

Status of the Observatory

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7 Sept. 2023 - invited talk for the “First Year of JWST Science”

JWST Overview: a Special Issue of PASP

Please cite the
instrumentation papers.



Publications of the Astronomical Society of the Pacific

JWST Overview

Guest Editor **George Rieke** *Steward Observatory, University of Arizona, US*



Scope The articles in this focus issue describe the design, verification, and in-orbit performance of the James Webb Space Telescope (JWST) and its instrumentation... and an overall assessment of the JWST science performance as characterized during commissioning. **OPEN ACCESS**

[Performance of NIRCam on JWST in Flight](#)

Marcia J. Rieke *et al.* 2023, *PASP* 135 028001

[In-orbit Performance of the Near-infrared Spectrograph NIRSpec on the James Webb Space Telescope](#)

T. Böker *et al.* 2023, *PASP* 135 038001

[The Mid-infrared Instrument for JWST and Its In-flight Performance](#)

Gillian Wright *et al.* 2023, *PASP* 135 048003

[In-orbit performance of NIRISS](#)

René Doyon *et al.*, *PASP* in press

[The Science Performance of JWST as Characterized in Commissioning](#)

Jane Rigby *et al.* 2023, *PASP* 135 048001

[How Dark the Sky: The JWST Backgrounds](#)

Jane Rigby *et al.* 2023, *PASP* 135 048002

[The James Webb Space Telescope Mission: Optical Telescope Element Design, Development, and Performance](#)

Michael McElwain *et al.* 2023, *PASP* 135 058001

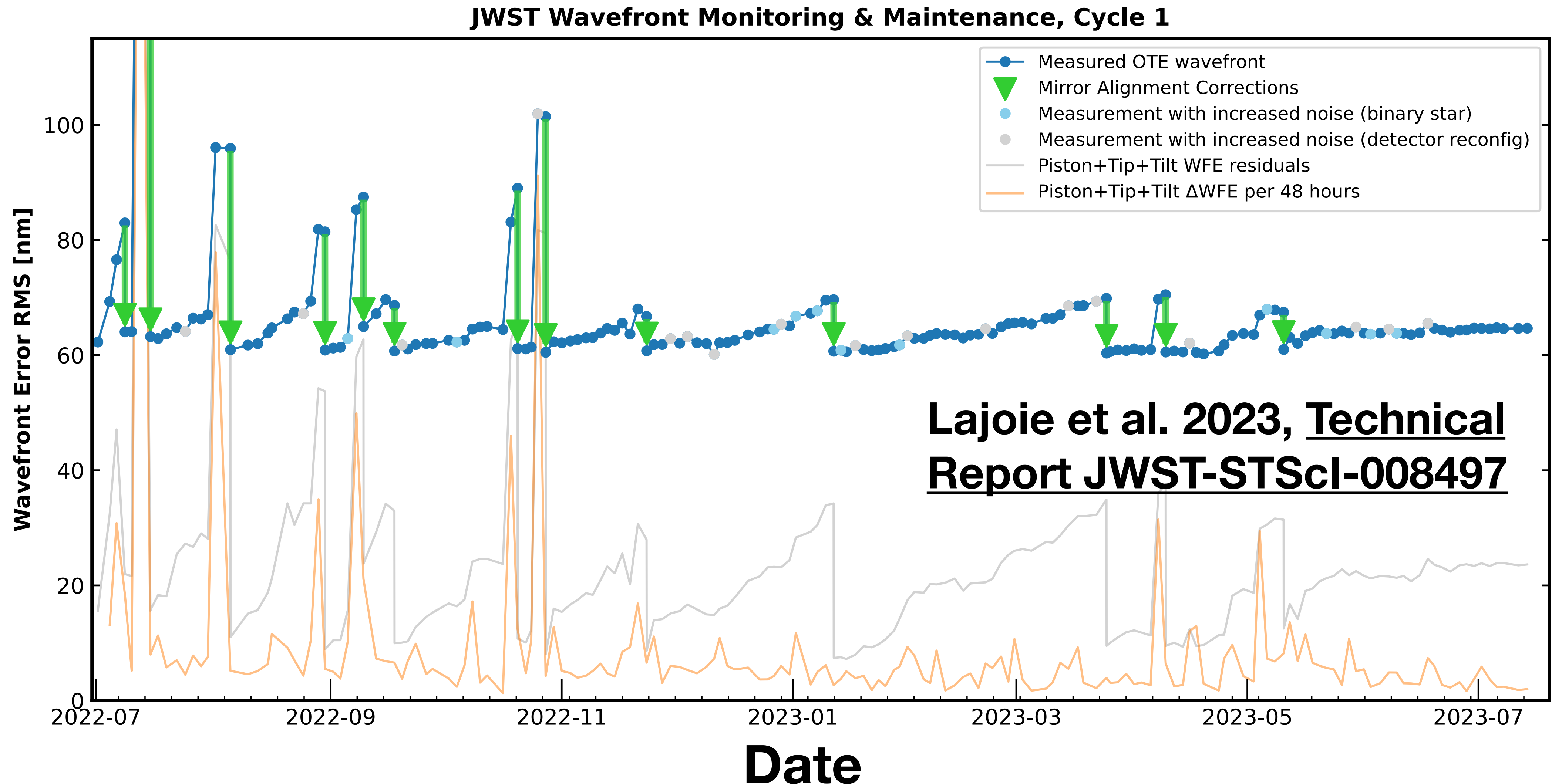
[The Design, Verification, and Performance of The James Webb Space Telescope](#)

M. Menzel *et al.* 2023, *PASP* 135 058002

[The James Webb Space Telescope Mission](#)

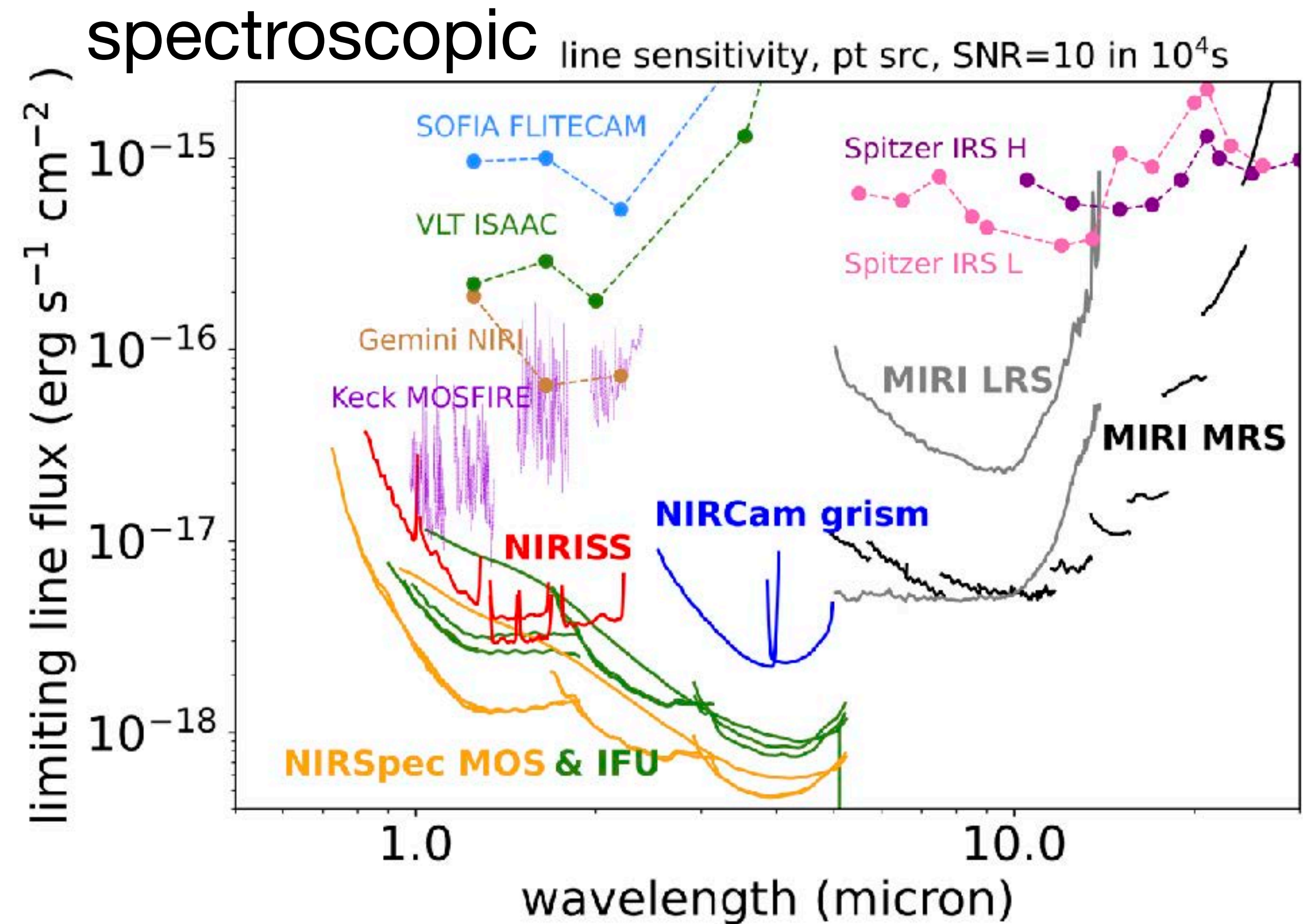
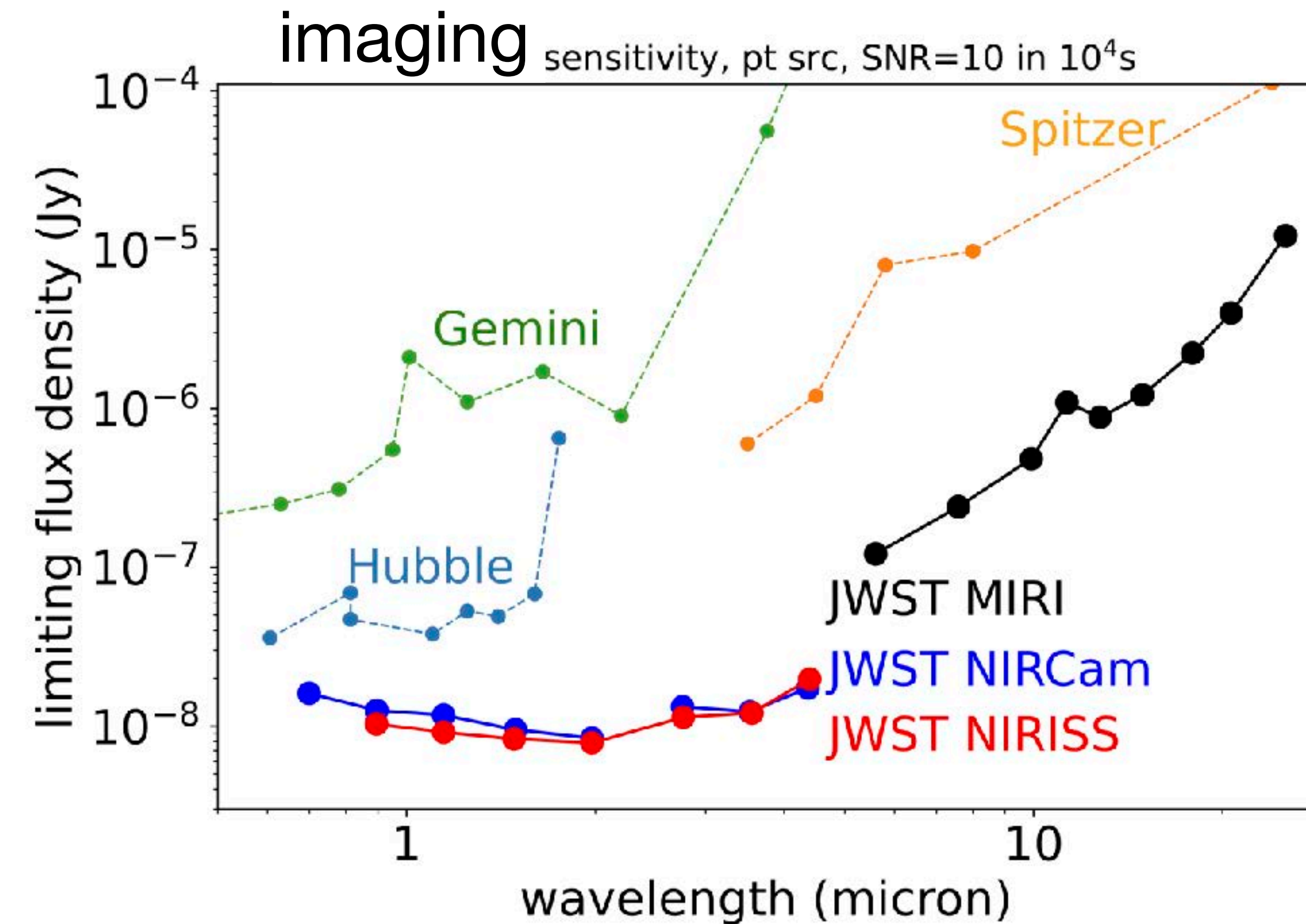
Jonathan Gardner *et al.* 2023, *PASP* 135 068001

JWST's optics are much more stable than requirements



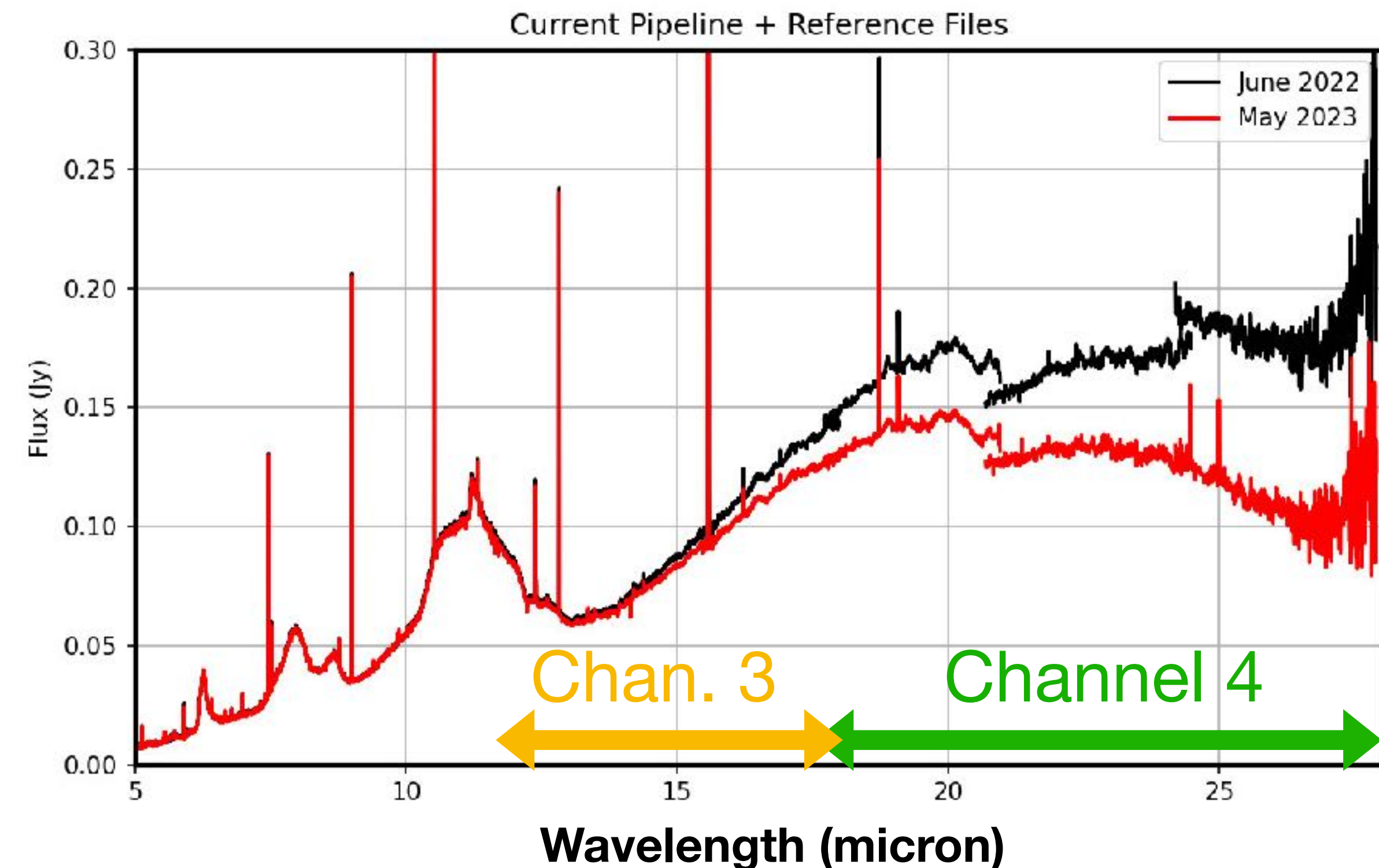
**We correct when wavefront drifts past 80 nm → diffraction limited at 1.1 μm .
92% of the time, it's better than that (McElwain et al. 2023, PASP).**

JWST actual sensitivity is better than expected



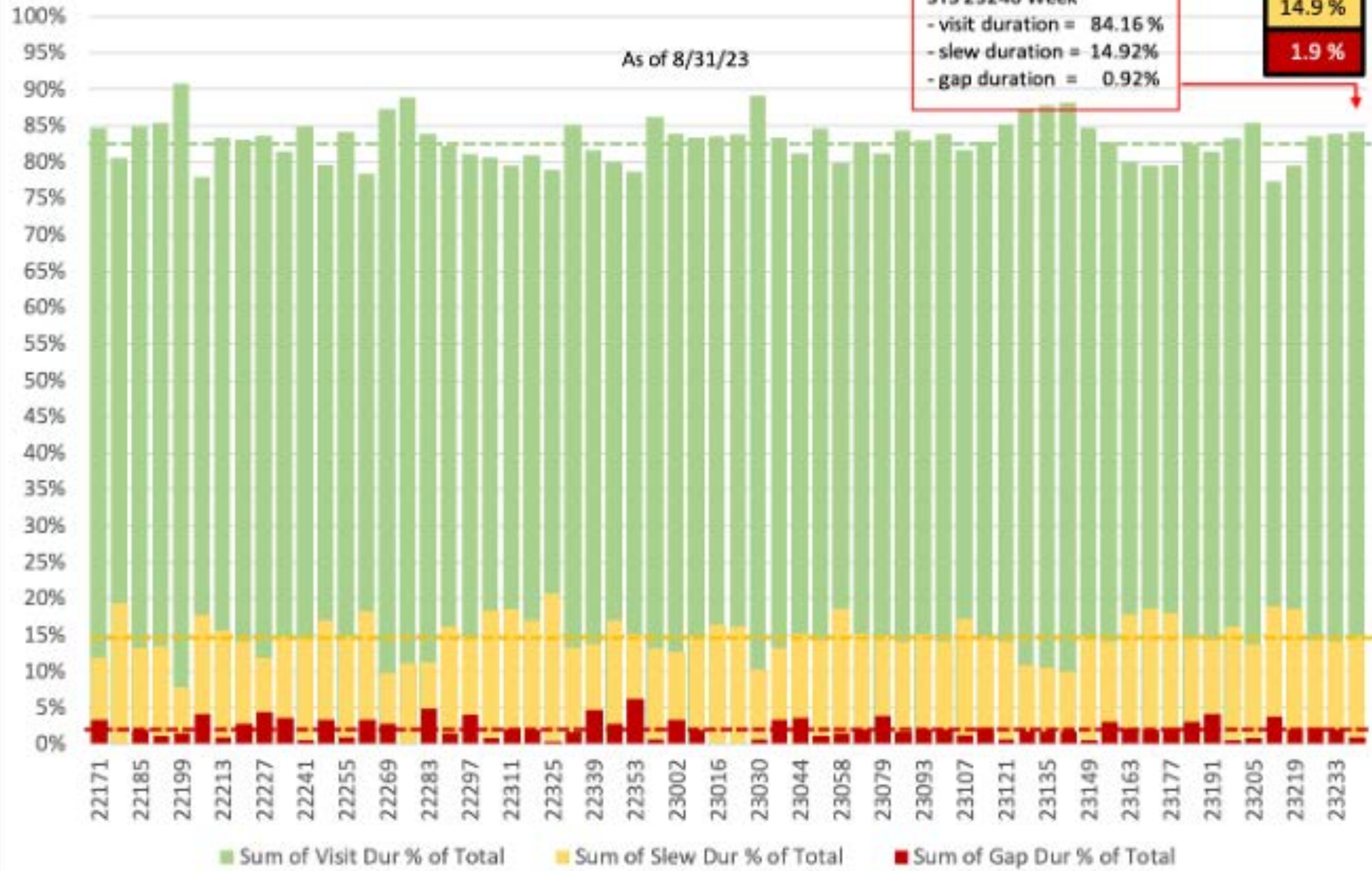
Rigby et al. (2023a), PASP,
using Pandeia 2.0 (Pontoppidan et al. 2017)

Issue: MIRI MRS throughput anomaly



- Throughput of MIRI in Medium Resolution Spectroscopy (MRS) mode is decreasing with time.
- We don't yet know why; anomaly process is underway.
- This plot shows 2 MRS spectra of the same planetary nebula, observed 1 year apart.
- Throughput in channel 3 has dropped by 1-10%; in channel 4 by 15-50%.
- Correction factor has been added to pipeline; PIs should contact helpdesk with concerns.

Short Term Schedule Efficiency



Average schedule efficiency to date is 83.2%.

Yellow is slew,
 Red is deadtime
 Green is in a visit (observing or setting up to observe)

Issue: Micrometeoroids

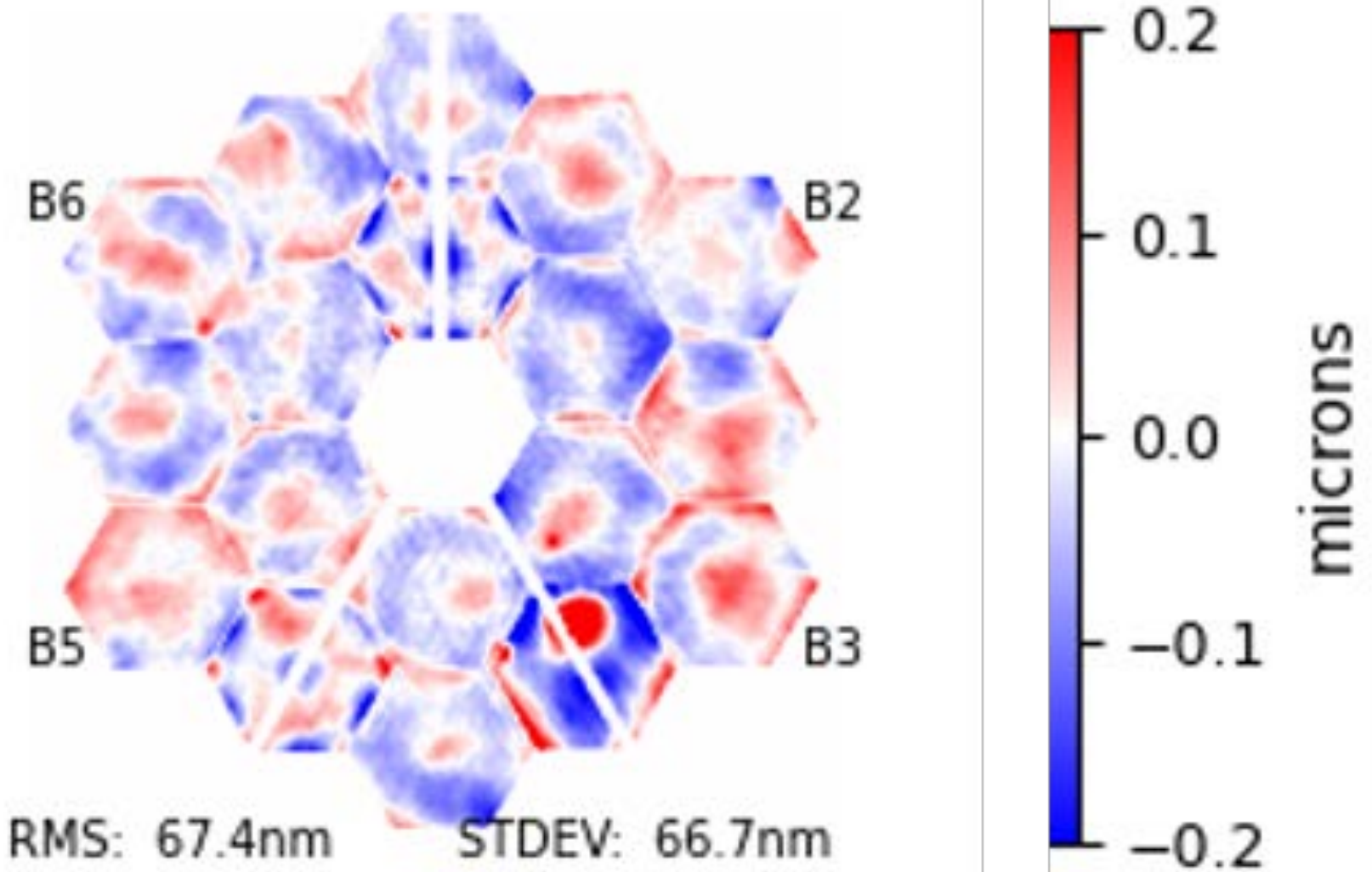
- Regular wavefront sensing detects the effects of micrometeoroid hits.
- 52 hits detected as of 8/31/2023. Hit rate of 2.6/month
- All but one hit caused negligible wavefront error (after correction).

One hit in May 2022 to segment C3 increased global wavefront error by 9 nm.

If we got ten hits that big, **then** we would reach the end-of-life requirement on image quality.

- To reduce risk to primary mirror from micrometeoroids, scheduling of Cycle 2 has reduced the amount of time pointed in the direction of orbital motion to ~20%, compared to 38% in Cycle 1. **This affects schedulability of programs.** See Cycle 2 Call for Proposals.

Sensing Obs. PID 04500, Obs 092
O2023082901
(2023-08-28 16:33:54.746000)

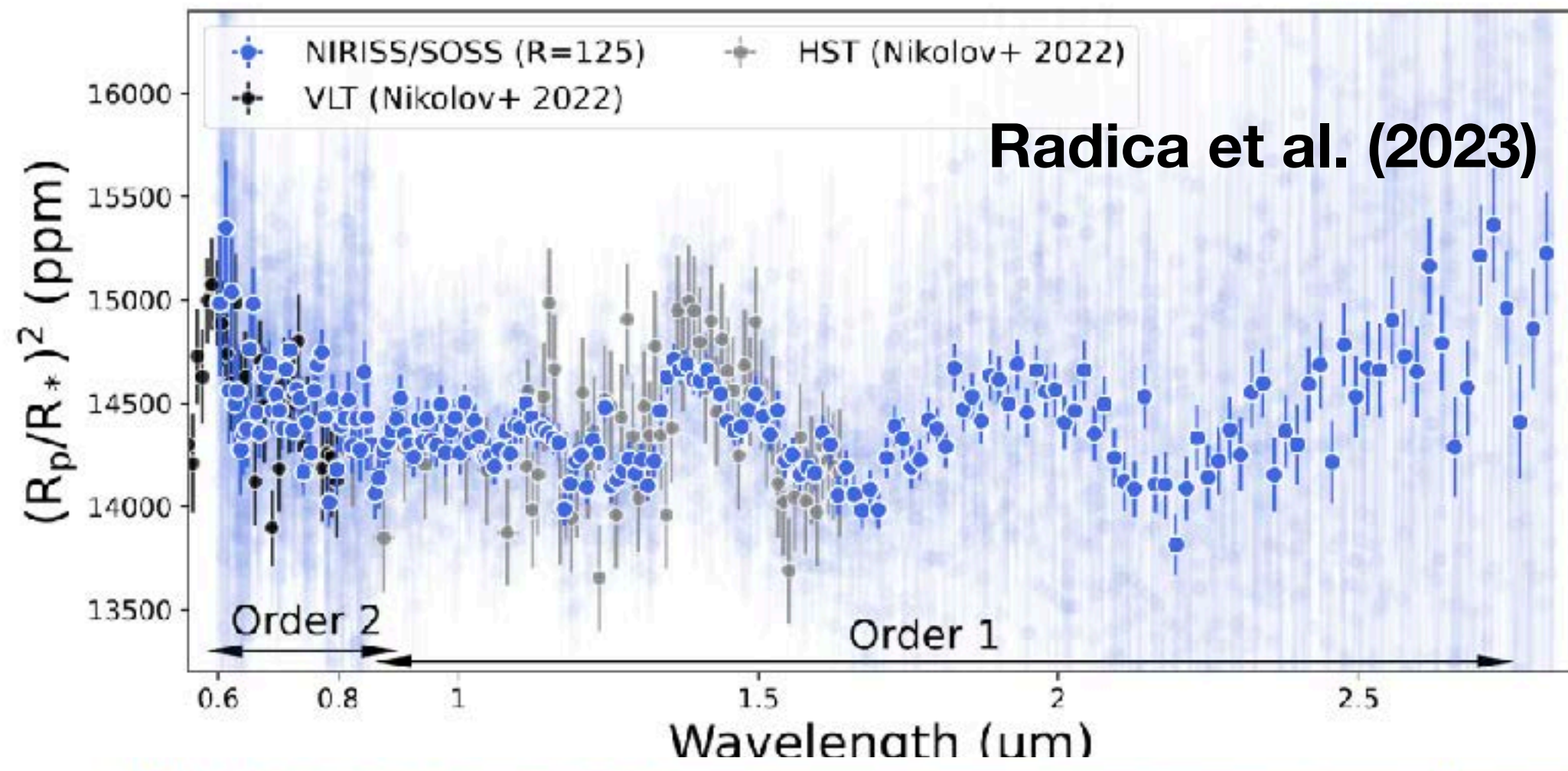


Plot from Mission Systems Engineering

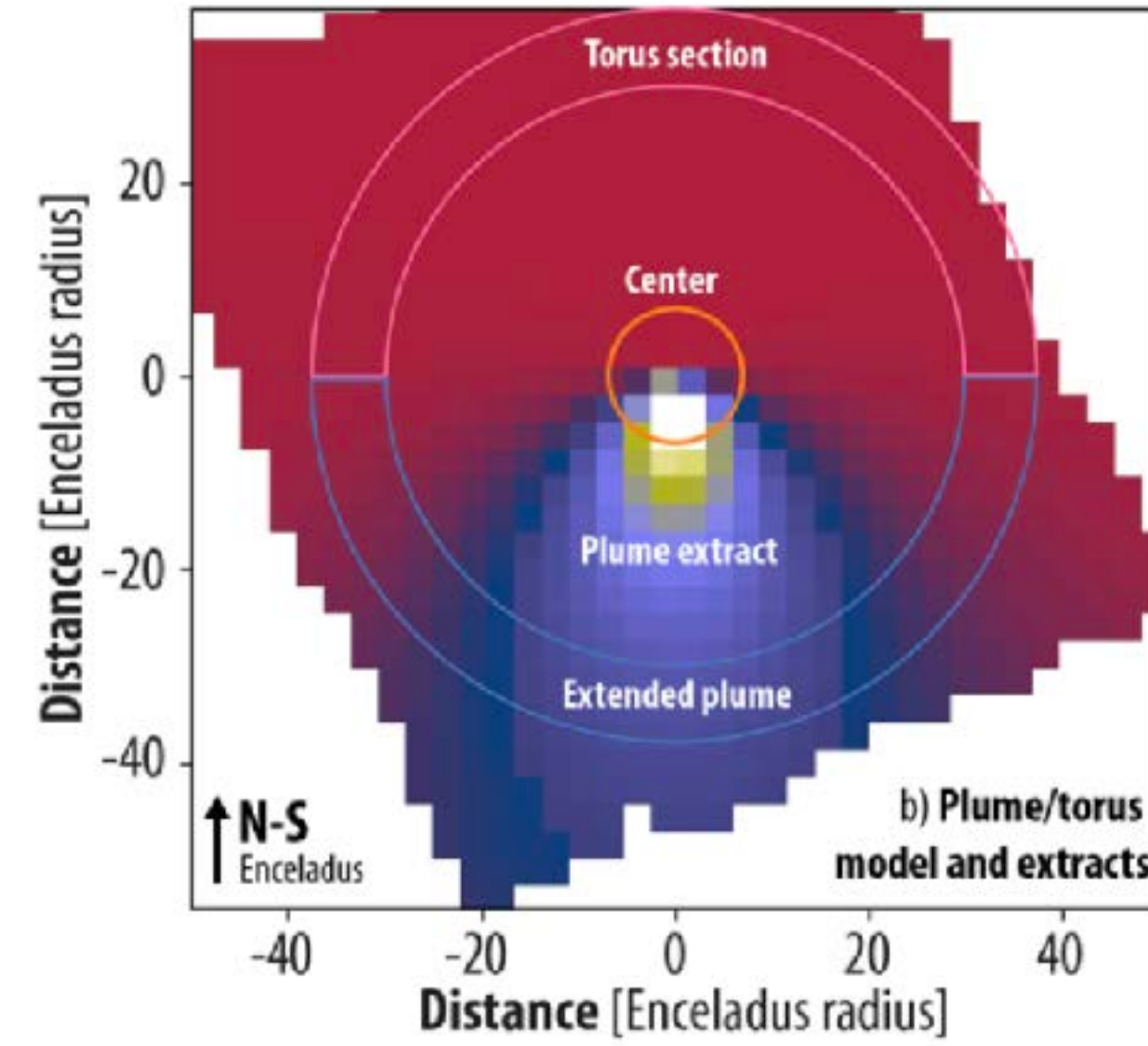
Issue: Calibration and Pipeline

- The current pipeline and calibrations are not yet where they need to be, to support JWST's revolutionary capabilities for all 17 instrument modes.
- Users expect a pipeline that delivers science-ready data.
- Many Cycle 1 programs require accurate, precise measurements — the data are clearly good enough, but the current calibrations are not, yet.
- Calibrating JWST is a complex task. 17 instrument modes, 10 detectors in NIRCam alone, non-linearity, detector effects, large dynamic range from bright calibration stars to faint science targets.
- Please hold us to high standards, and understand that it's a complex task.

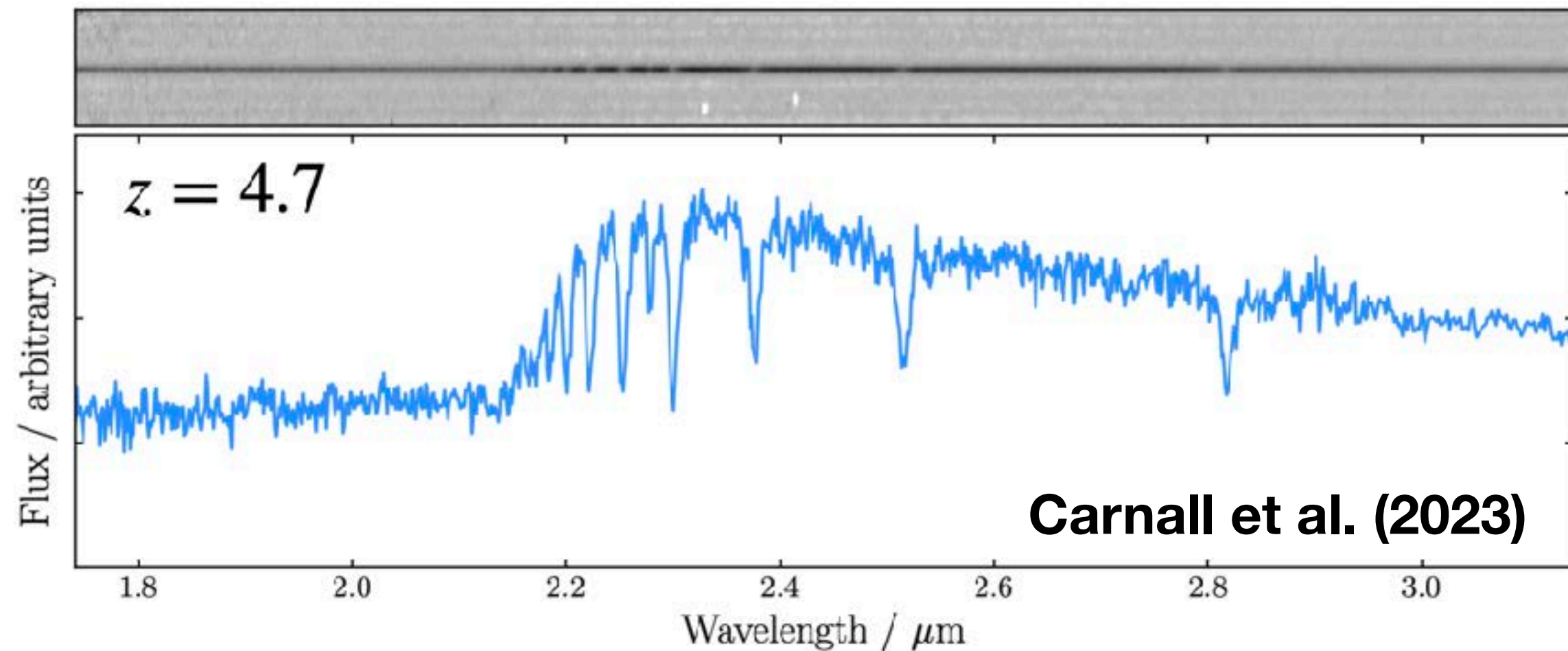
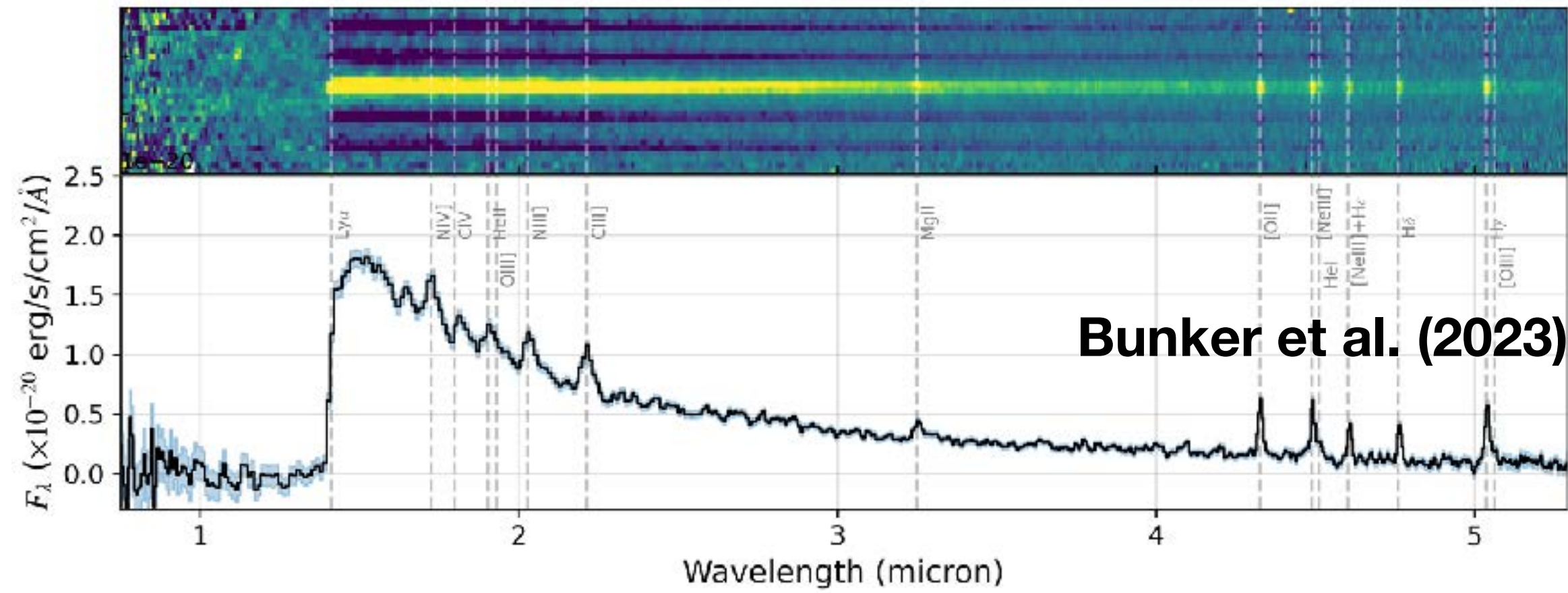
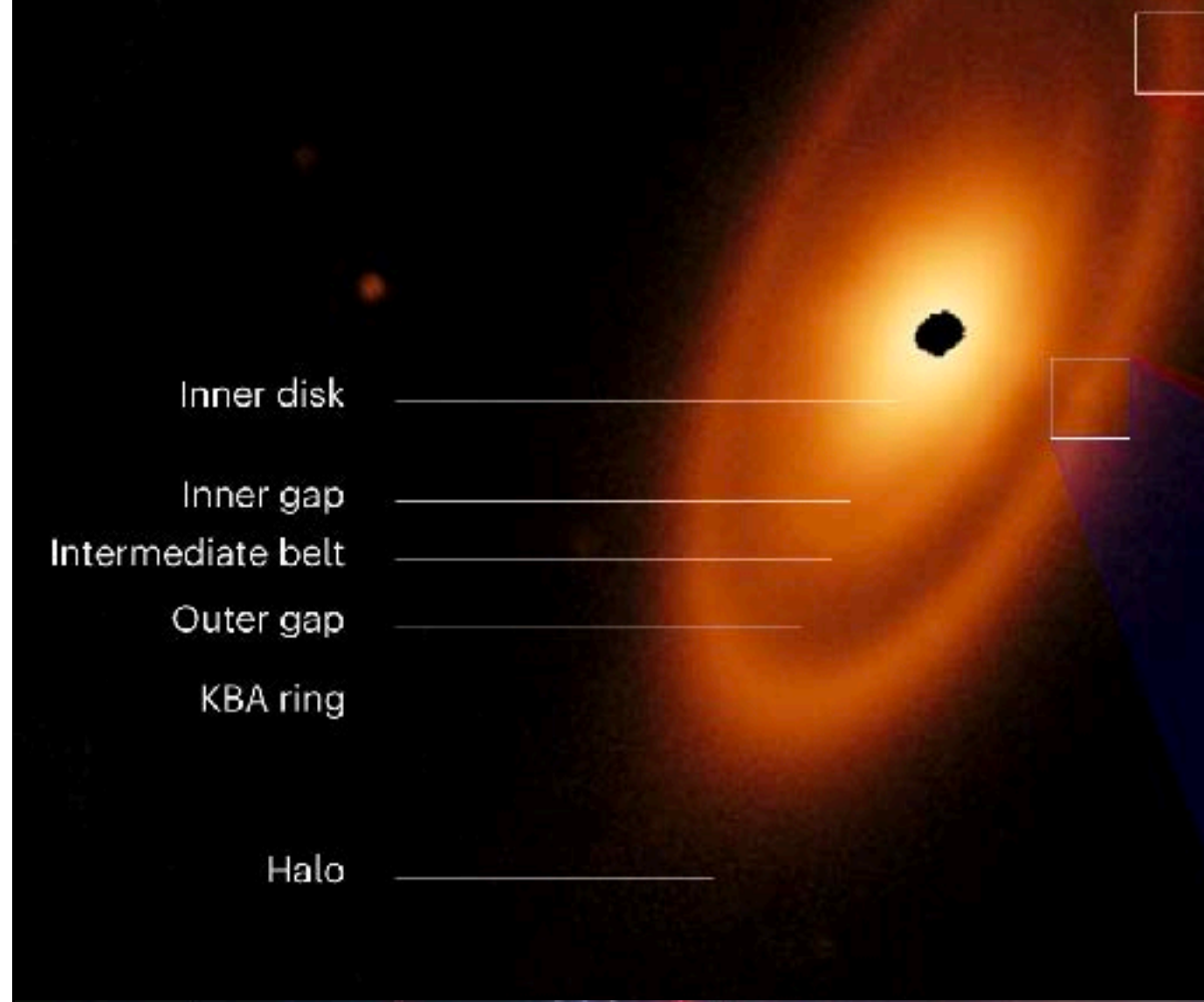
I'm excited for new science results!



Water plume in Enceladus,
Villanueva et al. (2023)



Fomalhaut w/ MIRI at 25um.
Gaspar et al. (2023)



Summary

- PSF is twice as sharp as requirements, and far more stable than requirements.
- Sensitivity is better than expected, and well-characterized in ETC.
- Level 2 MIRI long-wavelength sensitivity requirement is under threat, due to MIRI reduced count rate anomaly.
- Efficiency is good; there are many opportunities for small improvements.
- We carefully monitor the impact of micrometeoroids hitting the primary mirror; one significant impact and ~50 minor impact since March 2022. To ensure a long lifetime for JWST, we now limit the time spent pointing into the rain.
- We are still predicting 20+ years of propellant lifetime.
- Efforts underway to improve the pipeline and calibrations for all 17 instrument modes.