SYEC 5: Photonic Measurement Technology for the Environment

Time: Tuesday 17:15–18:30 Location: ELP 6: HS 4

Invited Talk SYEC 5.1 Tue 17:15 ELP 6: HS 4

Studying atmospheric dynamics with lasers in remote places — •Bernd Kaifler — Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen, Germany

Light detection and Ranging (LiDAR) is so far the only active remote sensing technology which allows almost continuous profiling of the atmosphere from ground to space. LiDAR systems provide measurements of key variables related to atmospheric dynamics such as air density, temperature and wind speed. As numerical weather prediction and climate models are extended to higher altitudes, observations in the middle atmosphere (approximately 15-90 km altitude) have become increasingly important for process studies and the validation of these models, and in the last decade a new generation of automatic LiDAR systems has been developed and the instruments deployed to locations around the world. Driven by the desire to probe regions of particular scientific interest, such as hotspots of atmospheric gravity waves, the instruments are often set up in remote places that could be described as "the world's end": from a small town above the Arctic Circle in Finland, the southern tip of the Andes Mountains in South America, to South Pole Station high on the Antarctic Plateau. This presentation highlights these places and the scientific results that were obtained by observing atmospheric gravity waves using LiDAR instruments operated on the ground, on aircrafts and on long duration stratospheric balloons.

SYEC 5.2 Tue 17:45 ELP 6: HS 4

A portable OCT system to investigate the influence of environmental factors on plants under field conditions — •Miroslav Zabic[1,2], Mohamad Bsata[1], Akshay Solleti[1], Timm Landes[1,2,3], Hans Bethge[1,2], and Dag Heinemann[1,2,3] — [1]Hannover Centre for Optical Technologies (HOT), Leibniz University Hannover, Germany — [2]Institute of Horticultural Production Systems, Leibniz University Hannover, Germany — [3]PhoenixD Cluster of Excellence, Leibniz University Hannover, Germany

Optical coherence tomography (OCT), a non-destructive imaging technique, is increasingly recognized in the field of plant biology for its potential in addressing environmental challenges in agriculture. The conventional stationary setup of OCT systems limits their application for on-site use, often necessitating plant dissection for laboratory analysis. Here we present a portable OCT system, enabling direct observation of plants in their natural environments. A possible application of this system is the monitoring of russeting in apple skin. Russeting in apples, which manifests as brown, rough patches on the skin, is promoted by several environmental factors and leads to significant economic losses, as affected apples often fail to meet market standards for sale. This not only affects profitability but also raises concerns about sustainability, as it results in increased food waste and resource inefficiency. By enabling OCT imaging on apples still on the tree, our system could offer new insights in russeting development and its dynamic interplay with environmental factors such as humidity. We detail technical aspects of our system and present preliminary results.

SYEC 5.3 Tue 18:00 ELP 6: HS 4

Characterization of PFAS transport in groundwater via laser-based ^{85}Kr and ^{39}Ar age dating — •Florian Meienburg[1,2,3,4], David Wachs[1,2], Axel Suckow[3], Christoph Gerber[3], Alec Deslandes[3], Punjehl Craine[3], Rohan Glover[4], Thomas Chambers[4], Ivan Herrera[4], Hue T. Nguyen[5], Jochen Müller[5], Markus Oberthaler[1], and Werner Aeschbach[2] — [1]Kirchhoff Institute for Physics, Heidelberg, Germany — [2]Institute of Environmental Physics, Heidelberg, Germany — [3]CSIRO, Adelaide, Australia — [4]University of Adelaide, Adelaide Australia — [5]University of Queensland, Brisbane, Australia

Radioisotopes are a widely used and important tool for dating environmental systems. Due to their chemical inertness and their well-understood input functions, the radioisotopes of argon and krypton are especially valuable tracers. Furthermore, their half-lives of 10.8 years (^{85}Kr), 269 years (^{39}Ar) and 229,000 years (^{81}Kr) cover a wide range of timescales and are therefore of interest for various tracer-based water studies. However, a very small abundance as small as 10^{-16}, requires an ultra-sensitive and highly isotopically selective detection method which is achieved by the quantum technology Atom Trap Trace Analysis (ATTA).

The presented study makes use of this unique measurement technique to investigate a per- and polyfluoroalkyl substance (PFAS) plume in groundwater at a site in Queensland, Australia. Age dating tracers combined with PFAS concentration measurements give insights into the transport characteristics of these forever chemicals.

SYEC 5.4 Tue 18:15 ELP 6: HS 4

ArTTA - Dating of environmental samples with ^{39}Ar — •David Wachs[1,2], Joshua Marks[1], Pascal Bohleber[3,4], Andrea Fischer[3], Yannis Arck[1], Martin Stocker-Waldhuber[3], Julian Robertz[2], Markus Oberthaler[2], and Werner Aeschbach[1] — [1]Institute of Environmental Physics, Heidelberg — [2]Kirchhoff-Institute for Physics, Heidelberg — [3]Institute for Interdisciplinary Mountain Research, Innsbruck, Austria — [4]Ca* Foscari University of Venice, Venice, Italy

Argon Trap Trace Analysis (ArTTA) for measuring ^{39}Ar concentrations represents an applied quantum technology to perform age dating of environmental samples. The isotope ^{39}Ar with its half life of 268 years uniquely enables dating in the age range between 50 and 1000 years. The very low isotopic abundance of about 10^{-15} however sets high demands on the measurement method. ArTTA has reduced the required sample sizes to routinely applicable amounts and thus enables ^{39}Ar age measurements in various settings from oceans over groundwater to glaciers. This work aims at presenting the technical concept of the ArTTA analytical method, from the initial excitation of the atoms by plasma discharge to the trapping by laser cooling methods and the current challenges and upgrades of the system. Furthermore, environmental applications will be discussed with a focus on the dating of Alpine glaciers. In this environmental archive, the age itself can provide information about environmental changes and processes.