Advanced Expertise in Fundamental and Applied Research

This team of LLS specialises in high-resolution molecular spectroscopy for the study of gas mixtures, including atmospheric pollutants.
The team’s objectives are to understand the interactions within gas mixtures and to carry out applied research.

Three complementary approaches contribute to achieving the LLS objectives: experimental (measurements with cutting-edge instruments), theoretical (simulation with state-of-the-art models), and technological (development, co-development of instruments). As the importance of environmental issues grows, the ‘Atmospheric Pollutants’ team has been contributing its long-standing expertise in high-resolution molecular spectroscopy to atmospheric studies.The quantification of pollutants in the atmosphere can be deduced from atmospheric spectra recorded by instruments on various platforms (ground, satellite, stratospheric balloons, etc.). The analysis of these spectra, based on state-of-the-art physico-chemical models that require an accurate knowledge of spectroscopic parameters previously determined in the lab, allows the determination of pollutant concentrations and their spatiotemporal evolutions.

© UNamur - Prof. Dr. Muriel Lepère, director of LLS

The ‘Atmospheric Pollutants’ team uses its technological, experimental, and theoretical expertise, and the complementarity of these approaches, to determine accurate spectroscopic parameters in support of atmospheric studies. These parameters are needed for:

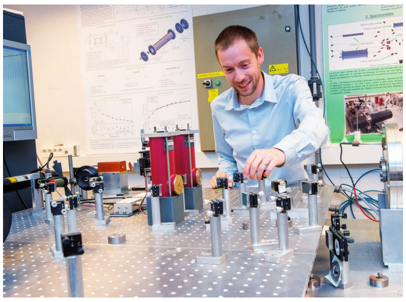
- Earth’s atmospheric pollutant concentration retrievals,
- Residual gases of combustion studies,
- Remote sensing of extraterrestrial atmospheres (planets, exoplanets, stars, etc.).

The LLS ‘Atmospheric Pollutants’ team is involved in numerous ongoing research projects. These include the study of methane under specific atmospheric (terrestrial, planetary) pressure and temperature conditions. Methane is diluted in various gases such as N_2, CO_2, or H_2O. Other studies focus on small hydrocarbons (such as acetylene) produced by diesel engines, the absorption spectrum of water vapour to clarify its role in the atmosphere (to prepare specific satellite missions), and nitrous oxide, relevant in the issue of nitrogen fertilizers.

The Lepère’s team’s expertise in spectroscopic studies of gases with great atmospheric interest explains its long-standing collaboration with the Royal Belgian Institute for Space Aeronomy (BIRA-IASB). This collaboration takes several forms:

- Joint participation in international projects, such as an ESA project on methane.
- Thesis co-supervisions, including one on the characterization of Mars’ atmosphere to determine whether the planet could host life, and others on Venus’ atmosphere to prepare a future space mission using the VenSpec-H instrument developed by BIRA-IASB.
- Postdoctoral collaborations, such as Dr. B. Vispoel, a former PhD student of Prof. Dr. M. Lepère, who now develops his expertise at LLS after stays in the USA and BIRA-IASB.
- Master’s lectures by Prof. Dr. A. C. Vandaele (IASB) on the sounding and physics of atmospheres at UNamur.

Today, the LLS ‘Atmospheric Pollutants’ team considers the increased performance of atmospheric sensing instruments and atmospheric models.
Laboratory measurements and calculations of spectroscopic parameters must achieve the accuracy required for future space missions.
Other challenges include the lab study of new gas mixtures relevant for terrestrial and extraterrestrial atmospheres, and exploring
extreme pressures and temperatures. Together, all these research efforts carried out by several teams worldwide will improve the
understanding of atmospheres and better predict the evolution of our atmosphere.



© UNamur - Dr Bastien Vispoel, F.R.S.-FNRS post-doctoral researcher at LLS

Laboratory of Lasers and Spectroscopies (LLS)
UNamur
Rue de Bruxelles 61 – B-5000 Namur
Tel.: +32 (0)81 724 584 – Email: muriel.lepere@unamur.be
https://www.unamur.be/en/sciences/physics/research/lls