EP 7: Poster Session

Time: Wednesday 16:15–18:45 Location: Redoutensaal

EP 7.1 Wed 16:15 Redoutensaal

Towards Ultra-Broadband Terahertz Time-Domain Spectroscopy for Space Research — •Bruno Broer[1,2], Dominic Azih[1,2], Yookyung Ha[2,1], Jonas Woeste[1,2], Emma Kinne[1,2], Sergey Pavlov[2], Oliver Gueckstock[3], Tom Seifert[3,4], Nikola Stojanovic[2], Tobias Kampfrath[3,4], and Michael Gensch[1,2] — [1]Technical University of Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany — [2]German Aerospace Center (DLR), Institute of Space Research, Rutherfordstr. 2, 12489 Berlin, Germany — [3]Free University Berlin, Arnimallee 14, 14195 Berlin, Germany — [4]TeraSpinTec GmbH, Lüneburger Str. 26, 10557 Berlin, Germany

Femtosecond lasers have in recent years been shown to be compact, robust and space qualified, in particular regarding their radiation hardness [1]. This opens up opportunities for compact Terahertz Time-Domain Spectroscopy (THz TDS) systems to detect gases (e.g. CO2) and solids on planetary missions. By avoiding cryogenically cooled direct detectors and bulky opto-mechanics of conventional instruments e,g. in Fourier Transform Infrared systems, THz TDS becomes of high interest for in-situ sensing applications requiring robustness, compactness and high energy/mass efficiency. Here we show our progress en route to a THz TDS setup for space applications with a bandwidth of over 30 THz and a frequency resolution of below 100 GHz.

[1] J. Lee, K. Lee, Y. Jang et al. "Testing of a femtosecond pulse laser in outer space" Scientific Reports 4, 5134 (2014)

EP 7.2 Wed 16:15 Redoutensaal

Time-Domain Spectroscopy Techniques for the Identification of Minerals and Gases in Space Research — •Emma Kinne[1,2], Yookyung Ha[1,2], Sergey G. Pavlov[2], Jonas Woeste[1,2], Dominic Azih[1,2], Bruno Broer[1,2], Nikola Stojanovic[2], and Michael Gensch[1,2] — [1]Technische Universität Berlin, Berlin, Germany — [2]DLR Institute of Space Research, Berlin, Germany

On planetary missions, the identification of gases and the characterization of solids by their spectroscopic fingerprint are typically performed by infrared and/or Raman spectrometers. The advent of space-qualified femtosecond lasers enables to perform the same task by a new class of time-domain techniques which have the potential to be much more robust, compact and sensitive. Methods such as Time-Domain Raman Spectroscopy (TDRS) and Rotational Coherent Raman Scattering (RCRS) retrieve Raman-active fingerprints of solids and molecules, respectively. Recently, we reported TDRS to be a viable alternative to continuous wave Raman spectroscopy in identifying minerals [1]. Here, we demonstrate that the same experimental setup, that is used for TDRS, can detect molecular species via RCRS. We report measured rotational revival signatures from N_2 and O_2 at room temperature and atmospheric pressure. Simulations using the LIMAO software further show that this setup could detect a wide range of molecular species under extraterrestrial conditions.

[1] Y. Ha, et. al., Time-Domain Raman Spectroscopy: An Emerging Technique in Space Exploration? J. Raman Spectrosc. 56 (2025)