Subtraction Imaging as a Game-Changer for Planetary Tunable Laser Spectrometers

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Target: Planetary atmospheres of Venus, Saturn, Mars, Titan, Neptune etc; surface emissions from satellites such as Enceladus, Europa; cometary coronae.

- Accessed through in situ probes, landers, rovers, balloons, flyby, station-keeping spacecraft

Science:

- Gas abundances and C, H, N, O, S isotope ratios in planetary atmospheres, satellite emissions, or small body surface sampling
- Increased sensitivity would allow new science of cometary or satellite (Enceladus, Europa) plumes, or be traded against instrument size, mass, volume, power, integration time for better accommodation into volume-limited planetary probes (e.g. Venus, Saturn) for Discovery, NF missions.

Objectives:

- To demonstrate at least an order of magnitude improvement in performance of tunable laser spectrometers
- Performance would include increased sensitivity and reduction in power, contamination and integration time

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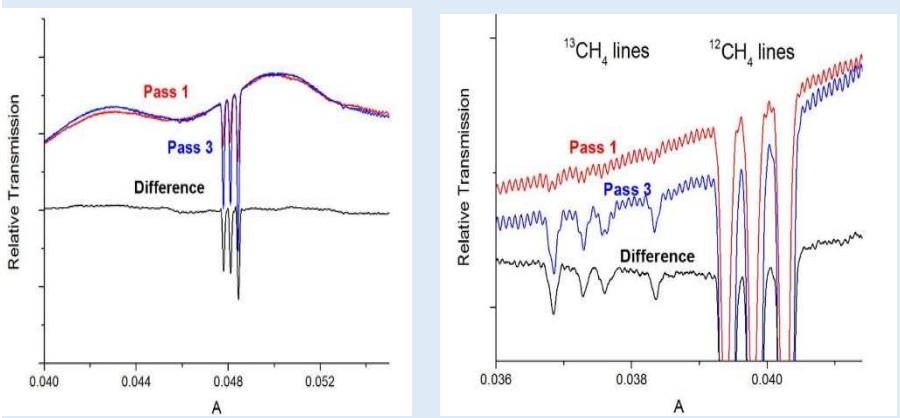

Figure Caption: Spectra recorded from our laboratory demonstration using CH_4 lines near 3.27 μm wavelength. Left panel demonstrates successful laser power normalization and removal of foreoptics contributions from fore optics fringes (and contaminant gas if present). The right panel shows an additional significant reduction in fine fringes occurring between the mirrors of the multi-pass cell without the need for cell heaters.

Key Milestones:

Year 1:

- To build, develop, and test a prototype spectrometer using pathlength subtraction of output beams on individual detectors.

Year 2:

- To build and install into a flight-duplicate TLS, an IR array detector, and demonstrate subtraction imaging of a multi-channel spectrometer.

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