From Observational Spectroscopic Studies to Experimental and Theoretical Simulations of Titan's Organic Chemistry

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Titan's atmosphere, mainly made of N_2 with methane as the second major gas, is the place of a rich organic chemistry that leads to the production of numerous hydrocarbons (e.g. C_2H_6 and C_2H_2*)* and nitriles (e.g.HCN).
Thanks to the Cassini-Huygens mission, our knowledge of Titan's composition has been greatly improved. However, some fundamental parameters such as absorption cross sections are still missing to interpret UVIS and CIRS observations. With the aim to analyse UVIS data, we have determined low temperature VUV high resolution spectra that can be used to feed models. These experiments have been carried out using VUV synchrotron facilities (BESSY II in Germany and SOLEIL in France). The most recent results concerning hydrocarbons like C_4H_2 and C_6H_2, and nitriles like HCN, HC_3N, HC_5N, C_2N_2, and C_4N_2 will be presented. At the same time, we have also built new infrared line list for several molecules like HC_3N, C_4H_2 and C_2N_2, in order to better analyse CIRS observations. Latest results will also be presented in this field.

Despite the theoretical studies recently developed, the chemical mechanisms involved in the evolution of Titan's atmosphere are not known yet with accuracy. As an example, the incorporation of nitrogen in the solid phase via photo-oligomerisation is still poorly characterized. That is the reason why new simulations are carried out in our laboratory. The initial gas mixture is exposed, for the first time, to both electrons and photons in order to improve the representativeness of such experiments. To quantify "in situ" the stable species as well as the short life intermediates involved in this complex chemistry, a time resolved technique will be used. Then, the implied chemistry will be determined precisely, and consequently, its description will be refined in theoretical models. The current status of this program will be given.