

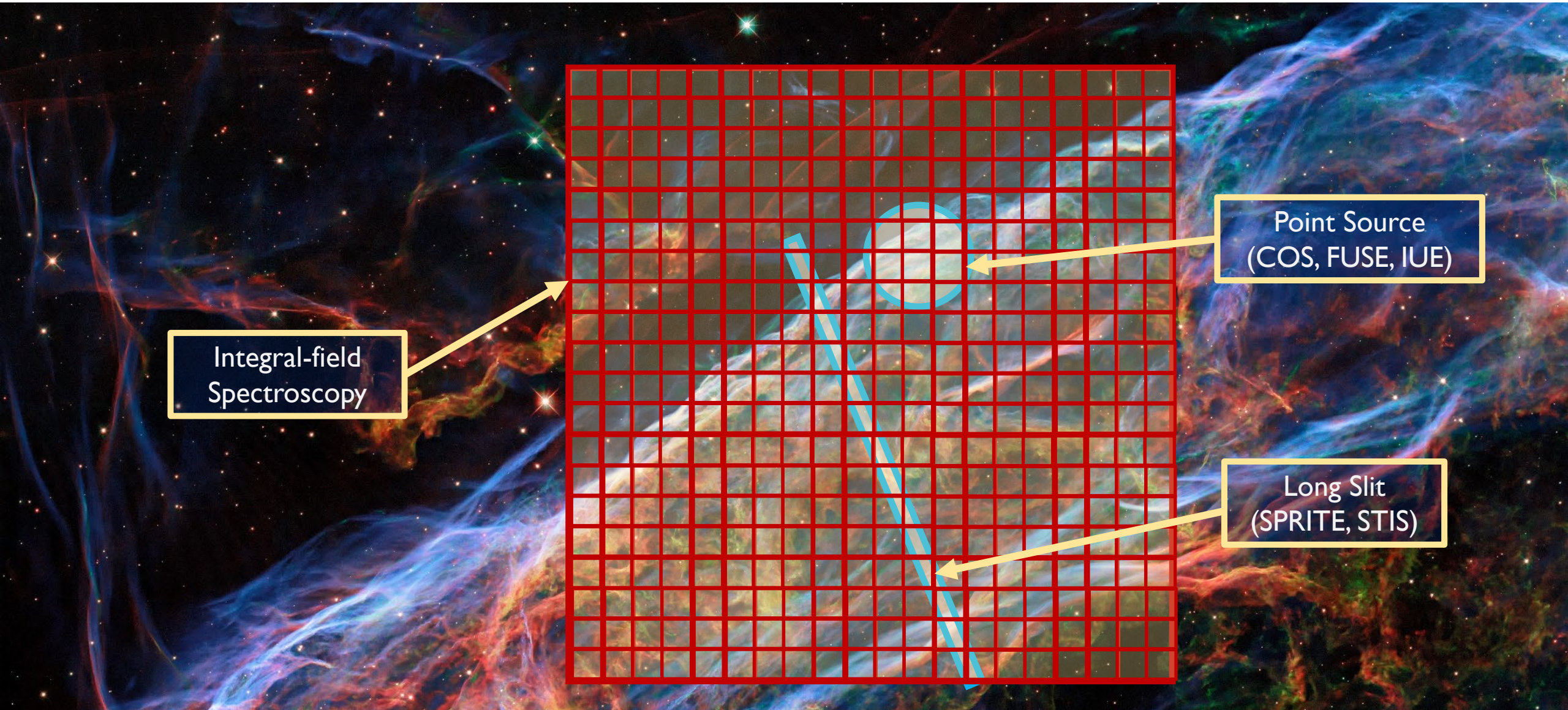
Credit: Marc White (RSAA-ANU)



# Efficient Spectral Multiplexing for Habitable Worlds Observatory

Emily M. Witt, Brian T. Fleming, Kevin France, James Green, Briana Indahl, Maitland Bowen, Alex Haughton

# Spectral Multiplexing: A Technology Gap



Integral-field Spectroscopy

Point Source  
(COS, FUUSE, IUE)

Long Slit  
(SPRITE, STIS)

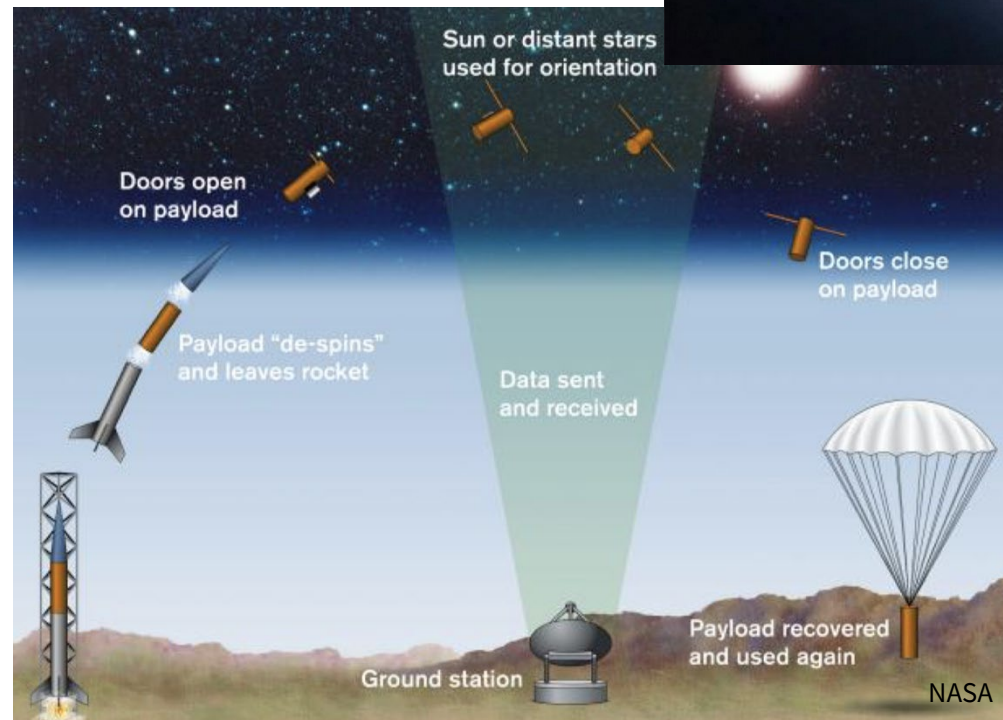
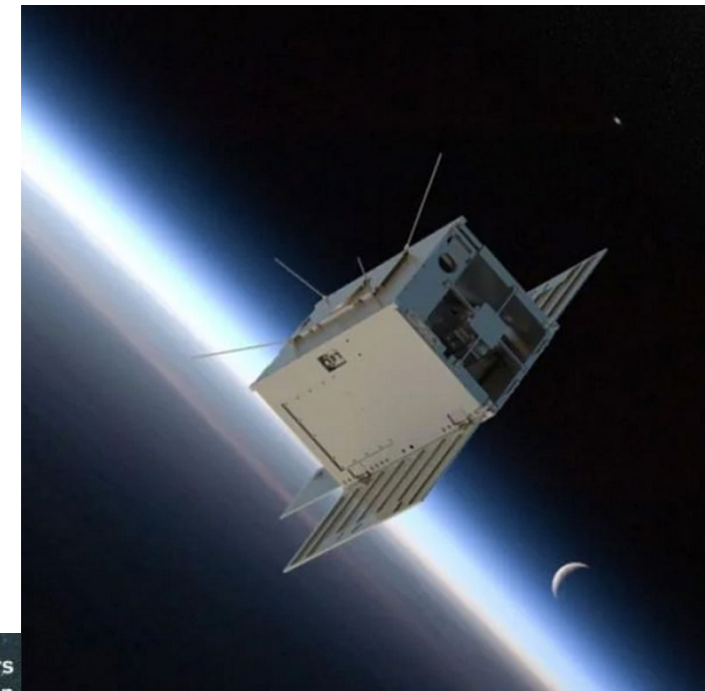
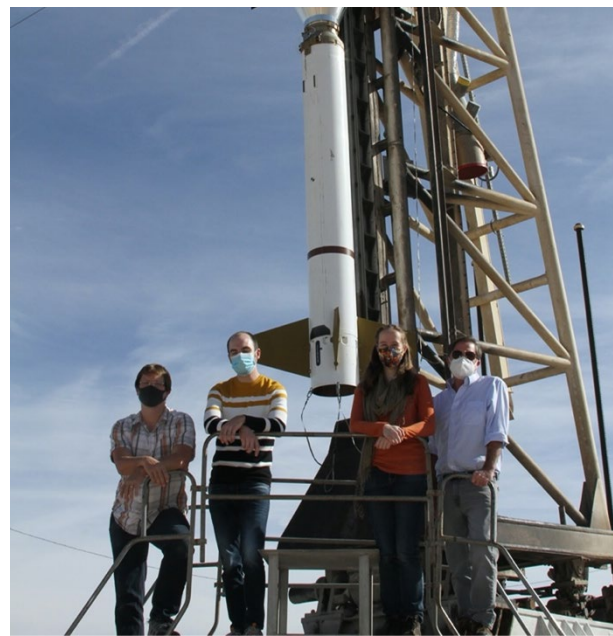
# Overview

The 2020 Decadal survey has endorsed UV IFUs (DQ-2 and DQ-4) and a FUV spectrograph and imager on the ***Habitable Worlds Observatory*** including the need to achieve sensitivity at 100 nm.

This requires the TRL advancement of mirror coatings, large-format detectors, and new optical systems the development of which has been driven by low-cost, risk-tolerant suborbital missions such as the Integral Field Ultraviolet Spectroscopic Experiment (**INFUSE**).

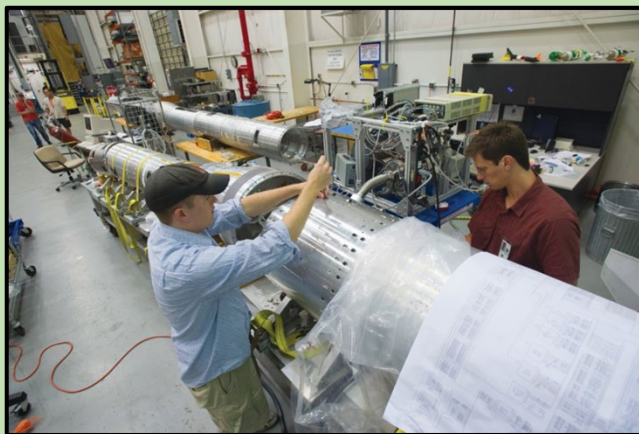
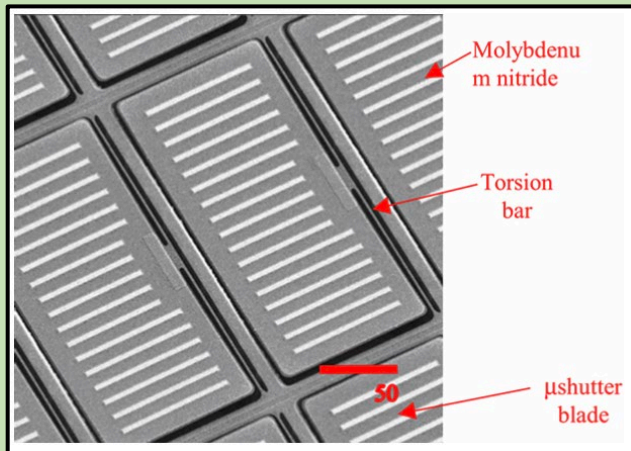
# Why Suborbital?

- Advance technologies to TRL 6 and above
- Shorter project timelines
- Sounding rockets permit iteration
- Cost effective
- Permit student involvement and leadership

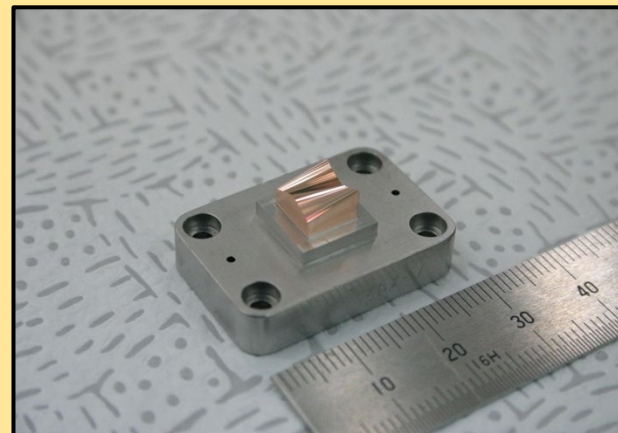


# Spectral Multiplexing in the FUV

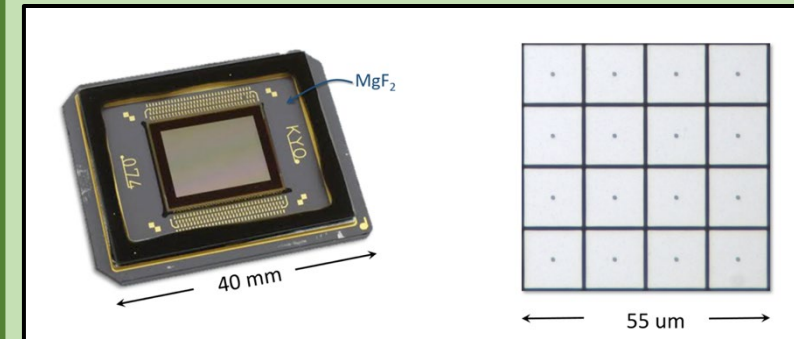
## Microshutter Arrays



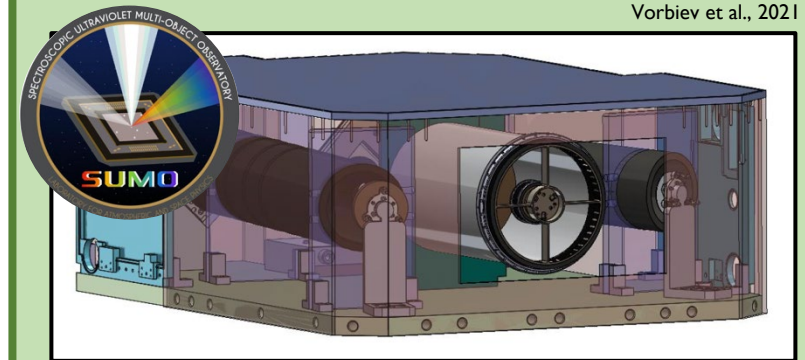
## Image Slicers



## Digital Micromirror Device Arrays



Vorobiev et al., 2021

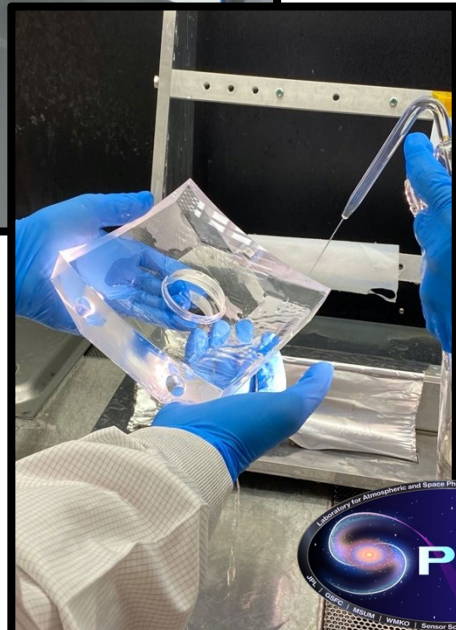
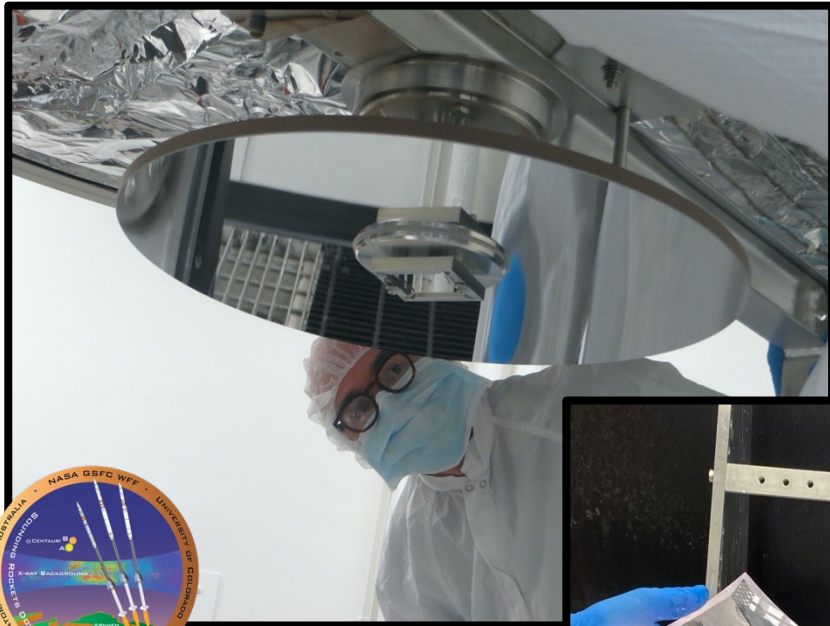


Halferty et al., 2023

For more detail on SUMO, see Dmitry Vorobiev's poster Thursday (1:00 PM, poster #51)

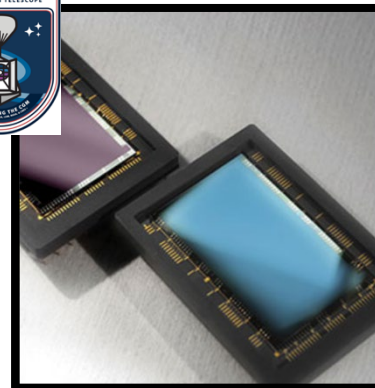
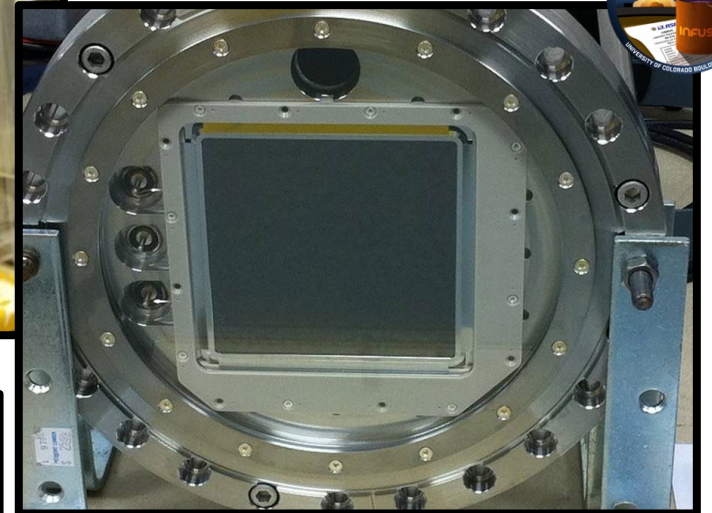
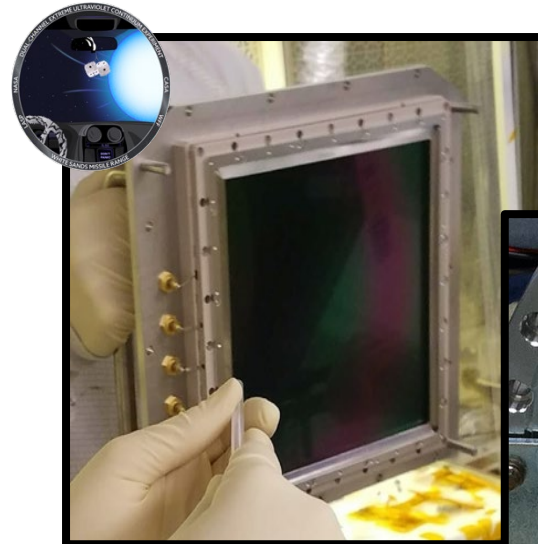
# Enabling Technology

## Broadband FUV Reflective Mirror Coatings

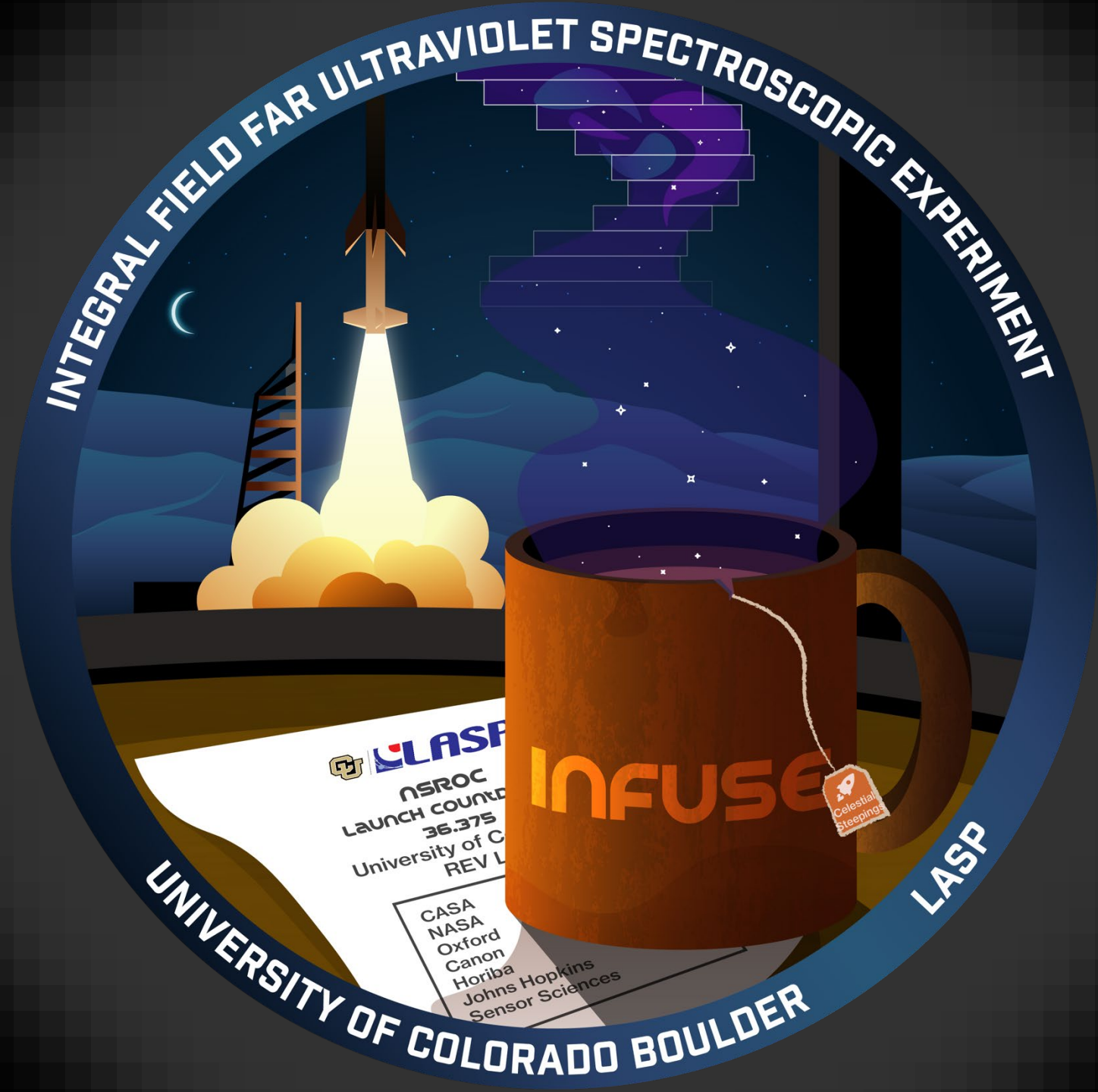


For more detail on SISTINE, see Patrick Behr's poster tonight (5:30 PM, poster #61)

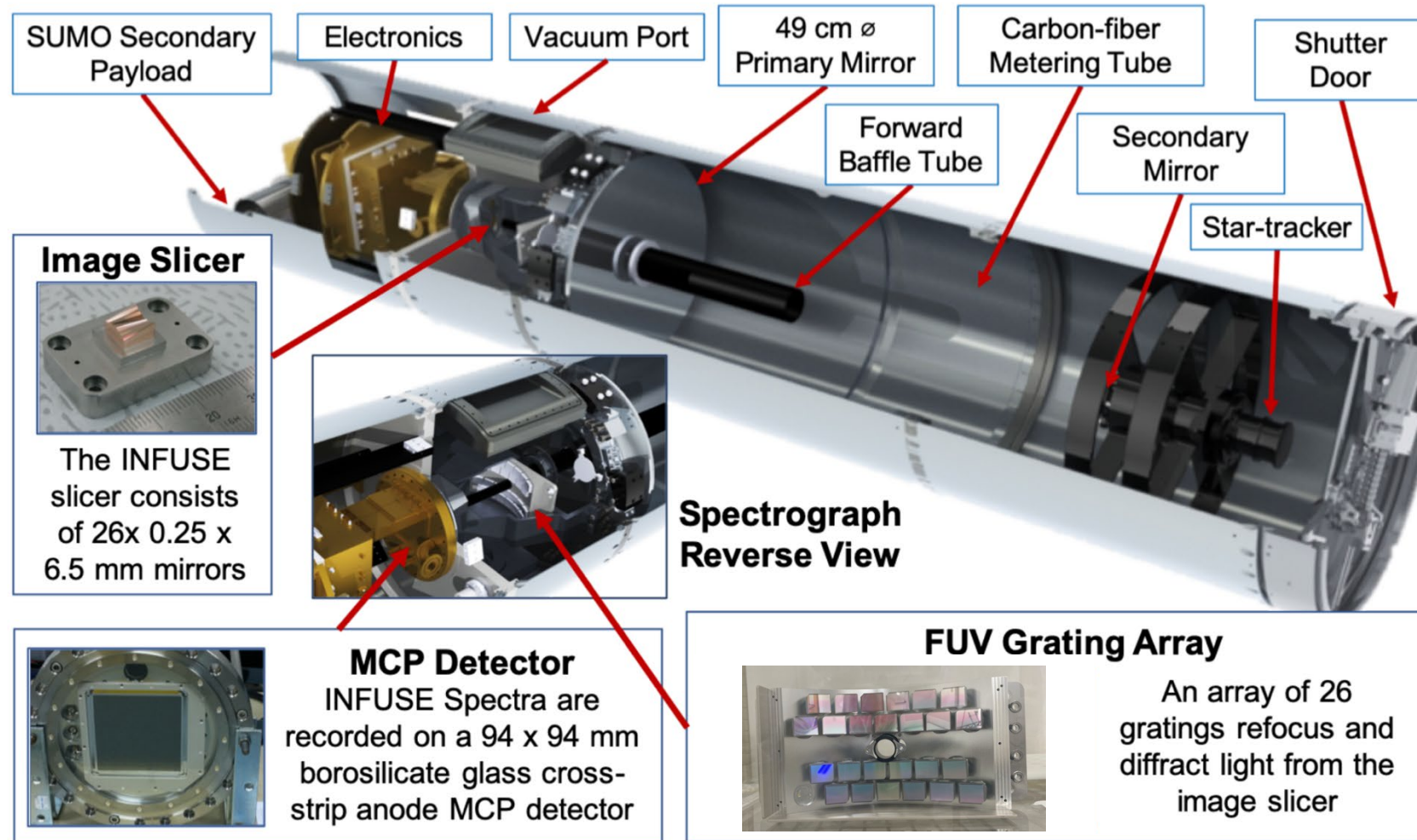
## Large-format Photon-Counting Solar Blind Detectors



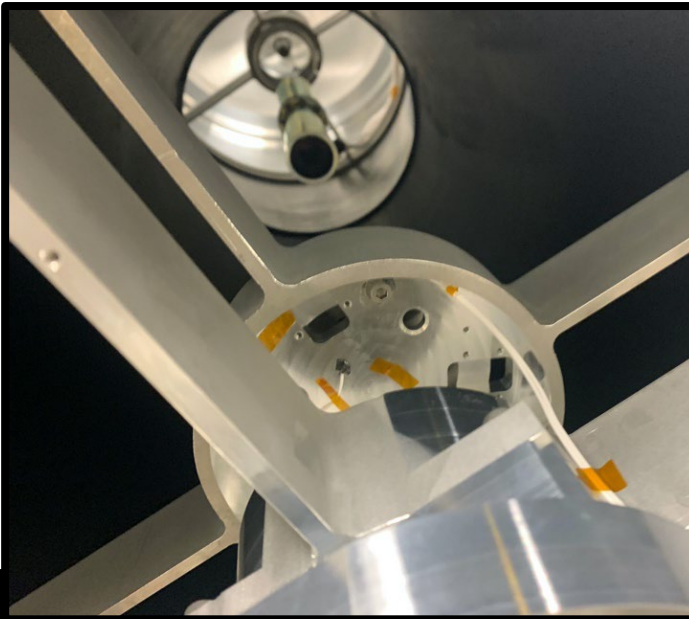
For more detail on FIREBALL-2, see Drew Miles's poster on Thursday (1:00 PM, poster #54)



# INFUSE: First FUV IFS Flown







NASA  
SOUNDING ROCKETS  
PROGRAM

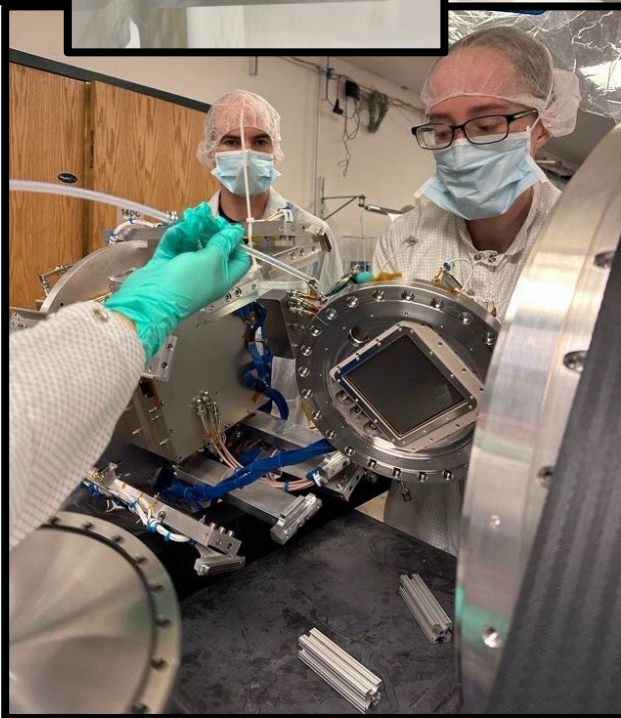
NSWC OIC	CDR LANEY
SITE DIR	ABIE PARRA
PGM. MGR	RAY WATSON
MISSION MGR	TED GASS
NASA SRPO	LIBBY WEST

FLIGHT NO. 36.375

CO INVESTIGATOR	EMILY WITT AD
PM INVESTIGATOR	DR. FLEMING

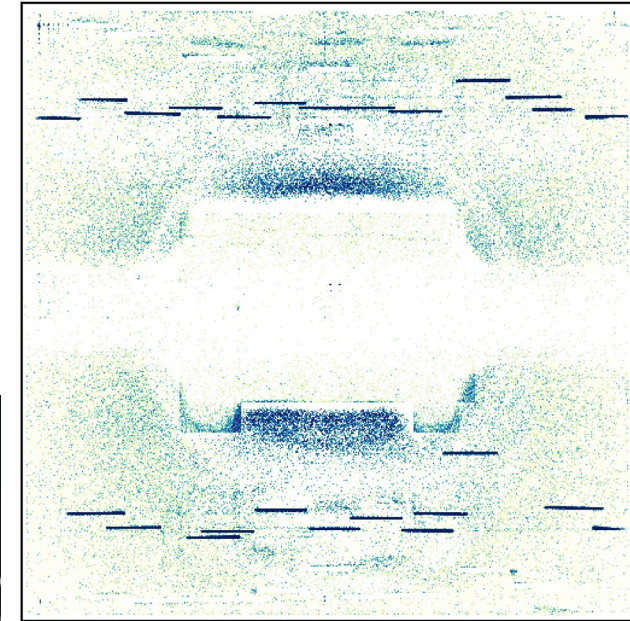
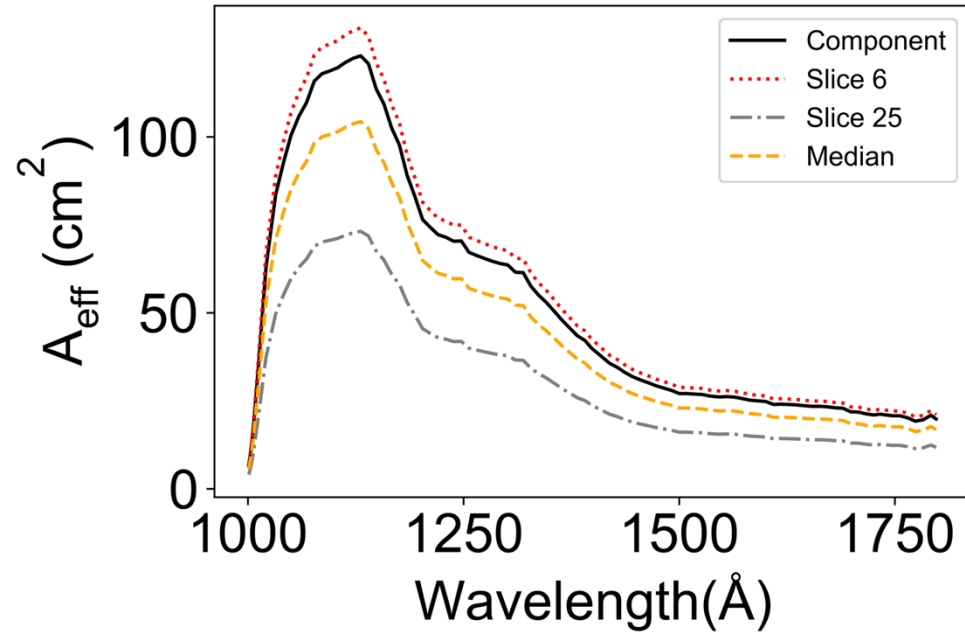
DATE 10/29/23 T-TIME 930 MDT  
1030

FIRING OFFICER	RAY WATSON
TEST CONDUCTOR	LUPE ARCHULETA
FIRING CONSOLE	CHRIS DANIEL CHANCE
SAFETY OFFICER	CHRIS GARZA
SAFETY OFFICER	DANIEL GUERRERO
VISUAL CONTROL	ANDREW MONTELLANO



# Launch!

- Launched October 29, 2023 at 11:44 PM
- 20 s of data instead of >300 s
- Successfully retrieved data
- C IV and O VI



# Looking to the Future

- INFUSE is scalable
- *JWST* had image slicer as a side instrument on MIRI
- INFUSE design prevents changing gratings
- A FUV IFU would be valuable to *Habitable Worlds*





**Thank you!**