SETUP Program: Presentation of New Laboratory Simulations of Titan's Atmosphere and their Related Experimental and Theoretical Studies on Nitrogen Plasma and Methane Photolysis

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With the aim to mimic the active atmospheric chemistry of Titan, a great number of laboratory experiments have been performed simulating the evolution of gaseous mixture containing N_2+CH_4 when submitted to energy flux. We are developing a new program of Titan's simulations (named SETUP, a French acronym for Theoretical and Experimental Simulations Useful for Planetology) which specificities are:

i) Representativeness towards Titan's condition improved in term of energy deposition: the coupled N_2/CH_4 chemistry is initiated in a flow reactor by both electrons (plasma discharge) and photons (Lyman α or 248 nm irradiations delivered by a continuous H_2/He lamp or a pulsed KrF laser respectively),
ii) Determination of the chemical mechanisms involved thanks to the detection of the stable species as well as the short life intermediates by in situ, qualitative and quantitative, time resolved Cavity Ring Down Spectroscopy.

The final goal of this program is to determine precisely the implied chemistry, and consequently, refine its description in theoretical models.

As a first step of the SETUP program, the Two-photon Absorption Laser Induced Fluorescence spectroscopy has been used to determine the absolute ground state atomic nitrogen density N (^{4}S) present in the reactor as the function of the plasma discharge conditions and the N_2/CH_4 ratio in the initial mixture. Secondly, as the different decomposition pathways of methane dissociation are not established at Lyman α and are totally unknown at 248 nm, CH_4 photolysis experiments at both wavelengths have been undertaken and tentatively explained with a 0D photochemical model. The implications of these plasma and photolytic studies for the future Titan's simulations program will be discussed.