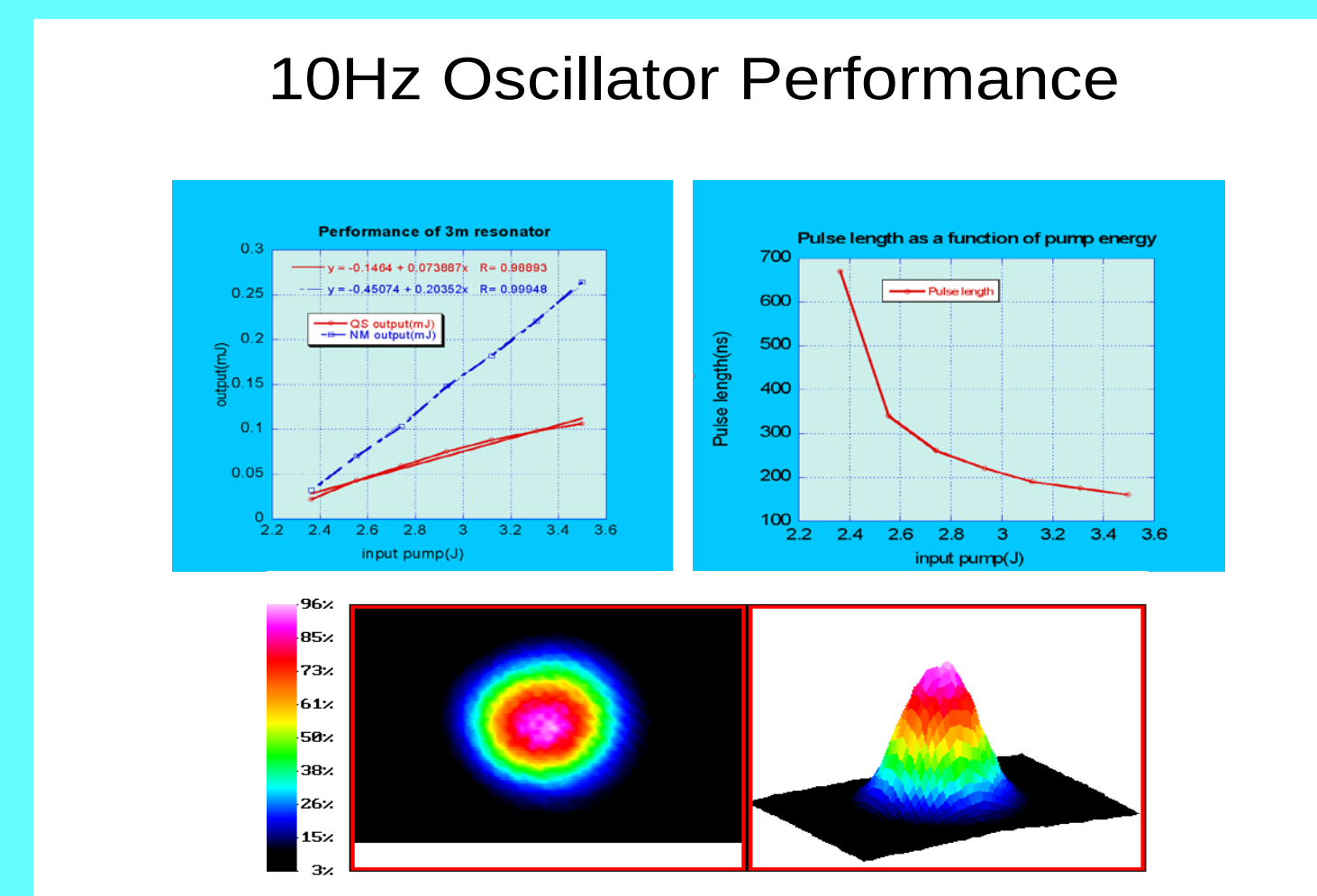
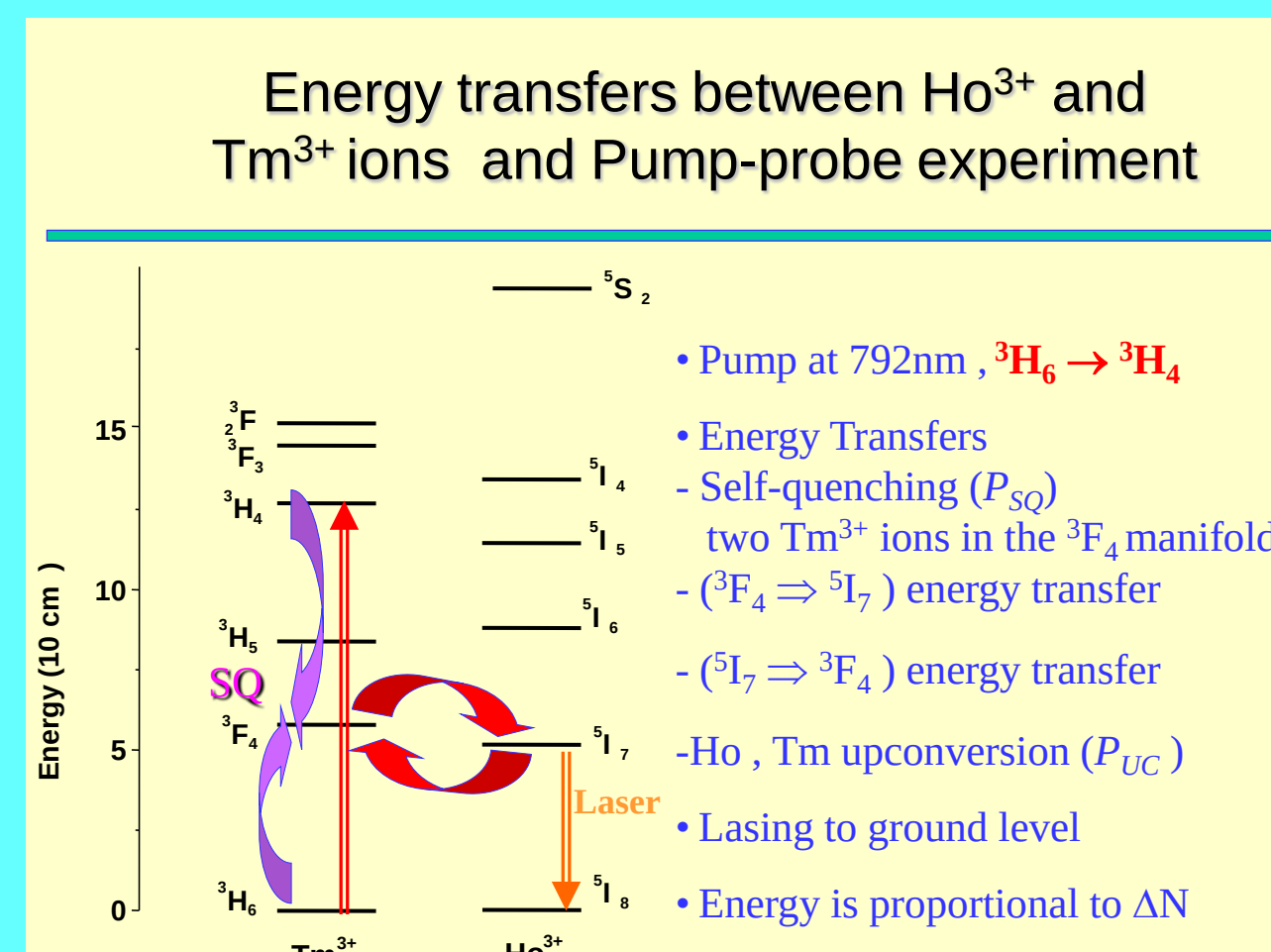
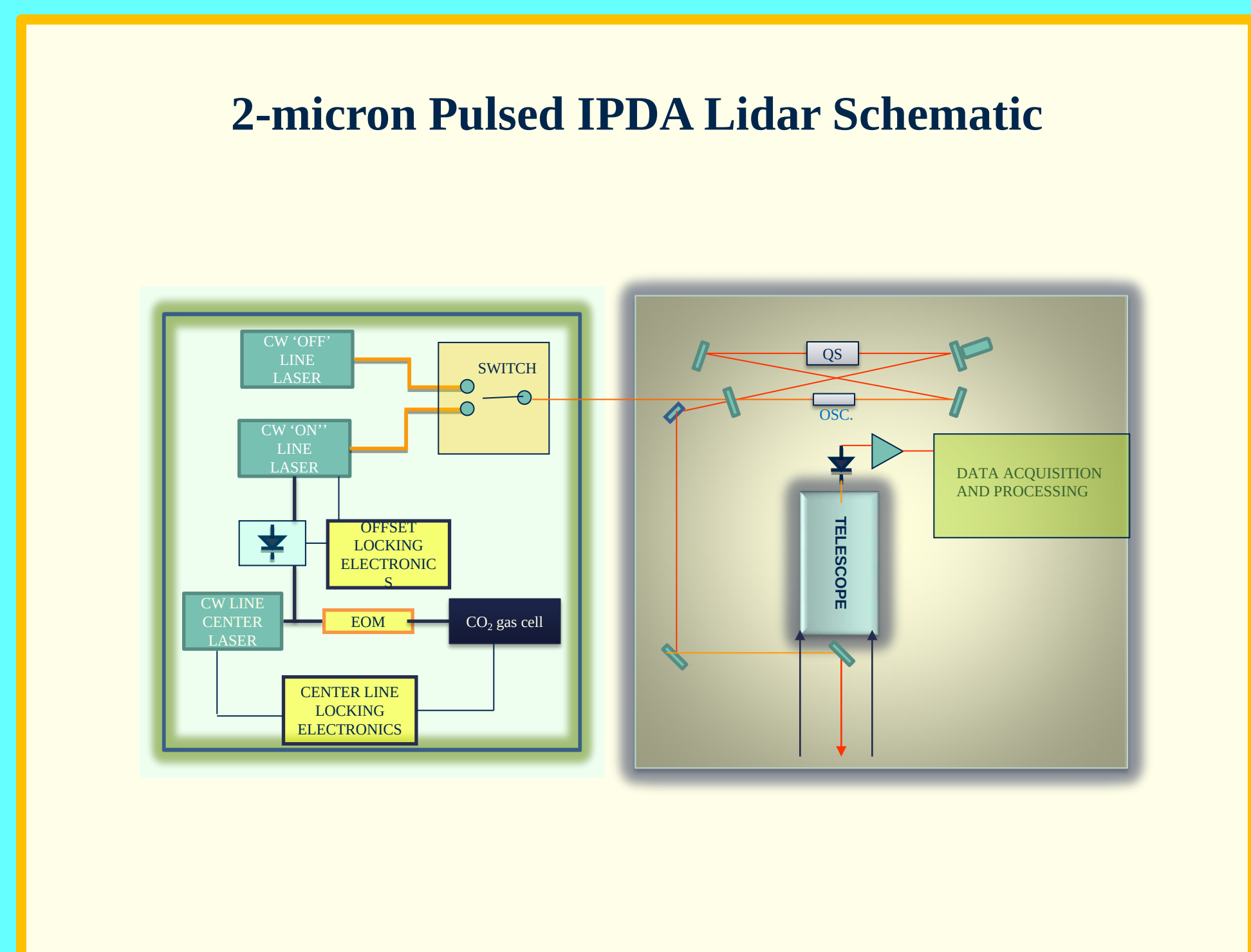
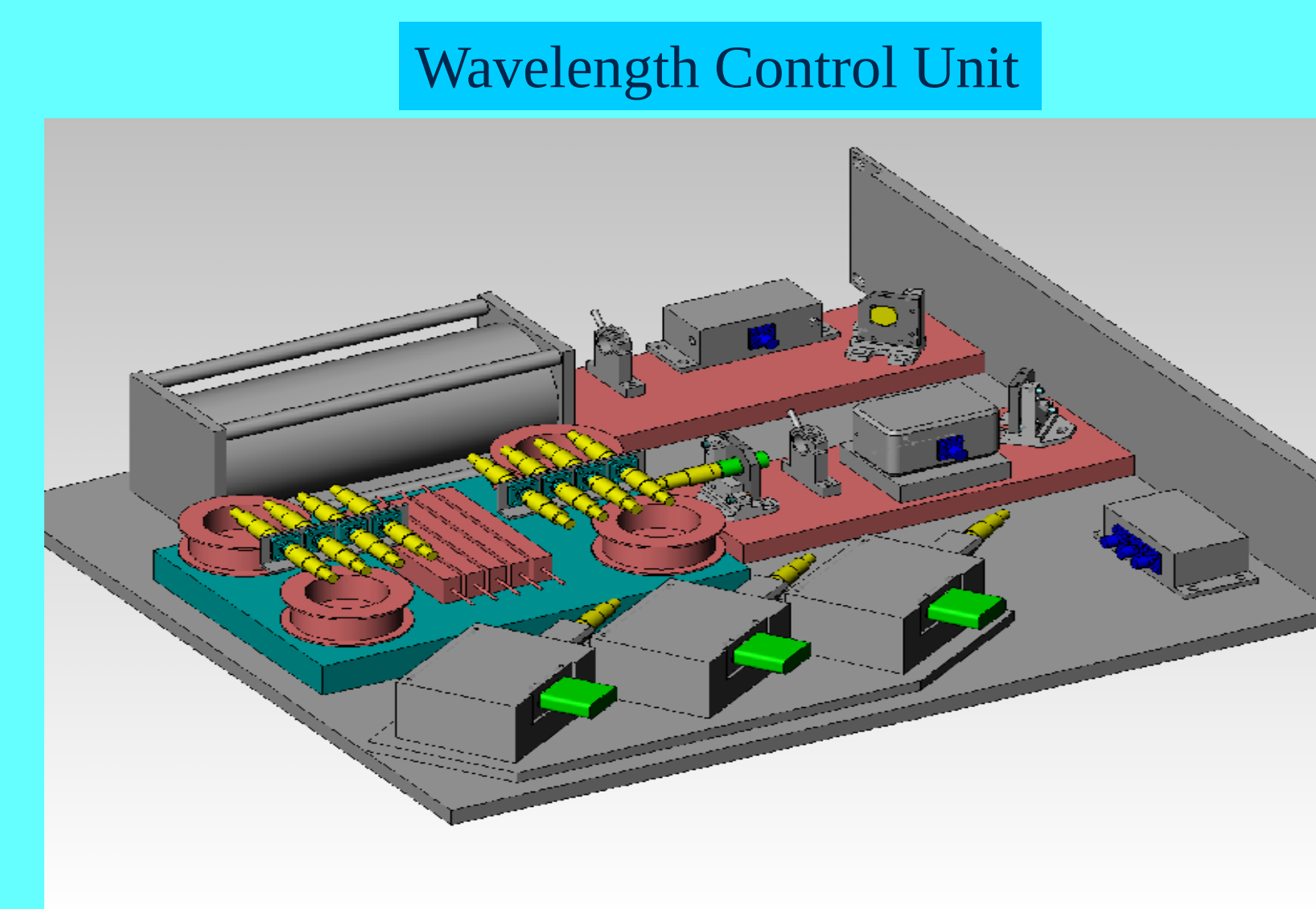
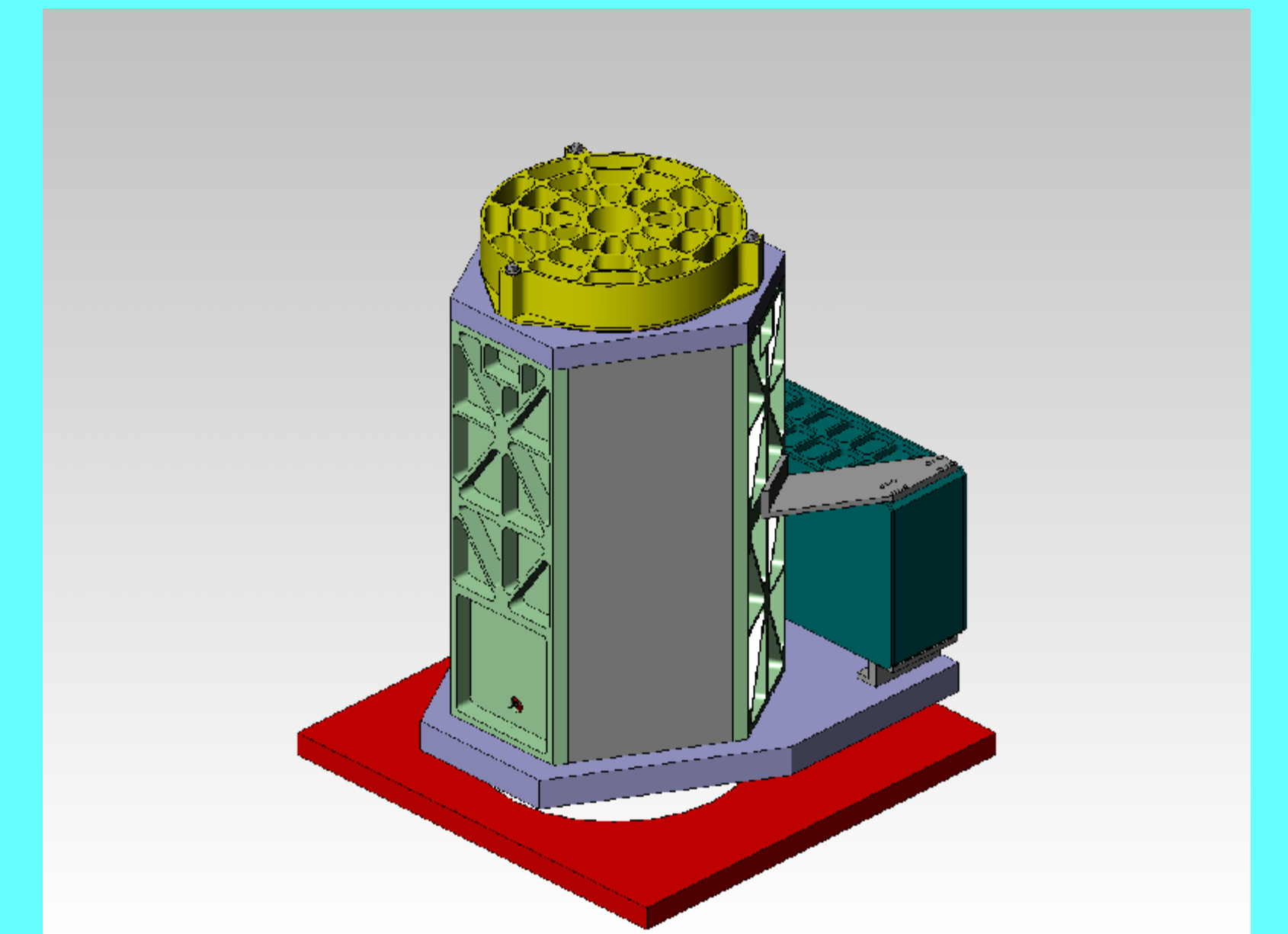


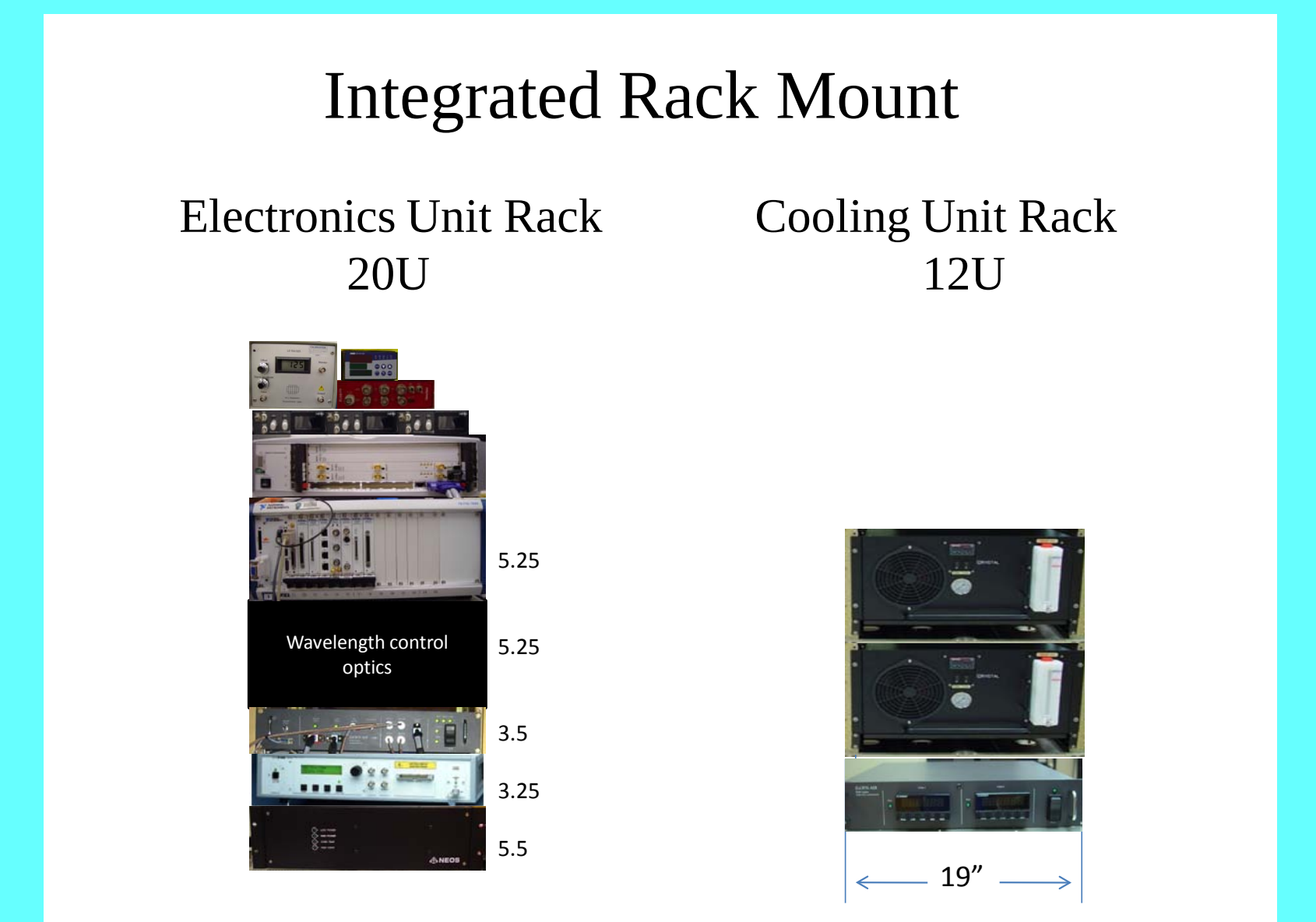
- **Objectives:**
 - Develop and evaluate an airborne 2-micron pulsed direct detection Integrated Path Differential Absorption (IPDA) lidar for CO₂ measurements
 - Advance lidar system TRL from 3-5
- **Goal:**
 - IPDA measurement precision 1-2 ppm (<0.5%) with 10 second time resolution
- **Applications:**
 - OCO-2/ASCENDS validation and deployable system for field experiments



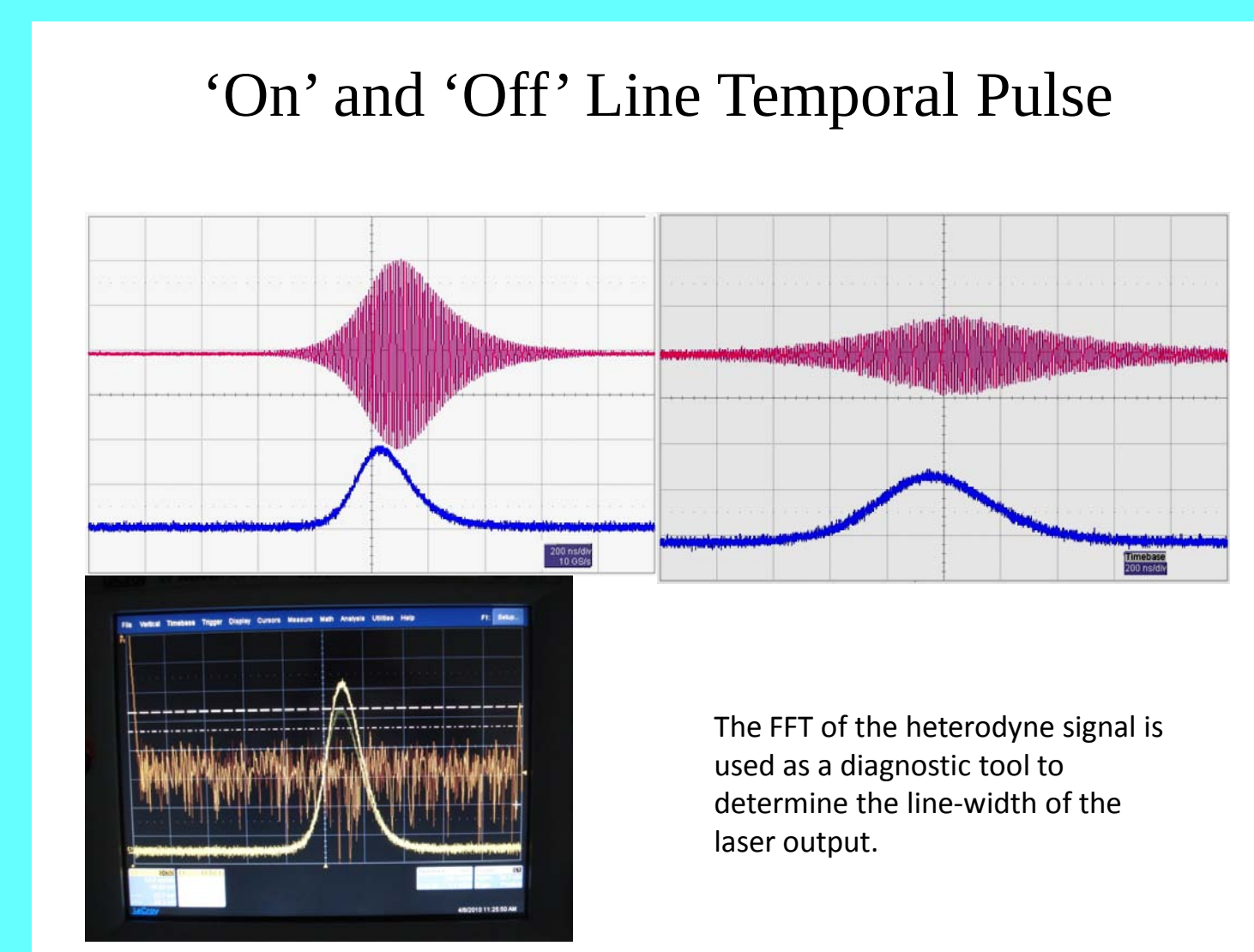
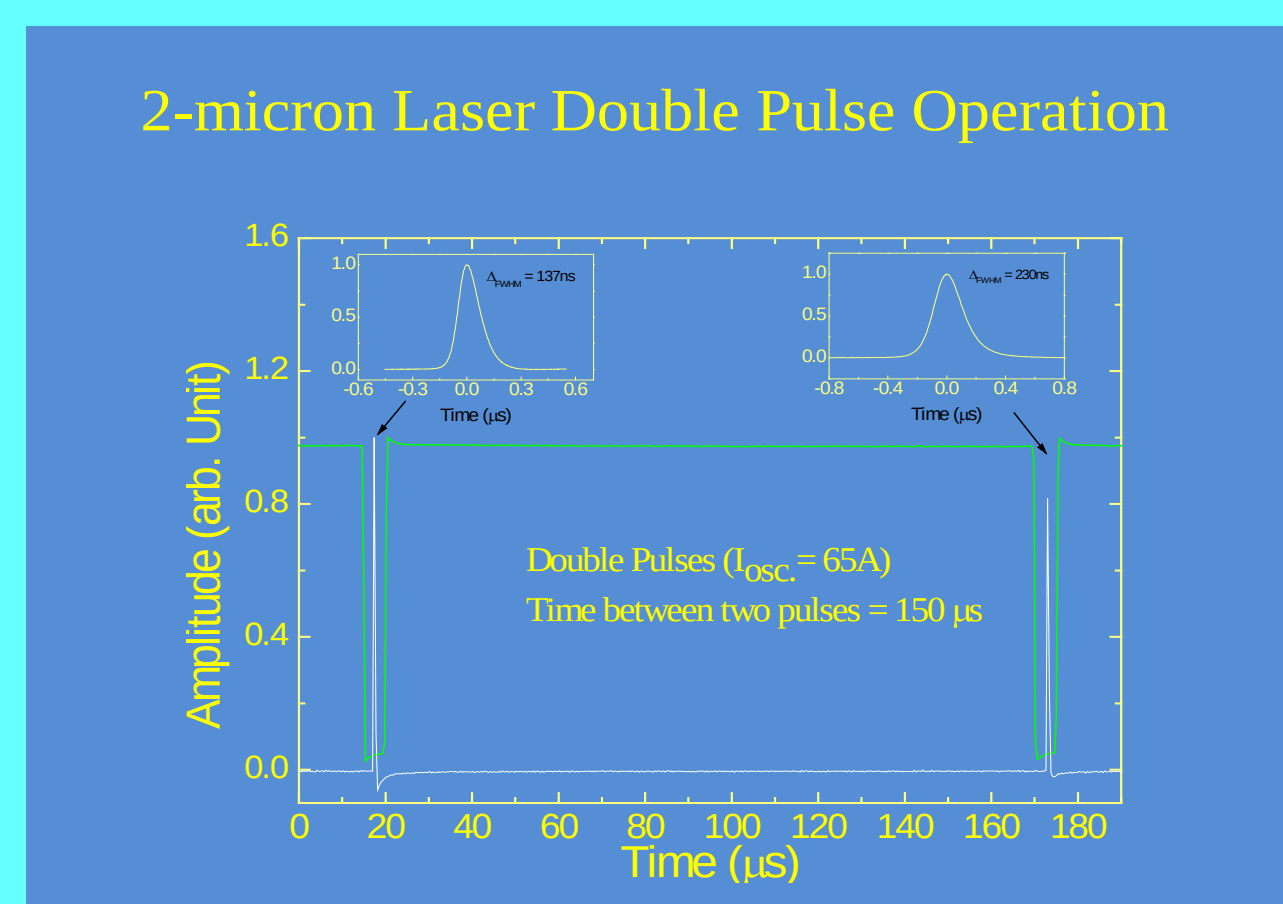
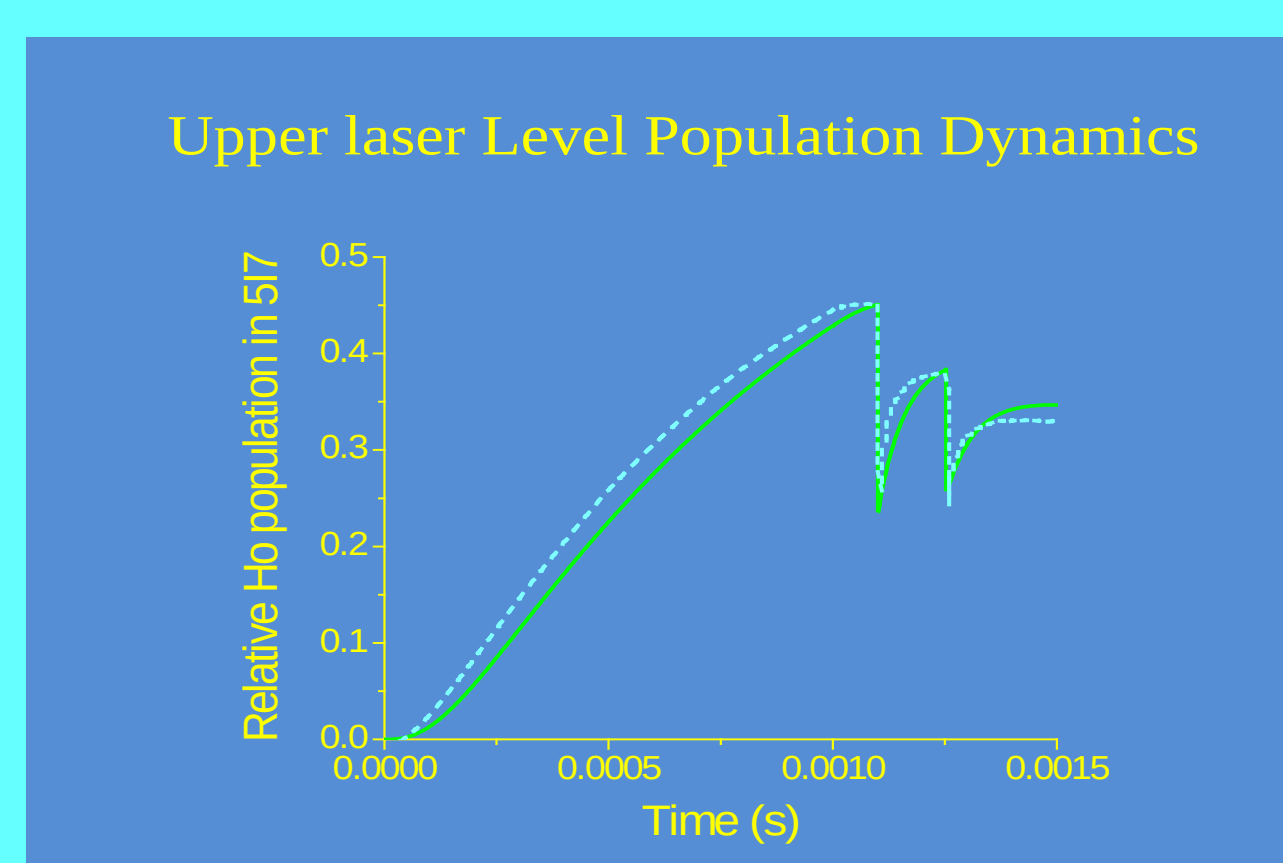
Detector InGaAs PIN

- Hamamatsu G5853 or Sensor Unlimited SU300-2.2TE

	Sensor Unlimited	Hamamatsu
Diameter (µm)	300, actual 230	300
Sensitive area (mm²)	0.061	0.07
Quantum Efficiency	0.7 @ 30°C, 0.38 @ -20°C	0.683 @ 30°C, 0.677 @ -20°C
Dark Current	387 nA @ -1V, 23°C 15 nA @ -1V, 20°C	175 nA @ -1V, 20°C
Capacitance	4.76pF @ -1V, 23°C	40pF @ -1V, and -20°C
Gain	1	1
Noise Factor	1	1
Shunt Resistance	140KΩ	9.132MΩ @ -1V and -20°C
Spectral Response	1.32A/W @ -1V, 30°C	1.18A/W @ 2.05
Noise current A/Hz ^{0.5}	8x10 ⁻¹⁴ @ -1V, 30°C	2.7x10 ⁻¹⁴ @ -1V, 20°C
NEP W/Hz ^{0.5}	6x10 ⁻¹⁵ @ -1V, 30°C	2.1x10 ⁻¹⁵ @ -1V, 20°C
Detectivity D* cm.Hz ^{0.5} /W	4x10 ¹⁴ @ -1V, 30°C 3x10 ¹³ @ -1V, 20°C (model)	1.2x10 ¹⁴ @ -1V, 20°C
Preamplifier noise for BW=2.5MHz	6x10 ⁻¹⁹ A/Hz ^{0.5}	6x10 ⁻¹⁸ A/Hz ^{0.5}



IPDA Lidar System Parameters	
Laser Transmitter	
Laser material	Tm, Ho : YLF
Online (3.5GHz)/Off-line	2051.016/ 2051.25 nm
Pulse energy	80/80 mJ (On/Off)
PRF On-Off	10 Hz Double Pulsed
Pulse width	100/100 ns (On/Off)
Frequency Jitter	<2.5 MHz
Beam Divergence	0.1 mrad
Local oscillator (LO) / Seeder laser	
On-Off-line CW laser (TmHo : YLF)	>25 mW single-mode
Direct Detection	
Telescope diameter	400 mm
Laser beam and telescope	Coaxial
Telescope FOV	0.25 mrad
Detector	0.3 mm InGaAs PIN
Lidar Signal digitization	10 bit/ 200 MHz



Airplane Altitude	24600 ft/ 7.50km
Effective Telescope Diameter (m)	0.405*0.9
Filter efficiency	0.8/ FWHW 5nm
Laser Divergence (FWHM)	0.1mrd
Telescope FOV	0.25mrad
Laser Footprint (m)	0.750
On/off pulse footprint overlap	>95%
Laser	80mJ/100ns
Average atmospheric transmission	0.921/(0.502(off/on) one way
Band width (MHz)	100
Receiver transmission	0.6
Surface Reflectance	0.015(snow), 0.025(sea), 0.03 (vegetation), 0.05(cloud), 0.22(desert)

Summary

- LaRC will convert a 2 μ m pulsed coherent CO₂ DIAL into an airborne 2 μ m pulsed direct detection CO₂ IPDA
- LaRC has successfully developed a unique double pulsed 2-micron laser, which is suitable for CO₂ DIAL/IPDA measurements
- For the first time, double pulse laser technique has been used in DIAL instrument, which increase the laser efficiency and improved measurement accuracy
- Accurate laser wavelength control and switching has been demonstrated, which meets the frequency stability and accuracy requirement of the CO₂ measurements
- 2 μ m pulsed direct detection CO₂ IPDA facilitates the test and evaluation of a new technology developments for potential high accuracy CO₂ measurements



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