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## **Miniaturized LIBS system for planetary exploration**

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Laser-induced breakdown spectroscopy (LIBS) is an emission spectroscopy technique to determine the elemental composition of samples and has many advantages for the in-situ geochemical investigation on planetary surface missions. LIBS needs no sample preparation and can analyze targets such as rocks or soils with optical access only. Other advantages are short analysis durations (<1 min), the feasibility to detect simultaneously major, minor and trace elements both, qualitatively and quantitatively, and its capability for dust removal, penetration of thin coatings and depth profiling. With the ChemCam instrument on NASA's Mars Science Laboratory (MSL) mission the LIBS technique was for the first time applied to study the surface of an extraterrestrial body. While the ChemCam instrument uses LIBS in a stand-off remote configuration in distances of up to 7 m, for which a telescopic system and a quite powerful laser are necessary, LIBS can also be applied in a close-up setup with a much more lightweight and compact instrument. Such a miniaturized system can be as light as ~1 kg in total, including the laser, the spectrometer and the electronics. The compact LIBS system can be attached to lander and rovers, directly on the body or on a robotic arm. One promising configuration would be a separation of the instrument into a module housed inside the lander or rover (including the optical spectrometer, pump laser and electronics) and one or several optical heads connected with optical fibers. The latter could be part of a robotic arm or get attached for instance to the locomotion system of a rover or crawler. A combination with / an integration of a miniaturized Raman spectrometer (see this conference) into the described configuration would complete the structural and chemical description of the investigated samples.