Development of a Miniature Dual Source Linear Ion Trap Mass Spectrometer for the ExoMars Rover Mission

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The Mars Organic Molecule Analyzer (MOMA) investigation on the 2018 ExoMars rover will examine the chemical composition of samples acquired from depths of up to two meters below the martian surface, where organics may be protected from radiative and oxidative degradation. The detection and analysis of martian organics is a central objective of the mission's search for signs of past or present life that may be preserved in the regolith. MOMA combines pyrolysis gas chromatography mass spectrometry (GCMS) of bulk powder samples and Mars ambient laser desorption mass spectrometry (LDMS) surface analysis, using a single ion trap MS. This dual source design enables MOMA to detect compounds over a wide range of molecular weights (up to at least 1000 Da) and volatilities. The structure of any detected organics may be further examined using MOMA's tandem mass spectrometry (MS/MS) mode. The flight model (FM) ion trap sensor and electronics have been assembled under the extremely clean and sterile conditions required by ExoMars, and have met or exceeded all performance specifications during initial functional tests. After Mars ambient thermal cycling and calibration, the FM will be delivered as a subsystem of MOMA to rover integration in Italy in mid-2016. There MOMA will join complementary rover instruments such as the Raman and MicrOmega spectrometers designed to analyze common drill samples. The full integration and testing of the payload in the rover vehicle will proceed through most of 2017, in preparation for a May, 2018 launch on a Russian Proton launch vehicle. The rover will arrive on Mars in early 2019 to begin its 218 sol surface mission.