶], **C. P. Safvan**[¶] **and Jyoti Rajput**[*2]

[*] Department of Physics and Astrophysics of University of Delhi, Delhi-110007, India.
[¶] Inter University Accelerator Centre, Aruna Asaf Ali Marg, New Delhi-110067, India.

Synopsis Several two-body dissociation channels of multiply ionized OCS molecules, generated by Xe^{9+} impact are studied for the angular distributions of fragments ions with respect to incoming projectile direction. We have used the technique of recoil ion momentum spectroscopy (RIMS) for measuring momenta of fragment ions in coincidence.

The angular distribution of the correlated dissociation fragments with respect to the beam direction has been topic of interest for both experimentalists and theoreticians. This is of fundamental importance in various areas of science and technology (see, e.g. [1]). In the past decades, many experimental methods have been used to study the anisotropy in the angular distributions of fragments of multiply ionized molecules formed by impact of highly charged ion (e.g. [2] and references therein).

To study the angular distribution of fragmented ions, we performed an experiment in which a beam of multiply charged ions 1.8 MeV Xe^{9+} are made to collide with neutral OCS molecules. This experiment was performed at the Low Energy Ion Beam Facility (LEIBF) of the Inter University Accelerator Centre (IUAC), New Delhi, India. At the collision point one or more electron(s) are released and the molecule gets multiply ionized (i.e. OCS^{q+}). The technique of multi-hit RIMS, using an electron signal as a start and employing a position sensitive microchannel plate (MCP) detector was used to measure the time and position information of the recoil ions generated upon fragmentation of OCS^{q+}. The three-dimensional momentum vectors are derived from the measured time of flight and position information of the detected fragment ions (for details see [3]).

The dissociation of OCS^{q+} molecular ions can have many possible two body fragmentation channels. According to charge on fragment ions, we classify dissociation channels into two categories: charge symmetric e.g. (CO^+, S^+) and charge asymmetric e.g. (CO^+, S^{2+}). These channels are studied for angular distribution of their momentum vectors with respect to projectile ion beam. For an isotropic distribution of the fragment ions, the angular distribution is expected to follow a $sin\theta$ distribution. The angular distributions of fragment ions resulting from symmetric channels match well with $sin\theta$ distribution, however for the asymmetric case, the angular distributions of fragment ions deviate from $sin\theta$ distribution. A deviation from the sine distribution indicates anisotropy. The anisotropy of (CO^+, S^{2+}) asymmetric channel varies with its measured kinetic energy release (KER). This KER distribution ranges upto about 28 eV. If we divide the KER range into three equal parts, the maximum anisotropy is shown for KER condition over lowest range i.e. 0 to 9 eV (see figure 1). Further, we note that the fragment ion of higher charge of asymmetric channel is emitted preferentially in the backward to the beam direction. For example, in (CO^+, S^{2+}) channel, the S^{2+} is observed in the backward direction.

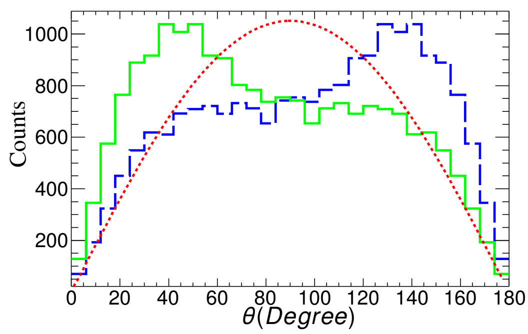

Figure 1. Angular distributions for breakup of OCS^{3+} into CO^++S^{2+}. θ is the angle between momentum vector of fragment ion and direction of incoming projectile. The dashed (blue) line and solid (green) line indicate the angular distribution of S^{2+} and CO^+ fragments, respectively. The dotted red line is for the $sin\theta$ distribution. This plot is under the condition $0 \leq$ KER ≤ 9 eV.

References

[1] Z. D. Pesic *et al.* 2009 *J. Phys. B: At. Mol. Opt. Phys.* **42** 235202

[2] B. Siegmann *et al.* 2003 *Nucl. Instr. and Meth. in Phys. Res.B* **205** 629-633

[3] Kumar *et al.* 2014 *J. Mass Spect.* **374** 44

[1]E-mail: harendraamu@gmail.com
[2]E-mail: jrajput.du@gmail.com