PhD position
Institut de Physique de Rennes UMR CNRS 6251

Optical frequency comb spectroscopy for diagnostic in uniform supersonic flows for astrophysical applications

Job description: A PhD student position is available in experimental physics to perform research in laser-based precision spectroscopy for astrophysical applications. The position is funded by the French national agency for research (ANR) within the framework of the CECoSA project and by the French ministry of research.

Our understanding of the chemical composition and reaction kinetics of the interstellar clouds and planetary atmospheres remain incomplete. Observations are improving ever year, allowing the retrieval of ever more precise information. However, analysis of this information remains very challenging due to the extreme thermodynamic conditions probed. Without proper laboratory spectroscopic analysis of the species present in these atmospheres and understanding of the chemical mechanisms involved, no quantitative information can be retrieved from these space observations. Over the past decade, the advent of optical frequency combs has deeply transformed the field of laser-based precision spectroscopy. Such lasers are now used as the direct excitation source of the sample, providing broad spectral coverage, high resolution and fast measurement. Their spectral comb-like pattern is particularly suitable for coupling to enhancement-cavities, which makes comb-based cavity-enhanced spectrometers highly sensitive as well. The project aims at combining cavity-enhanced optical frequency comb spectroscopy with uniform supersonic gas flows to investigate spectra of astrophysical interest and explore the kinetics of nucleation processes and of chemical reactions involving radicals. It will take place in the Laboratory Astrophysics team of the Department of Molecular Physics. The group is internationally renowned for gas jet technology, which combined with optical or mass spectrometers enables the study of non-equilibrium molecular systems, and of kinetic phenomena such as chemical reactions and cluster formation.

The successful applicant will develop the mid-infrared optical frequency comb source and a time-resolved Fourier transform spectrometer which will be coupled to the uniform supersonic flow chamber. The system will be employed to study elementary nucleation processes, infrared spectroscopy of free radicals and kinetics of elementary reactions. Collaborations with other research groups are planned to cross-check spectroscopic results.

Required skills: The applicant should have a master degree in a relevant area of experimental physics or chemical physics. Knowledge in Matlab/Labview programming, and in the fields of electro-optics, optical cavities, absorption spectroscopy, and/or interferometry will be highly beneficial.

Contacts: Interested applicants should email an application letter, a resume and the contact details of two referees to
Lucile Rutkowski – lucile.rutkowski@univ-rennes1.fr, (+33)2 23 23 38 34
Robert Georges – robert.georges@univ-rennes1.fr, (+33)2 23 23 67 53