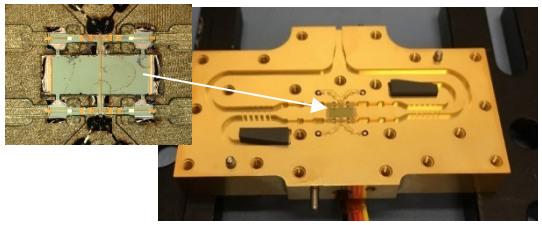
G-Band Humidity Sounding Radar Transceiver

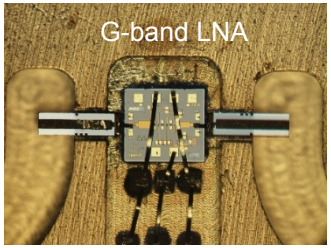
PI: Ken Cooper, JPL

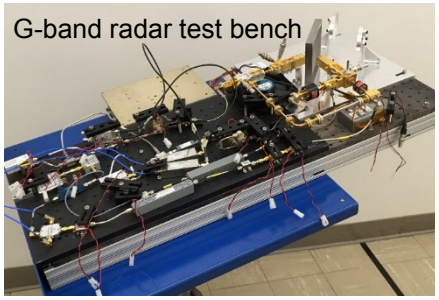
Objective

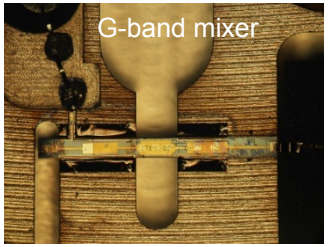
- Develop a compact radar transceiver tuned to the lower flank of the 183 GHz water absorption line to enable high-resolution humidity sounding inside boundary layer clouds using differential absorption radar.
- Demonstrate the transceiver performance, targeting:
  - 0.5 W transmit power
  - 5% tuning bandwidth
  - 500 K receiver noise temperature
- Validate the principle of differential absorption radar for range-resolved humidity measurements inside clouds.

Quad-Chip Frequency Doubler









Accomplishments

- Developed and demonstrated two four-way power-combining techniques for power generation near 183 GHz. The first is with an external amplifier that pumps frequency-doubling diodes through W-band hybrid couplers, and an average power of 460 mW over 167-175 GHz was achieved. The second is with waveguide-integrated power amplifiers at each port of the quad-chip frequency doubler, with measured power exceeding 0.5 W over 177-187 GHz.
- Built an integrated G-band receiver that includes a waveguide twist, an InP low-noise amplifier, and a subharmonic mixer. The receiver noise temperature performance of 400-600 K was achieved over 167-175 GHz.
- Proved that ultra-high isolation, low-loss duplexing is feasible at G-band, and used this technique to build radar bread-boards at 183-193 GHz and 167-175 GHz.
- Conducted the world's first demonstration of differential absorption radar for range-resolved measurements of humidity inside rain clouds. This demonstration also involved the development of novel simulation and retrieval algorithms.

Co-Is/Partners: Jose Siles, Matthew Lebsock, Pekka Kangaslahti, Steve Durden, JPL

TRL_{in} = 2 **TRL_{out} = 4**