Invited Lectures F

August 31, Wednesday, 9:00 – 10:30

Title: Towards Sustainable Absorption Spectroscopy

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Since a few years, the paradigm claiming that experiment is providing data with accuracy generally beyond the theoretical analysis needs is called into question. As an example, state of the art ab-initio calculations on H_2 are challenging the experimental limits for line strength and transition frequency determination. The latter is calling for the help of optical frequency comb (OFC) used as an absolute frequency ruler refining the (x) frequency axis, a technique born out of the metrology community. This quest for accuracy pushes us to consider series of potential biases, among which the real shape of the line profile could be one of the most deleterious. Series of refined models have been developed, impacting on both the total line surface and the line position retrieved out of a same dataset. To discriminate amongst the line profile zoology, high absorption axis (y) dynamics is mandatory, steered by the use of high quality optical sources and ultra sensitive absorption technique.

In this talk, we will first present the straightforward benefits brought by an "on the fly absolute frequency stamping" approach applied to a conventional continuous-wave cavity ring down spectrometer (cw-CRDS) referenced to an OFC. We will then describe our newly developed very stable and narrow laser source and highlight the improvements it leads on both x and y axes. Finally, we will explain why our ambitious metrological approach ought to deliver durable data that would fulfil present and, we suppose, close future needs in terms of spectroscopy analysis and calibration-less instruments for gas monitoring or isotopic ratio measurements.

Cavity-Enhanced Laser Spectroscopy for Exacting Measurements of Atmospheric Species

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A fundamental understanding of how greenhouse gases (GHGs) influence climate depends critically on the ability to quantify light-matter interaction in the atmosphere. In this context, physics-based models that describe the absorption and emission of electromagnetic radiation are required to predict the fate of short-wave (solar) and longer-wave (geosphere) radiation. This spectroscopic information is also necessary for precise and accurate measurements of atmospheric GHG concentrations from satellites, aircraft and terrestrial spectrometers.[1,2] Here, I will discuss basic principles, detection limits and source of uncertainty in cavity-enhanced laser absorption techniques[3,4] with applications to laboratory measurements of CO_2, CH_4, H_2O and O_2. These experiments yield high-signal-to-noise ratio measurements of line shapes and intensities[5], positions,[6] and line mixing parameters.[7] Measurements of this type are traceable to the international system of units (SI) through observations of time and frequency and can be used to assess the uncertainty of quantum calculations of line parameters.[5,8] I will also discuss new spectroscopic techniques that use phase-locked, single-frequency lasers and broadband frequency combs to probe high-finesse optical resonators.[9-11]

References

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