A 180 GHZ PULSED TRANSMITTER AND HETERODYNE RECEIVER 28 NM CMOS CHIPSET FOR MOLECULAR SENSING

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The size, weight, and power requirements of emerging millimeter-wave transmitter and receiver integrated circuit elements make them ideally suited for use in high-resolution *in situ* gas sensors. Previous work at the Jet Propulsion Laboratory has demonstrated a tunable 90-105 GHz transmitter fabricated in 65 nm complementary metal-oxide semiconductor (CMOS) process having phase noise and output power characteristics suitable for making sub-doppler measurements when deployed as the source in a traditional frequency modulated absorption spectrometer.[a] When paired with a heterodyne receiver of complementary bandwidth and cavity end mirror outfitted with embedded coplanar waveguides a miniaturized cavity enhanced pulsed Fourier transform spectrometer can be realized where all source and detection electronics are housed on a single 100 cm^2 printed circuit board. [b]

This talk will highlight ongoing work to expand our current capabilities in order to target more strategic molecular transitions, such as the $3_{1,3} \leftarrow 2_{2,0}$ ($J''_{K''_a,K''_c} \leftarrow J'_{K'_a,K'_c}$) H_2O line at 183.310 GHz, with a new Tx/Rx chipset. Unlike the previous generation these integrated circuit elements, now fabricated with 28 nm CMOS techniques, deploy a 90 GHz phase-lock loop the output of which is either frequency doubled, pulse modulated, then amplified (as in Tx) or frequency doubled for use in pumping a down-conversion mixer (as in Rx). Preliminary results will be presented along with a discussion on how the higher frequency radiation generated from these devices can be coupled into (and out of) an optical cavity to allow for exploitation of sensitive pulsed emission schemes.

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[a] D. J. Nemchick *et al.*, "Sub-Doppler spectroscopy with a CMOS transmitter," *IEEE Trans. THz Sci. Technol.*, vol. 8, no. 1, pp. 121-126, 2018.

[b] D. J. 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