PULSE-ECHO MILLIMETER WAVE $INSITU$ SENSOR WITH 65 nm CMOS TRANSMITTER AND HETERODYNE RECEIVER ELECTRONICS

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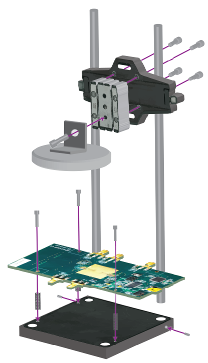

Cavity enhanced pure rotational spectroscopy has long been a potent laboratory tool for the elucidation of structure and dynamics in isolated molecular systems where sensitive pulsed-echo techniques are routinely performed up to frequencies as high $\sim$50 GHz. Although the associated narrow linewidths ($\sim$800kHz), wide-bandwidth (often $>$10 GHz), and long optical path lengths have long been identified as a desirable combination for sensitive and specific gas sensing, the unaccommodating size and power requirements of traditional microwave optics/electronics are unsuitable for the stringent demands required for *in situ* deployment. Additionally, efforts to drive pulsed-echo techniques into millimeter and submillimeter wavelength regimes, where the size of optics can be reduced without suffering large diffraction losses, have failed largely due to inefficiencies of injecting radiation into the resonant optical cavity.

Recent pursuits at the Jet Propulsion Laboratory to realize compact, low-power devices capable of *in situ* chemical detections on extra-terrestrial objects have found success in calling upon novel transmitter and receiver elements built from CMOS architectures commonly employed in the high-speed communications industry. These low-power integrated circuit chipsets can be embedded directly into quasi-optical devices allowing for the realization of cavity based instruments where all source and detection electronics are hosted by a single 16 in^2 printed circuit board. The current talk will present a full system description of this miniaturized CMOS-based pulse-echo rotational spectrometer,[a] which has an operational bandwidth of 90-105 GHz, along with experimental trials taken in bulk gas flows and seeded molecular beam environments.

[a] D. J. Nemchick *et al.*, "A 90-102 GHz CMOS Based Pulsed-Echo Fourier Transform Spectrometer: New Approaches for *In Situ* Chemical Detection and Millimeter-Wave Cavity-Based Molecular Spectroscopy," *Rev. Sci. Inst.*, In Submission.