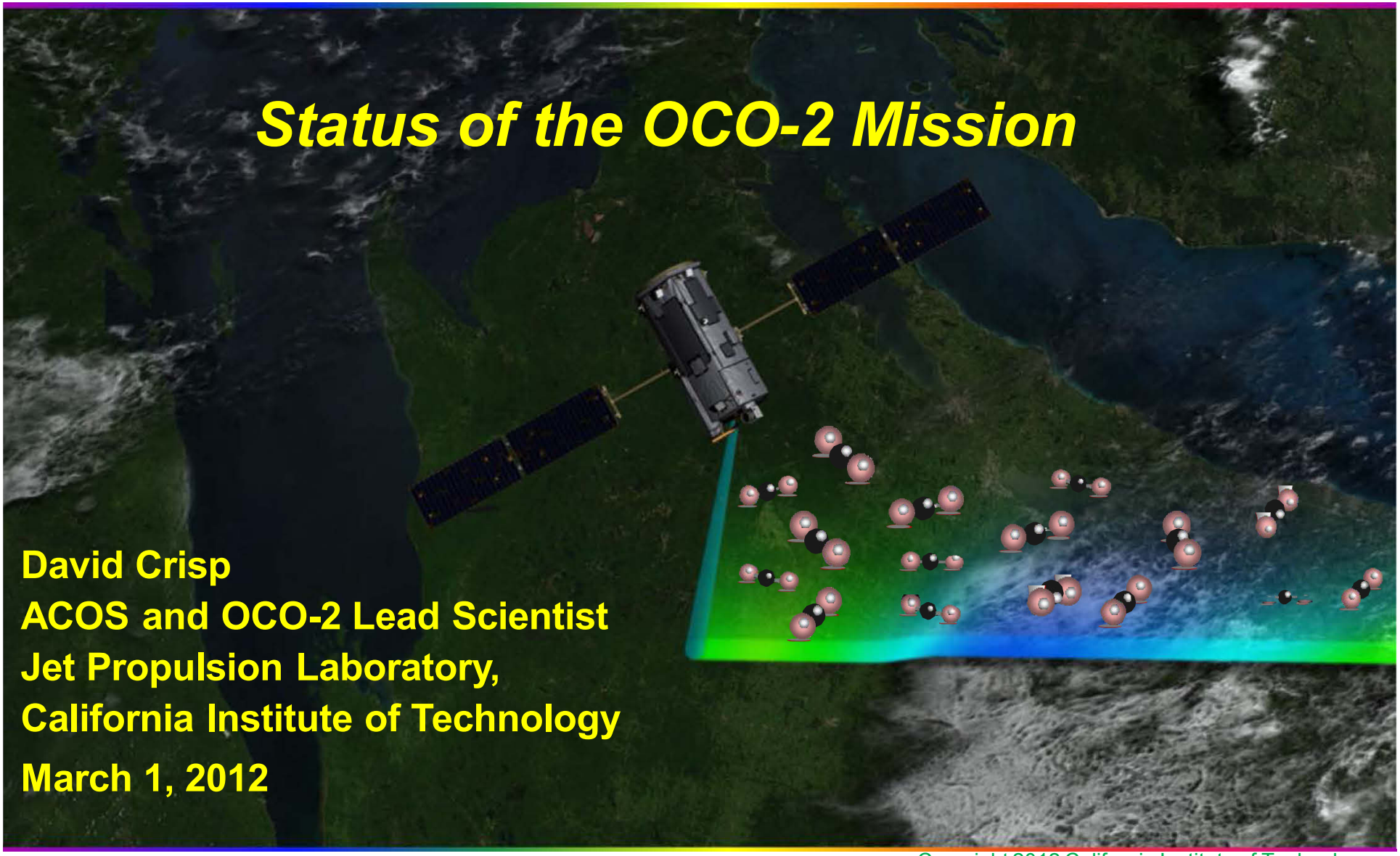
# *Status of the OCO-2 Mission*



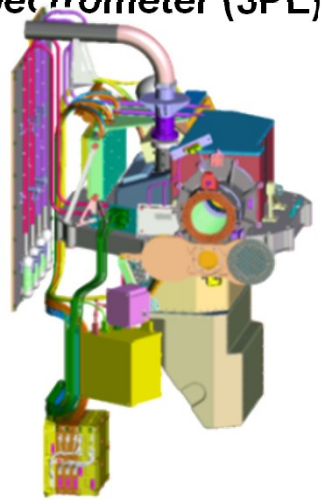
**David Crisp**
**ACOS and OCO-2 Lead Scientist**
**Jet Propulsion Laboratory,**
**California Institute of Technology**

**March 1, 2012**

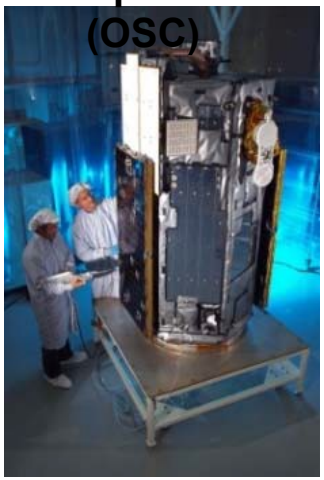
Copyright 2012 California Institute of Technology.
Government sponsorship acknowledged.

# *The OCO-2 Mission Architecture is Based on OCO*

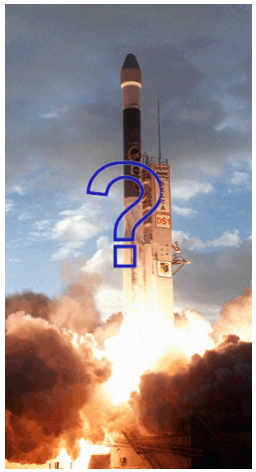
**3-Channel Spectrometer (JPL)**



**Dedicated Spacecraft Bus (OSC)**



**TBD Launch Vehicle**



**Mission Operations (OSC)**

**Formation Flying as Part of the A-Train Constellation**

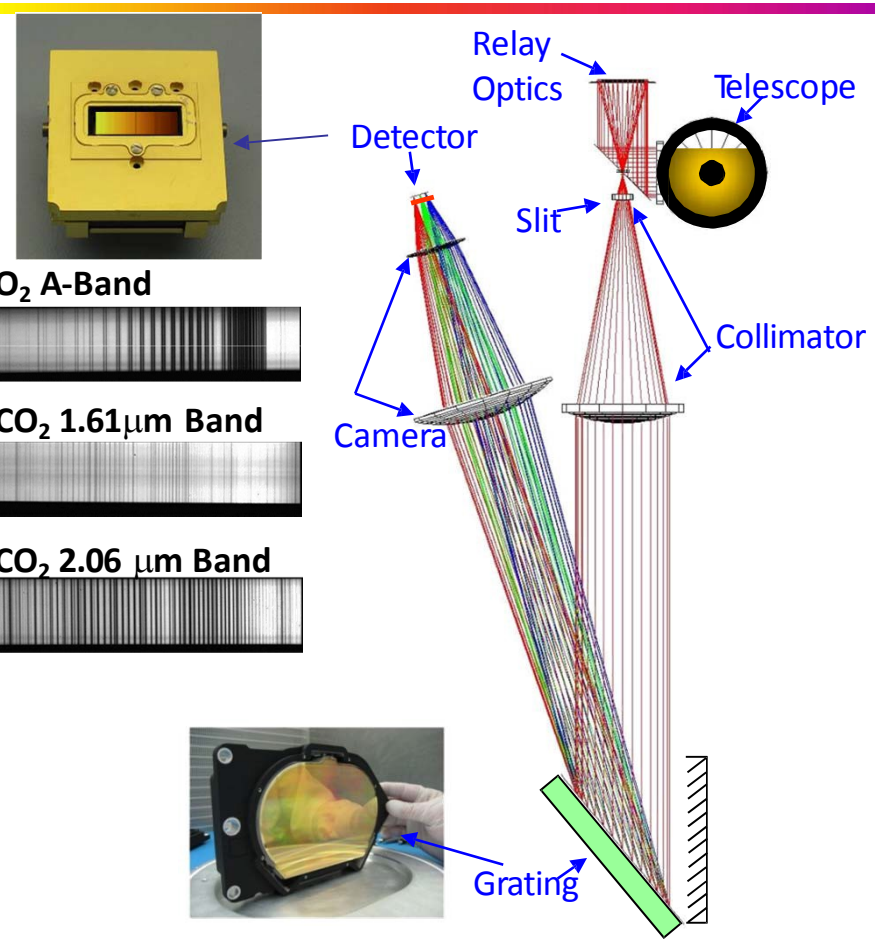
**NASA NEN (GSFC) and SN (TDRSS)**

# *The OCO Instrument – Optimized for Sensitivity*

- 3 co-bore-sighted, high resolution, imaging grating spectrometers
  - $O_2$ 0.765 μm A-band
  - $CO_2$ 1.61 μm band
  - $CO_2$ 2.06 μm band
- Resolving Power ~ 20,000
- Optically fast: f/1.8 (high SNR)
- Swath: < 0.8° (10.6 km at nadir)
  - 8 cross-track footprints @ 3 Hz
  - 1.29 x 2.25 km at nadir
- Mass: 140 kg, Power: ~105 W

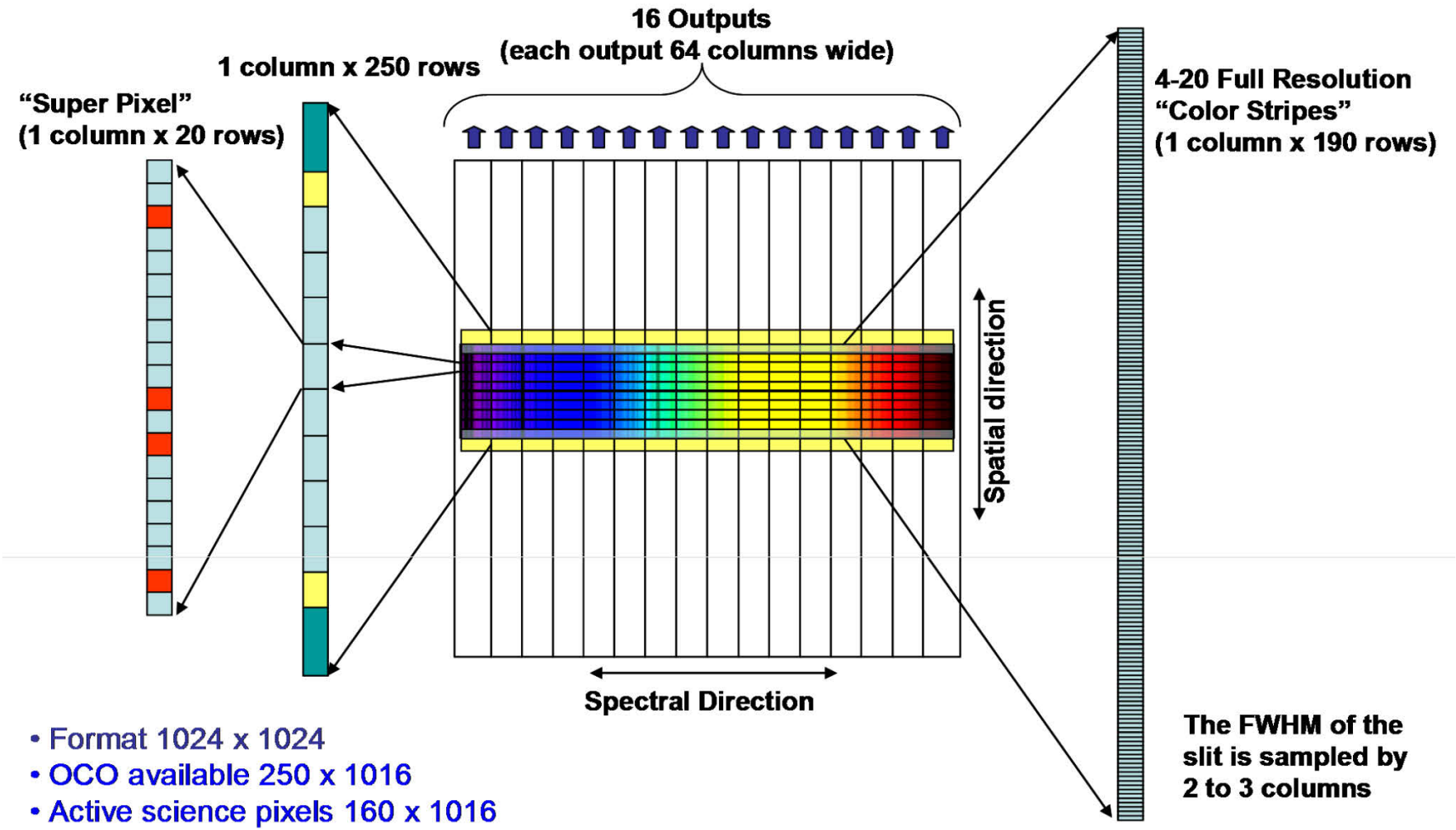
Changes from OCO

- Modified to mitigate residual image, slit alignment and stay light anomalies found in OCO pre-flight testing
- New cryocooler replaces obsolete unit



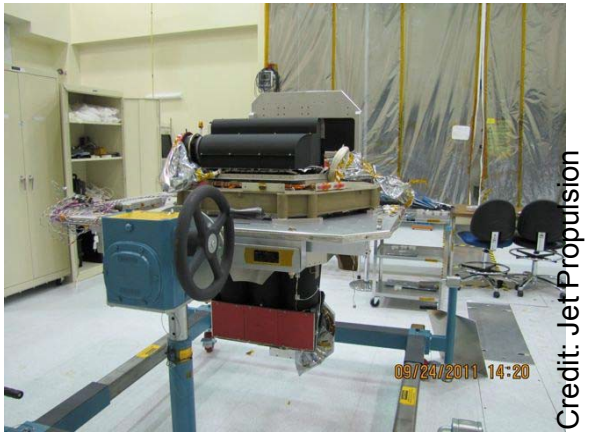

The OCO-2 instrument is more sensitive than the GOSAT TANSO-FTS, especially over dark scenes, and takes 48 to 96 times as many soundings over each orbit.

# *An Internal Imager – "Color Stripes"*



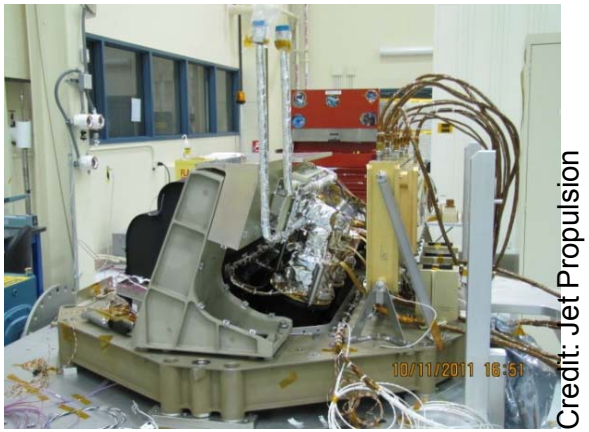

- Format 1024 x 1024
- OCO available 250 x 1016
- Active science pixels 160 x 1016

# *Instrument On Track for 30 April Delivery*




Credit: Jet Propulsion Laboratory

OBA (Optical Bench Assembly) integrated with the instrument deck

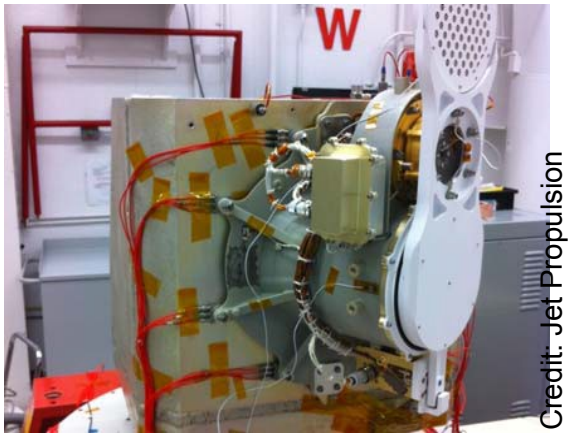



Credit: Jet Propulsion Laboratory

FPA (Focal Plane Arrays) integrated with AFE (Analog Front-end Electronics)

Credit: Jet Propulsion Laboratory

CSS (Cryogenic Subsystem) integrated with OBA

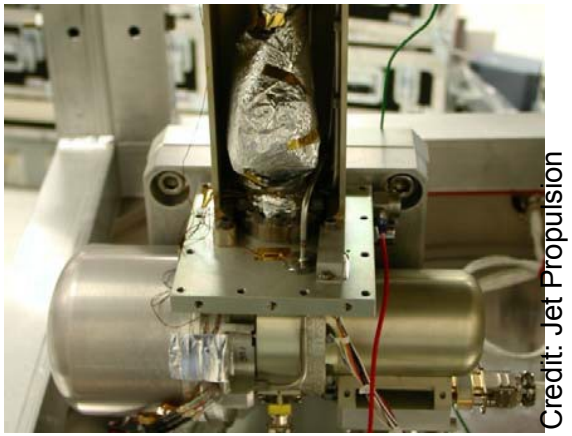



Credit: Jet Propulsion Laboratory

BCA (Baffle/Calibration Assembly)

Credit: Jet Propulsion Laboratory

Positioning the instrument inside the 10 ft horizontal thermal chamber

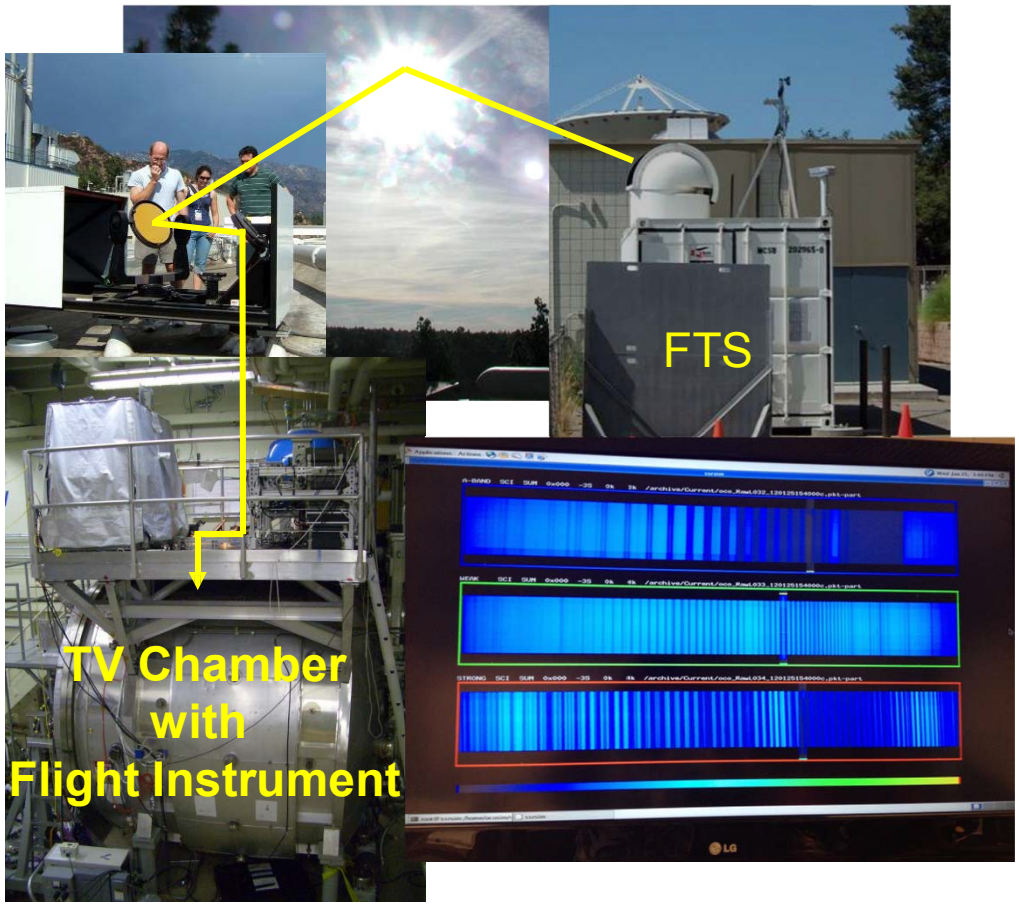


Credit: Jet Propulsion Laboratory

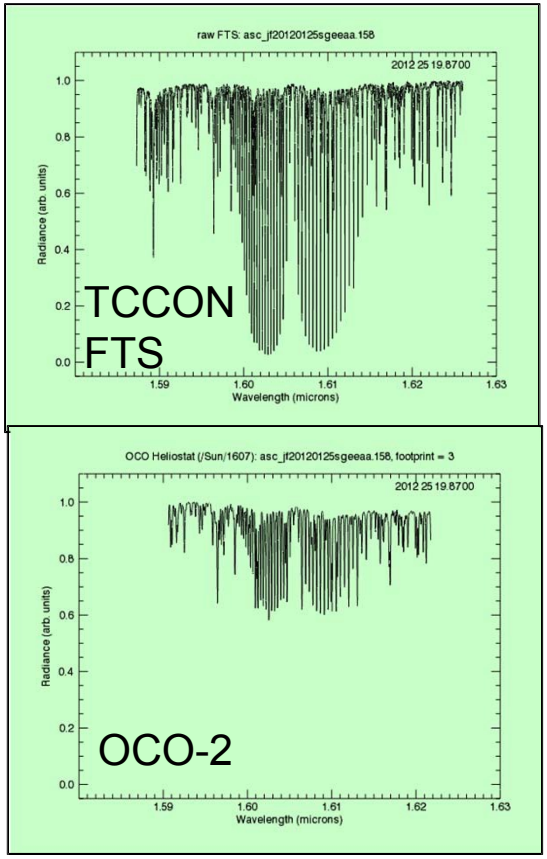
Pulse-tube cryocooler

# *Pre-Flight Instrument Qualification and Characterization*

Observations of the sun with the flight instrument taken during the thermo-vacuum tests provided an end-to-end test of the instrument performance.

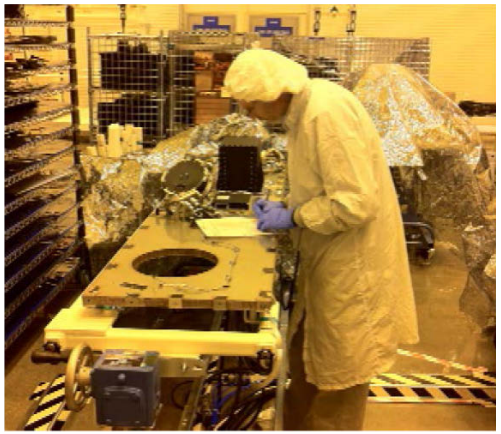



**1.6 μm CO2**

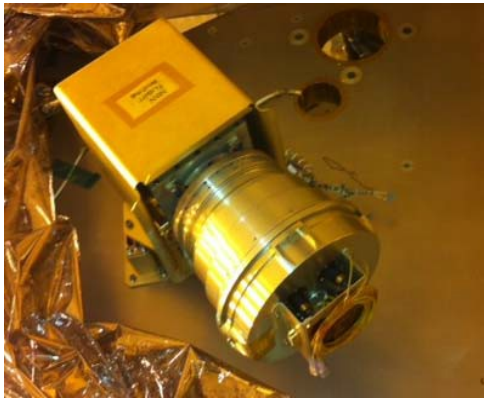



11:52 am on 25-Jan-2012

# *Spacecraft Bus I&T Underway at Orbital, Dulles*



Credit: Orbital Sciences Corporation



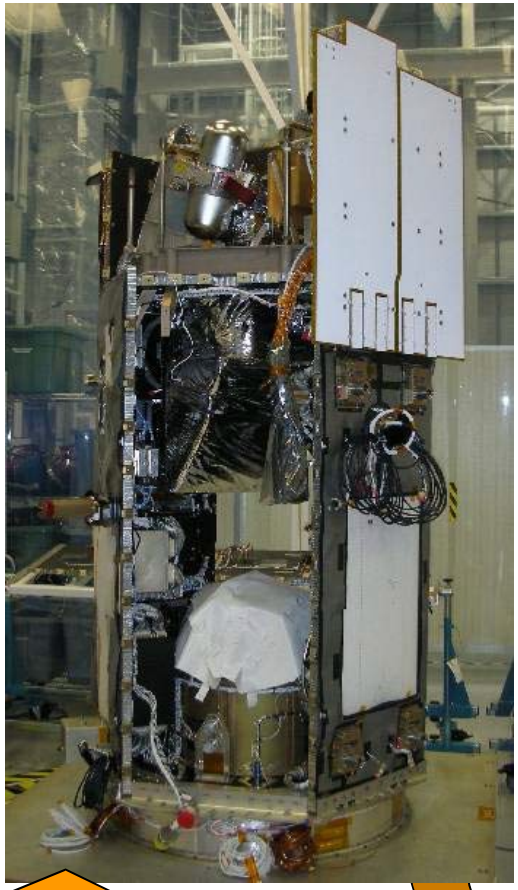
Credit: John “Brad” Burt, JPL

Credit: Orbital Sciences Corporation

Credit: Orbital Sciences Corporation

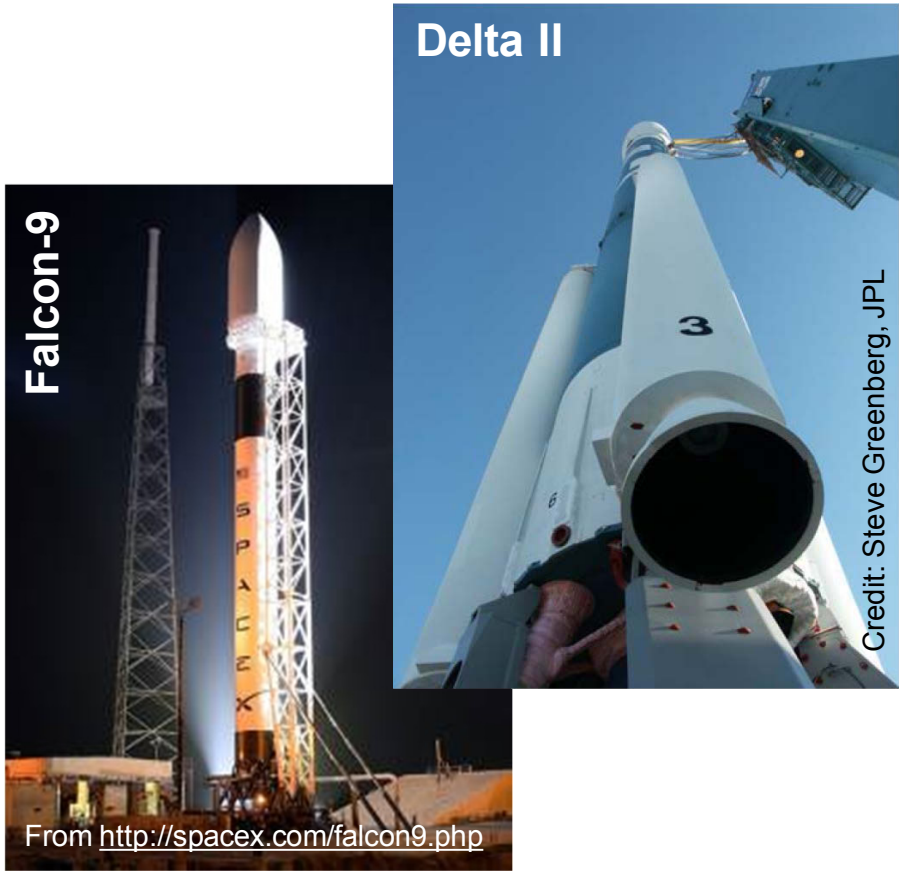
- Activities are being performed at the Orbital Sciences Corporation facility in Dulles, VA
- The spacecraft structure, system harness, and avionic assemblies have been integrated and tested
- Most subcontracted items have been received, integrated, and tested
- Spacecraft bus delivery also expected this spring

# *Instrument + Spacecraft Bus = Observatory*



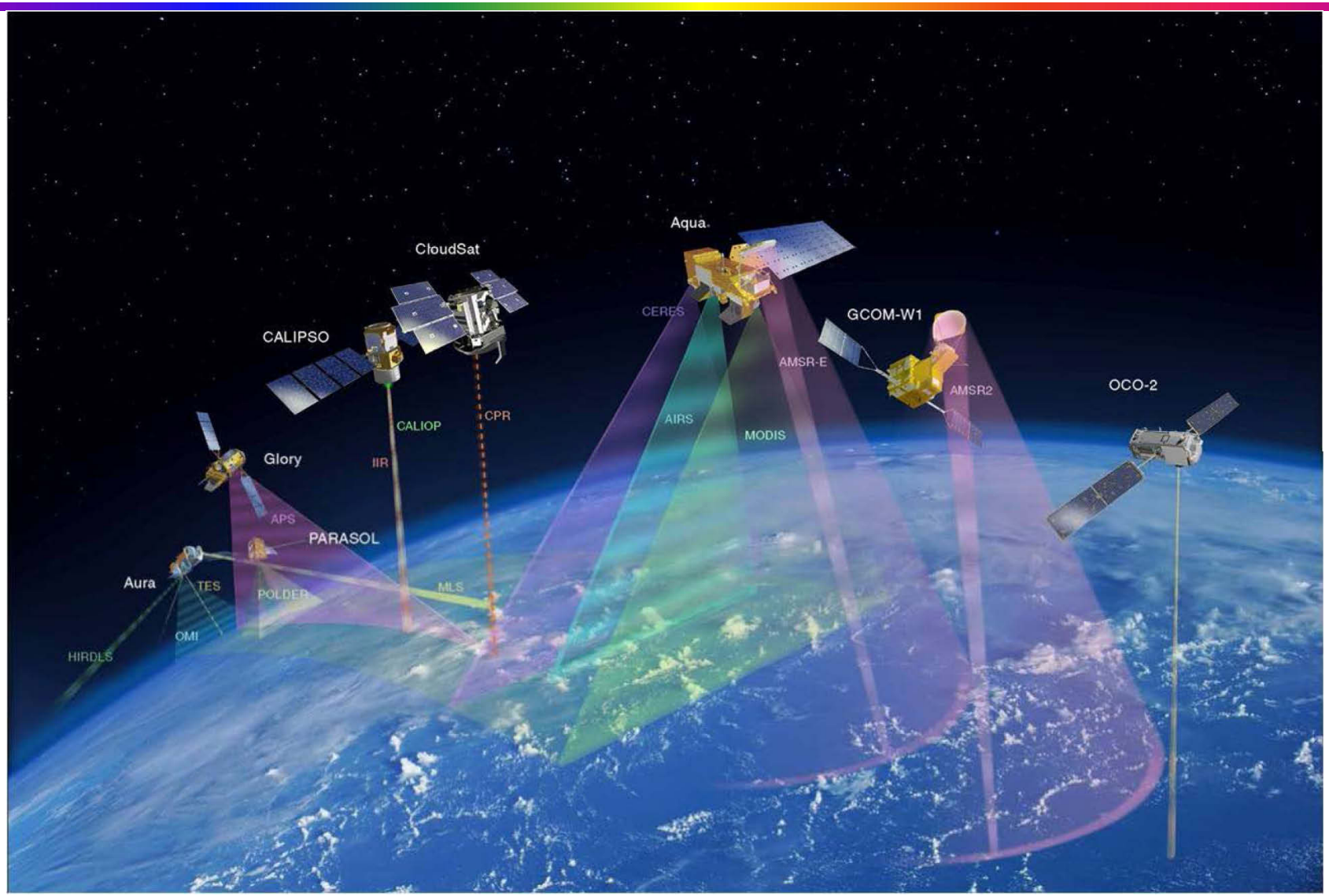
# *Launch Date Driven by Launch Service Provider*

- No root cause identified for either OCO or Glory Taurus XL launch vehicle anomalies
- Competitive selection process for OCO-2 has commenced
- Please, no communications with prospective bidders until a selection is announced




**A Couple of Possibilities for OCO-2**

# *Flying in Formation in the A-Train*

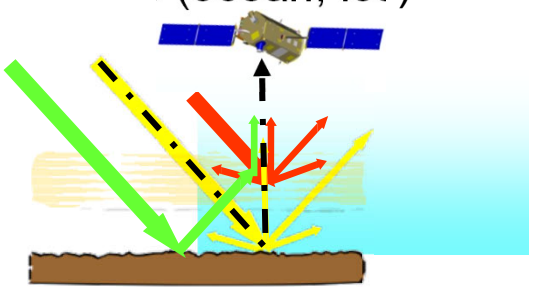


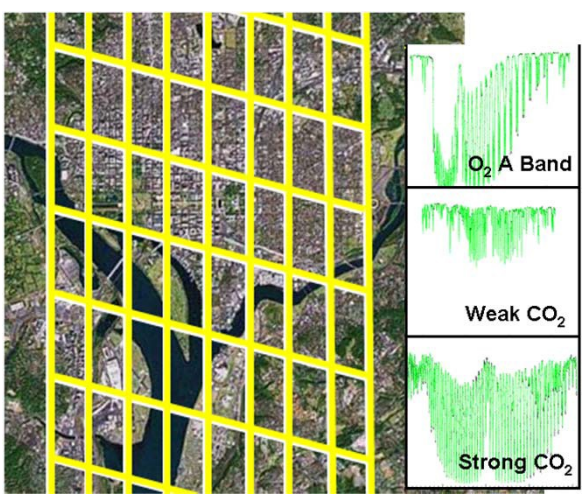
# *Observation Modes Optimize Sensitivity and Accuracy*

## Nadir Observations:

+ Small footprint (< 3 km$^2$)

– Low Signal/Noise over dark surfaces (ocean, ice)

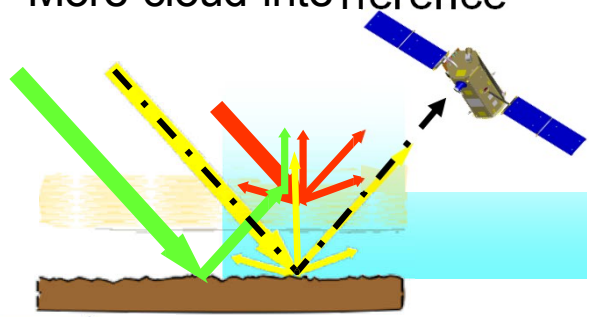


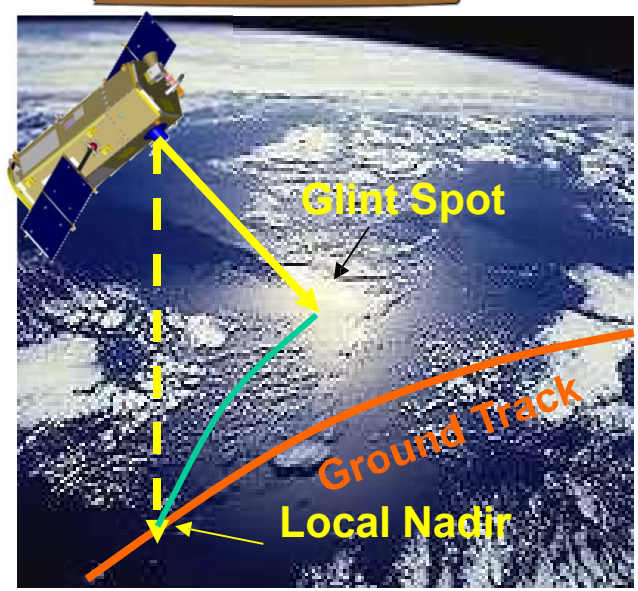



## Glint Observations:

+ Improves Signal/Noise over oceans

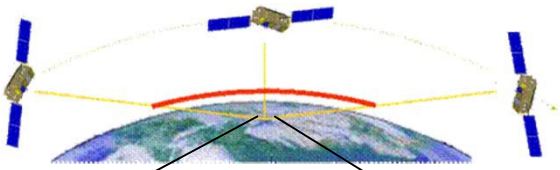
– More cloud interference

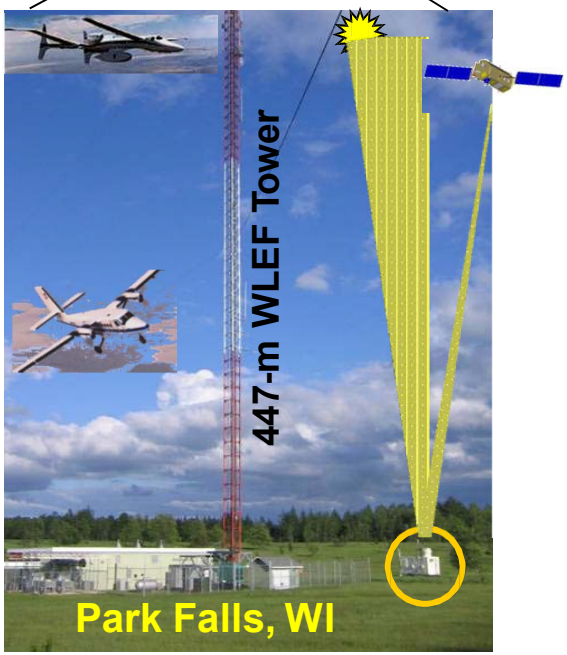


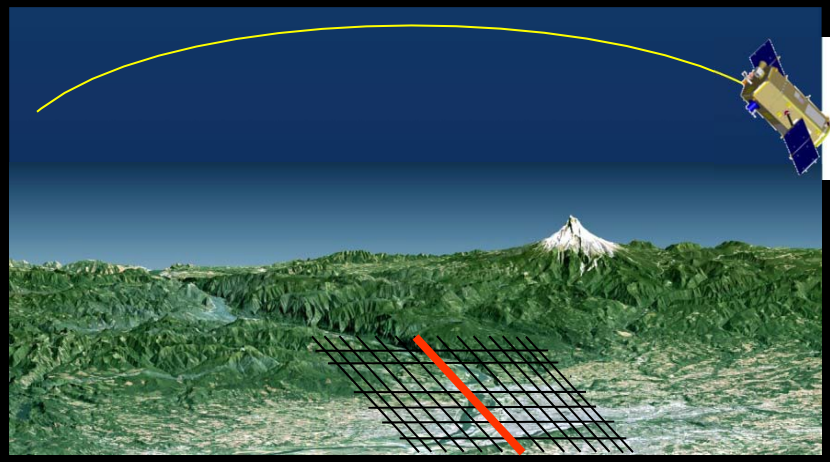


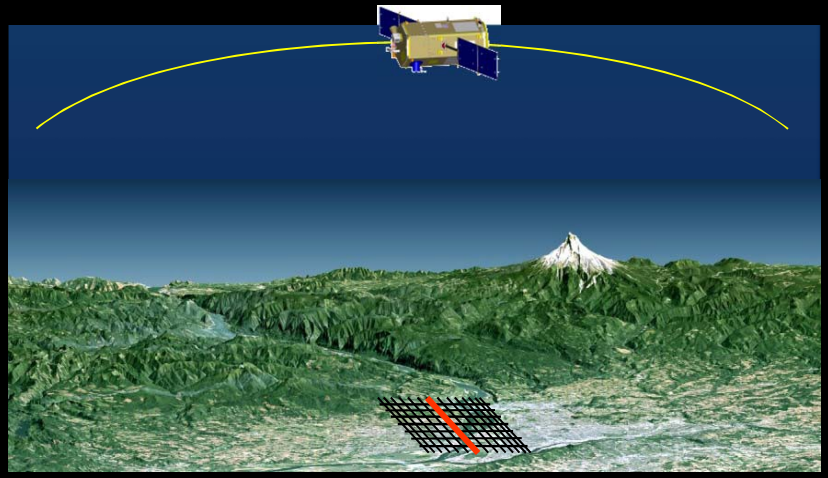

## Target Observations:

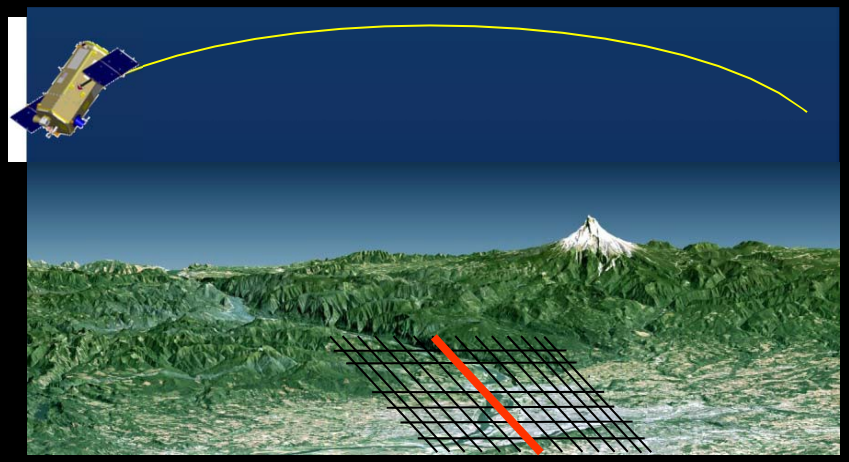
- Validation over ground based FTS sites, field campaigns, other targets



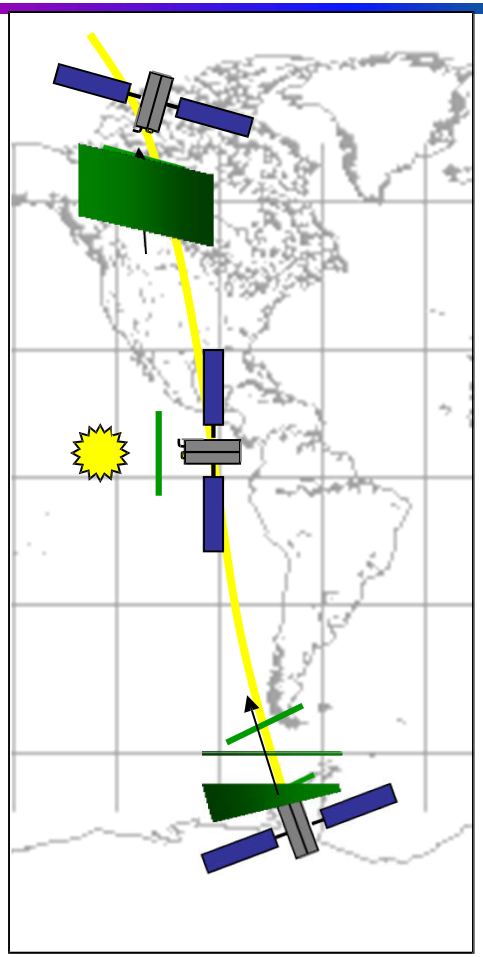






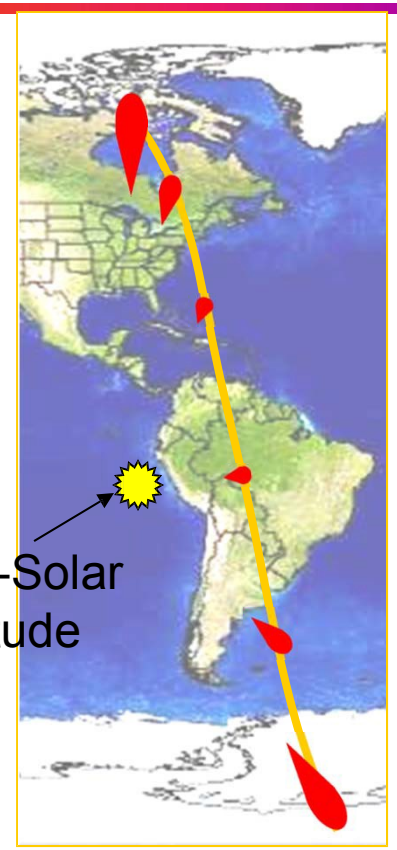


# *The OCO Footprint*



*Slit and Footprint orientation and overlap as a function of position in orbit track.*

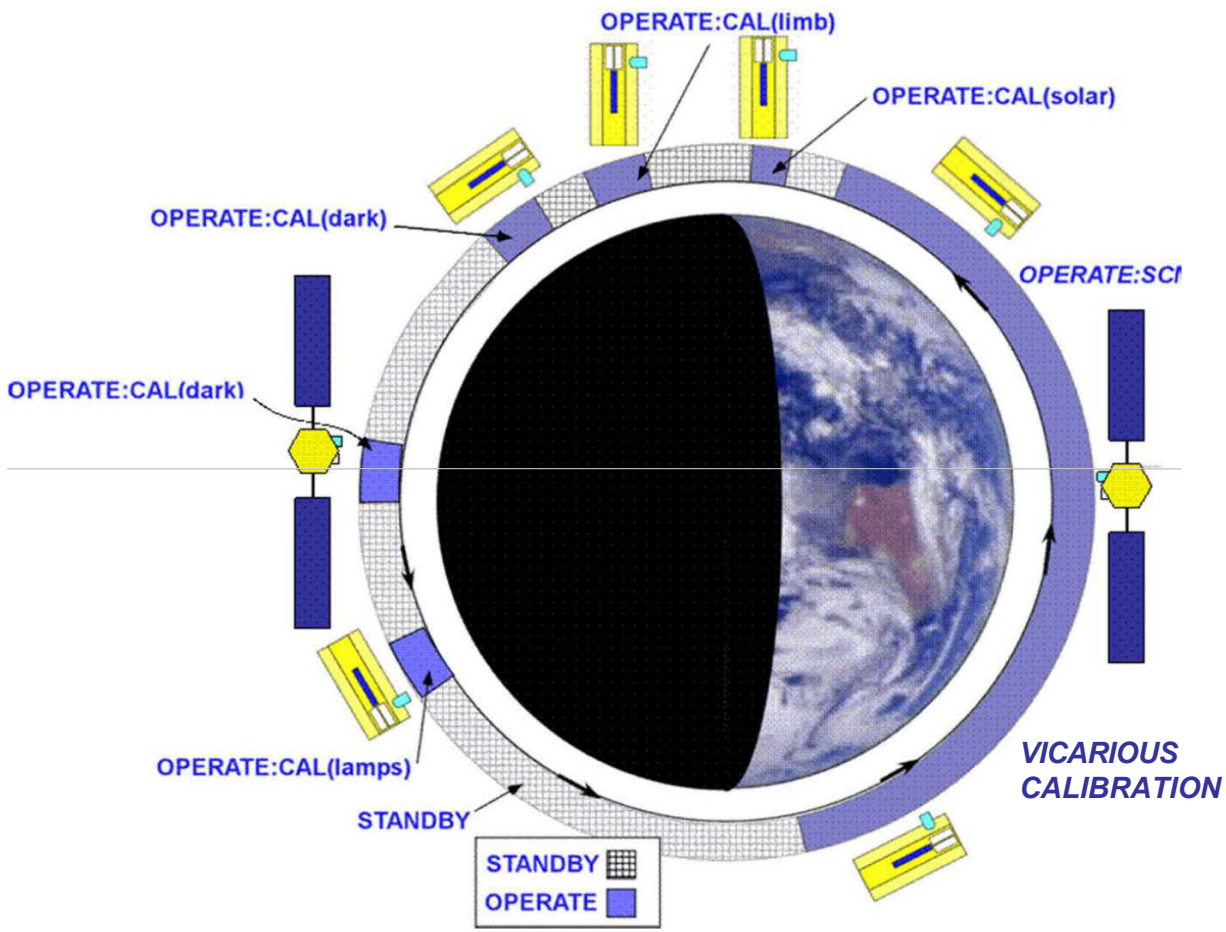
- The azimuth orientation of the OCO spacecraft varies along the orbit track to
  - Maintain alignment of the spectrometer slits orthogonal to the plane defined by the sun-surface spacecraft
  - Maintain constant power on the solar panels
- This approach produces an footprint shape and size that varies along the orbit
  - Surface footprint
  - "Atmospheric" footprint




*Orientation and shape of horizontal contribution functions for Nadir observations*

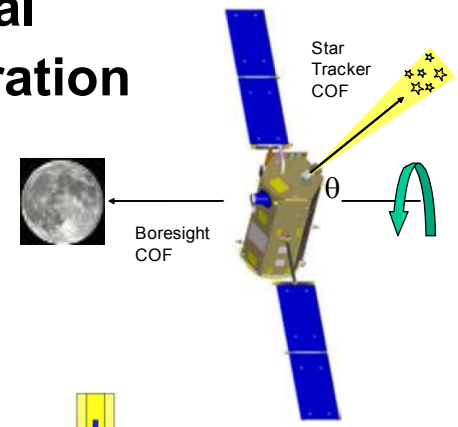
# *Routine and Special Calibration Observations Ensure On-Orbit Performance*

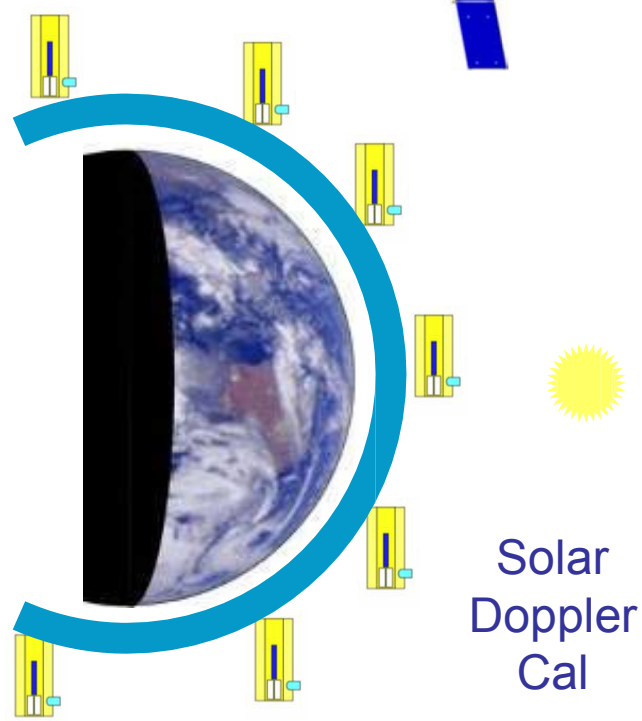
## Routine Calibration




## Special Calibration

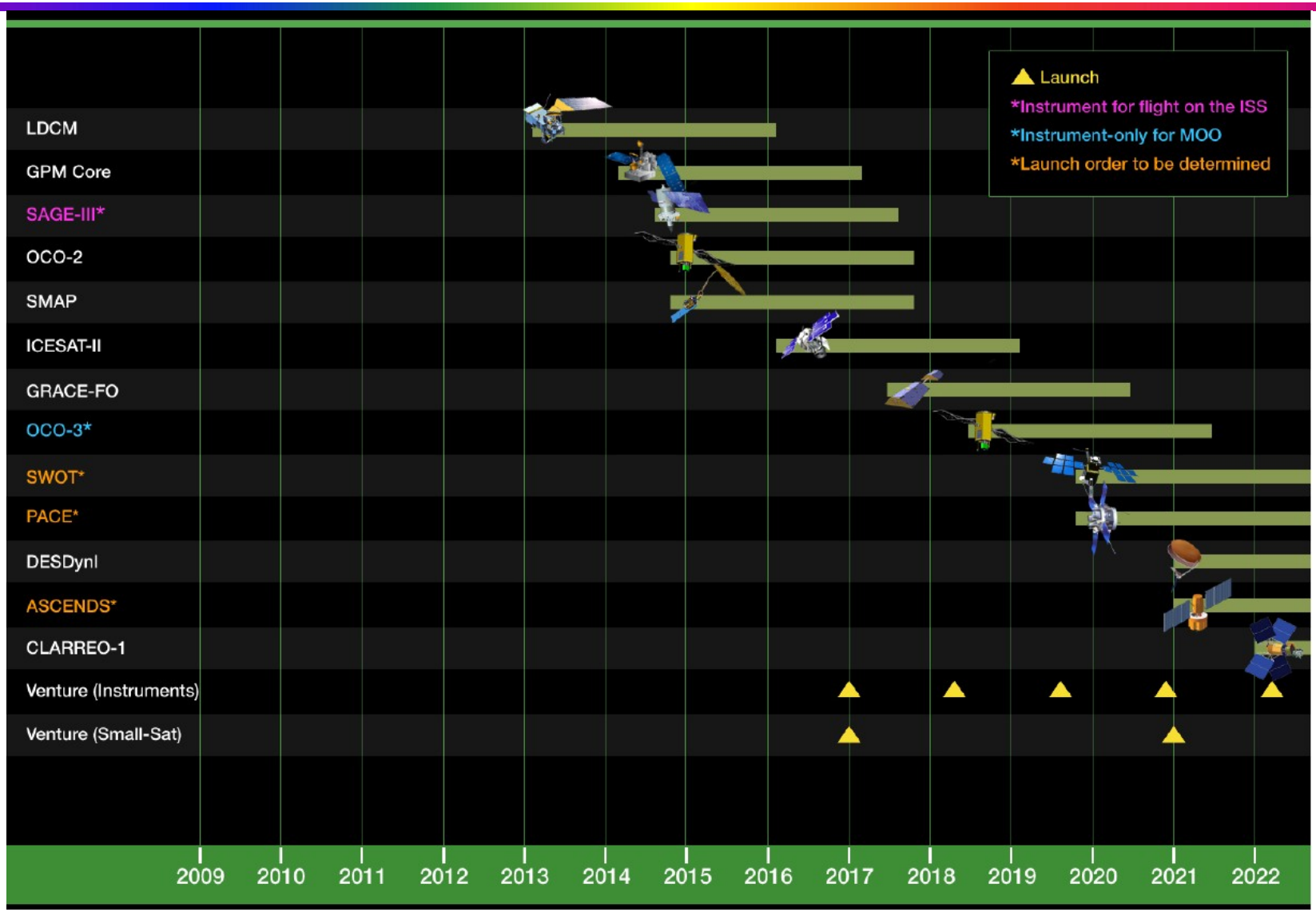
Lunar Cal



Solar Doppler Cal

# NASA Future Mission Time Line



# *Examples of Collaborative Activities with OCO-2, GOSAT, GOSAT-2, CarbonSat, MicroCarb …*

Pre Launch:

- Cross calibration of pre-launch radiometric standards
- Exchange of gas absorption coefficient and solar databases
- Algorithm development/intercomparison
- Validation system development (TCCON + Tsukuba FTS?)
- Dual/multi-Satellite OSSE's – what do you gain with truly coordinated observations

Post Launch:

- Cross calibration of solar/lunar/Earth(vicarious: RRV+?) observations
  - Including exchange of solar and lunar (ROLO) standards
- Cross validation: TCCON (possibly adding a validation campaign or two)
- Algorithm development/intercomparison
- Intercomparisons of flux inversions