# P-ACTIVE:
# Mid-wave IR filter beyond terrestrial

Hyun Jung Kim (hyunjung.kim@nasa.gov)

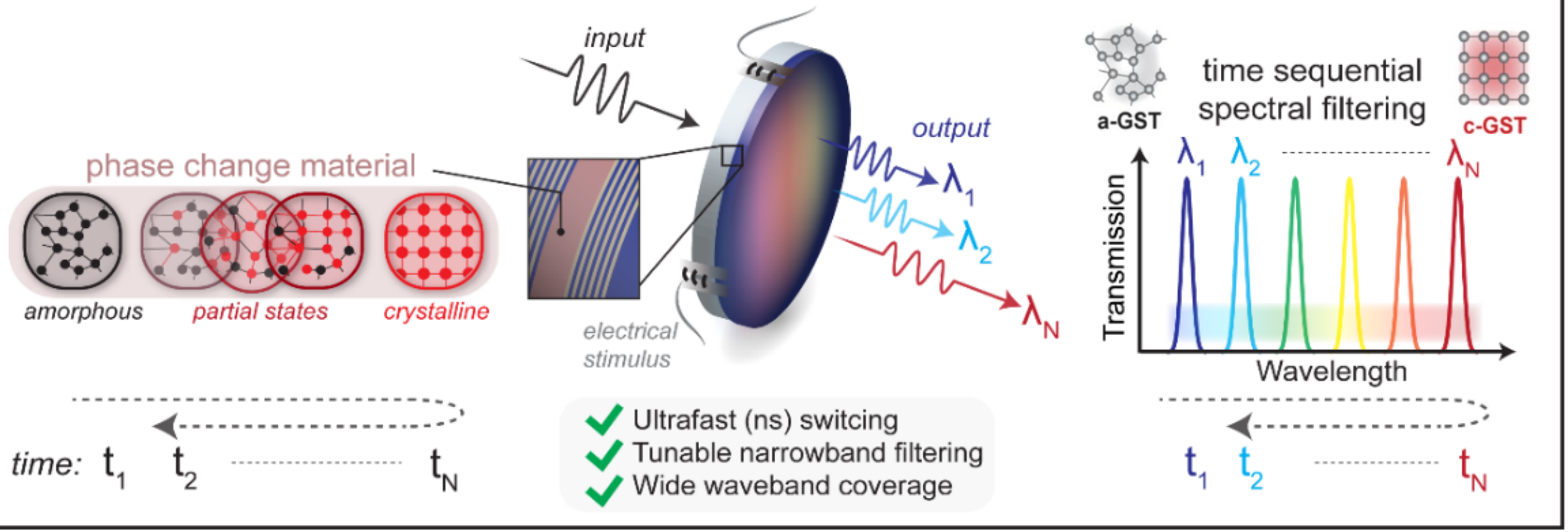
National Institute of Aerospace, Hampton, Virginia, USA

All Images Credit: NASA

# P-ACTIVE

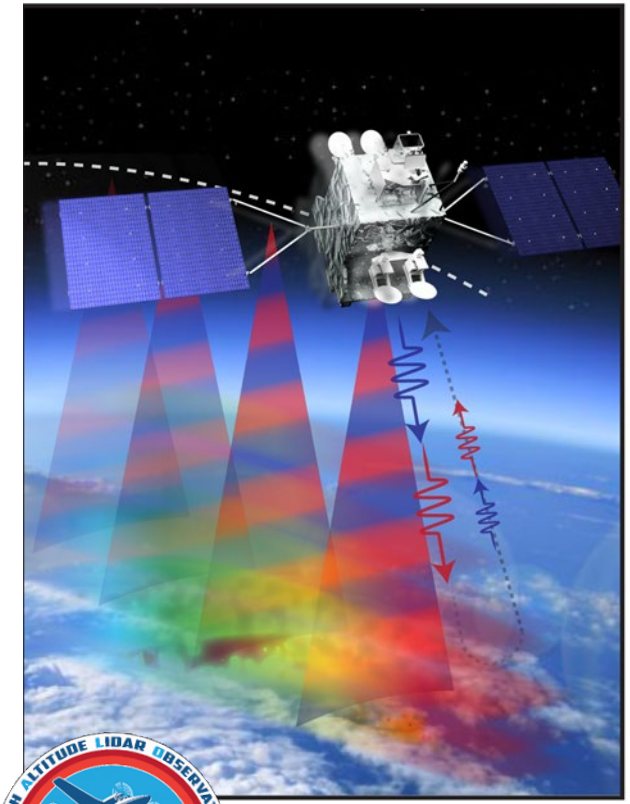
- ✔ Ultrafast-switching speed (nanoseconds / MHz ~ GHz) using all-solid-state phase-change materials (PCMs)
- ✔ Overcomes the limitation of SOA filter wheels via a $10^6$ temporal resolution increase (KHz vs. GHz)

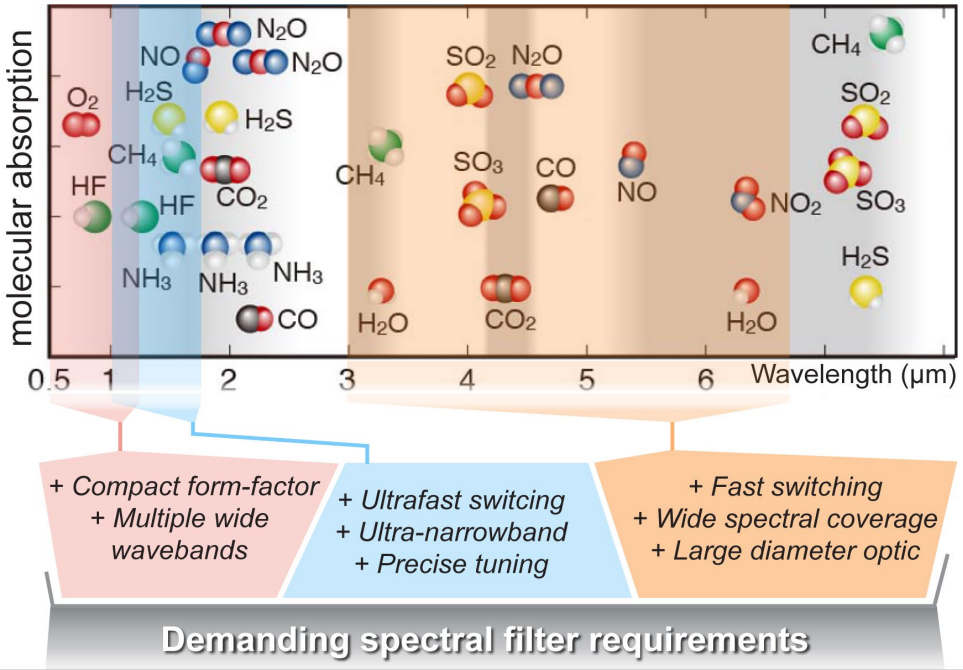
## PACTIVE (PCM-based actively tunable filter component)

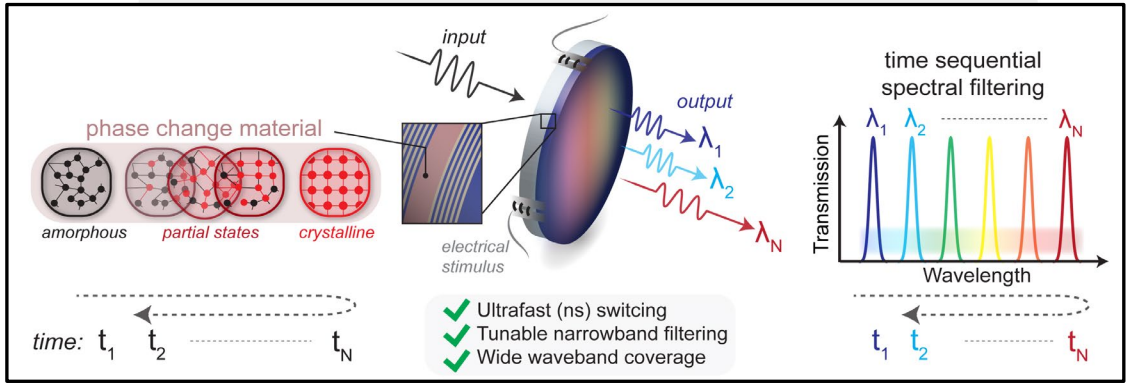


# Applications

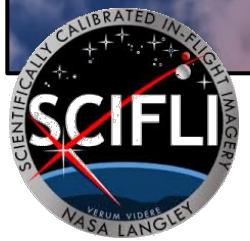
## Chemical / Gas sensing for LIDAR





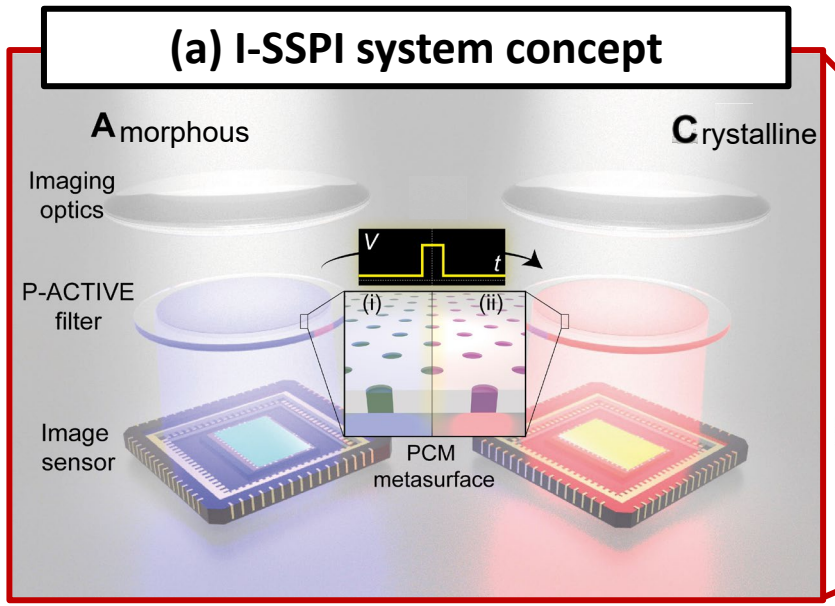



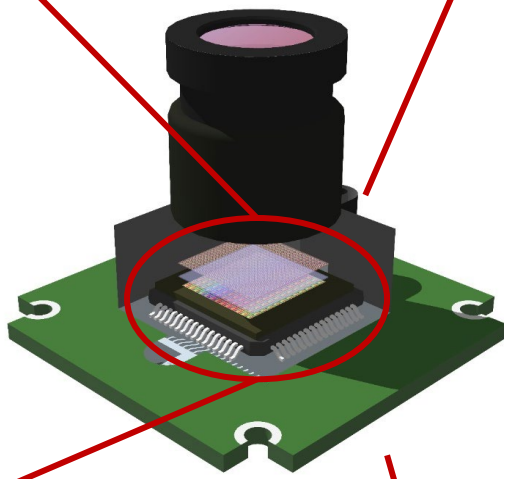

## Health Monitoring of Space Launch System

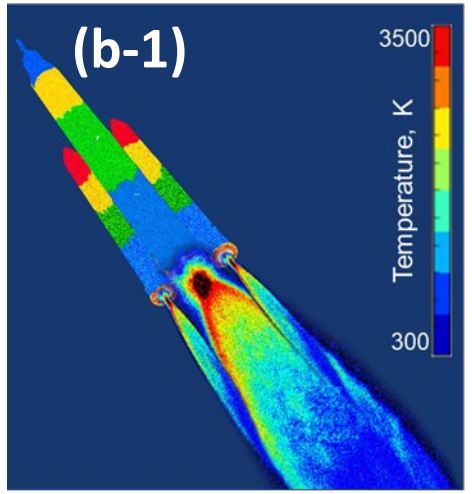


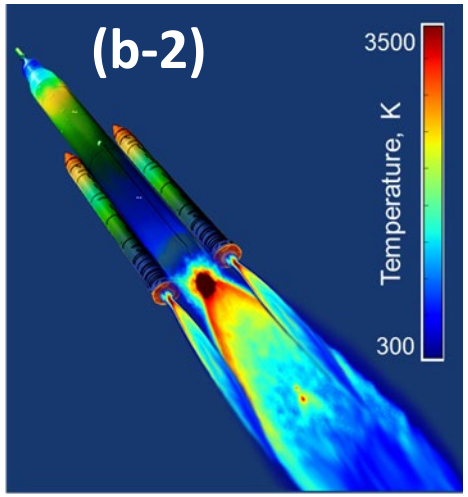
# I-SSPI System

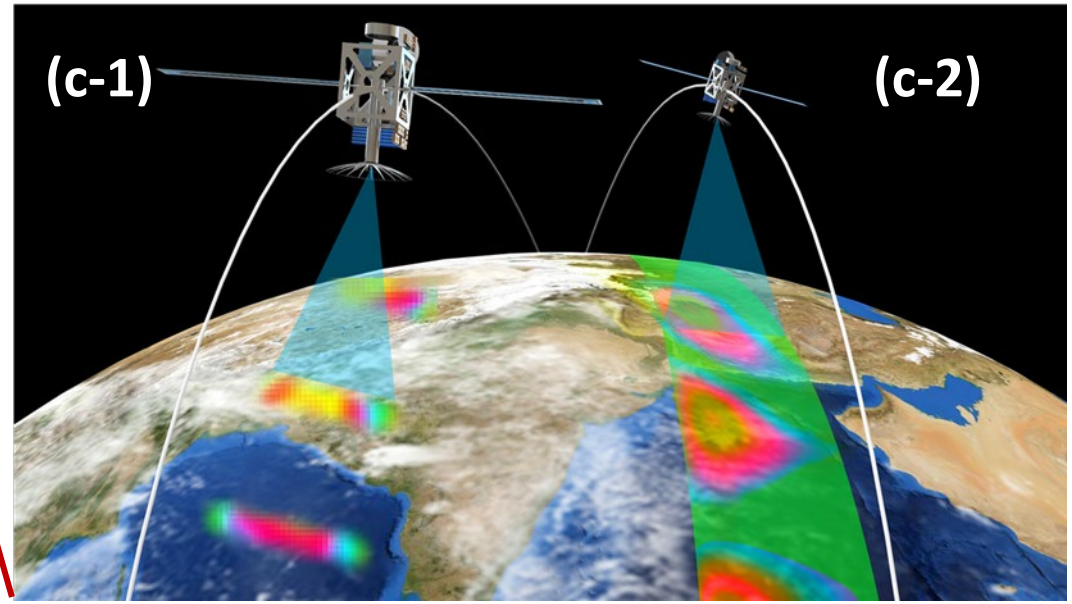
- Integrated Single-optic SPectroscopic Imager
- Increased measurement resolution in a reduced SWaP (size, weight, and power) form-factor





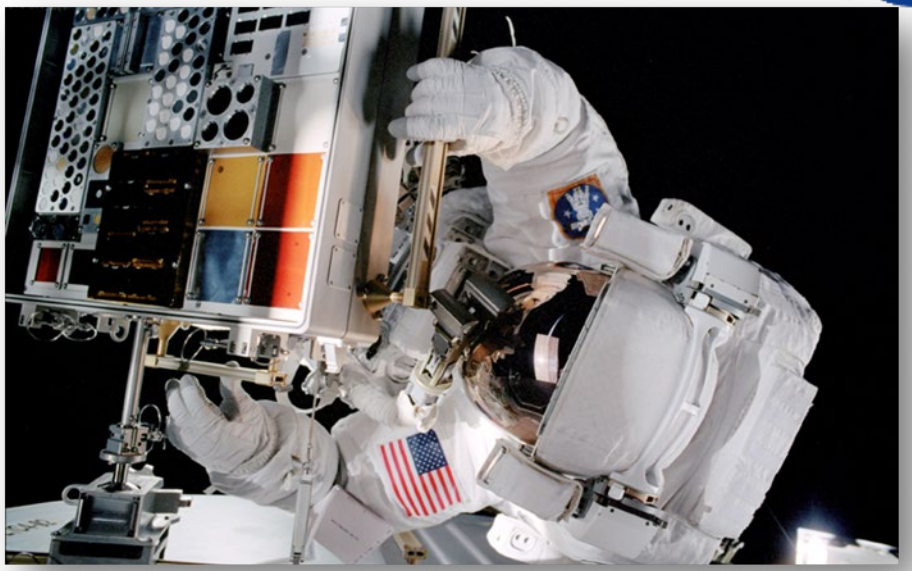




**P-ACTIVE's increased spectral and temporal resolution allows for much more accurate data collection for key measurement missions such as rocket launch ascent imaging (b-2) and aerosol cloud mapping (c-2). These are compared with images taken from filter wheels, shown in (b-1) and (c-1).**

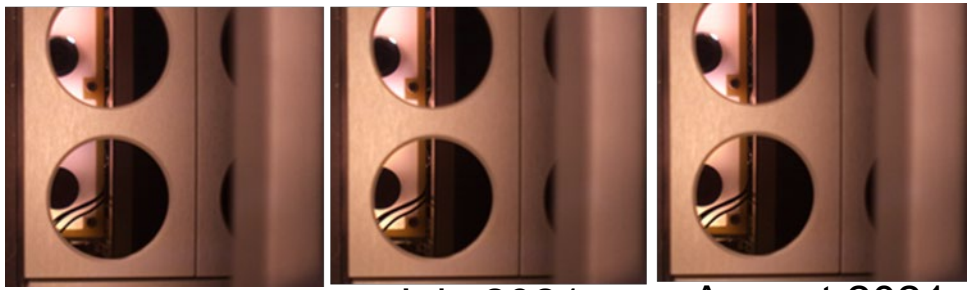
# MISSE

- 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

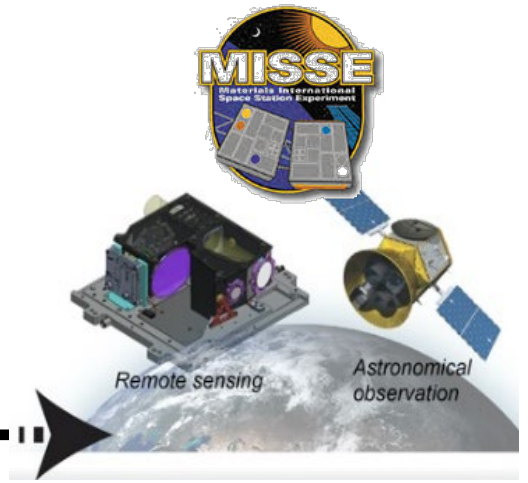
# Teams

- 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