A MINIATURE GAS CHROMATOGRAPH MAS SPECTROMETER (GCMS) FOR PLANETARY ATMOSPHERES IN SITU STUDIES. J. Simcic, S. Madzunkov, B. Bae, D. Nikolic, E. Neidholdt, M. Darrach, Planetary Surface Instruments Group, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA, 91109, jurij.simcic@jpl.nasa.gov

Introduction: There is a particular need for the development of miniaturized, high-G load tolerant, low-mass, low-power instruments for in situ studies of trace organic compounds, small inorganic molecules and their isotopes in planetary materials. Presented herein are the latest achievements in developing an instrument with the same analytical performance of commercial GCMS systems but approximately an order of magnitude smaller and optimized for space missions. The Jet Propulsion Laboratory (JPL) Planetary Surface Instruments (PSI) group has developed an instrument consisting of a quadrupole ion trap (QIT) Mass Spectrometer (MS), integrated with a Micro-Electro-Mechanical Systems (MEMS) Gas Chromatograph (GC), developed for human spaceflight applications for NASA Advanced Exploration Systems (AES).

JPL’s miniaturized GCMS has been under continuous development at JPL’s PSI Group for the last decade. The instrument inherits its basic design from the Vehicle Cabin Atmosphere Monitor (VCAM)[1,2], an autonomous GCMS operated continuously aboard the International Space Station (ISS) for monitoring the cabin atmosphere for major constituents and trace species from 2010 to 2012. VCAM has intrinsic characteristics comparable to commercial Earth-based analytical GCMS systems with total mass of 30 kg and average power consumption of 100W. It has a unique design enabling it to perform two very different tasks: a) trace organic measurements at parts-per-billion (ppb) concentrations; b) major constituent analysis (MCA) where the percent concentration of major gases present in ISS atmosphere, specifically N₂, O₂, CO₂ and Ar, are measured.

Compared to VCAM, our current GCMS instrument embodies several major improvements. The MS is redesigned to be more compact and robust using a unique wireless design in which all electrical connections to the electrodes are achieved through the mounting posts, thus eliminating the need for electrical wires, which represent liability in high-G environment. Also the end-cap electrodes of the QIT are electrically-isolated from the instrument’s ground to enable supplemental modes of operation using additional dipole radio frequency (RF) field[3]. The MS uses electron impact ionization for producing ions inside the QIT by means of a redesigned electron gun, consisting of tanta-