

MILLIMETER-WAVE CHIRALITY SPECTROMETER (CHIRALSPEC)

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Life detection through chemical analysis requires nearly unambiguous detection of specific chemical biosignatures. The US Decadal Survey paper, *Vision and Voyages for Planetary Science in the Decade 2013-2022*, recommends "a detailed characterization of organics to search for signatures of biological origin, such as molecules with a preferred chirality or unusual patterns of molecular weights" as a key future investigation of life detection (page 240). While mass spectrometry has often been proposed for measuring the abundance patterns of molecular weights, it lacks the chirality detection capability required for chiral analyses of chiral molecules such as amino acids, and cannot uniquely identify specific structure-based isomers such as fatty acids.

In this presentation we will report the status of the development of a millimeter-wave chirality spectrometer (ChiralSpec). ChiralSpec advances key technologies to enable chirality detection and discrimination of structural isomers with a simple instrument. It is applicable to mission focus areas such as Enceladus, Europa, Titan, and Mars. It could be used on planetary in-situ probes to measure amino acids and other organic molecules in the gas phase or brought into the gas phase.

ChiralSpec employs an innovative microwave three-wave mixing technology for chirality detection and the cavity resonance technology for sensitivity enhancement. It can be operated under two modes: (1) survey mode, with the instrument acting as a traditional microwave spectrometer to characterize chemical composition and quantify abundance of planetary samples; and (2) chirality detection mode, with the instrument determining which enantiomer is in excess and how much it is in excess for each existing chiral molecule.