



MSc. Projects in Astrochemistry

Are you interested in studies on chemistry in space?

The organic inventory and chemistry in the Universe is more diverse and complex than we ever imagined. This carbon chemistry plays a major role in planet and star formation and possibly life. Organic pre-building blocks of life seem to be abundant throughout the universe [1]. Our aim is to unravel the shapes and size of organics in space and the role they play in planet formation and the origins of life as well as look for their signatures. To do so, we investigate both the photochemical evolution and the spectral signatures and work with Leiden Observatory and NASA to combine our research directly with observations. There are two major spectral regions that are believed to reveal the organic inventory of the universe. These are the **Diffuse Interstellar Bands (DIBs)** and the **Aromatic Infrared Bands (AIBs)**. The DIBs are thought to represent the cosmic reservoir of *large organic material*. Though first observed a century ago, they remain a near-complete mystery with only a few lines identified of the over 400 lines observed. The AIBs are linked to *Polycyclic Aromatic Hydrocarbons (PAHs)*. Though their C-C and C-H vibrations are clearly visible, their exact nature is unknown and not a single individual molecule has been identified to date.

Research Questions

- What is the cosmic inventory of large organic matter?
- What is their organic evolution?
- What is their role in the origins of life?

Possible MSc projects:

- Measure spectral signatures and photochemical behaviour of PAHs using gas-phase spectroscopy techniques [2]
- Predict UV/VIS transitions and search for organic candidates using a semi-empirical all-valence-electrons theory

For *excellent BSc students* who have a min. of 3 months research time, a possibility may be created.

Collaborations:

Leiden Observatory: Dr. Candian, Prof. Tielens
 Radboud University: Prof. Oomens, Dr. Bakker
 NASA Ames: Dr. Lee
 University of Western Ontario: Prof. Cami

References

1. Rev. Mod. Phys. 85 (2013) 1021
2. A&A 610 (2018) A65, PCCP 20 (2018) 1189, ApJ 831 (2016) 58, JCP 145 (2016) 084313, ApJ 826 (2016) 33, JCP 143 (2015) 224314, ApJ 814 (2015) 23 (Err.: ApJ 820 (2016) 81), JCP 141 (2014) 241104



Interested?

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