The Dragonfly Mission to Titan and the Enabling Technologies of the DraMS Mass Spectrometer Onboard

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NASA's recent selection of the *Dragonfly* mission under the New Frontiers Program signals a return to investigate the surface of Titan, Saturn's largest moon, and one of the Ocean Worlds of primary interest to NASA. Titan is a complex planetary body with a dense atmosphere that is primarily composed of nitrogen, climate and weather patterns similar to those on Earth, a subsurface layer of (possibly ammonia-rich) liquid water, and surface lakes or seas of methane and ethane.

The density and complexity of the atmosphere and surface of Titan, combined with solar radiation and energetic particles from Saturn's magnetosphere, create an environment primed for extensive organic chemical synthesis. Simulations of this chemistry have produced a variety of organic molecules based on C, N and H atoms, from pre-biotically important molecules such as amines to amino acids. This complexity presents both a challenge and an opportunity for the chemical investigation of the surface of Titan, one of the major goals of the mission.

Dragonfly is a rotorcraft lander (a dual-quadcopter), which will enable aerial flight for transport between different locations on the surface of Titan. The low gravity and dense atmosphere make rotary flight favorable on Titan. *Dragonfly* will contain four different instruments, a camera suite, a geophysics and meteorology package, a Gamma-ray and neutron spectrometer, and a mass spectrometer. The *Dragonfly* Mass Spectrometer (DraMS) will perform both Laser Desorption/ionization Mass Spectrometry (LDMS) and Gas Chromatography Mass Spectrometry (GCMS), similar to the approach demonstrated by the Mars Organic Molecule Analyzer (MOMA). This presentation will discuss the key LDMS and GCMS techniques, operation schemes and instrument augmentations that will allow *in situ* analysis of materials collected at Titan's surface while also preparing for the complexity that is expected from these samples.