Los Alamos wizardry to aid new Mars science laboratory

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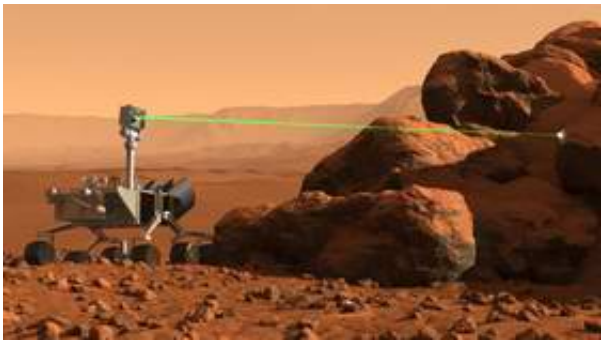

Having analyzed Mars from afar via orbiting satellite, Los Alamos National Laboratory instruments will next be on their way to get out and play in the Martian dirt. Two of the eight instruments aboard NASA's planned Mars Science Laboratory rover, scheduled for launch in 2009, include Los Alamos technology.

Image: Mars Science Laboratory rover using ChemCam to analyze a rock. Artist's conception, courtesy French Space Agency (CNES) and Los Alamos National Laboratory.

The laboratory's contribution to the new Mars effort is two-fold, providing a laser unit to measure elemental composition of rocks and soils, plus an x-ray diffraction device to analyze minerals in complex soil

and rock samples from a different perspective. The rolling Mars Science Laboratory rover will be designed to operate for a full Martian year, or two Earth years, exploring potential habitats for evidence of past or present life.

The Los Alamos laser unit, called ChemCam, uses laser-induced breakdown spectroscopy (LIBS), to measure the chemical content of the target samples. ChemCam works by firing an intense pulse of laser light at a surface from as far as 13 meters away.

The laser beam zaps a pinhead-sized area on the target, ablating or vaporizing it. A spectral analyzer then peers closely at the light from the vaporized sample. Atoms ablated in ionized states emit light and each sample yields a unique spectral emission of bright lines characteristic of the elements present in the material. Like fingerprints, the emission line wavelengths can be matched to a library of known chemical compounds. Even dust-covered rocks will reveal their inner secrets to the ChemCam interrogation. The laser also can be used to clean dust or weathering coatings from the sample prior to the analysis without the need to drive up to the target rock.

"ChemCam is the only instrument that can determine the elemental compositions of dust-covered rocks remotely," said Roger Wiens, Los Alamos' principal investigator on the project. The unit can recognize all known elements, noted Wiens, so detailed information on possible future Mars base sites can then begin flowing back to Earth for analysis.

The other piece of the ChemCam combo, the Remote Micro-Imager, will give very close-up images of the samples being analyzed, with an effective resolution that exceeds MER's Pancam by 5-10 times. The laser and camera are provided by the French space agency. Los Alamos is in charge of the spectrographs, data processing unit, power supply, software and project management.

Another of the rover's planned instruments is CheMin: an x-ray diffraction/x-ray fluorescence instrument for mineralogical analysis. Its principal investigor is David Blake of NASA's Ames Research Center in Moffett Field, Calif. Partnering with him are Los Alamos geologists Steve Chipera and David Vaniman. CheMin will identify and quantify all minerals in complex samples such as basalts, evaporites and soils, one of the principle objectives of Mars Science Laboratory.

"CheMin is named for its ability to obtain chemical and mineralogical data simultaneously from samples of soil or rock. The mineralogical capability is particularly powerful because it is based on x-ray diffraction, the standard method for mineral identification used in laboratories on Earth and required by the International Mineralogical Association for recognition of any new mineral," said Vaniman.

Both ChemCam and CheMin are previous winners in the "R&D 100" competition sponsored by Research and Development Magazine.

Source: Los Alamos National Laboratory