GeoCarb:

The Geostationary Carbon Observatory

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The Carbon Cycle: A Multi-scale Problem

The **carbon cycle** persists as **one the three leading uncertainties** in projections of future climate. This is partially due to the **sparseness of observations** of atmospheric carbon at the relevant spatiotemporal scales, which could be used to improve carbon cycle models as well as **emissions estimates** from natural sources and sinks as well as anthropogenic sources.

Surface sampling sites across the globe play a critical role in determining the baseline sources and sinks at **continental scales**, but there may be large biases present in the fluxes they constrain due to the mismatch in concentration measurement and inferred flux scales. Furthermore, there are **very few measurements** in the regions of the globe that are believed to be the **most important for understanding feedbacks** between the carbon cycle and the climate system: the **tropical forests** and the boreal forests.

The launch of Greenhouse Gas Observing Satellite (**GOSAT**) in 2009 and more recently (2014) the Orbiting Carbon Observatory 2 (**OCO-2**) have brought the power of space based remote sensing to bear on the problem, but suffer from a few persistent issues: bias in the retrieved column average CO_2 concentration being the most important, but also difficulties related to visibility through clouds and aerosol contaminated scenes, and the fact that **all observations occur at the same local time** and have no information on the diurnal cycle or high latitude winters. Even more, the **long period between revisits** can means that the size of regions that can be constrained by satellite observations remains fairly large (**regional to continental**). Meeting the challenge of better quantifying the sources and sinks of carbon, both natural and anthropogenic, thus requires a new observing system that combines the **data density** of OCO-2 and GOSAT but with better fidelity and at **multiple times per day**.

GeoCarb Mission Specs

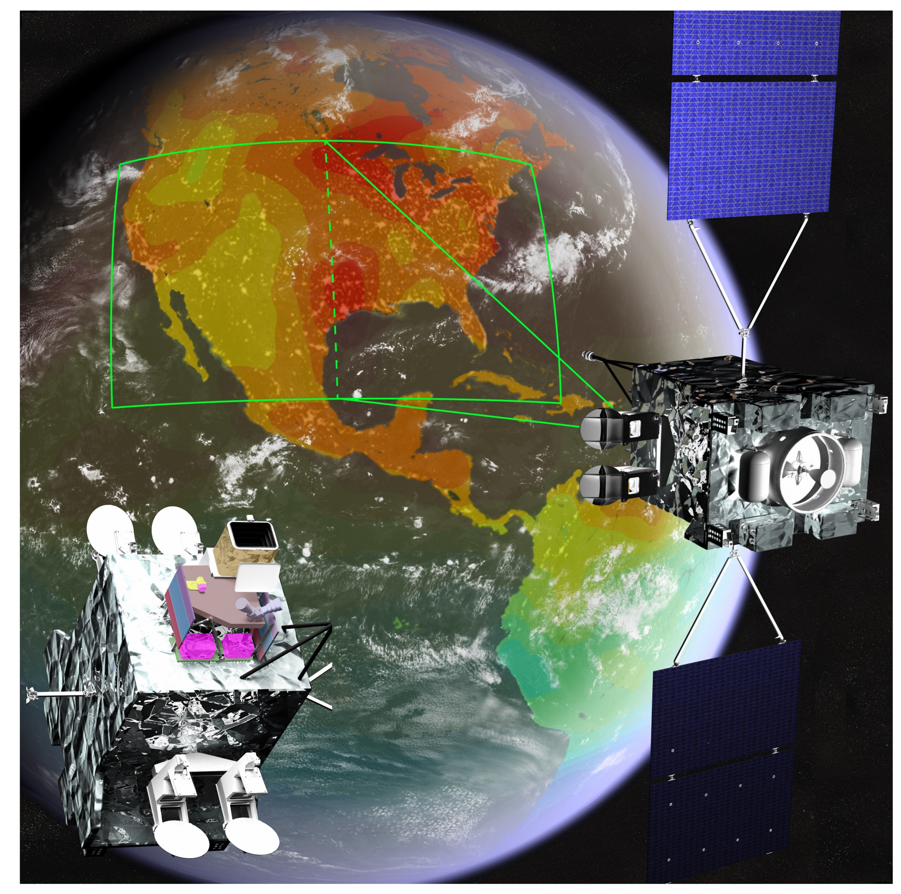
Instrument	Single slit, 4-Channel IR Grating Spectrometer
Bands	0.76μm, 1.61μm, 2.06μm and 2.32μm (OCO-2 Instrument and Alg Heritage)
Measurement Precision	CO_2 (0.3%), CO (10%), CH_4 (0.6%) & Solar Induced Fluorescence (1.0 W/m2/sr/s)
Footprint Size	5-10km by 5-10km
Mass	158 kg (CBE)
Dimensions	1.3 m x 1.14 m x 1.3 m
Power	500W (CBE)
Data Rate	10 Mbps
Data Volume	~4,000,000 soundings per day
Expected Launch Date	Dec 2024

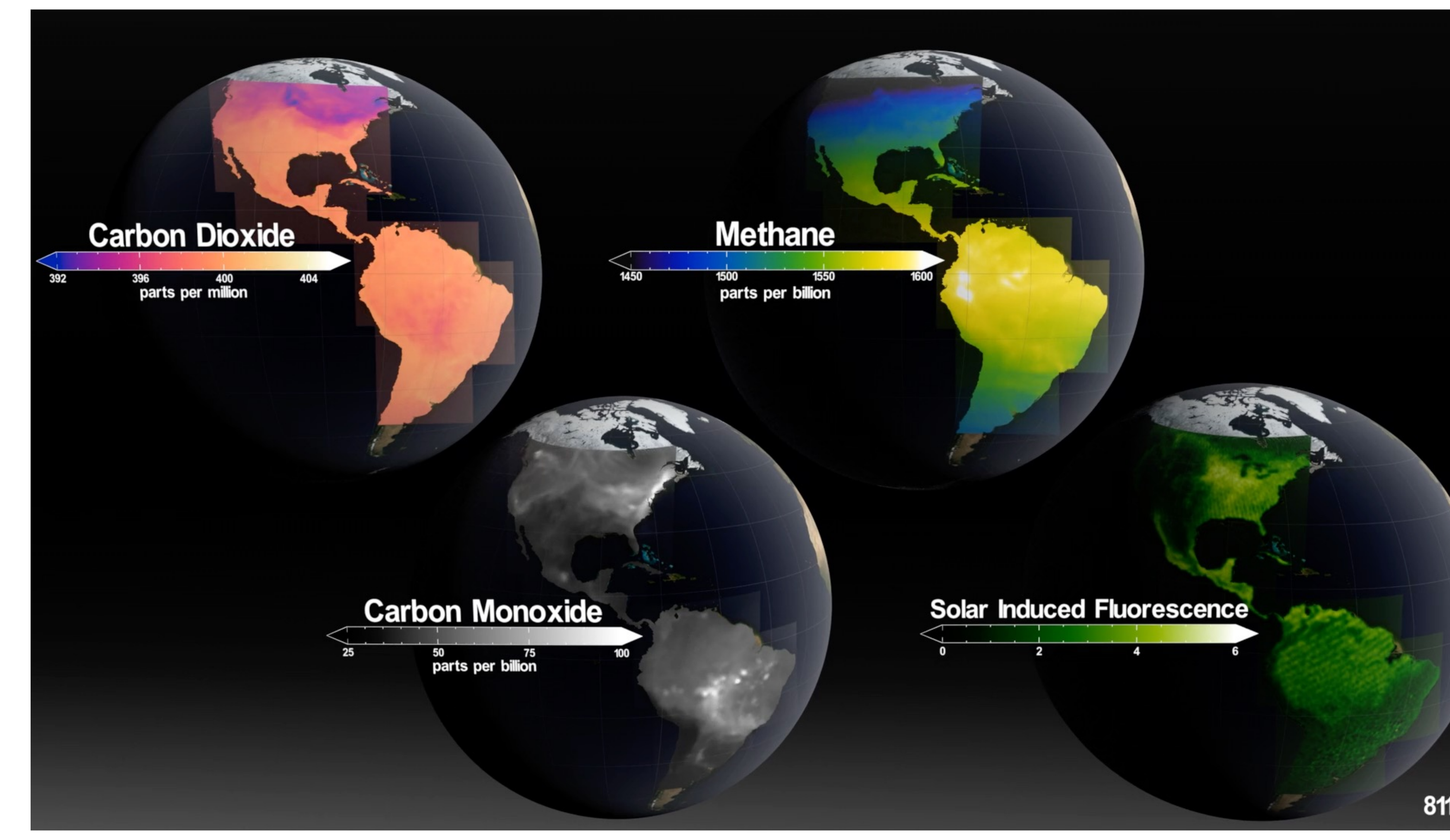
GeoCarb was selected in December 2016 as the next NASA Earth Venture Mission (following CYGNSS).

By observing from **geostationary orbit**, **GeoCarb** solves the problem of **visibility from space** for the midlatitudes and tropics. An adaptable scanning system allows for **flexible observing strategies**, to avoid areas that are covered with dense cloud layers, or to **target areas** that are of immediate interest, such as plumes and other anomalies. Persistent scanning as well as a **3km (N-S) by 6km (E-W) footprint** at nadir will allow for unprecedented coverage and monitoring capability of both **natural and anthropogenic** systems of **CO_2, CO and CH_4**.

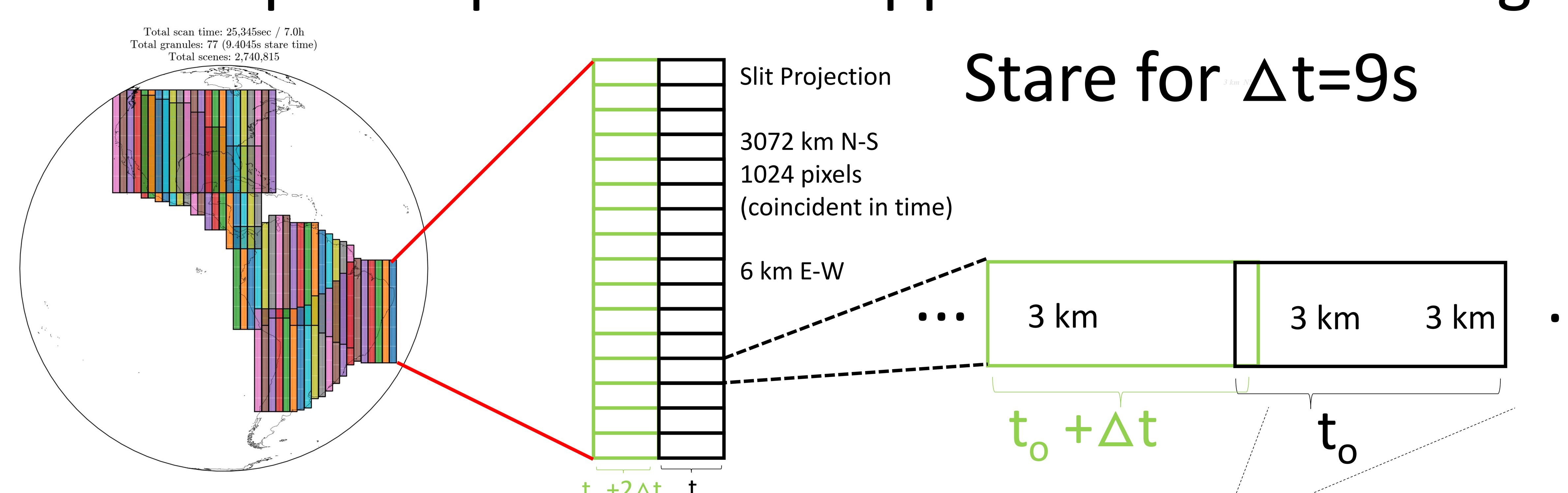
GeoCarb employs a four channel grating spectrometer that measures reflected sunlight in four bands: **0.76 µm (O_2 and SIF), 1.61 µm (CO_2) 2.06 µm (CO_2), and 2.32 µm (CO and CH_4).** Numerous instrument model studies and OSSEs were performed to tie signal and noise characterizations and science objectives to realizable and scientifically useful measurement requirements that are listed in the accompanying table.

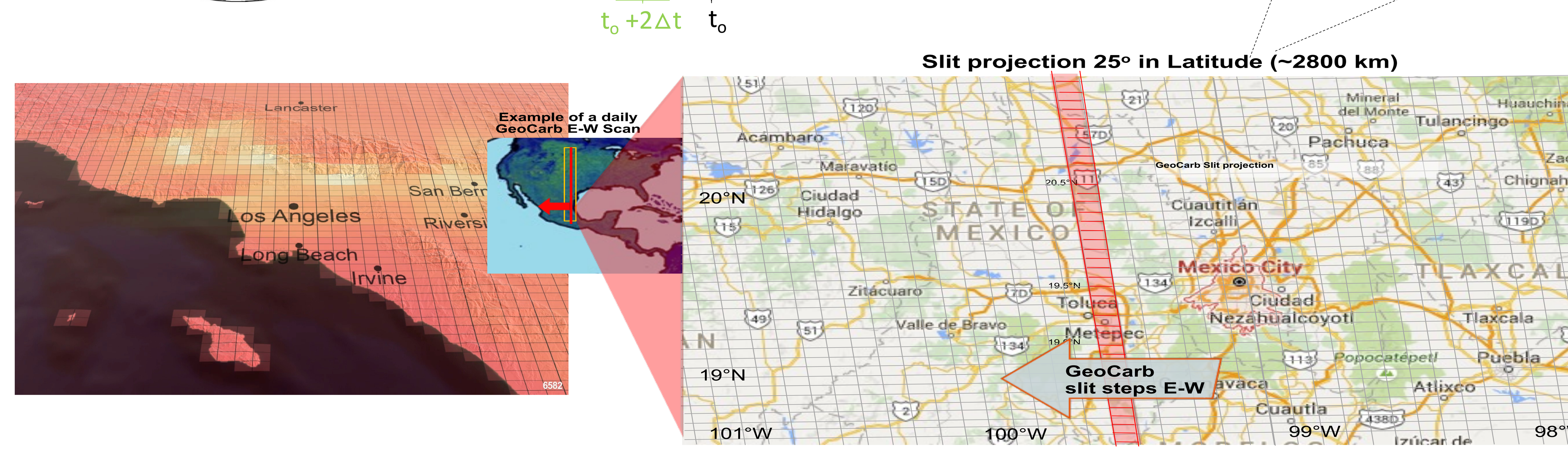
The View from 22,000 Miles Up



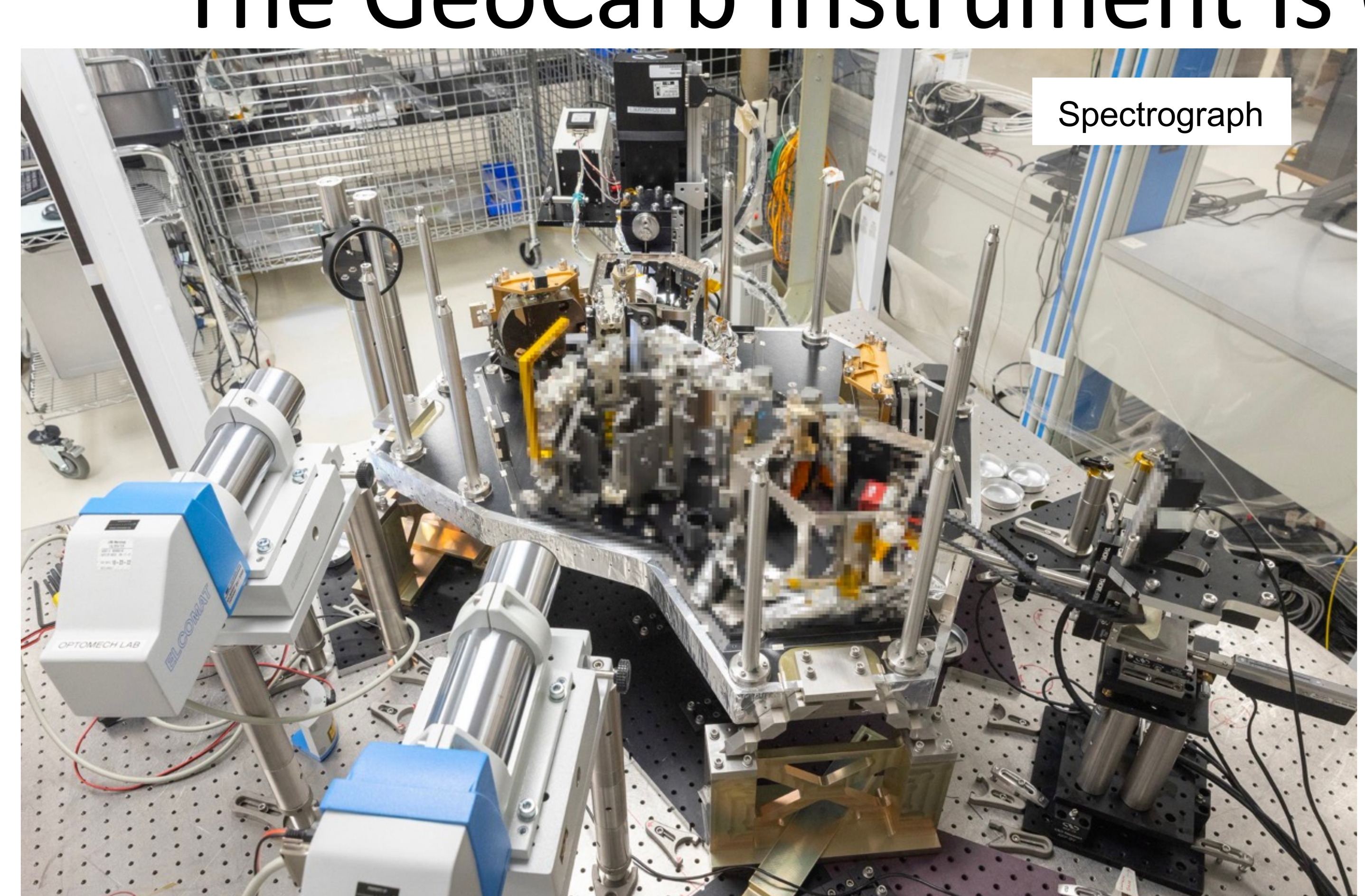


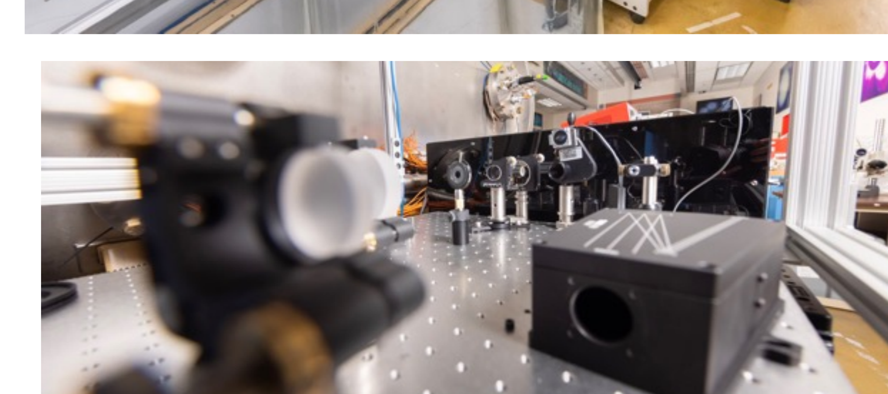
A Unique Step-and-Stare Approach to Observing





The GeoCarb Instrument is Coming Together!





Light Inputs for Testing

More info at ou.edu/geocarb or email geocarb@ou.edu to collaborate!