High-Resolution Rotational Spectroscopy of Potential Exoplanet Biosignatures in Excited Torsional States

PhD Position – ANR-EXOBIOLAM Project

Host laboratory: Laboratory of Physical-Chemistry of the Atmosphere (LPCA) – Université du Littoral Côte d'Opale (ULCO), Dunkirk, France.

Research team: Molecular Physical-Chemistry & Instrumentation / THz Spectroscopy.

PhD supervision: Prof. Arnaud Cuisset & Dr. Anthony Roucou.

Scientific collaborations: Dr. Luyao ZOU (Junior Professor Chair, LPCA Dunkirk) and Dr. Isabelle Kleiner (CNRS Research Director, LISA Créteil) + Pierre Drossart (Astronomer, IAS, Paris).

Project description:

Within the framework of the ANR-EXOBIOLAM project, this PhD aims to provide crucial laboratory spectroscopic data for the interpretation of observational spectra from the James Webb Space Telescope (JWST). The objective is to detect potential "biosignatures" such as methanol (CH_3OH), methyl mercaptan (CH_3SH), dimethyl sulfide (CH_3SCH_3), and dimethyl disulfide (CH_3SSCH_3) in exoplanetary atmospheres.

The PhD candidate will employ state-of-the-art THz spectroscopy techniques (resonant cavity absorption methods: CEAS and CRDS) developed at LPCA, as well as measurements coupled to the SOLEIL synchrotron. The work will focus on measuring rotational transitions with ultimate precision in highly excited torsional states (v_t = 3, 4) in order to improve theoretical models describing large-amplitude motions that perturb molecular energy levels.

Tasks and timeline:

Optimization of the spectrometer and recording of the methanol spectrum (Year 1); Recording and analysis of methyl mercaptan (Year 2) and dimethyl sulfide (Year 3) spectra; Measurement campaign on dimethyl disulfide at the SOLEIL synchrotron (Year 1), followed by dissemination of results through publications and national and international conferences (Years 2 and 3).

Application requirements and candidate profile:

Applicants should be graduated by a Master's degree (MSc) in Physics or Physical Chemistry, with solid foundations in optics and molecular spectroscopy; a strong interest in high-precision experimental work and molecular modeling; and the ability to work in a collaborative research environment involving multiple laboratories.

Funding: Doctoral fellowship (36 months, ANR co-funded).

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