Compact High Resolution QIT-Mass Spectrometers for Lunar and Planetary Applications

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The JPL Mass Spectrometer Team develops components and instruments based on a Paul quadrupole ion trap mass spectrometer (QIT-MS) for Earth and space applications. Over the past 20 years, the team has miniaturized the QIT-MS and verified its performance successfully for the International Space Station. The technology was demonstrated with the recent delivery of the first Spacecraft Atmosphere Monitor (S.A.M.) to the International Space Station (ISS).

The next step is to build a QIT-MS intendent to investigate the lunar exosphere via a funded ROSES 2019, DALI/NASA proposal over the next three years.

The QIT-MS will be the first in-situ lunar mass spectrometer capable of identifying and quantifying exosphere species (ex. H, H2, 3He, 4He, Ne, N2, O2, Ar, CH4, CO, CO2, Kr, Xe, OH, H2O) with abundance greater than 10 molecules/cm3 [1]. The combination of low mass (7.5 kg), low power (max. 30W with heater bulb on), high sensitivity (0.003 counts/cm3/sec), and ultrahigh precision (1.7 x 10^-10 Torr, Kr measured continuously for 7 hours yielded a 0.6 ‰ precision on the 86Kr/84Kr ratio) will provide an unprecedented inside of the scientific processes in the lunar exosphere.

Other implementation approaches will be discussed, which entail the development of different frontends to expand applications for dense atmospheres (ex. Venus) or liquids (ex. ocean worlds). Most of these developments can be used to determine contaminants in the air, water, or volatile in solids.