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Study of the photolytic dissociation processes of methane within the framework of S.E.T. U.P., an experimental simulation program of Titan's atmosphere

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As methane is the second most abundant gas in Titan's atmosphere, its photolytic behaviour is a key question to the understanding of the active photochemistry occuring in this fascinating atmosphere. For this reason, an experimental simulation program called S.E.T. U.P. (french acromym for Theoretical and Experimental Simulations Useful for Planetology) is currently developped in our laboratory. Its first goal is to investigate the mechanisms implied in the atmospheric chemistry of Titan.

The starting step of this program consists of a comprehensive study of methane photolysis. Indeed, the nature of the primary fragments issued from its atmospheric photolysis determines the formation of more complex molecules. The point is that the conditions of Titan's atmospheric photolysis could not be exactly reproduced in our experiments. A KrF excimer laser has been prefered for our simulation device considering the difficulty to work in the VUV range. This way, photolysis of methane will occur via a two-photons process at 248 nm energetically equivalent to the atmospheric one involving mainly an unique Lyman-α photon (121.6 nm).

With respect to our concern, it is thus of primary importance to characterize this multiphotonic photolysis in comparison with the Ly-α one. So comparative irradiation experiments of methane at 121.6 and 248 nm have been carried out in order to follow, by means of IR spectroscopy, the appearance and the abundances of hydrocarbons formed during the photolysis. These data will permit to establish the relevance and the representativeness of the experimental simulations to come.

This experimental work and its interpretation based on a 0D theoretical model will be presented.