

JPL Flyby Mass Spectrometer

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The JPL Flyby Mass Spectrometer is designed for deployment in one of the outer Solar System's harshest radiation and temperature environments, the Jupiter system. Proposed as the Mass Analyzer for Real-time Investigation of Neutrals at Europa (MARINE) for the Europa Clipper mission concept, the instrument is designed to operate in the 2 Mrad radiation environment for a period of 40 Europa flybys, where each flyby is a portion of the spacecraft's orbit around Jupiter.

The instrument comprises the JPL ion trap mass spectrometer and passive neutral collector (PNC) deployed on a boom attached to the spacecraft high gain antenna, with the instrument electronics in the spacecraft-provided, shielded 'vault.' Challenging aspects include operation of the electron-multiplying detector and charge-sensitive preamplifier in the 2 Mrad environment, 300 krad tolerant instrument electronics, and separation of the electronics and sensor by up to 4 meters of cabling. The spacecraft trajectory for arrival at Europa may include passes inside Venus's orbit, raising the sensor's temperature to as high as 250 C due to close approach to the Sun. Despite the environment, the instrument must maintain a resolution of 4000 m/ Δ m FWHM at oxygen for determining isotopic ratios at Europa, as well as capability out to m/z 300 for the determination of trace organics that may be present. The sensor has a mass of 5.9 kg, and the electronics has a mass of 3.0 kg. Including cabling mass, the system as designed for the Europa mission has a current best estimate mass of 10.9 kg. Sensor architecture and prototyping, electronics architecture and implementation, and a recent opportunity for deployment of this instrument on the exterior of International Space Station will be discussed.

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