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Linear Ion Trap for the Mars Organic Molecule Analyzer

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The 2018 ExoMars rover mission includes the Mars Organic Molecule Analyzer (MOMA) investigation. MOMA 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. When combined with the complement of instruments in the rover's Pasteur Payload, MOMA has the potential to reveal the presence of a wide range of organics preserved in a variety of mineralogical environments, and to begin to understand the structural character and potential origin of those compounds. MOMA includes a linear, or 2D, ion trap mass spectrometer (ITMS) that is designed to analyze molecular composition of (i) gas evolved from pyrolyzed powder samples and separated on a gas chromatograph and (ii) ions directly desorbed from solid samples at Mars ambient pressure using a pulsed laser and a fast-valve capillary ion inlet system. This "dual source" approach gives MOMA unprecedented breadth of detection over a wide range of molecular weights and volatilities. Analysis of nonvolatile, higher-molecular weight organics such as carboxylic acids and peptides even in the presence of significant perchlorate concentrations is enabled by the extremely short ($\sim$1 ns) pulses of the desorption laser. Use of the ion trap's tandem mass spectrometry mode permits selective focus on key species for isolation and controlled fragmentation, providing structural analysis capabilities. The flight-like engineering test unit (ETU) of the ITMS, now under construction, will be used to verify breadboard performance with high fidelity, while simultaneously supporting the development of analytical scripts and spectral libraries using synthetic and natural Mars analog samples guided by current results from MSL. ETU campaign data will strongly advise the specifics of the calibration applied to the MOMA flight model as well as the science operational procedures during the mission.