

MASS Spectrometer for Planetary EXploration – ORganic Composition Analyzer (MASPEX-ORCA) for Europa Lander

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MASPEX-ORCA is a collaborative instrument development project from four institutions: John's Hopkins University Applied Physics Laboratory (JHU-APL), University of Michigan, Southwest Research Institute, and University of Bern. MASPEX-ORCA is designed to investigate Europa's surface, funded by NASA's Instrument Concepts for Europa Exploration-2 (ICEE-2) for a future Europa Lander mission. Europa, a moon of Jupiter, has a large liquid water ocean beneath its icy surface and may contain necessary ingredients for life. Investigating Europa's habitability is a priority of the science community and NASA's Planetary Science Division. MASPEX, a high resolution mass spectrometer and part of the Europa Clipper instrument payload, is paired with other instruments for increased analytical capabilities for Europa Lander.

MASPEX-ORCA is designed to process european surface material (ice) and go through various heating steps for evolution of volatiles and semi-volatiles, followed by microfluidic movement of the remaining liquid to a chemistry wet lab. Sample handling, heating, preparation, microfluidics, and chemistry wet lab including a microfluidic chip with ion exchange chromatography and chemical derivatization agents are provided by JHU-APL. Semi-volatiles (organics) and chemically derivatized biomolecules (amino and fatty acids, lipids, etc.) are separated by a MEMS multi-dimensional GC-GC from the University of Michigan and subsequently mass analyzed by MASPEX. An alternative mass spectrometer with lower resource requirements, the neutral gas mass spectrometer (NGMS), from the University of Bern is also under investigation for mass analysis after chromatographic separation.

The poster presentation will highlight accomplishments to date. The preliminary design of the sample cup to accept the european surface sample (ice) has been accomplished. In addition, thermal analyses during sample cup heating has been performed. The layout of the microfluidics system (valves, solvent and waste chambers) is in the design phase. The chemistry wet lab with ion exchange chromatography microfluidic chip has successfully enriched amino acids while removing salts from a liquid sample. A MEMS GC from the University of Michigan has been successfully tested and shows excellent reproducibility. The MEMS GC has also been coupled to MASPEX and organic separation and mass analysis has been shown for a variety of organic molecules. A MEMS two-dimensional gas chromatograph (GC-GC) is currently under test at SwRI.