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# GAS-PHASE ION-MOLECULE CHEMISTRY: CONTROLLED REACTIONS OF $\text{CH}_3^+$ AND $\text{C}_3\text{N}^-$

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In this contribution, we will present recent results concerning ion-molecule reactions of both cations and anions obtained with the CERISES set-up: a guided ion-beam experiment.

First, we will report on reactions of the  $\text{CH}_3^+$  ion with several small hydrocarbon molecules ( $\text{CH}_4$ ,  $\text{C}_2\text{H}_2$ ,  $\text{C}_2\text{H}_4$ ...). The originality of these experiments is to monitor the effect of internal degrees of freedom (vibrational, electronic) on reactivity. Control of the degree of internal excitation in the parent-ion is achieved by producing the  $\text{CH}_3^+$  ions *via* direct photoionization of a molecular beam of  $\text{CH}_3\cdot$  radicals and by tuning the energy of the VUV photon (DESIRS beamline, synchrotron SOLEIL). Branching ratios and absolute reaction cross-sections have been obtained for different reactive systems, and their dependence on vibrational and electronic excitation of the parent ion will be discussed [1]. This will guide us to identify the systems for which further state-to-state reactivity experiments are relevant. The CERISES experiment indeed also allows for pure state selection of the parent ion thanks to photoelectron-photoion coincidence techniques [2].

In addition to cations, it is now possible to study the reactivity of anions on CERISES. The first results obtained concern the reaction of the  $\text{C}_3\text{N}^-$  ion with the acetylene molecule. In this latter experiment, we focus on the control of collision energy of the parent-ion with the reactant molecule. Three reactive channels leading respectively to  $\text{C}_2\text{H}^-$ ,  $\text{CN}^-$  and  $\text{C}_5\text{N}^-$  have been observed. Although, formation of the last two products is exoergic, all reaction pathways exhibit large barriers as confirmed by the observation of energetic reaction thresholds for all of them [3]. The contribution of this reaction to the growth of larger anions is thus unlikely.

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## REFERENCES

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