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Angular distributions of multiply charged fragments from dissociation of Nitrogen molecules by Xe^{9+} impact

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Synopsis The angular distribution of the correlated molecular fragments with respect to the incoming beam direction for several of dissociation channels of multiply charged N_2 molecule on collision with Xe^{9+} was studied.

The angular distribution of the correlated molecular fragments with respect to the beam direction has been an active field of research both experimentally and by theoreticians due to the fundamental importance of these processes in many areas of science and technology. In the past two decades, significant experimental efforts have been devoted to studies of anisotropy in the angular distribution of fragments in fast highly charged ion-molecule collisions [1, 2]. The study of anisotropy in the angular distribution of fragments from highly charged molecular ions produced in slow highly charged ion collision is still mostly unexplored.

We present result on the angular distribution of fragmented nitrogen molecules emerging from collision between 450 keV Xe^{9+} projectile and neutral N_2. The measurements were made using a multihit, position sensitive, time of flight based recoil ion momentum spectrometer. The experiment was performed using the ECR ion source based low energy ion beam facility (LEIBF) at Inter-University Accelerator Centre (IUAC), New Delhi, India [3].

Several possible channels observed in the dissociation of multiply charged N_2 molecules formed by the impact of Xe^{9+} are studied. We have found that for the symmetric dissociation channels, the distribution of fragments is isotropic in nature. But in the case of asymmetric dissociation channels, the distribution of fragments are anisotropic. To confirm the nature of the distribution, we compared our result with results of Monte Carlo simulations for isotropic distributions of the fragments. We find that the simulated results match well with the angular distribution of fragments from symmetric channels. This shows that the angular distribution of fragments from symmetric channels is isotropic. But in the case of the angular distribution of fragments in asymmetric dissociation channels, the measured results do not match with the results of the simulation. We find that in any asymmetric dissociation channel the recoil ion fragment with the higher charge is emitted preferentially in the backward direction with respect to the beam direction. For example, in the dissociation channel $N_2^{3+} \rightarrow N^{2+} + N^{+}$, the N^{2+} fragment is preferentially observed in the backward direction as shown in figure 1 .

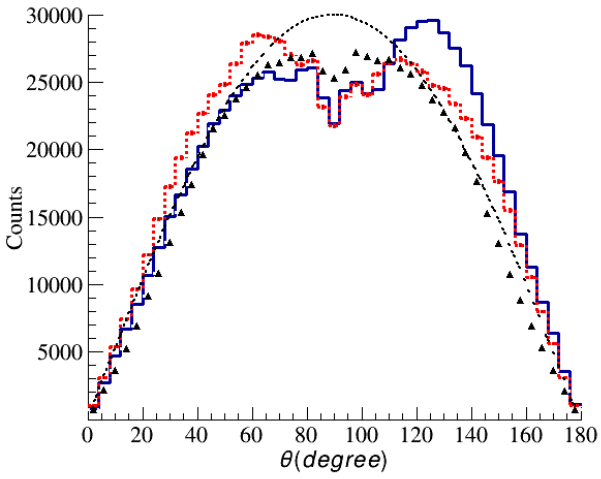

Figure 1. (color online) Angular distribution of fragments observed in the dissociation channel $N_2^{3+} \rightarrow N^{2+} + N^{+}$ with respect to projectile direction (θ). The blue (thick solid line) and the red (dashed line) curves represent the angular distribution of N^{2+} and N^{+} fragments respectively. The smooth dotted curve is the sine theta distribution expected from an isotropic distribution while the black triangles show the expected distribution after taking into account the spectrometer acceptance.

References

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