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## Introduction

- The Arctic Climate is changing more rapidly than models predict.
- With declining ice cover, the Arctic Ocean will be subject to increased shipping traffic and exploration activity for natural resources.
- Monitoring Greenhouse Gas (GHG) emissions from these new sources requires high spatial resolution.
- Some of the important atmospheric species that contribute significantly to climate change are methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>).
- This poster report on progress developing instrumentation to measure these gases as well as O<sub>2</sub> A-band for producing temperature profiles.

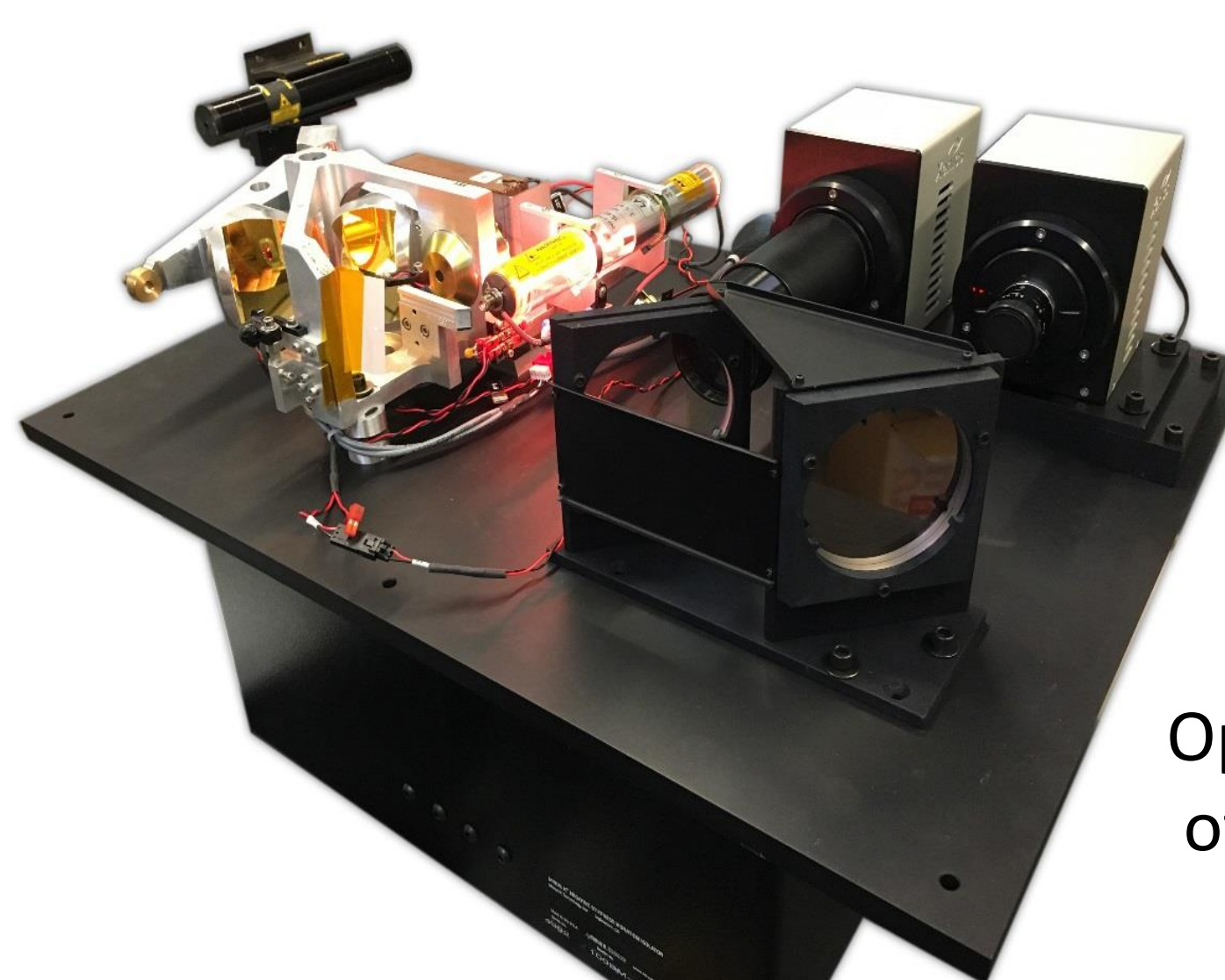
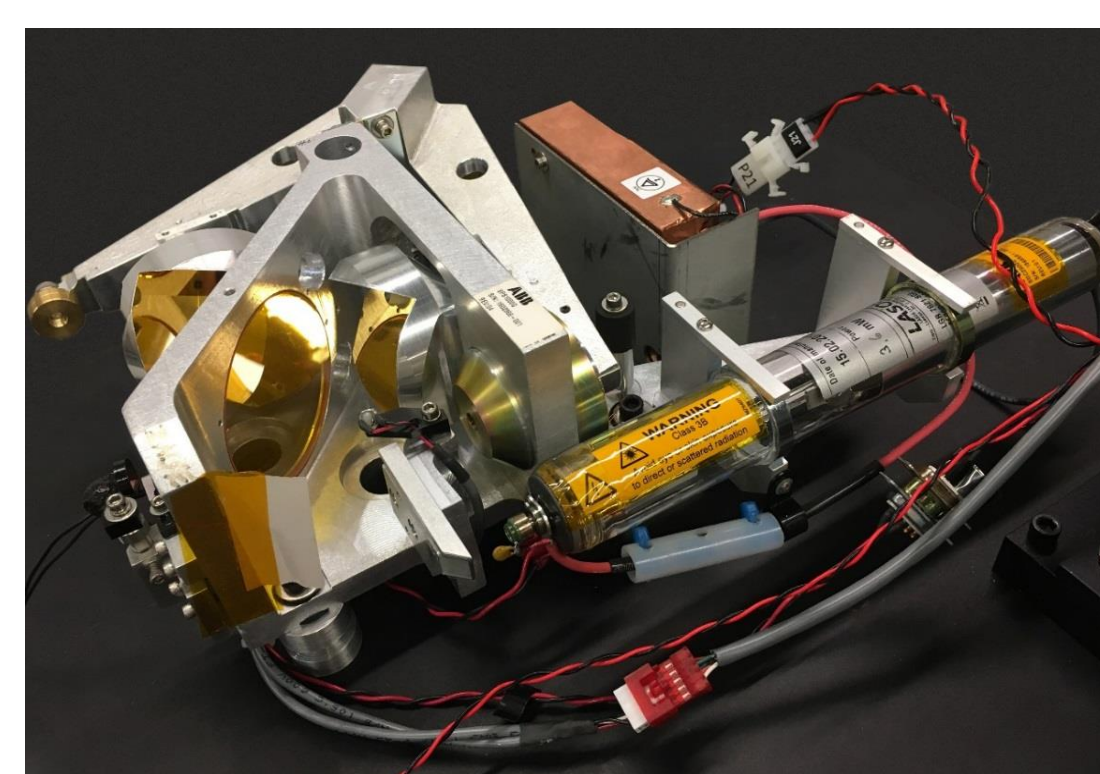
## Objectives

- Development of a demonstrator Imaging Fourier Transform Spectrometer (IFTS) intended for flight on a high-altitude balloon or satellite platform.
- Demonstrating the capacity of this instrument to measure atmospheric mixing ratios of CH<sub>4</sub> and CO<sub>2</sub> and the O<sub>2</sub> A-band in near-space conditions.
- Develop software and electronics to support these measurements.
- Achieve these goals autonomously.

## Instrument

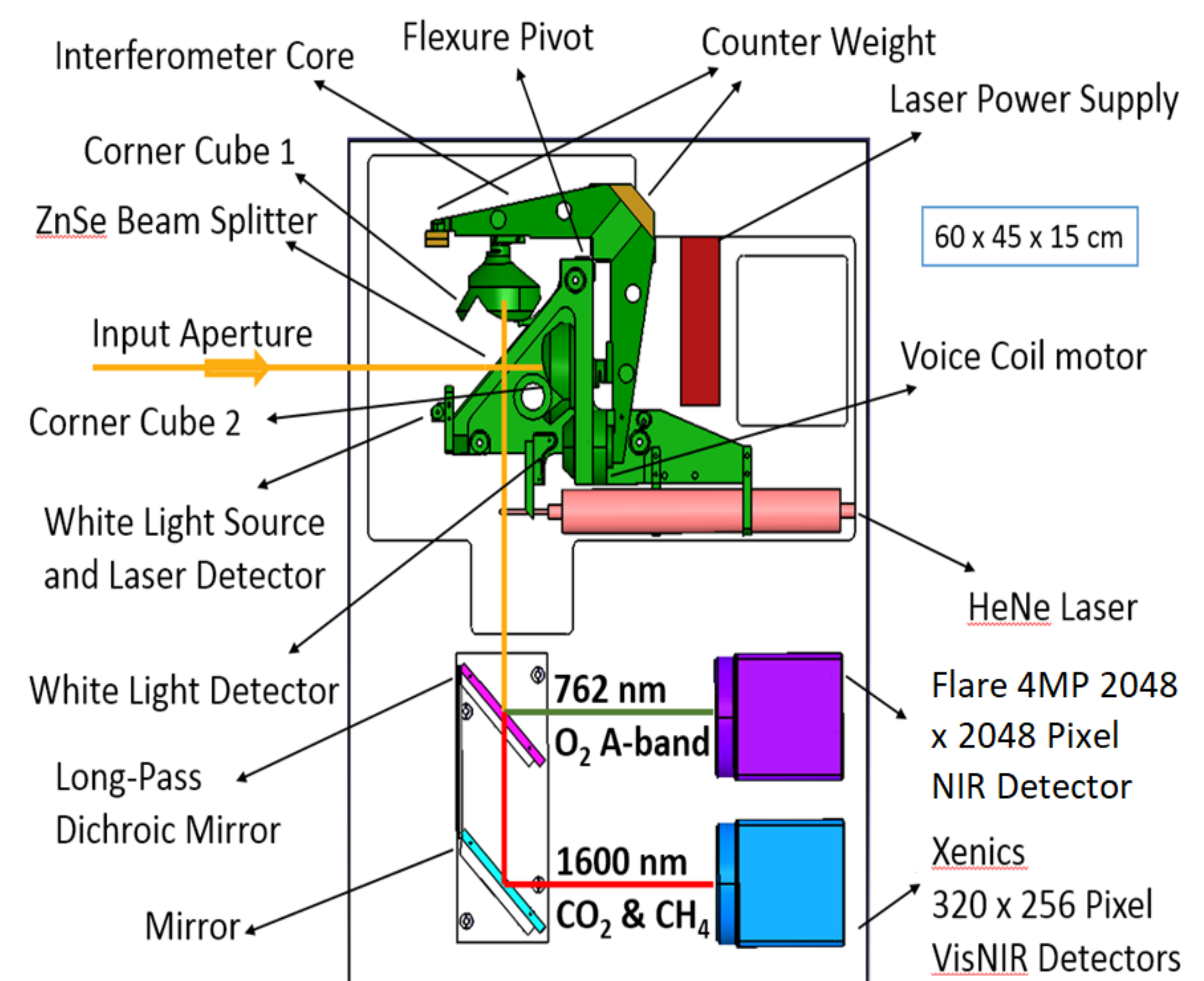
- Based on the Michelson interferometer.
- Uses corner cube mirrors to maintain wave front alignment.
- Flexure-pivot scanning mechanism.
- Standard off-the-shelf design provided by ABB.
- Detectors:
  - Xenics VisNIR InGaAs 320 x 256 Pixel CCD camera.
  - Flare 4MP NIR Silicon 2048 x 2048 Resolution Camera.
- Interferogram sampling: 100-500 Hz.
- Two spectral channels centered at:
  - 762 nm for the O<sub>2</sub> A-band.
  - 1600 nm for CO<sub>2</sub> and CH<sub>4</sub>.
- Spectral Resolution: 0.5 cm<sup>-1</sup>.
- Aperture: 50 mm.
- Dimensions: 60 x 45 x 15 cm.
- Weight: 22 kg.

Interferometer Core provided by ABB Inc.



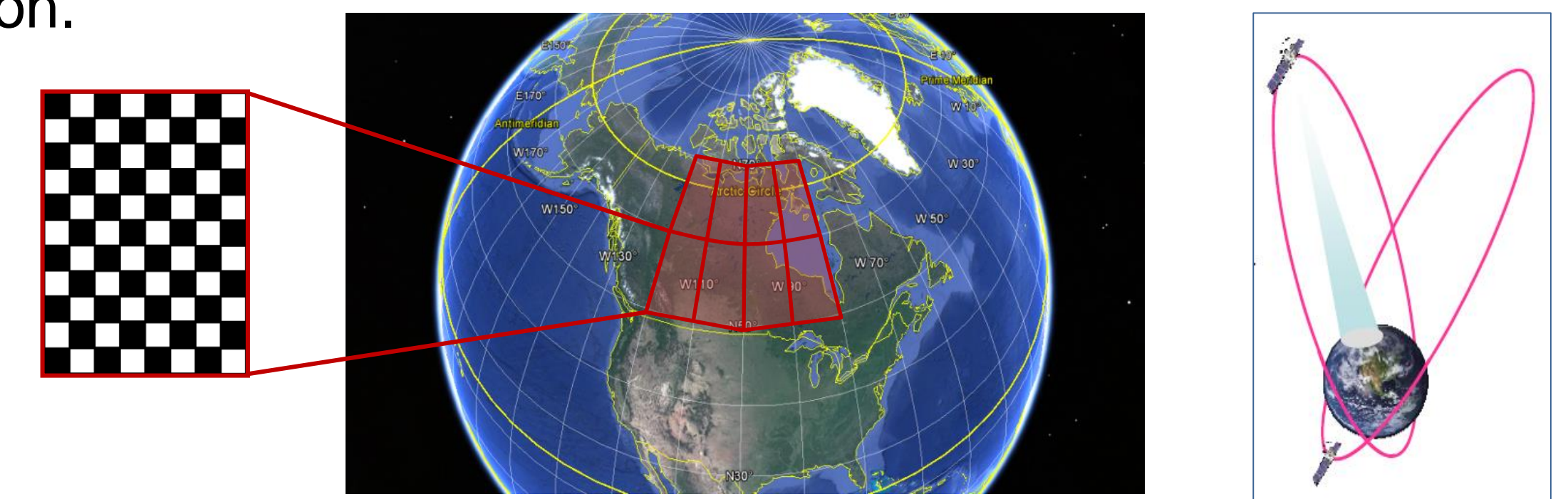
Optical bench setup of the payload.

## Optical Layout



## Novelty

- Simultaneous measurement of an approximately 3800 by 3000 km (FOV) spatial element with a spatial resolution of 10-12km from a highly elliptical three apogee orbit or a geostationary orbit (36000-40000 km altitude).
- Intended for observing a 3x3 panel of the northern latitudes, approximately 9000x9000km from HEO.
- Will take 75 minutes at 100 Hz scan resolution.

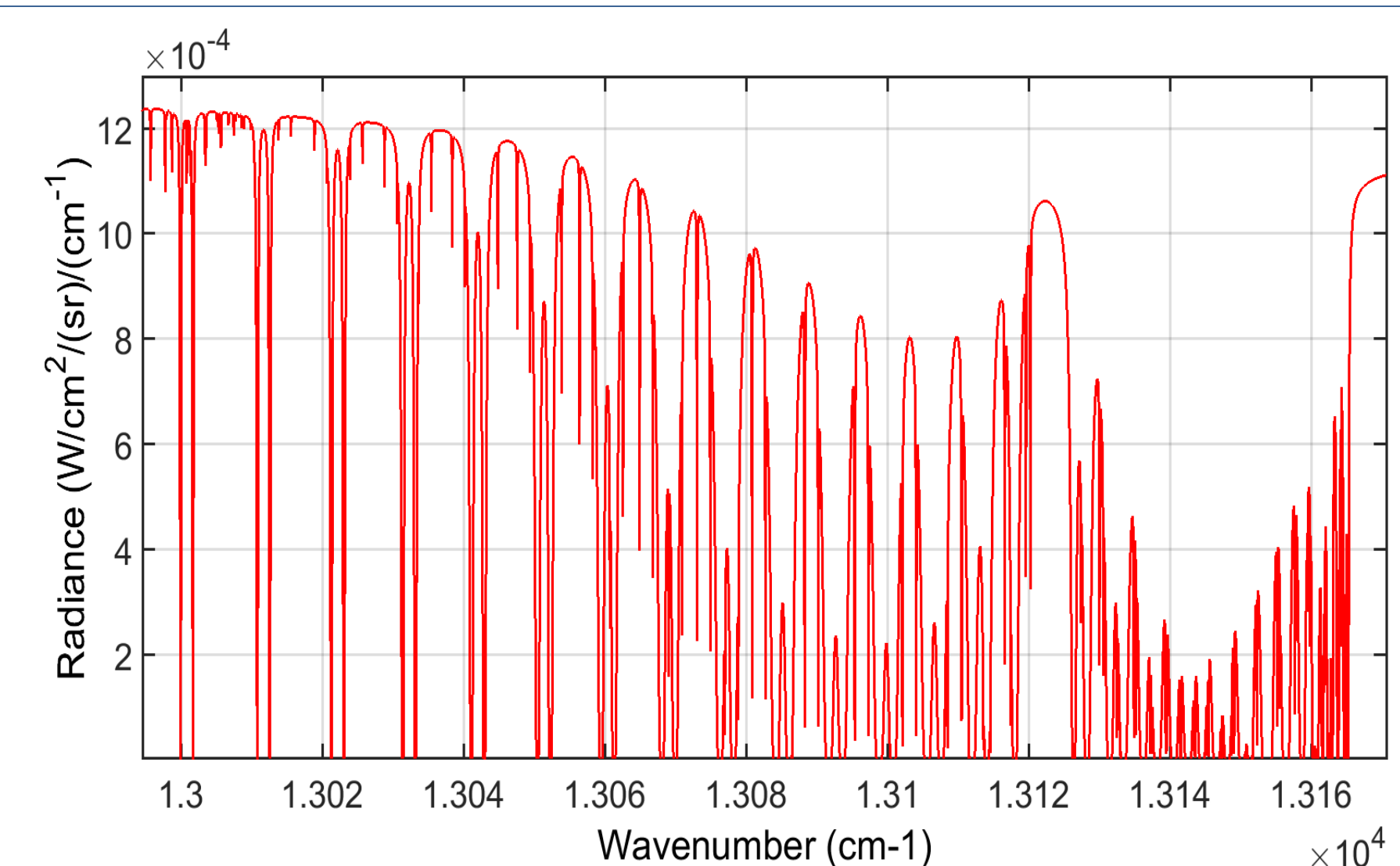


## Simulated Spectra

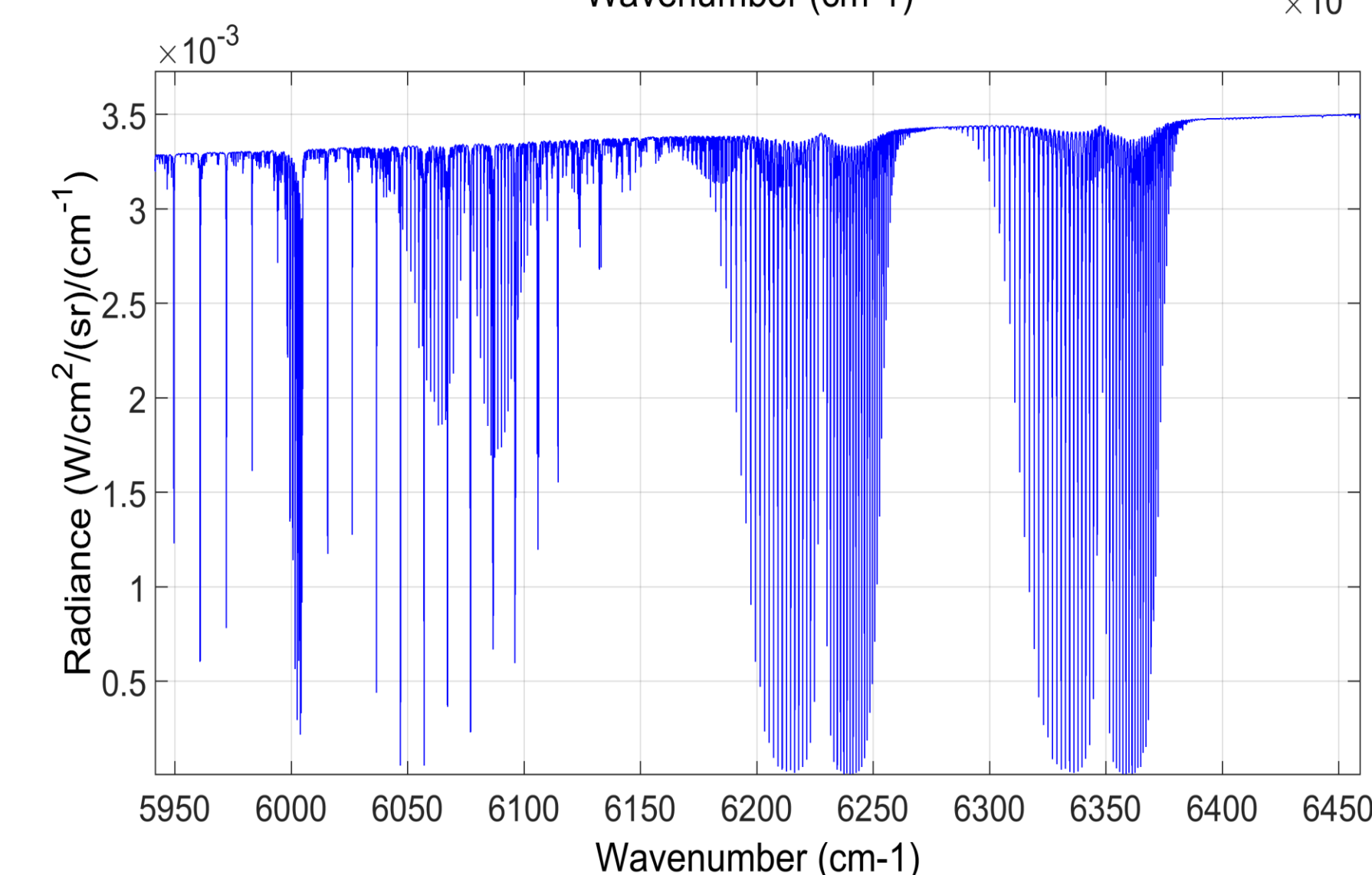
Instrument Line Shape: Gaussian

Spectral Resolution: 0.5 cm<sup>-1</sup>

O<sub>2</sub> A-band



CO<sub>2</sub> and CH<sub>4</sub>



Simulated Spectra for the O<sub>2</sub> A-band channel (top) and the CO<sub>2</sub> and CH<sub>4</sub> channel (bottom) from 40 km altitude above earth in the nadir direction. (R.Siddiqui, 2018)

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## References

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