Radiation mixer based on the 2DEG in a GaN heterostructure

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***Abstract*—Radiation THz mixer utilizing the hot-electron effect in the two-dimensional electron gas (2DEG) has several important features (microwatt level local oscillator (LO) power, ~ 100 K operating temperature, multi-GHz IF bandwidth) making it attractive for the space applications where cryogenic cooling is unacceptable (e.g., planetary missions). Enhancement of this mixer sensitivity to the level similar or better than that of the Schottky mixer may lead to significant advancements in the future instrument architecture enabling single-pixel and array receivers up to the highest frequency available for the solid-state multiplier LOs (currently, close to 3 THz). An AlGaAs/GaAs based 2DEG mixer has been pursued in past with a limited success because of the somewhat unfavorable for realization of the strong Drude absorption combination of the material parameters (high electron mobility, low electron density) found in typical GaAs heterostuctures. In particular, the intrinsic kinetic inductance of the mixer was large that leads to the high reactive component in the THz impedance.**

We are revisiting the 2DEG mixer approach, this time utilizing a GaN based heterostucture. This relatively new material has become quite popular due to its importance for blue LED and high-power HEMT transistor technologies. A favorable for the 2DEG THz mixing combination of the mobility < 1000 V cm^2 (V sec)$^{-1}$ and the electron density > 10^{13} cm^{-2} is readily available in these heterostructures. Initial FTS transmission tests have shown a significant THz absorption in the GaN heterostructures grown on sapphire substrates. More FTS low-temperature (down to 77 K) tests are under way followed by the proof-of-concept demonstration using a quasioptical 0.6-2 THz mixer design. The 2DEG mixer analysis and experimental results will be presented at the meeting.