180 GHZ RESONANT CAVITY FOR FOURIER TRANSFORM MILLIMETER-WAVE IN-SITU SENSING

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The development of portable millimeter-wave gas sensors that operate using pulsed Fourier transform detection schemes and meet the stringent demands for space deployment depend on the advancement of several key technologies. A prototype system[a] that operates at 90-100 GHz has already been demonstrated with efforts now focusing on a system to target the $3_{1,3} \leftarrow 2_{2,0}$ ($J''_{K''_a,K''_c} \leftarrow J'_{K'_a,K'_c}$) H_2O transition at 183.310 GHz. The performance properties of a 180-190 GHz CMOS-based pulsed transmitter and heterodyne receiver set has already proven viable for system incorporation.[b] Another key component is the hybrid coupling plate that interfaces with the integrated circuit transmitter and receiver chips and serves as the cavity end mirror of the resonant sample cell. The performance of the waveguide fed version of this cavity system will be discussed including demonstrative examples of cavity quality factor measurements (Q>10000) and molecular detections deploying both CMOS and traditional mm-wave sources/detectors. System performance will be discussed in the context of realizing a dual band system capable of near simultaneous detection of both H_2O (at 183.310 GHz) and D_2O (at 80.359 GHz).

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[a]Nemchick, *et al.*, A 90-102 GHz CMOS based pulsed Fourier transform spectrometer: New approaches for *in situ* chemical detection and millimeter-wave cavity-based molecular spectroscopy *Rev. Sci. Inst.*, vol. 89, pp. 073109:1-12, 2018

[b]Nemchick, *et al.*, "A 180 GHz Pulsed Transmitter and Heterodyne Receiver 28 NM CMOS Chipset for Molecular Sensing", International Symposium on Molecular Spectroscopy, Urbana-Champaign, IL, 2019