P-ACTIVE:
Mid-wave IR filter beyond terrestrial

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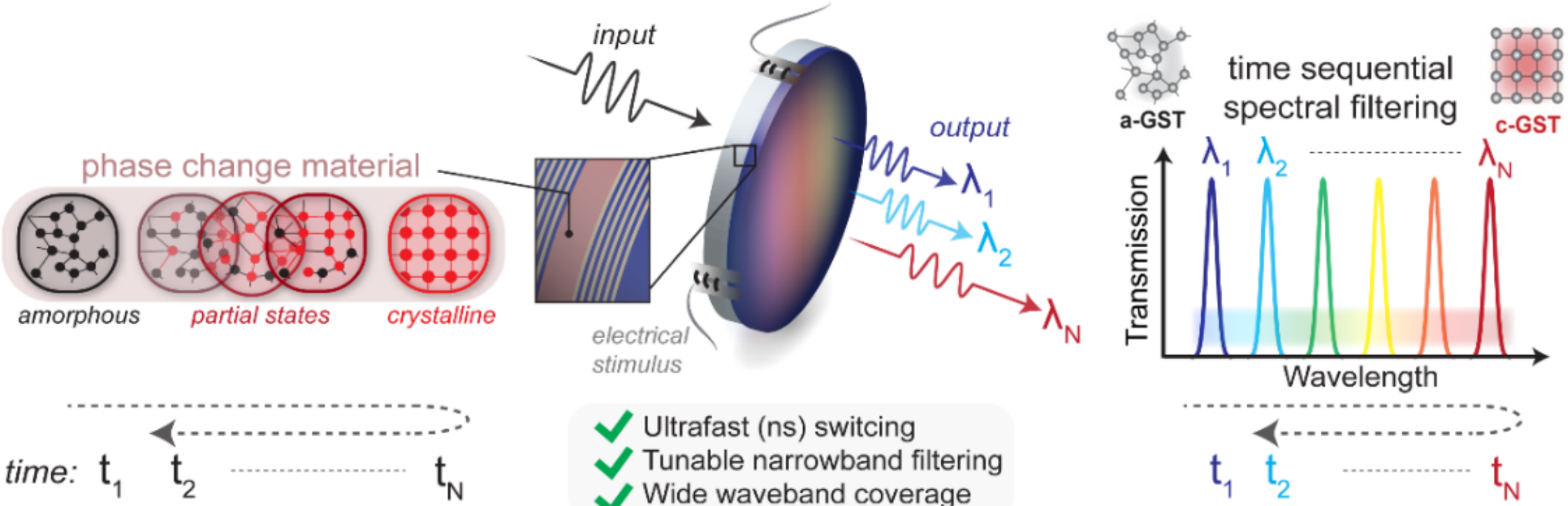
All Images Credit: NASA

P-ACTIVE

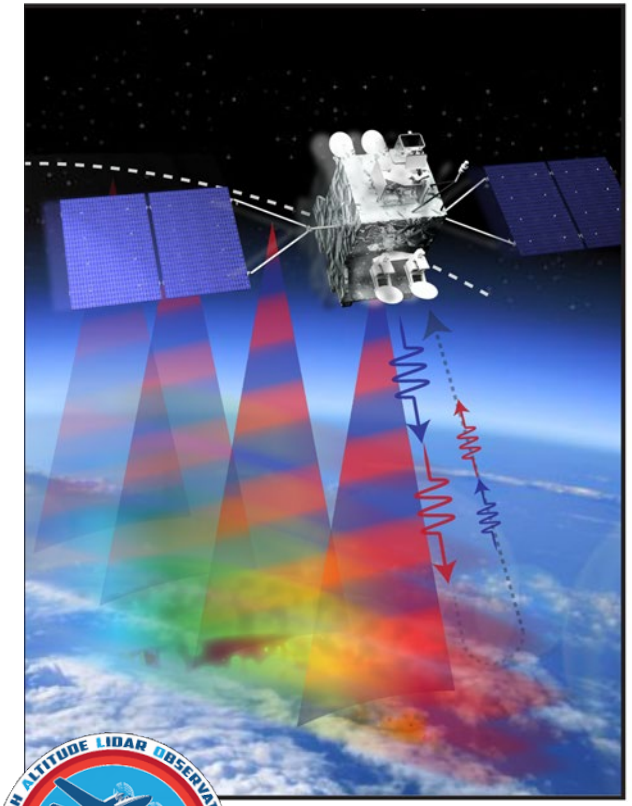
- ✔ Ultrafast-switching speed (nanoseconds / MHz ~ GHz) using all-solid-state phase-change materials (PCMs)
- ✔ Overcomes the limitation of SOA filter wheels via a 10^6 temporal resolution increase (KHz vs. GHz)

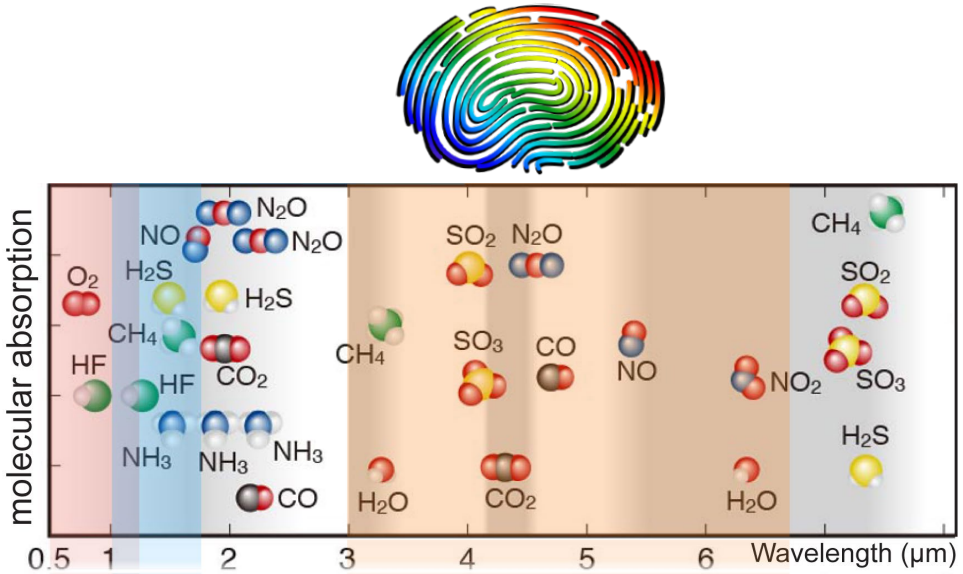
PACTIVE (PCM-based actively tunable filter component)



Applications

Chemical / Gas sensing for LIDAR



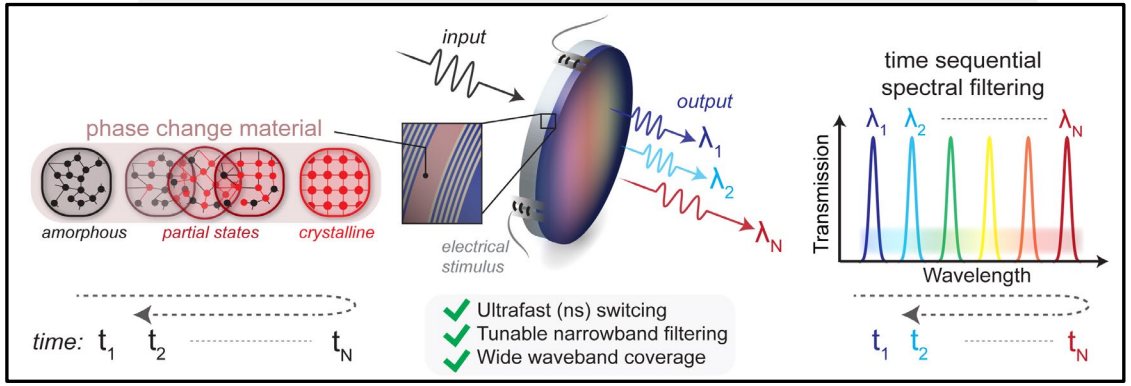


+ Compact form-factor
+ Multiple wide wavebands

+ Ultrafast switching
+ Ultra-narrowband
+ Precise tuning

+ Fast switching
+ Wide spectral coverage
+ Large diameter optic

Demanding spectral filter requirements

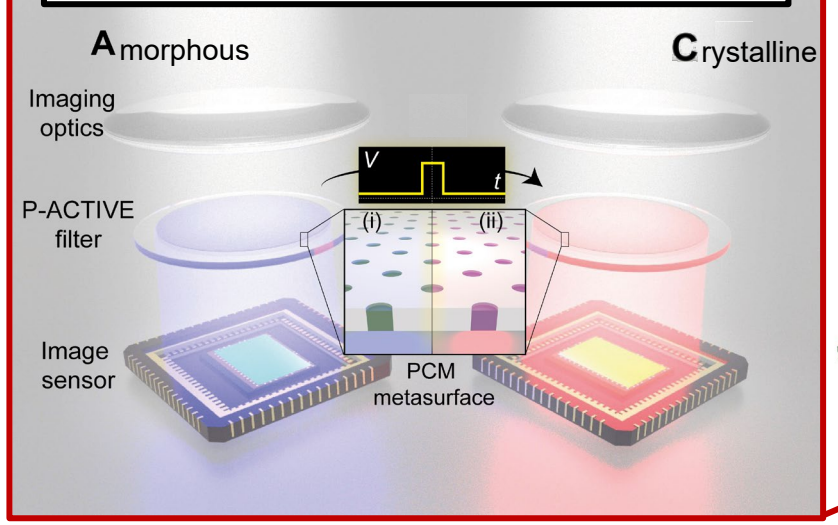


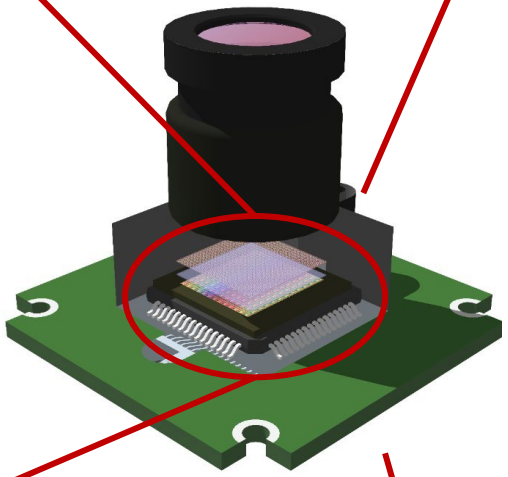
Health Monitoring of Space Launch System

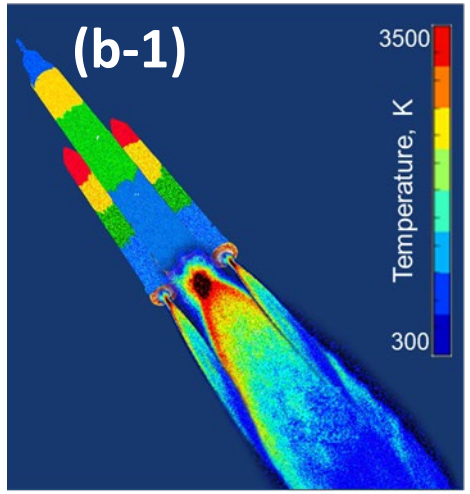
I-SSPI System

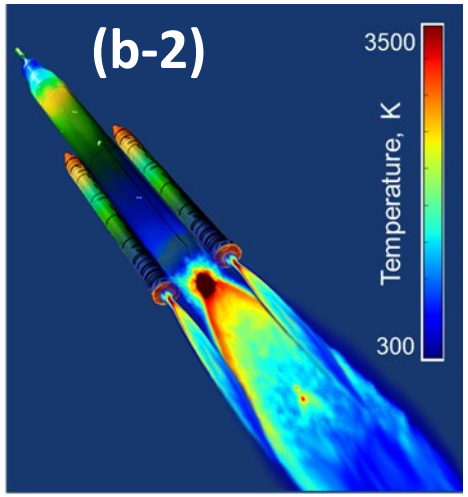
- Integrated Single-optic SPectroscopic Imager
- Increased measurement resolution in a reduced SWaP (size, weight, and power) form-factor

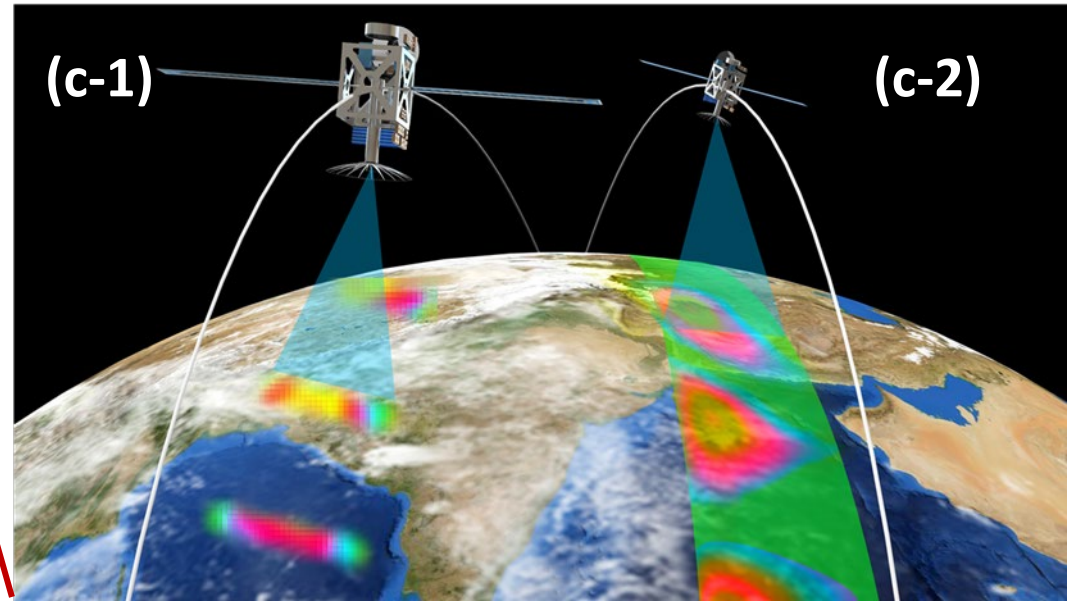
(a) I-SSPI system concept







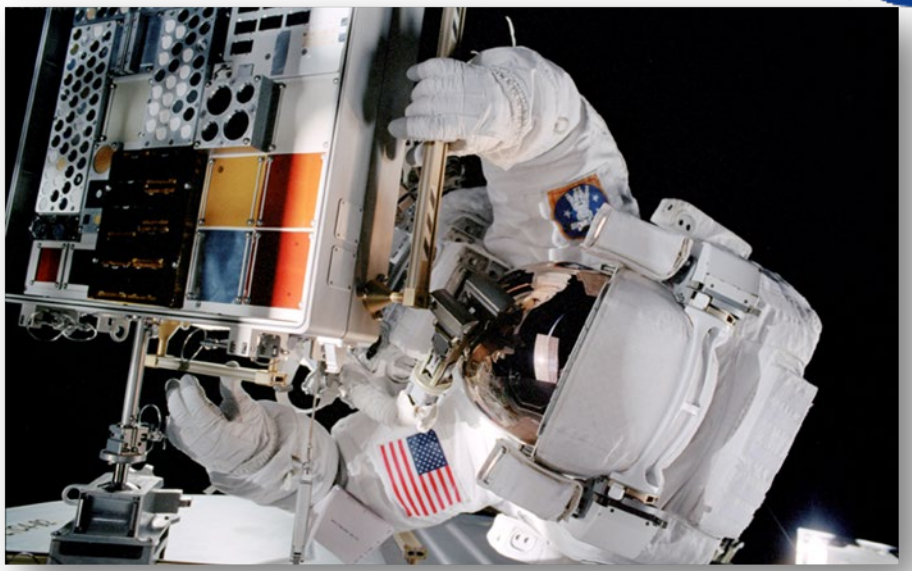




P-ACTIVE's increased spectral and temporal resolution allows for much more accurate data collection for key measurement missions such as rocket launch ascent imaging (b-2) and aerosol cloud mapping (c-2). These are compared with images taken from filter wheels, shown in (b-1) and (c-1).

MISSE

- MISSE - Materials International Space Station Experiment
- Purpose is to determine the effects on the specimens due to the space environment
- All specimens returned to Earth for analysis
- P-ACTIVE launched through the MISSE-14 platform (Wake and Zenith exposures)
- Wake Direction - Facing away from the direction of ISS travel, no AO and moderate solar exposure (Lunar surface demo)
- Zenith Direction - Facing away from Earth, grazing AO and highest solar exposure (LEO demo)
- Qualitative Analysis: High-resolution photographs of specimens about once a month to detect changes as a function of time
- MISSE environment flight data also provide temperature and Ultraviolet (UV) radiation



(Top) Wake side of MISSE-2, during deployment on the ISS in 2001

(Bottom) On-orbit images of P-ACTIVE on MISSE-14 in Zenith direction

June 2021 July 2021 August 2021

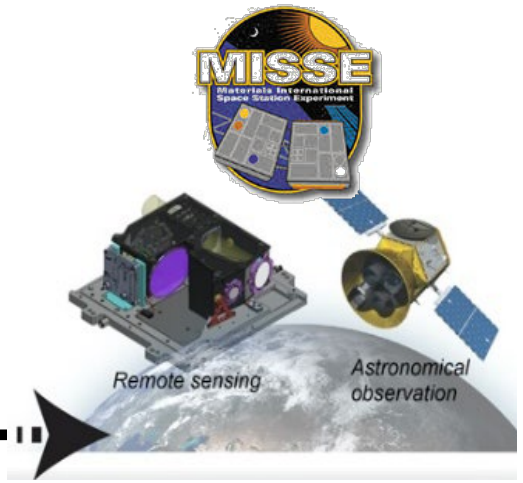
Teams

- NASA LaRC (USA): Mr. Stephen Borg, Mr. Scott Bartram, and Mr. William Humphreys
- MIT (USA): Prof. Juejun Hu and Dr. Tian Gu
- Booz-Allen Hamilton (USA): Dr. Matthew Julian

- NASA LaRC: Dr. Amin Nehrir and Dr. Rory Barton-Grimley (Science mission)
- NASA LaRC: Dr. Jennifer Inman, Mr. Thomas Horvath, and Mr. Carey Scott (Space mission)

- University of Cambridge (UK): Dr. Calum Williams

- MIT & University of Washington (USA): Prof. Arka Majumdar



1966

PCM for optical storage media

2017

P-ACTIVE starts at NASA Langley Research Center

2019

I-SSPI Research team

Mission support team

New application collaborator (biomedical)

2020

2021

MISSE -Space application team