

**Laboratoire** : Physique des Interactions Ioniques et moléculaires (PIIM), UMR 7345, Aix Marseille Université, Centre de Saint Jérôme, case 252, 13397 Marseille cedex 20

**Equipe** : ASTRO

**Directeur de thèse** : Isabelle Couturier

**Co-directeur** : Eric Quirico (IPAG Grenoble)

### PhD project summary

Titan, Saturn's largest satellite, is the only satellite in the solar system to have a dense atmosphere (1.5 bar) composed mainly of nitrogen and a few percent of methane. Subjected to various sources of irradiation, this atmosphere constitutes a very reactive medium evolving by molecular growth and by permanent production of aerosols. Among the molecules formed, hydrocarbons ( $C_6H_6$ ,  $C_4H_2$ ...) and nitriles ( $HC_3N$ ,  $HCN$ ...) are known to condense in the lower stratosphere and lead to the formation of icy particles (Figure 1). During their stay at the level of the lower atmosphere (stratosphere and troposphere), these particles are then subjected to radiation of wavelengths higher than 230 nm and presumably to GCR ions, and can thus evolve chemically. The objective of this project is to study the aging of the ice formed in the lower stratosphere of Titan. For that, the student will have to take in hand the experimental device (PIIM) in order to condense the molecules present in the stratosphere while making them undergo the average UV radiations and electronic bombardments. In order to analyze the results, the student will use infrared spectrometry, UV spectrometry and very high-resolution mass spectrometry. The student will have to travel to Grenoble and Caen to carry out some experiments and model the interactions of aerosols with ion sources from both a qualitative and quantitative point of view, in particular the  $dN/dE$  flux density of GCRs in the atmosphere.

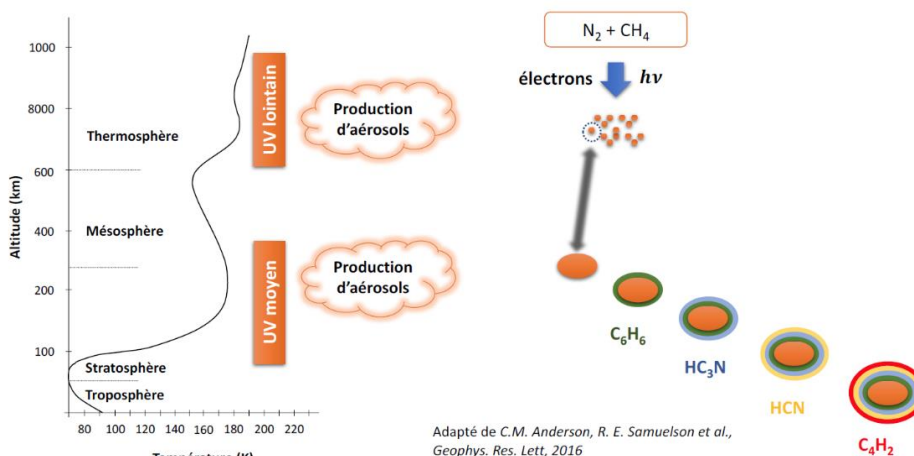


Figure 1: Aerosol evolution in Titan's atmosphere

### Expected profile of the candidate

Candidates for the PhD position should have a Masters' degree in chemistry, with major interest in spectroscopy, physical chemistry and analytical chemistry. The successful applicant will have obtained excellent grades in his/her Bachelor and Master's degrees (or equivalent). He/she should be well motivated, hardworking, willing, and able to work as part of a team. Background / experience in astrochemistry would be beneficial, interest for planetology welcome. Applicants are invited to send their CV, a cover letter, their transcripts of academic records, and the contact information for at least two references to Isabelle Couturier ([Isabelle.couturier@univ-amu.fr](mailto:Isabelle.couturier@univ-amu.fr)) before June 10.

ANR funding has already been secured for this project.

### Références bibliographiques :

1. I. Couturier-Tamburelli, M. S. Gudipati, A. Lignell, R. Jacovi, N. Piétri, *Icarus* 2014, 234, 81–90.
2. M. S. Gudipati, R. Jacovi, I. Couturier-Tamburelli, A. Lignell, M. Allen, *Nat. Commun.* 2013, 4, 1648.
3. J. Mouzay, I. Couturier-Tamburelli, N. Piétri, T. Chiavassa, *J. Geophys. Res. Planets*, 2021, 126, e2020JE006566.
4. J. Mouzay, K. Henry, A. Ruf, I. Couturier-Tamburelli, G. Danger, N. Piétri and T. Chiavassa, 2021 *Planet. Sci. J.* 2 37.

