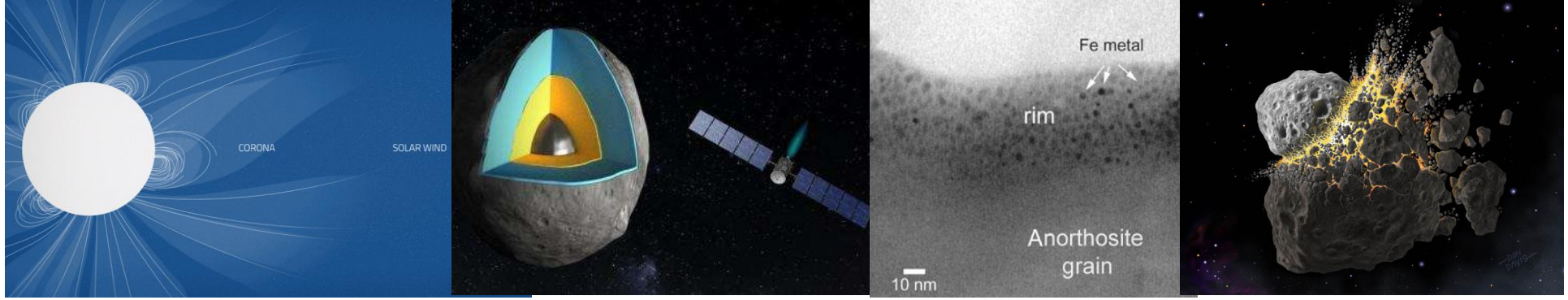

Laboratory experiments on Complex Organic Molecules (COMs) of interest for Astrobiology

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Astrobiology

one of the main challenges

comprehension of the physical–chemical principles governing the evolution of

Complex Organic Molecules (COMs) into prebiotic systems

COMs are considered to be potential building blocks of molecules of biological interest (such as amino acids, sugars, and nucleobases) and have been already detected or tentatively detected in various astrophysical environments (from interstellar clouds and protoplanetary disks (e.g., [1-5]) to the outer solar system (e.g., [6-9]).

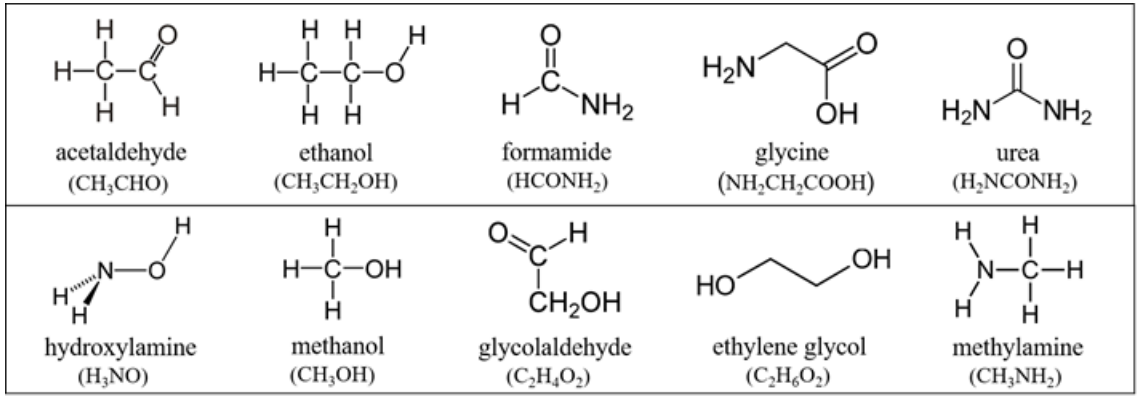

Fig. Example of simple COMs of astrobiological interest [10]

Astrobiology

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Infrared (IR) spectroscopy and **mass spectrometry (MS)** are the most commonly used techniques for the study of simple solid-state COMs under conditions simulating the space environment.

However ***these techniques have reached their intrinsic limit when analyzing larger COMs:*** is not always possible to distinguish the spectral contribution coming from larger species and their proper identification.

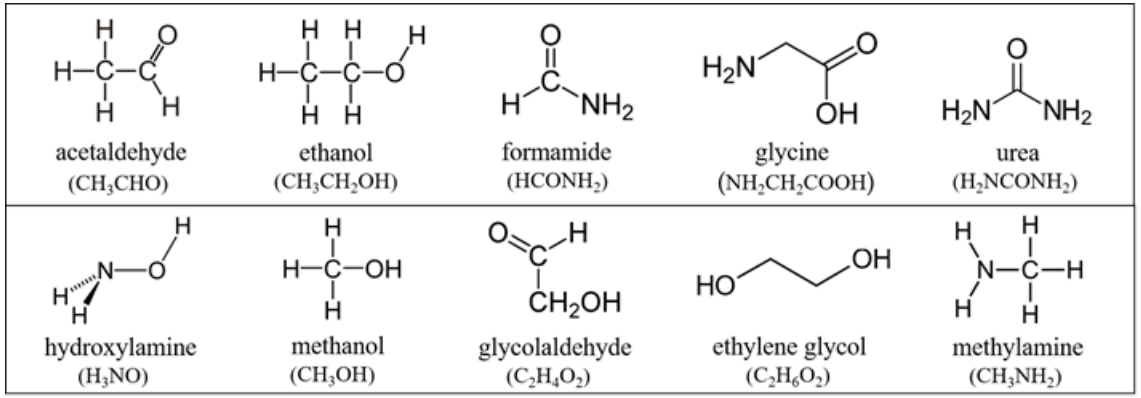

Fig. Example of simple COMs of astrobiological interest [10]

State of the art techniques

(able to overcome the limitations of IR spectroscopy and MS)

1) Orbitrap Mass Spectrometry (Orbitrap-MS)

2) Time Of Flight Mass Spectrometry (TOF-MS).

Pros:

These are high-resolution techniques able to identify and discriminate larger COMs and have been proven to have huge applications when working with large biomolecules [10, 11].

Orbitrap-MS and TOF-MS can also be coupled to traditional IR spectroscopy, resulting powerful validating tools for the correct interpretation of IR astronomical observations.

Cons:

These are expensive technique, therefore strongly limiting their diffuse availability.

To date there are no INAF laboratories employing such high-resolution techniques, leaving a gap with the most innovative astrobiology laboratories in the world.

<u>The main goal of this proposal is to gain the knowledge and expertise regarding these high-resolution techniques:</u>

Orbitrap-MS ***TOF-MS***

This goal will be achieved by means of dedicated research visits to laboratories which offer these state of the art techniques to perform experiments on the characterization of COMs and biomolecules of astrobiological interest.

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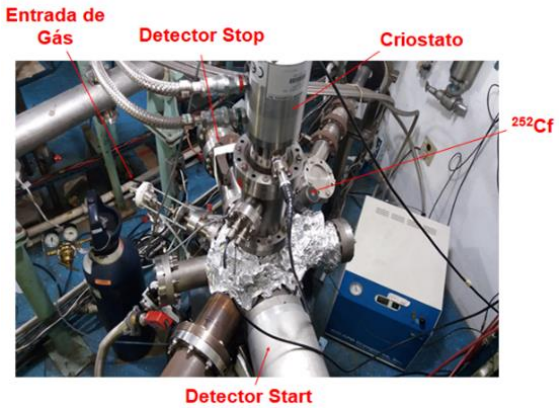
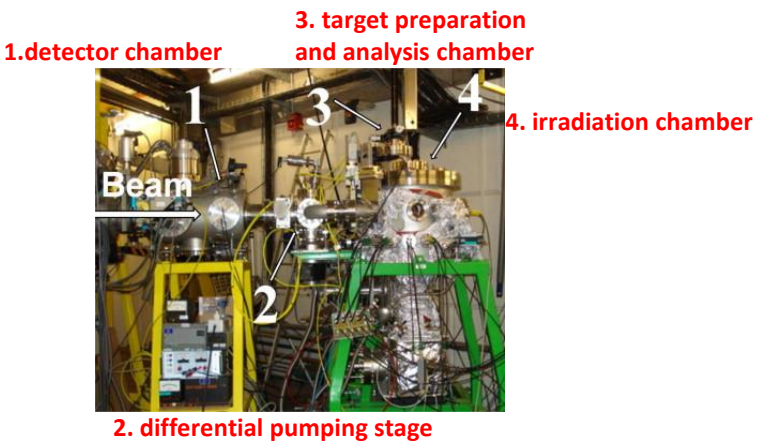
Thanks to long-standing and consolidated collaborations, we will operate and perform dedicated experiments in the following laboratories:

1) VDG Laboratories - Pontifical Catholic University of Rio de Janeiro (Brazil): TOF-MS



2) GANIL Laboratories in Caen (France): TOF-MS



3) Max Planck Institute for Astronomy in Heidelberg (Germany): Orbitrap-MS

The main goal of this proposal is to gain the knowledge and expertise regarding these high-resolution techniques:

Orbitrap-MS ***TOF-MS***

Additional Benefits:

Short-term:

publications in high-level peer-review journals, from the experiments performed in the framework of this proposal;

Medium- (3-5 years) and long-term (5-10 years):

the gained expertise will give us the ***possibility to apply for major national and international funding opportunities to upgrade our laboratories*** and compete with the leading laboratories in this research area full of possibilities;

We believe that the whole INAF community of astrochemists and astrobiologists could benefit from the unique technological and scientific heritage acquired through this project.

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Thanks

Participants

Daniele Fulvio will lead the project. He will write and submit research proposals for the competitive evaluation and assignment of experimental time slots at the GANIL Laboratories in Caen (France). He will perform most of the laboratory experiments, analyze and interpret experimental data, write scientific publications, and present results at national and international scientific conferences, meetings, and workshops.

Giovanni Strazzulla will assist with most phases and tasks of the project. In particular, he will perform some of the experiments and will assist with the analysis and interpretation of experimental data and writing of scientific publications. He will also present results at national and international scientific conferences, meetings, and workshops.