A NEW FACILITY FOR THE PLANETARY SCIENCE COMMUNITY: THE PLANETARY SAMPLE ANALYSIS LABORATORY (SAL) AT DLR. E. Bonato[1], C. Stangarone[1], A. Maturilli[1], J. Helbert[1]. [1]Department of Planetary Laboratories, Institute for Planetary Research, DLR, Berlin, 12489, Germany (enrica.bonato@dlr.de).

Introduction: Laboratory measurements of extra-terrestrial materials like meteorites and ultimately materials from sample return missions can significantly enhance the scientific return of the global remote sensing data. The long-lasting heritage in spectral studies on planetary (analogue) materials and the available infrastructure at the DLR Berlin, motivated the addition of a dedicated Sample Analysis Laboratory (SAL) to the facilities in the Department of Planetary Laboratories including the Planetary Spectroscopy Laboratory (PSL) and the Astrobiology Laboratories.

SAL will add over the next 3 years capabilities in preparation to receive samples from sample return missions such as JAXA Hayabusa 2 and MMX missions, the Chinese Chang-E 5 and 6 missions as well as the NASA Osiris-REX mission.

SAL will focus on spectroscopic, geochemical, mineralogical analyses at microscopic level with the ultimate aim to derive information on the formation and evolution of planetary bodies and surfaces, search for traces of organic materials or even traces of extinct or extant life and inclusions of water.

Sample Analysis Laboratory: The near-term goal, or first step, is to set the facilities up to receive samples from the Hayabusa 2 mission. The operations have already started in 2018 with the acquisition of a vis-IR-microscope (more in the next paragraph) and it will continue with the acquisition of:

1. Field Emission Gun - scanning electron microscope (FEG-SEM),
2. Field Emission Gun – Electron microprobe analyser (FEG-EMPA),
3. X-ray diffraction (XRD) system with interchangeable optics for µXRD analysis and a petrologic microscope for high resolution imaging.

The facilities will be hosted in a clean room (ISO 5) equipped with glove boxes to handle and prepare samples. All samples will be stored under dry nitrogen and can be transported between the instruments in dry nitrogen filled containers.

Based on current planning the first parts of SAL will be operational and ready for certification by end of 2022.

Current facilities: To characterize and analyse the returned samples, SAL facilities will work jointly with the existing analytical capabilities of PSL, which was already upgraded with a vis-IR-microscope to extend spectral analysis to the sub-micron scale.

PSL at DLR is the only spectroscopic infrastructure in the world with the capability to measure emissivity of powder materials, in air or in vacuum, from low to very high temperatures [1-3], over an extended spectral range. Emissivity measurements are complemented by reflectance and transmittance measurements produced simultaneously with the same set-up. It is the ground reference laboratory for the MERTIS thermal infrared spectral imager on the ESA BepiColombo mission [4, 5]. Members of the PSL group are team members of the MarsExpress, VenusExpress, MESSENGER and JAXA Hayabusa 2 missions [6]. For the latter mission PSL has performed ground calibration measurements. In addition PSL has been used extensively in support of the ESA Rosetta mission. The samples analyzed at PSL ranged from rocks, minerals, to meteorites and Apollo lunar soil samples. In a climate-controlled environment PSL operates currently two Fourier Transform Infrared Spectrometer (FTIR) vacuum spectrometers, equipped with internal and external chambers, to measure emittance, transmittance and reflectance of powdered or solid samples in the wavelength range from 0.3 to beyond 100 micron.

In addition, the department is operating a Raman micro-spectrometer lab as part of the Astrobiology Laboratories with a spot size on the sam-ple in focus of <1.5 µm. The spectrometer is equipped with a cryostat serving as a planetary simulation chamber which permits simulation of environmental conditions on icy moons and planetary surfaces, name-ly pressure (10-6 hPa –1000 hPa), atmospheric constituents, and temperature (4K –500K). The samples, which are analyzed in the laboratory range from minerals, Martian analog materials, meteorites, biological samples (e.g. pigments, cell wall molecules, lichens, bacteria, archaea and other) to samples returned from the ISS (BIOMEX) [7, 8, 9] and the asteroid Itokawa (Hayabusa sample).

The current PSL and Raman facilities are operating in climate-controlled rooms and follow well-established cleanliness standards. All laboratory facilities undergo regular evaluations as part of the DLR quality management process. The evaluations address laboratory protocols, documentation, safety, data archival and staff training. PSL is a community facility as part of the “Distribute Planetary Simulation Facility” in European Union funded EuroPlanet Research Infrastructure (http://www.europlanet-2020-ri.eu/). Through this program (and its predecessor) over the last 7 years more than 60 external scientists have obtained time to use the PSL facilities. PSL has setup all necessary protocols to support visiting scientist, help with sample preparation, and archive the obtained data.

Outlook: DLR has started establishing a Sample Analysis Laboratory. Following the approach of a distributed European sample analysis and curation facility as discussed in the preliminary recommendations of EuroCares (http://www.euro-cares.eu/) the facility at DLR could be expanded to a curation facility. The timeline for this extension will be based on the planning of sample return missions. The details will depend on the nature of the returned samples. Through the BIOMEX project a collaboration has been established with the Robert-Koch Institute (RKI) (http://www.rki.de) for question of samples that might pose a bio-hazard. RKI is operating BSL 4 facilities, which might be used as part of the DLR curation facilities. Moreover, the DLR-SAL will be running in close cooperation with the Museum für Naturkunde in Berlin and it will be operated as a community facility (e.g. Europlanet), supporting the larger German and European sample analysis community.

References: [1] Ferrari et al., *Am. Min.*, (2014), *99(4): p. 786-792*. [2] Maturilli and Helbert, *JARS* (2014), 8(1): p. 084985. [3] A. Maturilli, et al., (2019) Infrared Remote Sensing and Instrumentation XXVII, 10.1117/12.2529266.[4] Hiesinger and Helbert, Space Science Review, (2020), *10.1007/s11214-020-00732-4*. [5] Helbert et al. (2008), *SPIE*, 7082: p. 70820L. [6] Okada et al., SSRv, (2016), [7] de Vera et al. (2012), *PSS, 74(1): p. 103-110*.[8] Serrano et al. (2014), *PSS, 98: 191–197*.[9] Serrano et al. (2015), *FEMS Microbiology Ecology*, *91(12): 2015, fiv126*.