The PanFTS Instrument Concept

The Panchromatic Fourier Transform Spectrometer (PanFTS) is an Instrument Incubator Program (IIP) funded development to build and demonstrate a single instrument capable of meeting or exceeding all GEO-CAPE requirements. The PanFTS design combines measurement capabilities for IR (e.g., TES) and UV-Vis (e.g., OMII) in a single package (including full spatial coverage), plus the ability to measure ocean color.

GEO-CAPE Flight Instrument Design Drivers

- **Capability**
  - **Wide-Field**
  - **Narrow-Field**
  - **Comments**

- **Field of regard**
  - 50° N to 45° S latitude
  - 30° to 120° longitude
  - Approximately 11,000 km by 11,000 km

- **Spatial sampling geometry**
  - 250 m ground sampling distance at nadir
  - 500 m ground sampling distance at zenith

- **Spectral range**
  - 0.5 μm to 15 μm
  - 0.35 μm to 2.1 μm

- **Spectral resolution**
  - 0.2 cm⁻¹
  - 0.5 cm⁻¹

- **Spatial SNR**
  - 1000
  - 1000

- **Temporal SNR**
  - 2
  - 2

- **Sampling interval**
  - Approximately hourly
  - Approximately hourly

- **Lifetime**
  - 5 years
  - 5 years

- **Reliability**

**PanFTS Spectral and Temporal Coverage**

High spectral resolution (0.05 cm⁻¹) and wide spectral sensitivity (from 5 μm to 2.5 μm) allows simultaneous observations of reflected sunlight and thermal emission (day/night) enabling retrieval of several important species such as:

- **Greenhouse Gases:** CO₂, CH₄, N₂O, O₃, H₂O
- **Dynamical Tracers:** CO₂, CH₄, N₂O, O₃, H₂O

Need to measure several species with high temporal and vertical resolution to capture rapidly evolving tropospheric chemistry.

**PanFTS IIP Instrument Block Diagram**

- **Infrared Focal Plane Array**
  - JPL-designed digitizer employs dual 8-bit, 5 MHz ADC's interfaced to a Xilinx FPGA with ethernet connection to host processor (storage/display)
  - FPGA board controls the operation of the FPA via digital isolators in the interface box
  - FPGA board captures data (from ADCs) in internal HW FIFOs
  - DMA engine transfers data packets from HW FIFOs to main memory
  - Raytheon 256x256 InSb array bump-bonded to a CMOS readout IC (ROIC) with twin outputs / references and windowing capability
  - 1.5 μm spectral response, LN₂ cooled in custom dewar
  - 8x8 pixel window can be read at 10 kHz frame rates with a 5 MHz clock

- **UV/Visible Focal Plane Array**
  - UV/Vis Hybrid CMOS FPA's, 206 photodetectors have been manufactured by Teledyne
  - Measured quantum efficiency is 80-90% (>50% from 400-1000 nm)

**Optical Path Difference Mechanism**

- OPDM is a flexure-based parallelogram mechanism that controls the optical path difference between the fixed and moving arms in the Michelson interferometer
- OPDM driving requirements:
  - Maximum optical path difference: 10 cm (physical travel 5 cm)
  - Maximum mirror tip/tilt error: < 1 micronrad
  - Full translation duration: 1 minute
  - Velocity stability: better than 1% over the full range of travel
  - Operating temperature: 180-320 K
  - Operational lifetime: 5 years (more than 2.6 million cycles)
- Heritage: JPL FTUVS instrument at Table Mountain Facility which has 12 years of continuous operation

**Summary**

- **PanFTS Capabilities and Development Status**
  - OSSE results (see Bowman poster) confirm panspectral retrieval benefits (vertical profiling, boundary layer visibility)
  - IIP optical design has continuous sensitivity over 0.4 – 5 μm spectral range
  - IR FPA testing is ready to begin
  - Visible FPA ROIC design incorporating parallel sigma-delta ADC's is complete
  - Sigma-delta ROIC performance has been verified by simulations
  - ROIC masks are made – semiconductor fabrication begins in 4-6 weeks
  - OPD mechanism is designed and built – characterization testing underway
  - IIP instrument fabrication and assembly has begun
  - Field testing will be done at JPL’s ML Wilson and Table Mountain facilities

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