

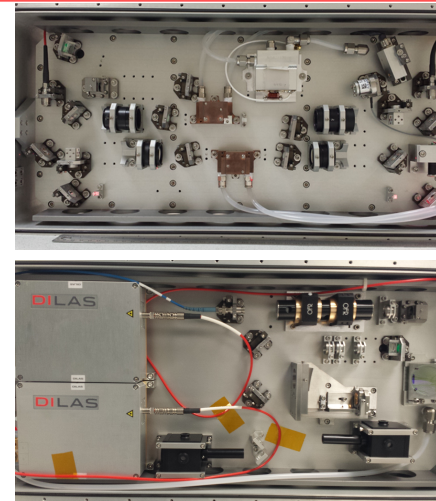


# Triple-Pulsed 2- $\mu\text{m}$ Direct Detection Airborne Lidar for Simultaneous and Independent $\text{CO}_2$ and $\text{H}_2\text{O}$ Column Measurement

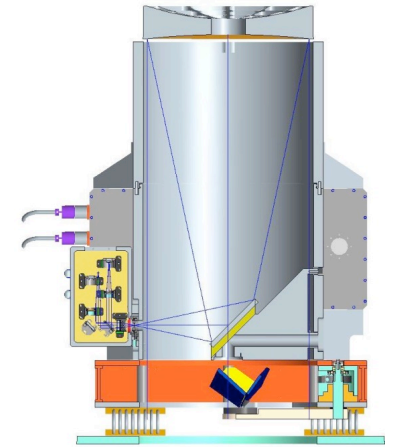
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## Objective

- Demonstrate simultaneous and independent measurement of the weighted-average column dry-air mixing ratios of carbon dioxide ( $\text{XCO}_2$ ) and water vapor ( $\text{XH}_2\text{O}$ ) from an airborne platform
- Design and fabricate a space-qualifiable, fully conductively-cooled, triple-pulsed, 2- $\mu\text{m}$  laser transmitter
- Design and develop wavelength control system for rapid and fine tuning of the three sensing lines of the  $\text{CO}_2$  and  $\text{H}_2\text{O}$  Integrated Path Differential Absorption (IPDA) lidar
- Integrate laser transmitter with receiver to develop the triple-pulsed 2- $\mu\text{m}$  direct detection IPDA lidar
- Conduct extensive ground and airborne column  $\text{CO}_2$  and  $\text{H}_2\text{O}$  measurement and validate with in situ sensors



Space-qualifiable, triple pulsed laser transmitter for airborne application



Integrated 2- $\mu\text{m}$   $\text{CO}_2$  and  $\text{H}_2\text{O}$  airborne packaged IPDA lidar

## Accomplishments

- Designed and fabricated a space-qualifiable, conductively-cooled, triple-pulsed, 2- $\mu\text{m}$  laser transmitter for airborne platforms. This transmitter produces 3 injection seeded pulses at a repetition rate of 50 Hz. Total energy as high as 75mJ was demonstrated (34mJ, 26mJ, and 15mJ for the first, second, and third pulse respectively).
- Developed wavelength control system for rapid and fine tuning of the three sensing wavelengths of the  $\text{CO}_2$  and  $\text{H}_2\text{O}$  IPDA lidar. The three seeding wavelengths are produced from a single semiconductor seed laser with respect to the  $\text{CO}_2$  R30 absorption line center using RF modulation technique and fiber grating discriminator to select 2050.509 nm for  $\text{H}_2\text{O}$  on-line, 2051.0509 nm for  $\text{CO}_2$  on-line and 2051.1915 nm for off-line.
- Integrated the laser transmitter with the receiver to conduct ground measurement for  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .
- Demonstrated simultaneous and independent measurement of the weighted-average column dry-air mixing ratios of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  from an airborne platform with 0.2 ppm and 4.8 ppm biases and 7.9 and 61.1 ppm sensitivity, respectively.

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**TRL<sub>in</sub> = 3    TRL<sub>out</sub> = 6**