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To cite this article: P. K. Najeeb et al 2017 J. Phys.: Conf. Ser. 875 122004

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IOP Conf. Series: Journal of Physics: Conf. Series 875 (2017) 122004

### Exploring metastable decay dynamics of polycyclic aromatic nitrogen containing hydrocarbons upon HCN evaporation

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Synopsis : Dicationic states of isoquinoline fragment is explored. A tail feature is observed in the coincidence map showing that  $C_8H_6^{2+}$  has a metastable state. Using time of flight difference spectrum life time has been estimated to be ~75ns.

Polycyclic Aromatic Nitrogen containing Hydrocarbons (PANHs) are known to be stable. In the interstellar regions photo or thermal processing may lead to dissociation of these species[1]. Earlier studies have focused on understanding the product formation from neutral and mono-cationic PANHs. However, the product formation from dicationic PANHs (present in interstellar) species has received far less attention. Moreover, understanding the dissociation of these metastable states may give us a hint regarding how the association reactions could have progressed to form these intact dications. Thus, to understand the mechanisms involved in the metastable dicationic species, simplest of PANHs quinoline  $(C_9H_7N^+)$  (and its isomer isoquinoline  $(C_9H_7N^+)$ ) have been chosen. Even though, loss of  $C_2H_2$  or HCN is feasible from these species, it has been shown that HCN is energetically favorable. In this article, we report metastable intermediate states that could be involved in the formation of  $C_7H_3^+$ , which belongs to  $C_{2n+1}H_3$  class and unlike their analogues  $C_3H_3$  and  $C_5H_3$  less explored. We report  $C_7H_3^+$  from quinoline and isoquinoline through an intermediate  $C_8 H_6^{2-1}$ which possess a metastable state.

quinoline/isoquinoline 
$$\rightarrow C_8 H_6^{2+}$$
 +HCN (1)  
 $C_8 H_6^{2+} \rightarrow C H_3^+$  + $C_7 H_3^+$  (2)

Earlier reports have obtained  $C_8 H_6^{2+}$  in the time of flight spectrum [2], since only a single hit information is obtained, it was attributed to be a stable species. Field et al.[3] have shown that the intensity variation of the difference of the time of flight(ToF) of the two ions in the tail region can give us an quantitative estimate regarding the lifetimes of the metastable species as shown in eqn.3.

$$I(t_2 - t_1) = Aexp(-\frac{m1 + m2}{m1 - m2} \frac{t_2 - t_1}{2\tau})$$
(3)

Here, m1 and m2 denotes the mass of the two fragments the metastable state is dissociating into,

au denotes the lifetime. It should be noted that the  $C_7H_3^+$  molecule and its isomers are linear in their ground state. Moreover, removal of  $CH_3^+$  is not energetically favored from the ring structures of  $C_8H_6^{2+}$ . The experiment was performed using ECR ion source based low energy ion beam facility (LEIBF) at Inter-University Accelerator Centre (IUAC), New Delhi, India [4].

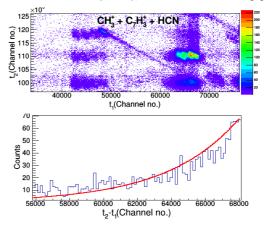


Figure 1. Top: The tail structure shown is formed when lifetime of parent  $C_8 H_6^{2+}$  has lifetime comparble to the time of flight of the fragments. Bottom: Shows the experimental intensity distribution as the function of ToF difference. This function is fit (red line) with eqn.3. giving lifetime ( $\tau$ ) of  $C_8 H_6^{2+}$  as ~=75ns.

#### References

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