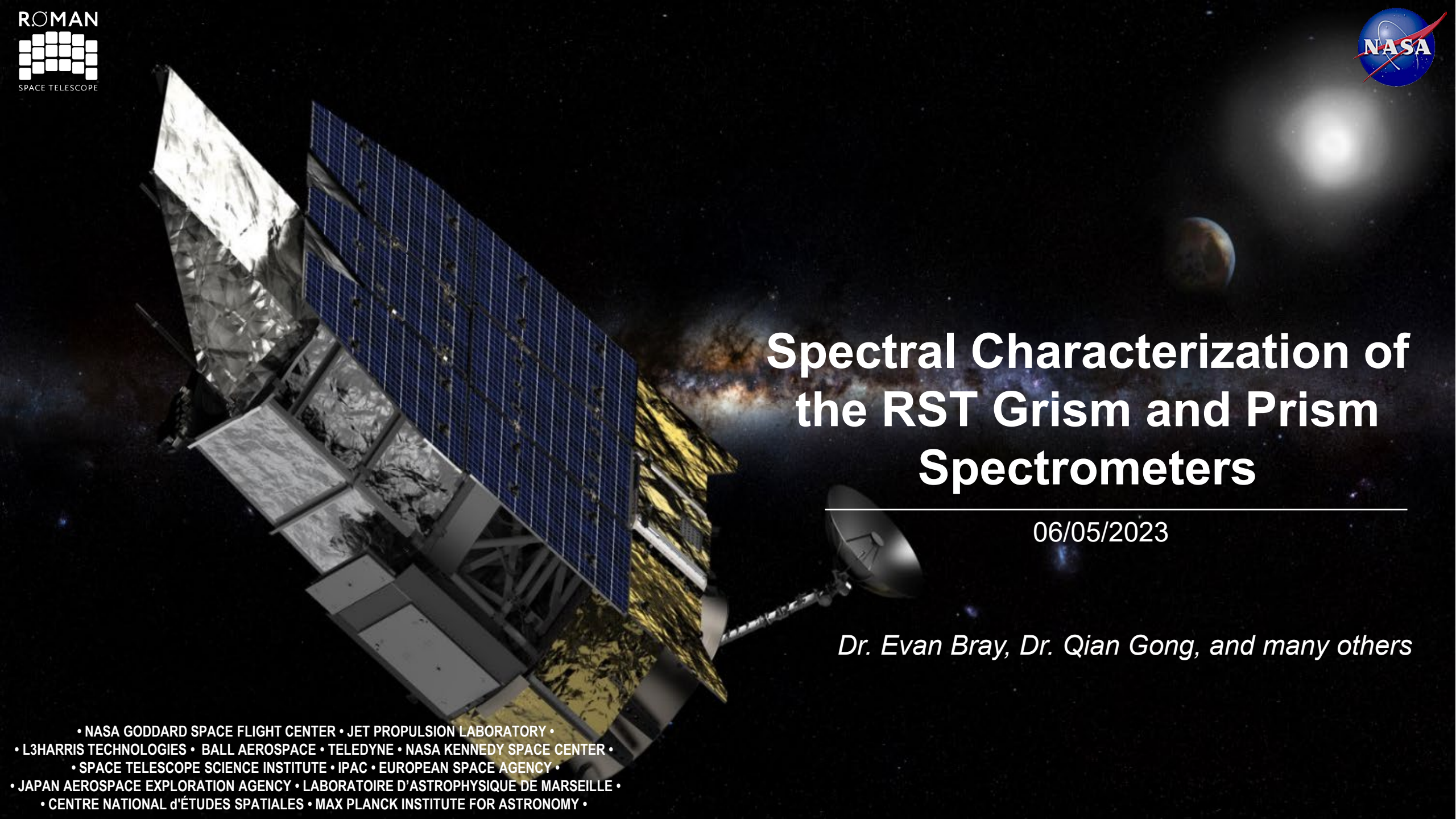

# Spectral Characterization of the RST Grism and Prism Spectrometers

06/05/2023

*Dr. Evan Bray, Dr. Qian Gong, and many others*

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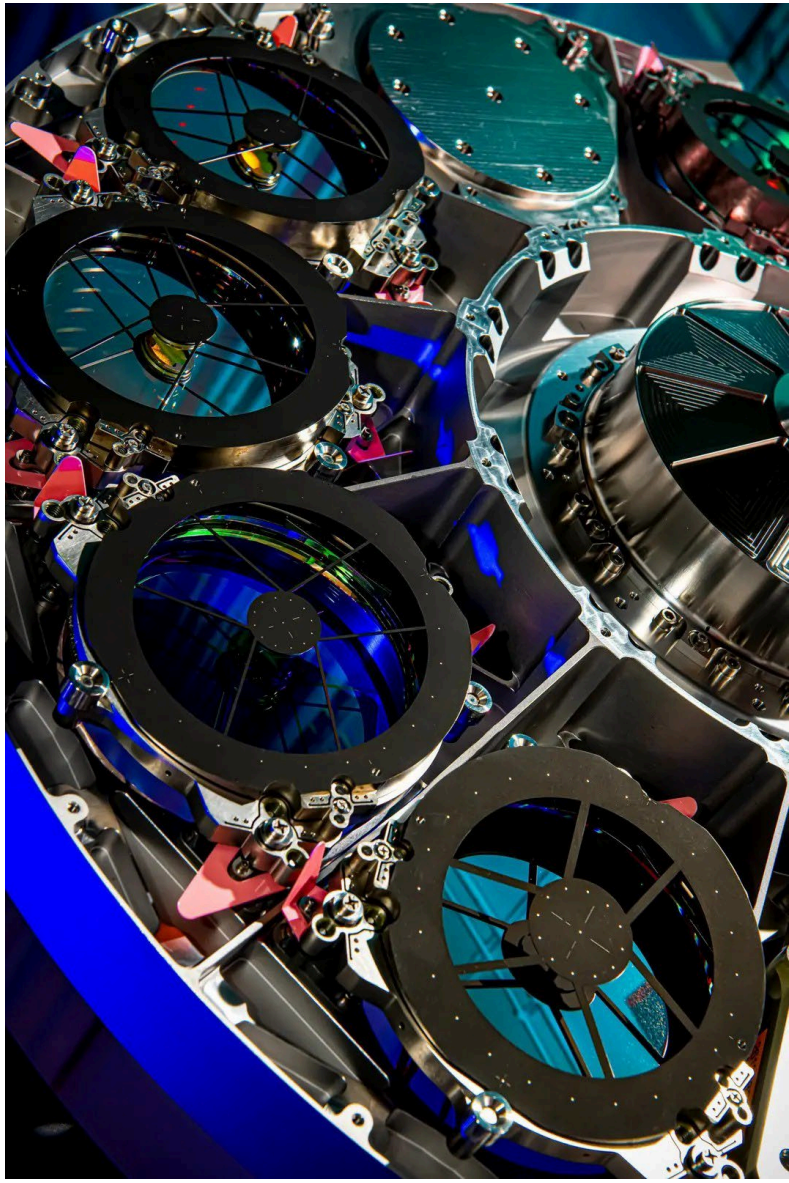
# Outline

- **The Grism and Prism assemblies acquire spectra for 10's of millions of faint galaxies and thousands of supernova.**

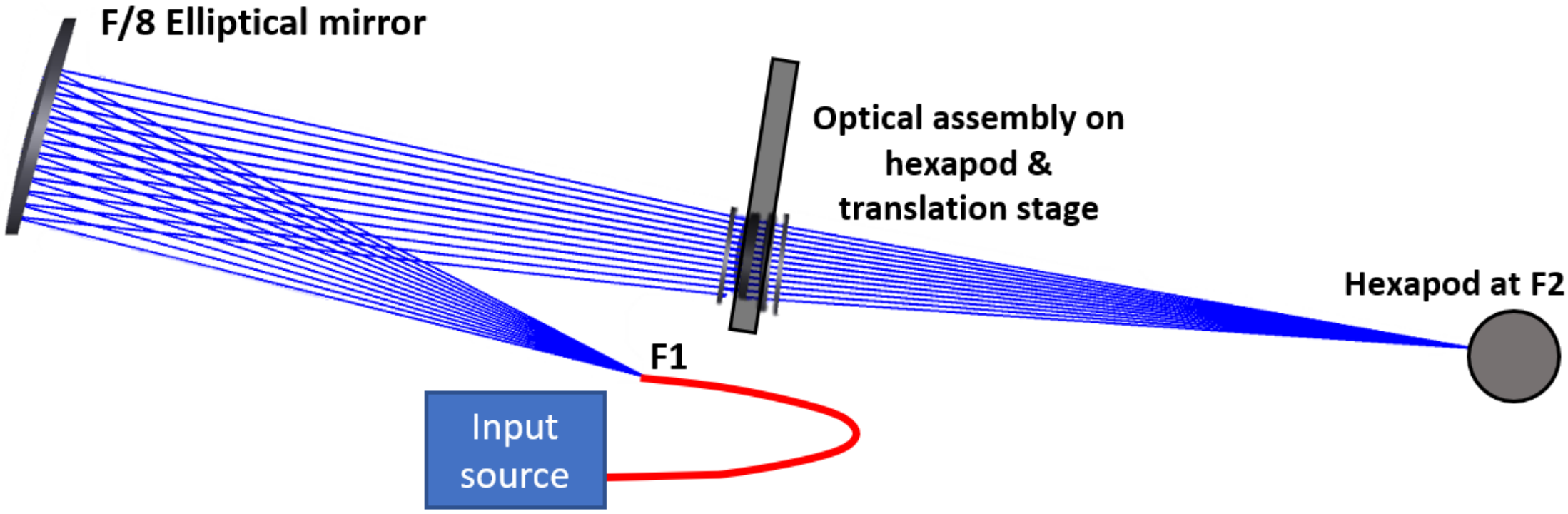
- **After several years of development with the Grism Prototype and Grism engineering test unit (ETU), the experimental plan had become very highly-optimized.**
  - In contrast, the Prism had no prototype, and the spectral tests we performed on it frequently had to be fine-tuned on the fly!

- **There were remarkably few surprises! Measured performance very closely matches expectations.**



# The Ellipse Test Bed

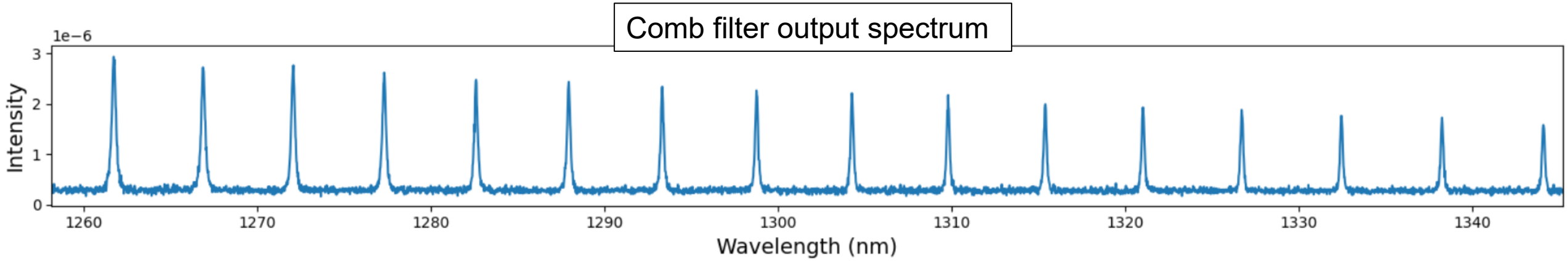
- The test bed consists of a large elliptical mirror, motorized stages, and a variety of NKT supercontinuum white light lasers that allow us to craft a wide variety of input spectra.
- All hardware is controlled via a custom suite of LabVIEW tools that allow for significant automation.

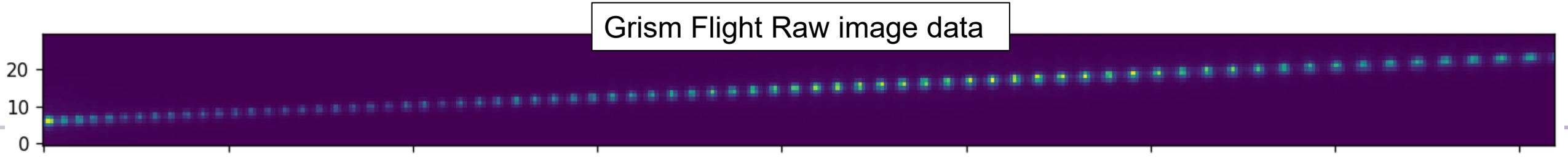


# DISPERSION SCALE

# Dispersion Scale

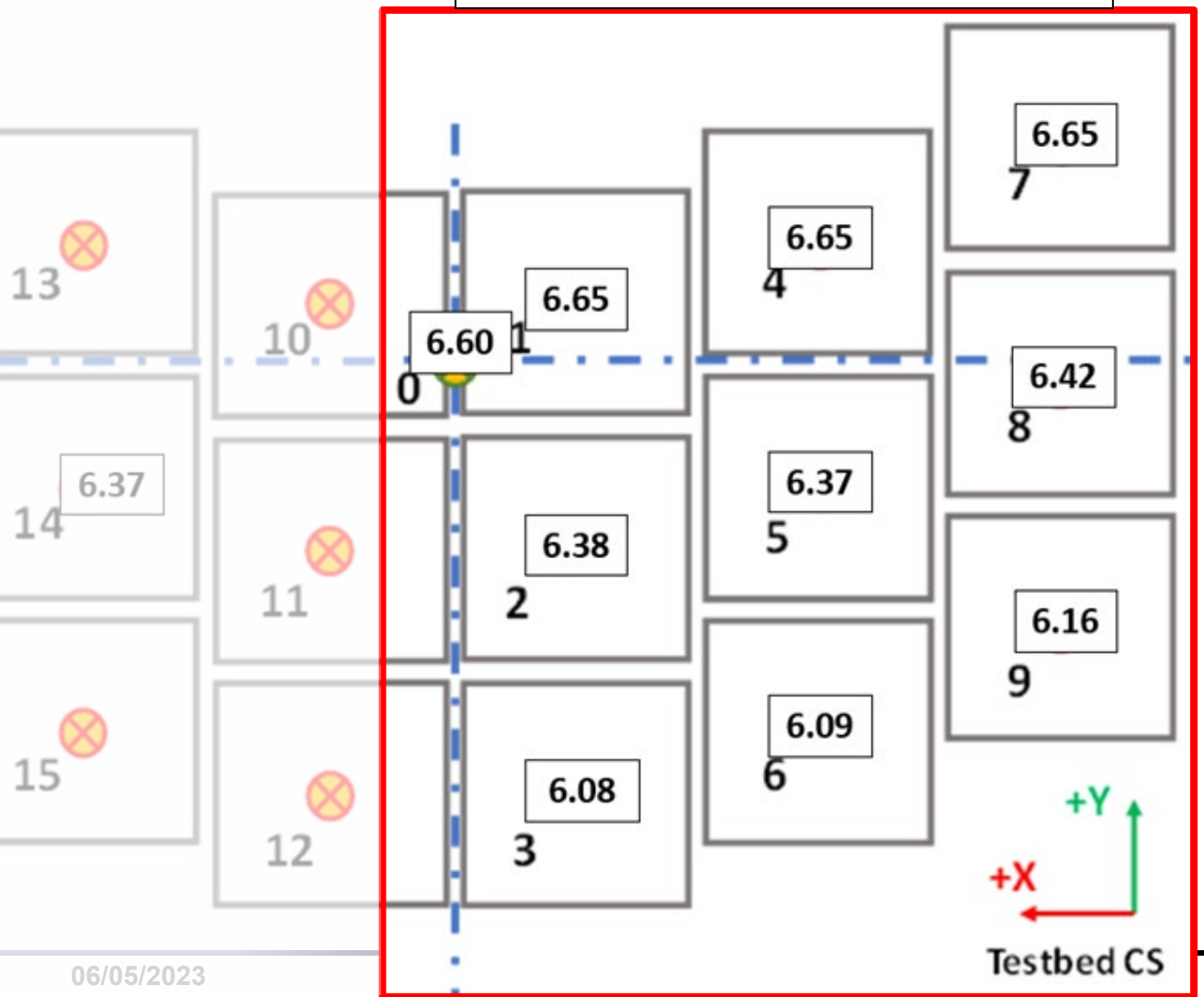
- **Image data from individual comb filters are stitched together to produce a table of (X, Y, λ) values across the complete Grism & Prism bandpass for many field positions.**

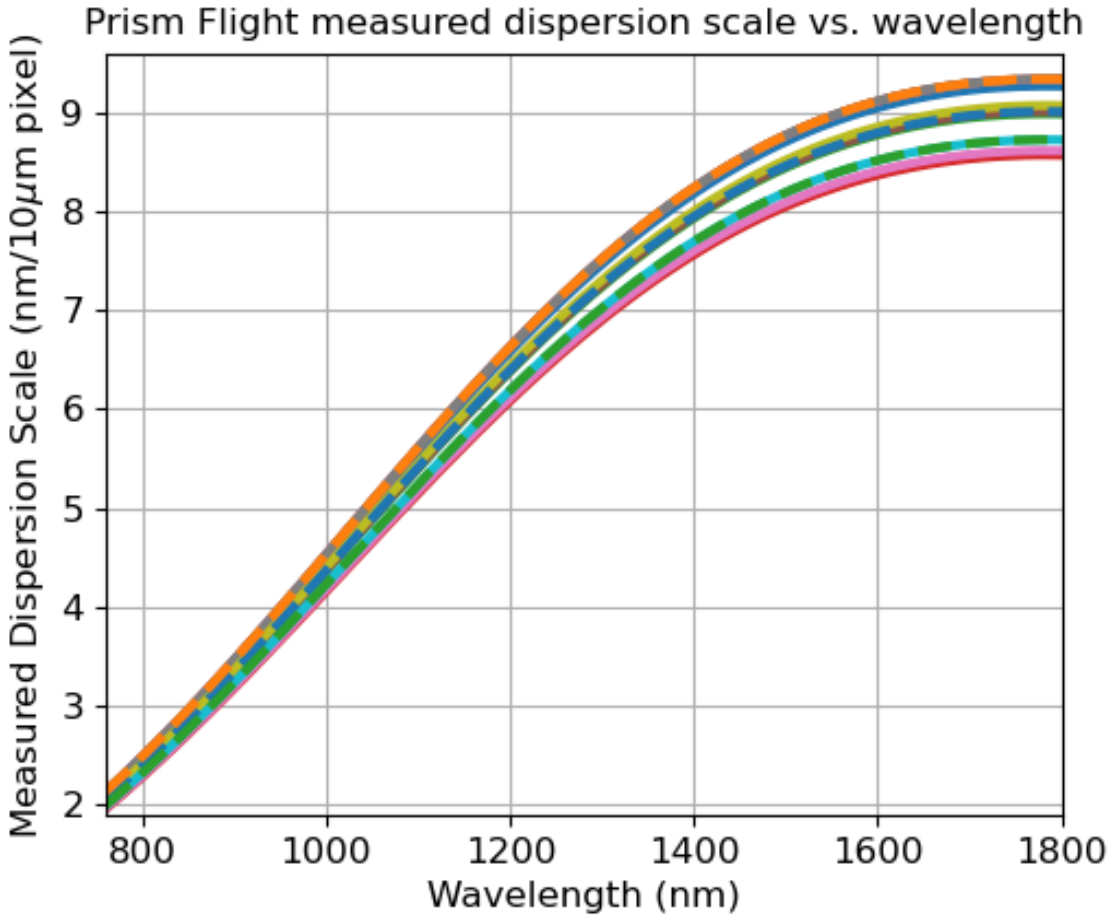


# Dispersion Scale – Prism Results

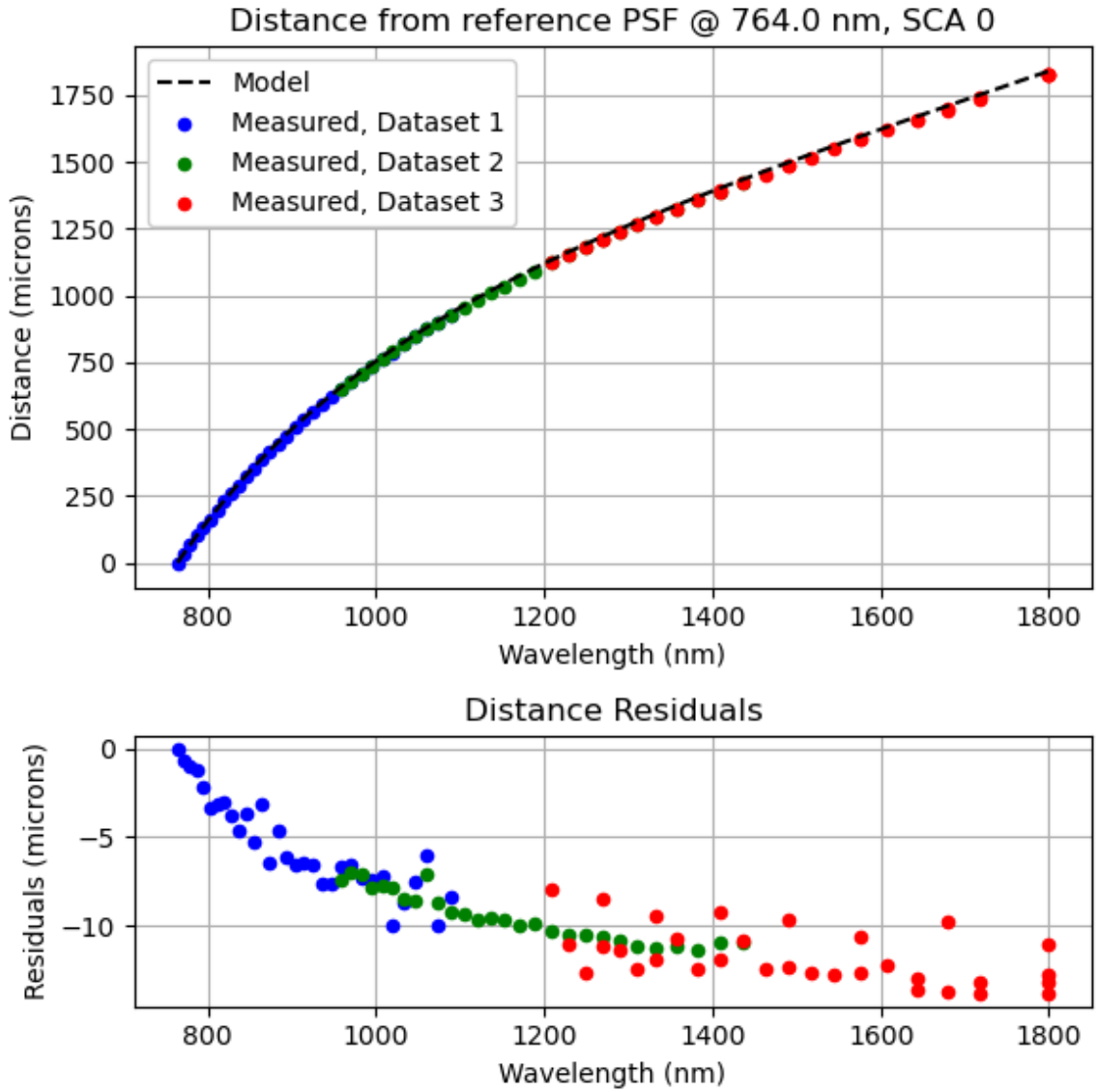
**Prism Dispersion Scale @ 1200 nm vs. Field**



# Dispersion Scale – Prism Results

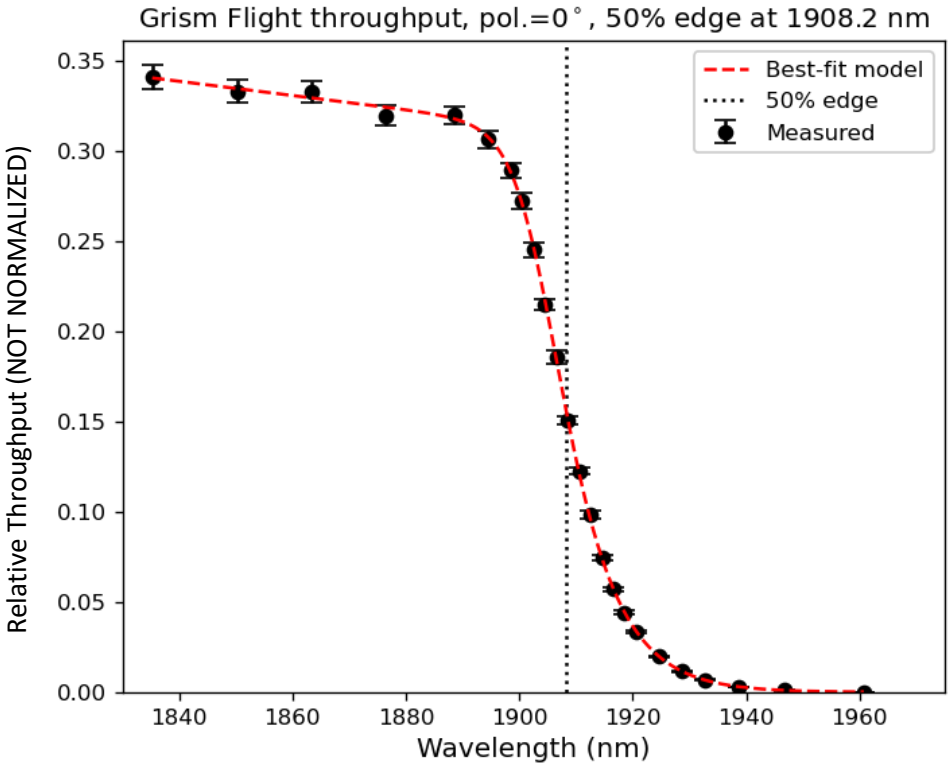
- **Measured trace length is consistently ≈0.7% shorter than model predictions!**
- **Most likely culprit: the wavelength-dependent index of refraction for the STIH1 material that makes up the glass is slightly off from prior measurements.**

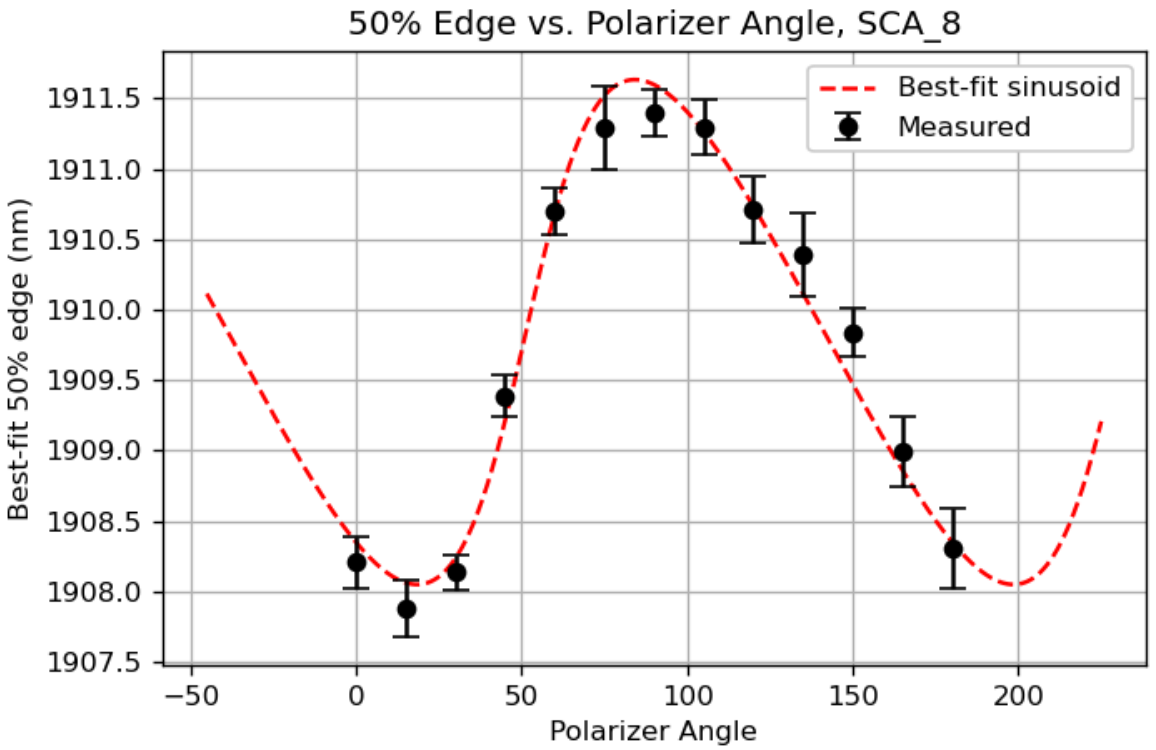


# BANDPASS EDGES

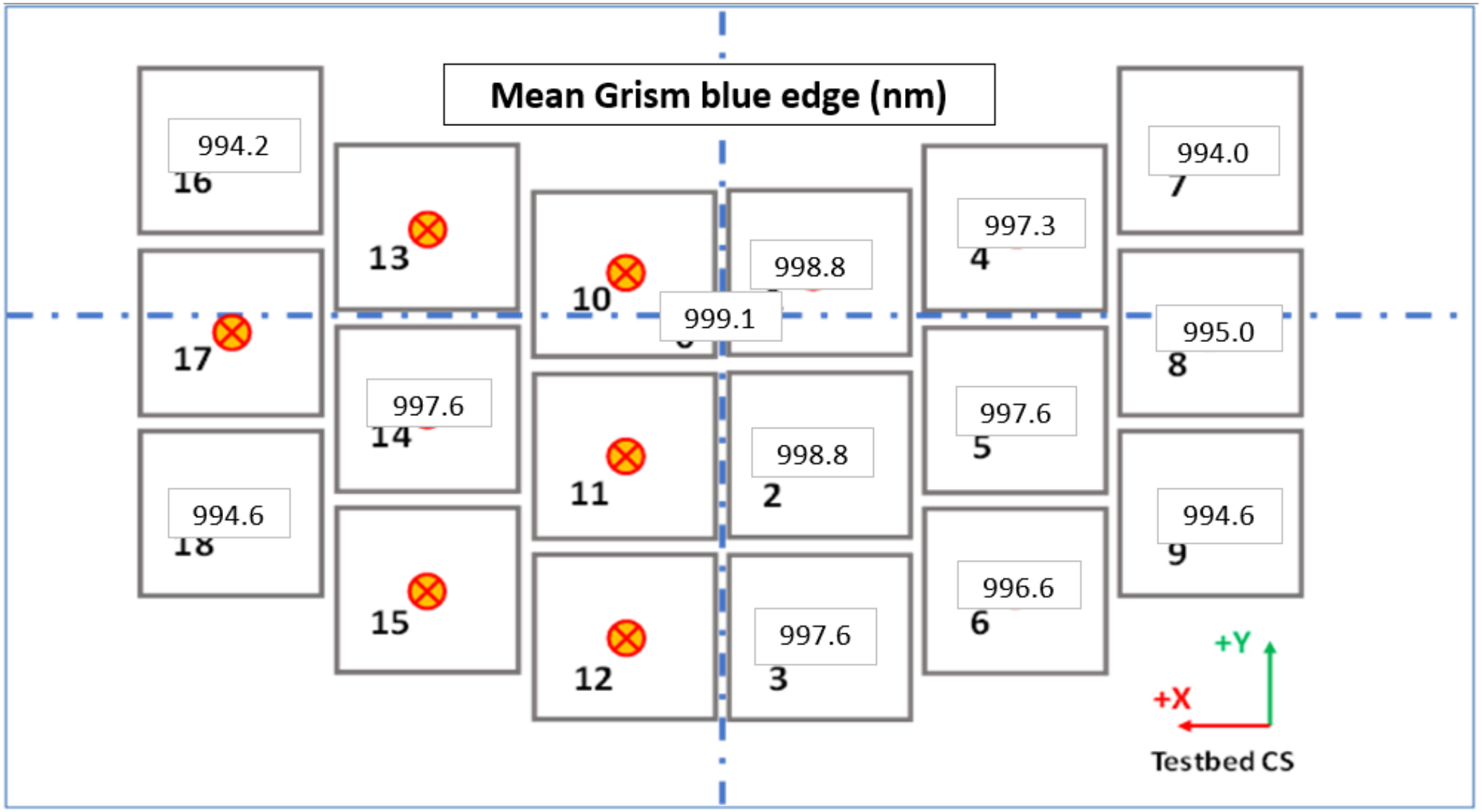
# Bandpass Edges - Grism Red Edge (EXAMPLE)

- **Cut-on and cut-off wavelength varies as a function of:**
  - Field position, angle of Incidence (AOI), temperature, polarization, position on the optic…
- **A huge amount of parameter space to explore! Automation was enormously helpful.**



# Bandpass Edges – Results



# Bandpass Edges - Conclusions

- **The true assembly bandpasses are slightly different than what you might find in prior literature.**
  - For example, Prism is not 750-1800 nm, it is 760-1820 nm (at the on-axis position).

- **Discrepancies between Flight parts and associated witness samples made predicting performance difficult.**
  - Clearly, predicting the performance of a custom interference-based bandpass coating *a priori* is hard.
  - We frequently found things that disagreed with the models. For example, how much the edge wavelength depended on polarization or angle of incidence.

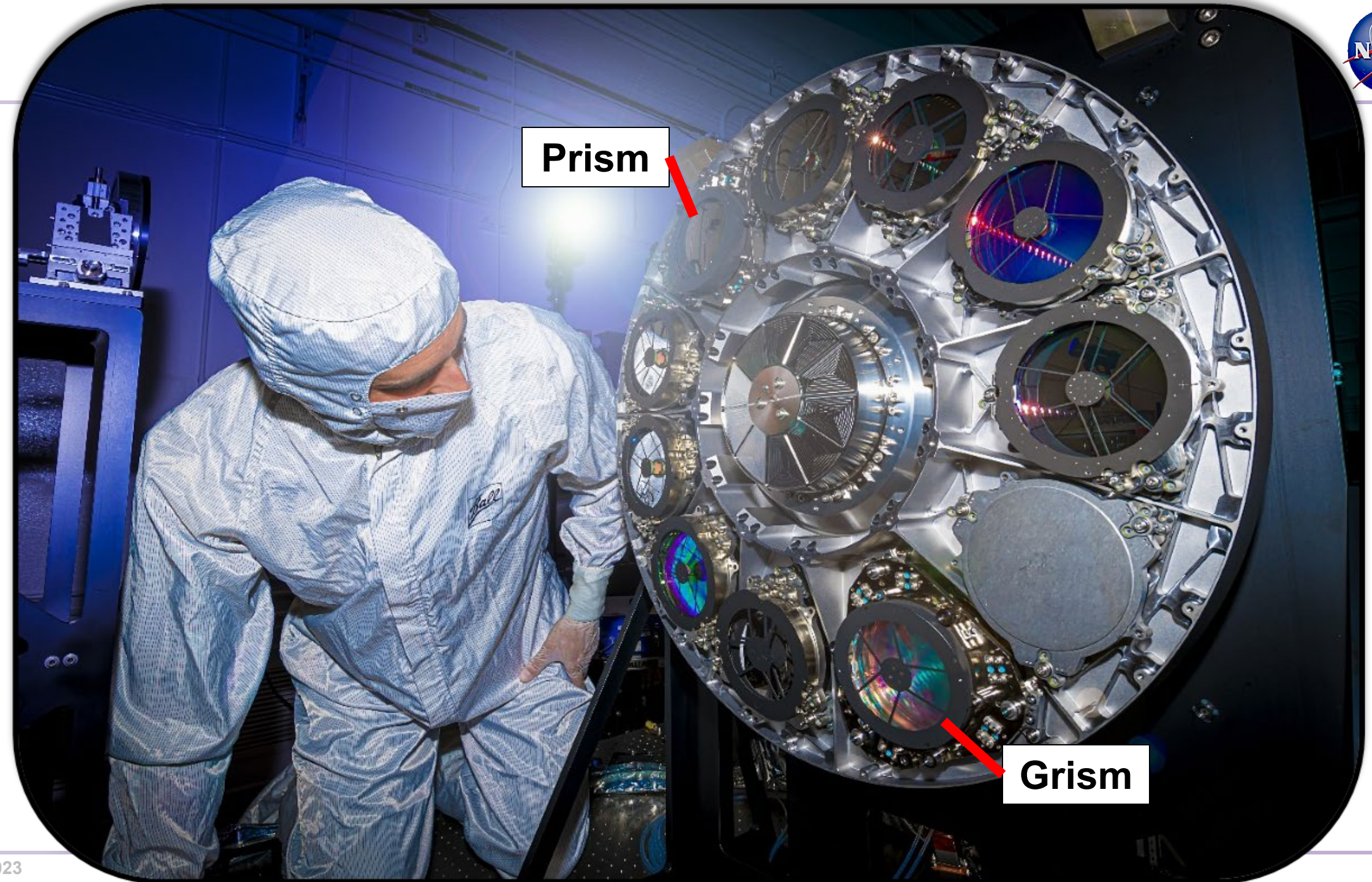
- **Assembly-level tests proved extremely valuable!**

# Conclusions

- **Experiment procedures were as fine-tuned as they could have possibly been.**
  - An extensive prototype test campaign combined with significant automation capabilities ensured the data was consistently coming in faster than we could process it.
  - “Drinking water from the fire hose”

- **The only path to a better characterization campaign would have been to:**
  - Double the budget
  - Double the amount of time we had with the Flight assemblies.
  - Obviously not realistic requests…

- **Both assemblies have since been shipped to Ball Aerospace in Boulder, CO and have been mounted to the Element Wheel Assembly in preparation for upcoming instrument-level testing (Late 2023)**


Prism
Grism