Three-body fragmentation dynamics of N_2O induced by 56 keV/u Ne^{8+} collision

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Synopsis: We report the concerted and sequential three-body fragmentation dynamics of the highly charged N_2O.

The formation and the decay dynamics of multiply charged molecules are of considerable interests to physics and chemistry as well as biology. In recent years, with the development of multiple coincidence methods using time- and position-sensitive detection, the study in this field, especially on the fragmentation dynamics of highly charged molecules using ion, electron and photon collisions [1-7], has been fuelled.

N_2O is a typical linear molecule where the two N atoms (terminal N_t and central N_c) are not equivalent. This may make it interesting to study the dissociation dynamics of N_2O. Here, we report the study of three-body fragmentation dynamics of highly charged N_2O induced by 56 keV/u Ne^{8+} collision. The experiment is performed by using Reaction Microscopes mounted on the 320 kV highly charged ions platform at the Institute of Modern Physics in Lanzhou. As an example, Figure 1 presents the Dalitz plot and Newton diagrams for three-body fragmentation of N_2O^{3+}. As shown in Fig. 1(a), we can observe an intense region at around x = 0 and y = -1/3 ~ -0.1 which represents a one-step concerted fragmentation process, $N_2O^{3+} \rightarrow N_t^+ + N_c^+ + O^+$ (denoted as Ch1), including Coulomb explosions from linear and bent geometries of N_2O^{3+}. The wing-like structures on the right and left sides of the x=0 line are the signature of the sequential fragmentation process. The left wing represents a two-step process that one O^+ is removed from N_2O^{3+} leaving a metastable N_2^{2+} ion which sequentially dissociates into two N^+ ions, $N_2O^{3+} \rightarrow N_2^{2+} + O^+ \rightarrow N_t^+ + N_c^+ + O^+$ (Ch2). While the right one indicates that the terminal N^+ is removed from N_2O^{3+} leaving a metastable NO^{2+} ion which successively dissociates into N^+ and O^+ ions, $N_2O^{3+} \rightarrow N_t^+ + NO^{2+} \rightarrow N_t^+ + N_c^+ + O^+$ (Ch3).

If the lifetime of the metastable N_2^{2+} and NO^{2+} is more than (or at least of the same order) their half-rotational time period, then semicircular structures will be seen in the Newton diagrams. It is found in Fig. 1(b)-(d) that the three-body fragmentation dynamics of N_2O^{3+} is identified clearly from the Newton diagrams. More information about the decay channels and the kinetic energy release distributions of multiply charged N_2O^{q+} will be presented in the poster.

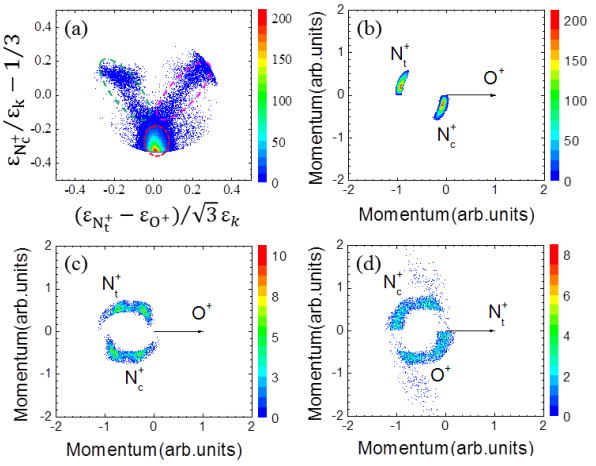

Figure 1. Dalitz plot and Newton diagrams for three-body fragmentation of N_2O^{3+}. (a) Dalitz plot. (b) Newton diagram for the Ch1 concerted process. (c) Newton diagram for the Ch2 sequential process. (d) Newton diagram for the Ch3 sequential process.

References

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