Excitation and fragmentation in high velocity C_nN^+ - He collisions

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Synopsis: We will present measurements and modeling for two aspects of the C_nN^+ - He collisions (n=1-3, v=2.25 a.u) : cross sections for electronic excitation processes and fragmentation branching ratios for the excited and ionized C_nN^{q+} molecules produced in the collision (q=-1,0,1,2-5).

The study of molecule-atom collisions is a difficult topic, both from the experimental and theoretical point of views. In the high velocity regime, mostly small molecular systems have been studied [1]. On the other hand, the so-called Independent Atom and Electron (IAE) model was applied recently with reasonable success to C_n^+-He, Ar systems with state of the art CTMC and SCAOCC P(b) probabilities [2]. We will test this approach again in this work.

Fragmentation of the excited molecular system is another topic of interest. In high velocity collisions (τ_{coll}~10^{-16}s) it occurs well after the excitation and can be treated separately. The MMMC approach and its new more general version M3C [3] is dedicated to treatment of statistical fragmentation. The systems studied here belong typically to this class of fragmentation [4]. We will ultimately compare our experimental fragmentation branching ratios (BR) to predictions of this statistical approach.

Experiments have been performed at the Tandem accelerator in Orsay with beams of C_nN^+ molecular ions (n=1-3) of constant velocity v=2.25 a.u colliding with helium atoms. The setup is identical to the one described in [5] (see also Jallat et al, this conference). Briefly the setup allows to reconstruct, from fragments complete collection and identification in charge and mass, the charge q of the projectile after the collision, signature of the process. An example is given in Table 1 for the case of double electron capture (q=-1) in the C_2N^+ - He collision where contribution of various channels to the $\{C_2N^-\}$ production is reported.

We will present two types of results. First experimental cross sections for various electronic processes will be presented and compared to predictions of the IAE + CTMC calculations. These calculations will use structure calculations for C_nN^+ systems that we performed. Second, fragmentation BR for C_nN^{q+} species with q=-1,0,1,2,3-5 will be presented. In addition to the fundamental aspects discussed before, these BR are also of interest in astrochemistry as already pointed out [6]. Note than C_nN species, on their neutral and anionic forms, have been detected in interstellar medium [7] and planetary atmospheres [8].

Table 1 Measured fragmentation BR of $\{C_2N^-\}$ species produced by double electron capture in the collision C_2N^+ - He (v=2.25 a.u).

Channel	Exp. BR	Error
C_2N^-	0.40	0.04
CN^- + C	0.51	0.06
C^- + CN	0.07	0.02
C_2^- + N	≤0.01	
C^- + C + N	0.020	0.012

References

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