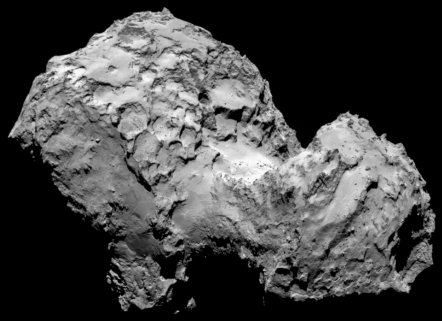
Rosetta and ExoMars



SUMMARY.
ESA's Rosetta mission had made spectators from all over the world dream: On Wednesday, 12 November 2014, the Rosetta mission tried to pose the little robot Philae on the nucleus of comet 67P/Churyumov-Gerasimenko. The Rosetta Space Probe collected information about the composition of the comet nucleus during its spectacular approach to the sun. Our gas chromatograph coupled to a mass spectrometer was on board. The lecture will summarize the main successes of the cometary Rosetta mission and look forward to ExoMars that includes our gas chromatograph coupled to a mass spectrometer and that will be launched in the near future.

OBJECTIVES

Students will learn how to design scientific instruments for space missions, how to accompany space missions with the help of laboratory experiments and how to treat space mission data. Gas chromatography and circular dichroism spectroscopy will be teached along with enantiomers, chirality, and stereochemistry.

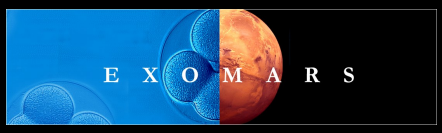
PREREQUISITES

BSc. (Licence 3) in physics, astrophysics, or chemistry.

THEORY

by BY UWE MEIERHENRICH

The aim of this Meteor is to better understand the molecular composition of a cometary nucleus. We therefore develop and teach a theoretical model on the formation of comets from dust grains in interstellar clouds. According to this model micro-meter sized dust grains accrete ice layers of volatile compounds that condense. During irradiation of those condensing volatiles the formation of molecules is assumed. The chirality and stereochemistry of those molecules will be teached; they contain important hints on their formation pathway and environment.



APPLICATIONS

by BY UWE MEIERHENRICH

Based on the 'Greenberg' model we simulate the formation of interstellar ices in the laboratory. We condense volatile molecules such as H2O, NH3, CO, CO2, and CH3OH in an ultra-high vacuum from the gas phase onto a cooled surface of T = 12 K. The gas chromatograms of the room temperature residues of the cometary ice analogues will be interpreted concerning their molecular composition. The ice analogues were already shown to contain amino acids, aldehydes and ribose. Students will compare the laboratory simulation experiments with original data of the cometary Rosetta mission : The cometary sampling and composition (COSAC) instrument, a device onboard Philae, which we developed in an international partnership lead by the Max Planck Institute for Solar System Research, is a gas chromatograph using eight stationary phases coupled with a mass spectrometer time of flight type. 25 minutes after Philae's landing and bouncing on the cometary nucleus, COSAC successfully performed the first chemical analysis of cometary surface material that cannot be analyzed from the Earth. 16 organic molecules were identified in the cometary sample by using COSAC's MS-only mode. After two additional bouncing events Philae finally landed on the cometary surface and operated for 60 h. During this time the COSAC instrument recorded 420 mass spectra in the enantioselective GC-MS mode. The identification of organic species in these mass spectra will be envisaged. Data will be interpreted in view of the ExoMars mission 2020 that involved our enantioselective GC-MS instrument.

MAIN PROGRESSION STEPS

- Theoretical courses, project development.
- Last week : preparation of the final oral presentation.

EVALUATION

- Type of examinations: written and oral presentation.
- Half project and half oral presentation will be evaluated

BIBLIOGRAPHY & RESSOURCES

Reference
Link

CONTACT

☎ +33 489 150146 (supervisor)
✉ Uwe.Meierhenrich@unice.fr