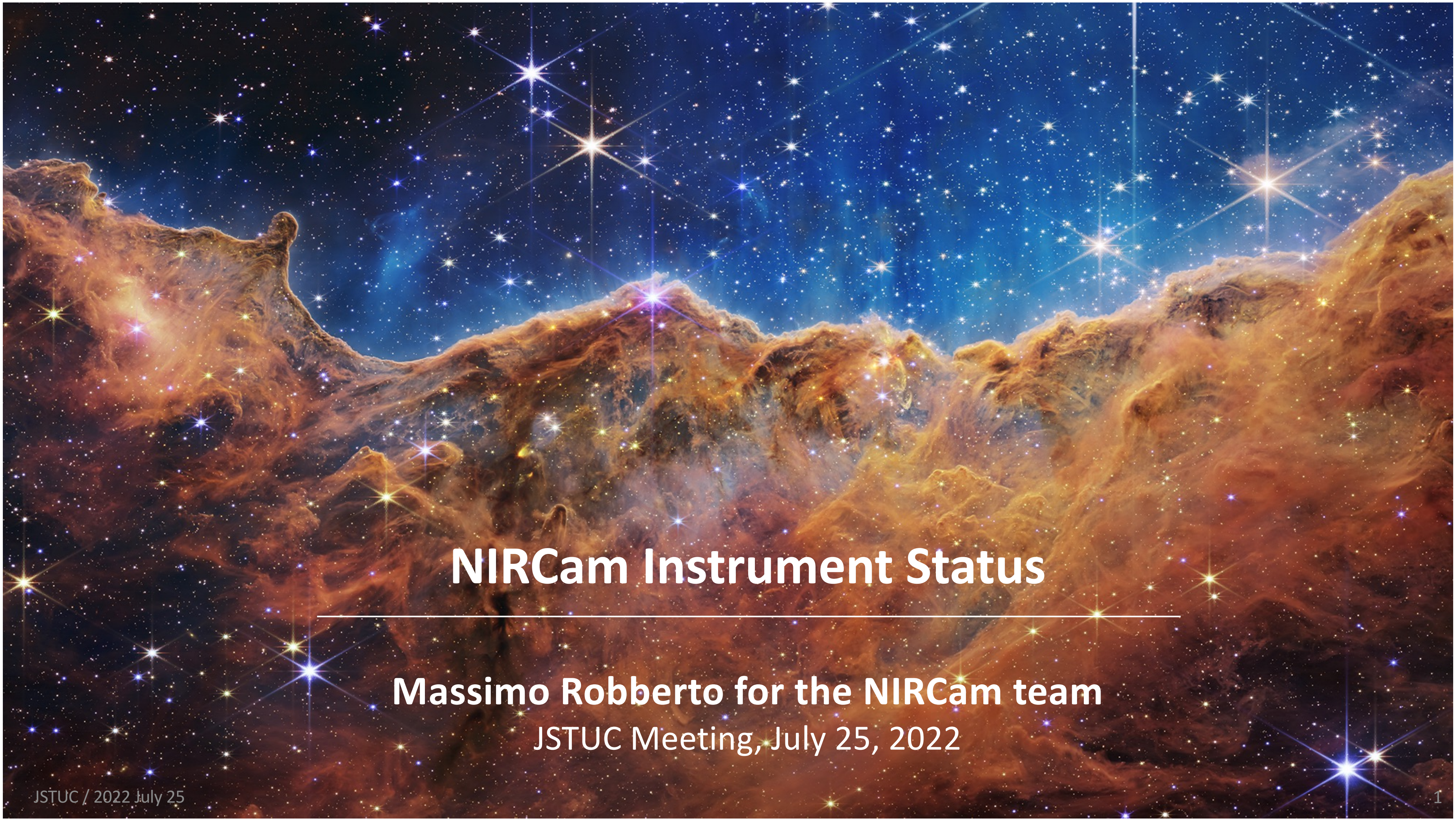


NIRCam Instrument Status

Massimo Robberto for the NIRCam team

JSTUC Meeting, July 25, 2022

NIRCam Team

Not pictured: Dan Lewis, Malcolm Ferry, Chuck Clark & honorary team members Tony Sohn and Nestor Espinoza

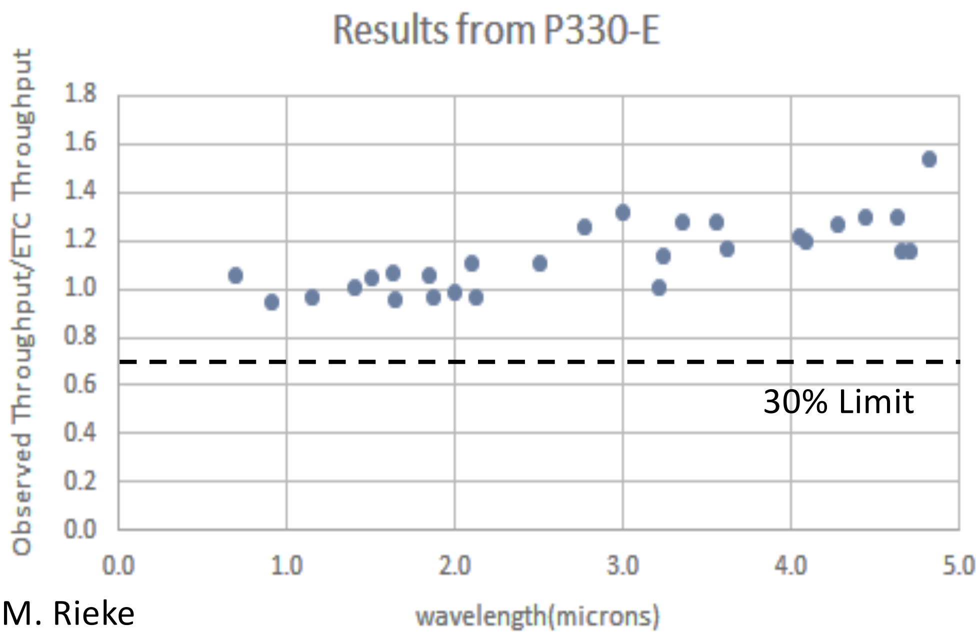
NIRCam serves as the primary wavefront monitor instrument

NIRCam has four science modes:

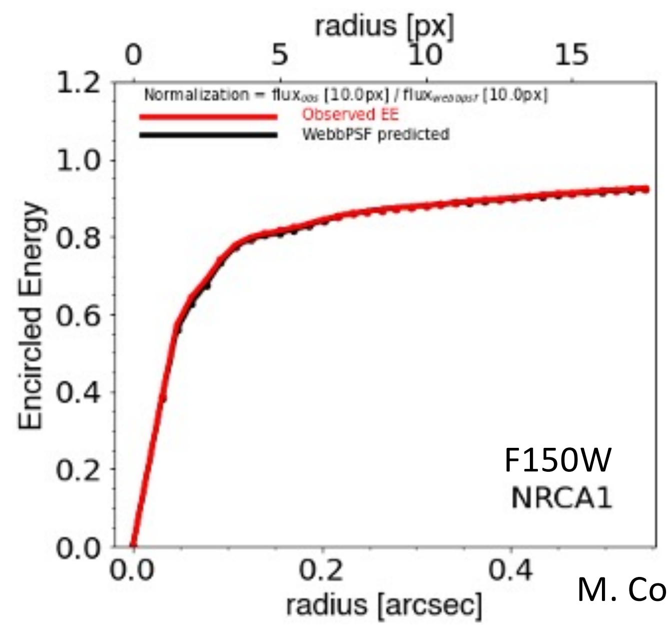
- Imaging with 29 filters
- Wide Field Slitless Spectroscopy
- Time Series photometry and spectroscopy
- Coronagraphic Imaging with variety of Lyot stops

All modes exceed requirements!

Sensitivity & EE are Excellent



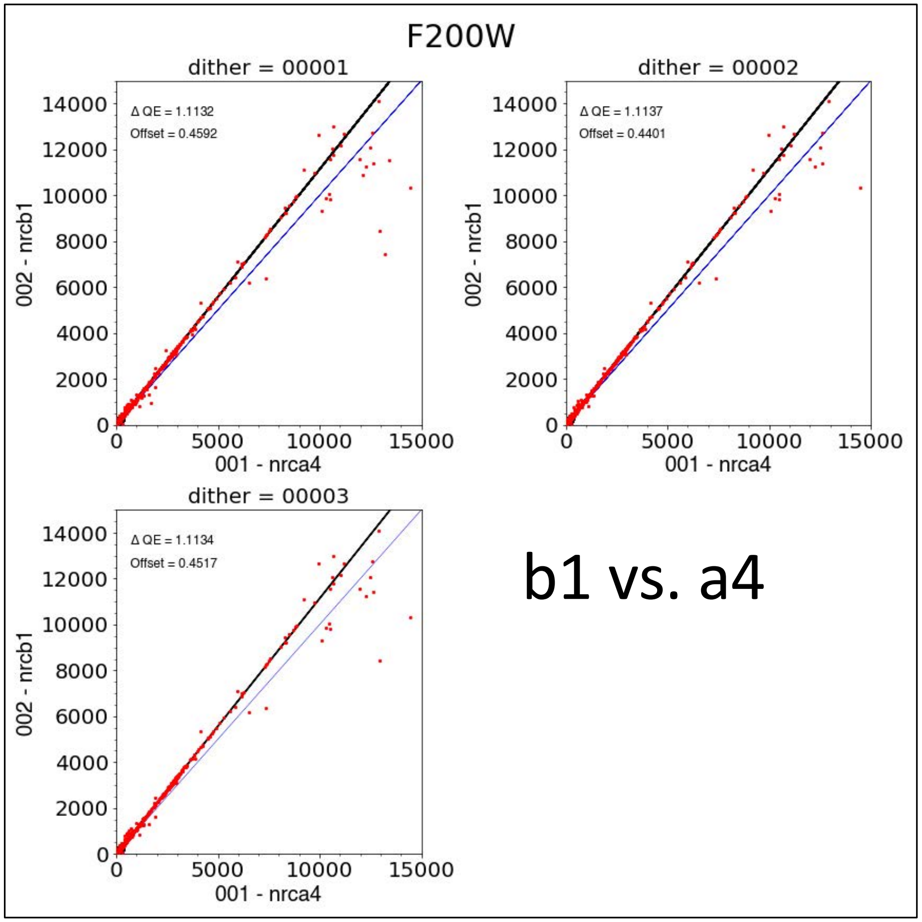
M. Rieke

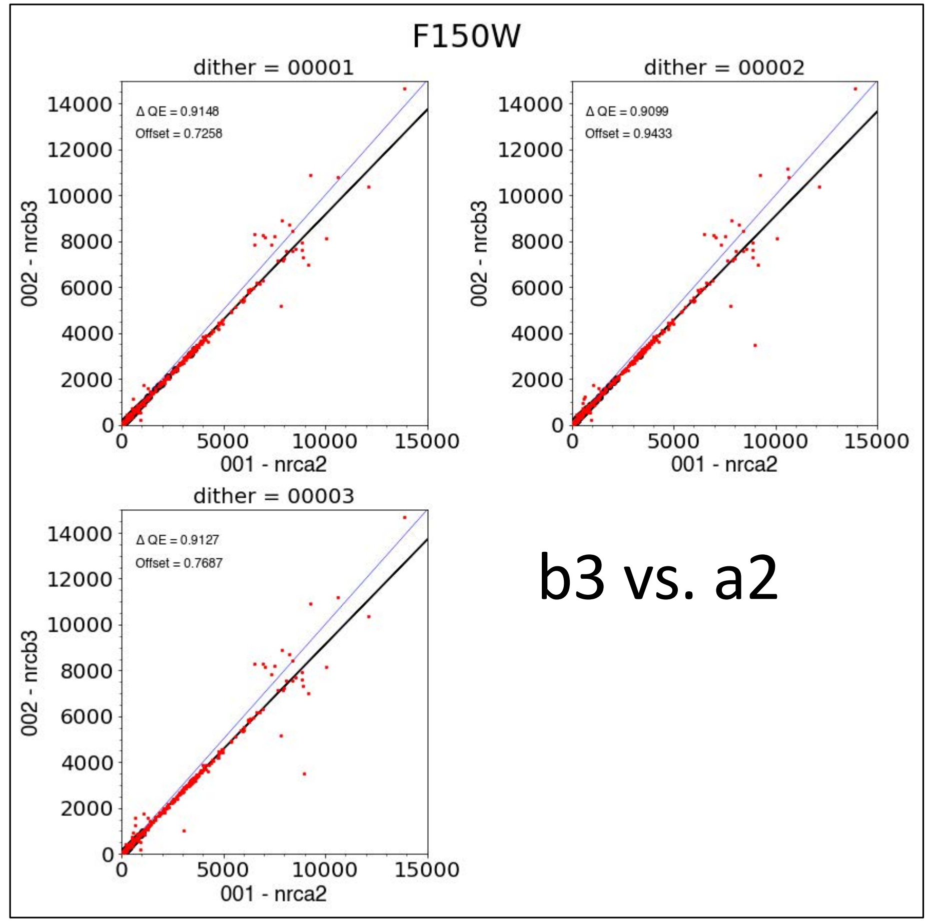


M. Correnti

Imaging Analysis by: M. Rieke, M. Correnti, B. Sunnquist, M. Gennaro, J. Stansberry, A. Rest, T. Sohn, V. Platais, E. Egami, M. Correnti, B. Hilbert, A. Canipe, B. Sunnquist J. Leisenring, C. Willmer, J. Girard, B. Brooks, A. Koekemoer, M. Robberto, K. Hainline, K. Misselt, E. Schlawin, and others

SCA-to-SCA response



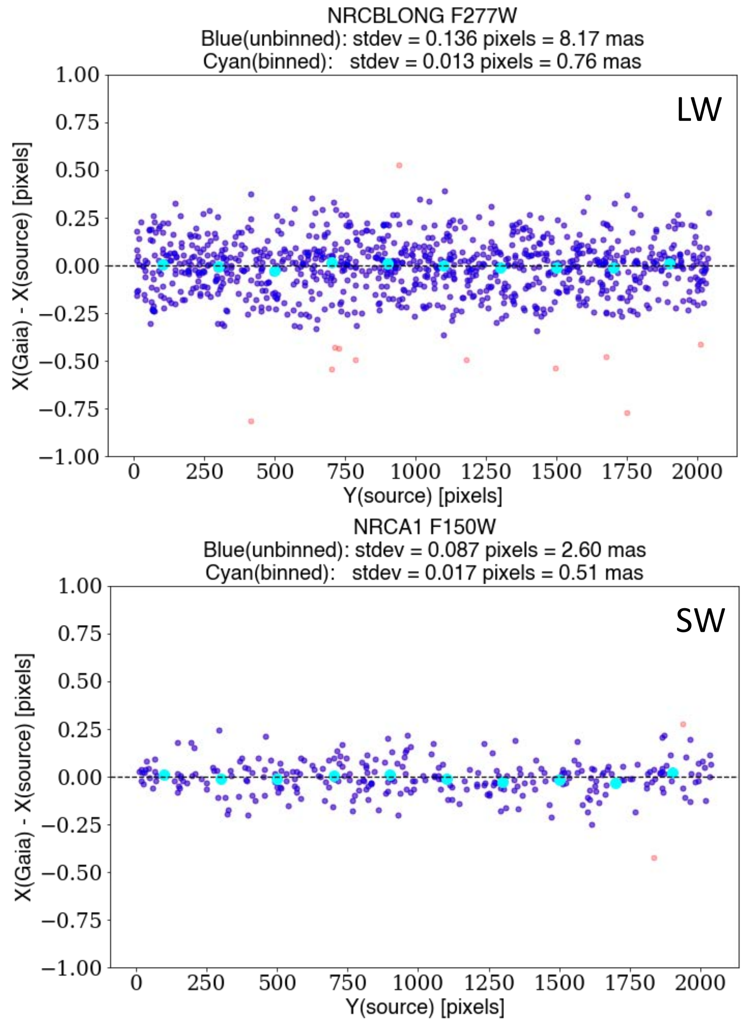


Astrometry

✶ Imaging
WFSS
Time Series
Coronagraphy

Field Distortion is Excellent

- Standard deviation of residuals wrt Gaia typically 0.08 – 0.15 pixels **(2-8 mas)**
- Standard deviation of binned residuals wrt Gaia typically 0.015-0.025 pixels **(0.4-1 mas)**
- For B2, B3, B4: residual systematic pixel scale change (0.15 pixels, 4.5 mas)

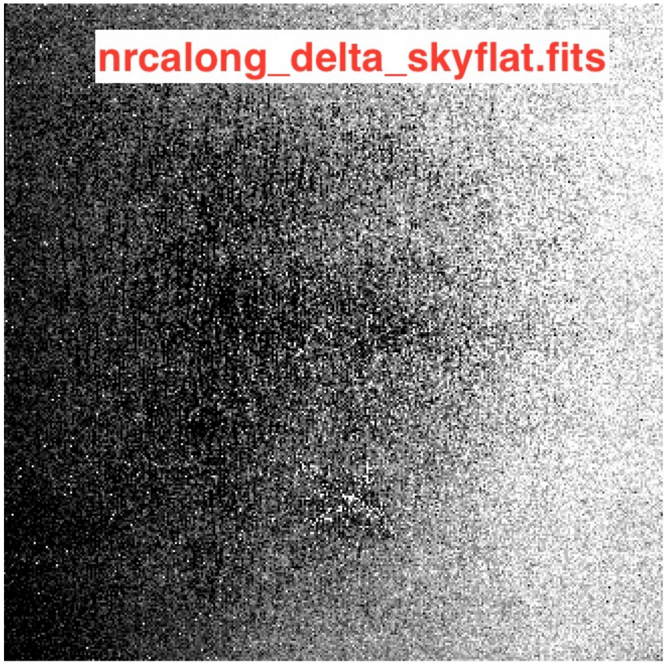


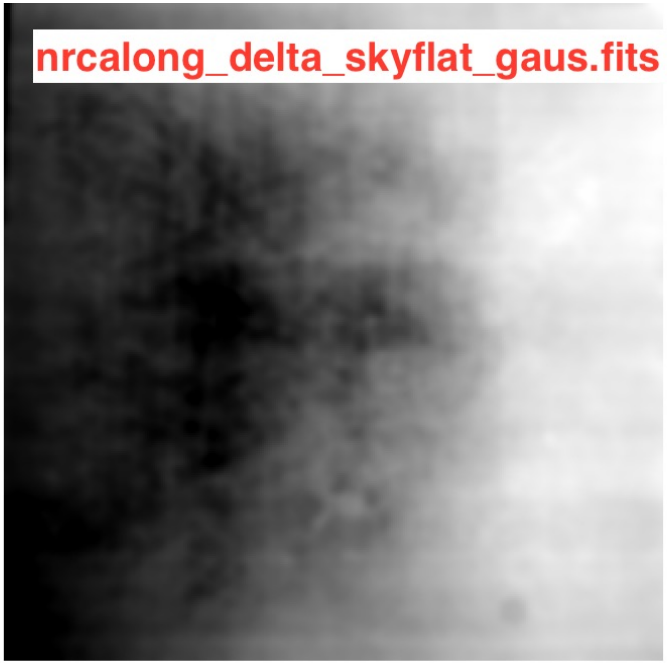
Absolute Astrometry in progress

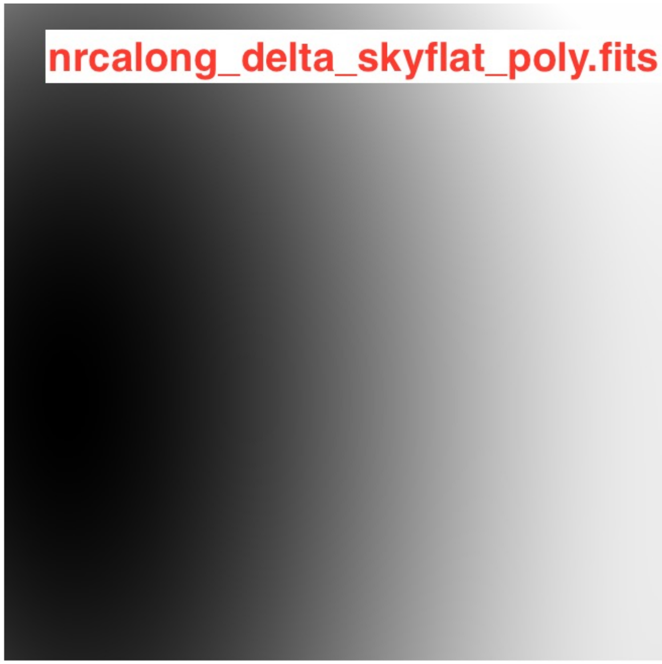
- Pipeline (assign_wcs) uses alignment info from both PRD/SIAF and CRDS. Refinements needed.

Analysis by A. Rest, T. Sohn, V. Platais, E. Egami, M. Correnti, B. Hilbert, A. Canipe, B. Sunnquist J. Leisenring, C. Willmer, and J. Girard

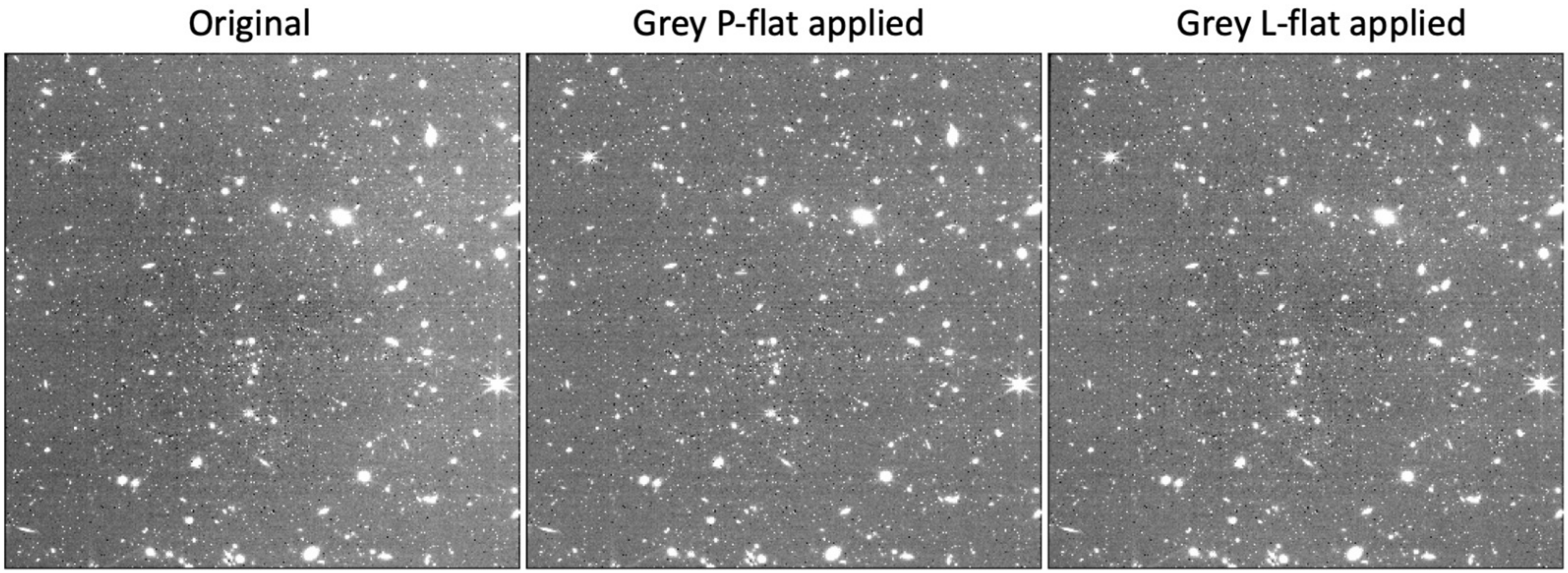
Flat Fields

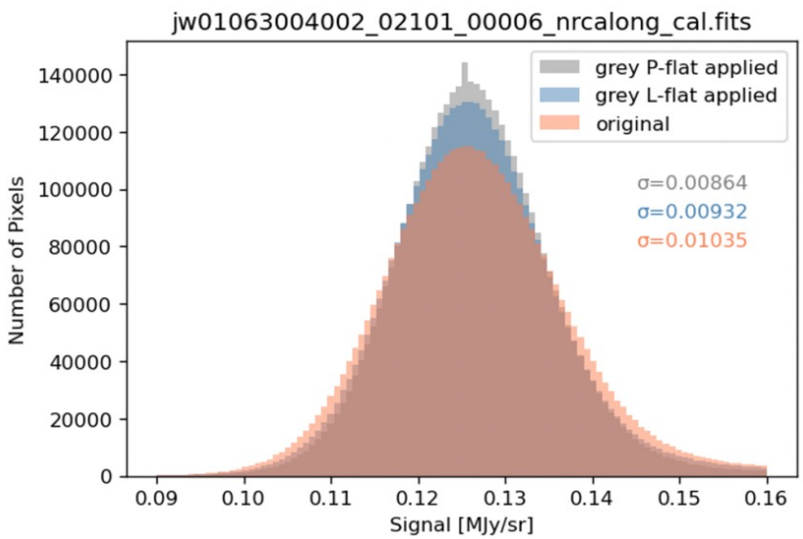






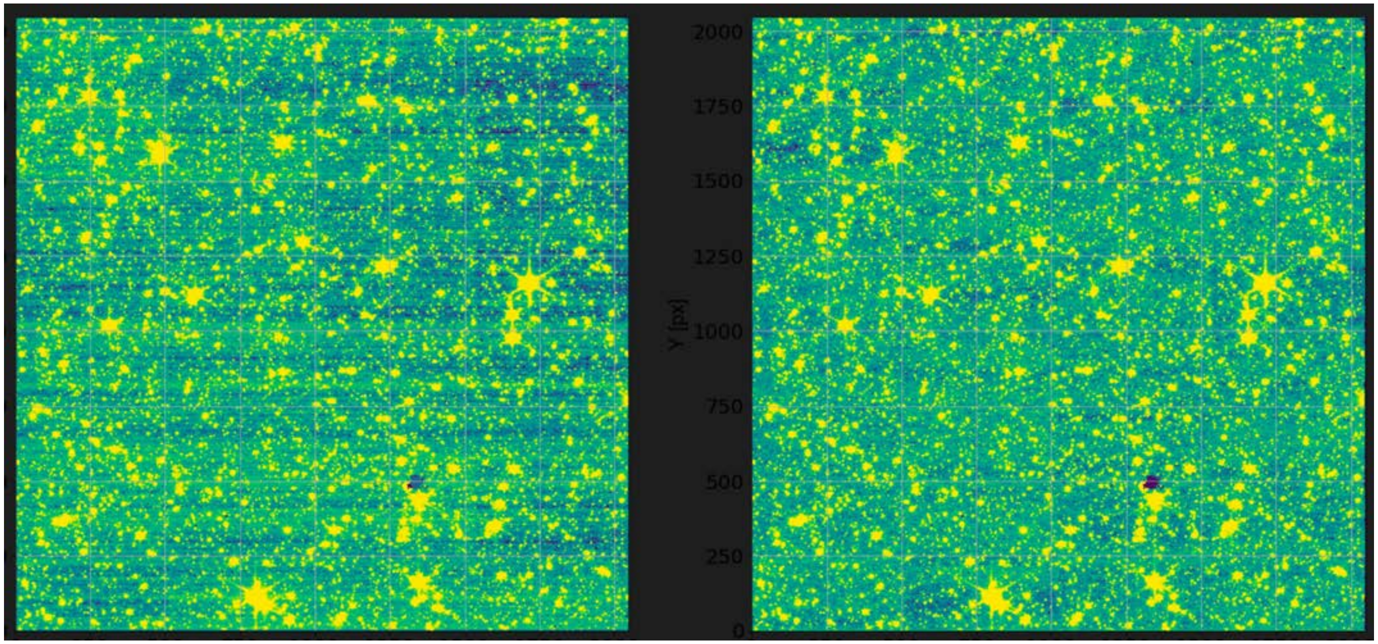
Testing various smoothing/masking strategies to avoid scattered light (e.g. wisps), striping, outlier, etc. effects while still capturing as much flat field variation as possible in the new reference files.





Running these new reference files through the JWST pipeline, and measuring image quality and photometric improvement.

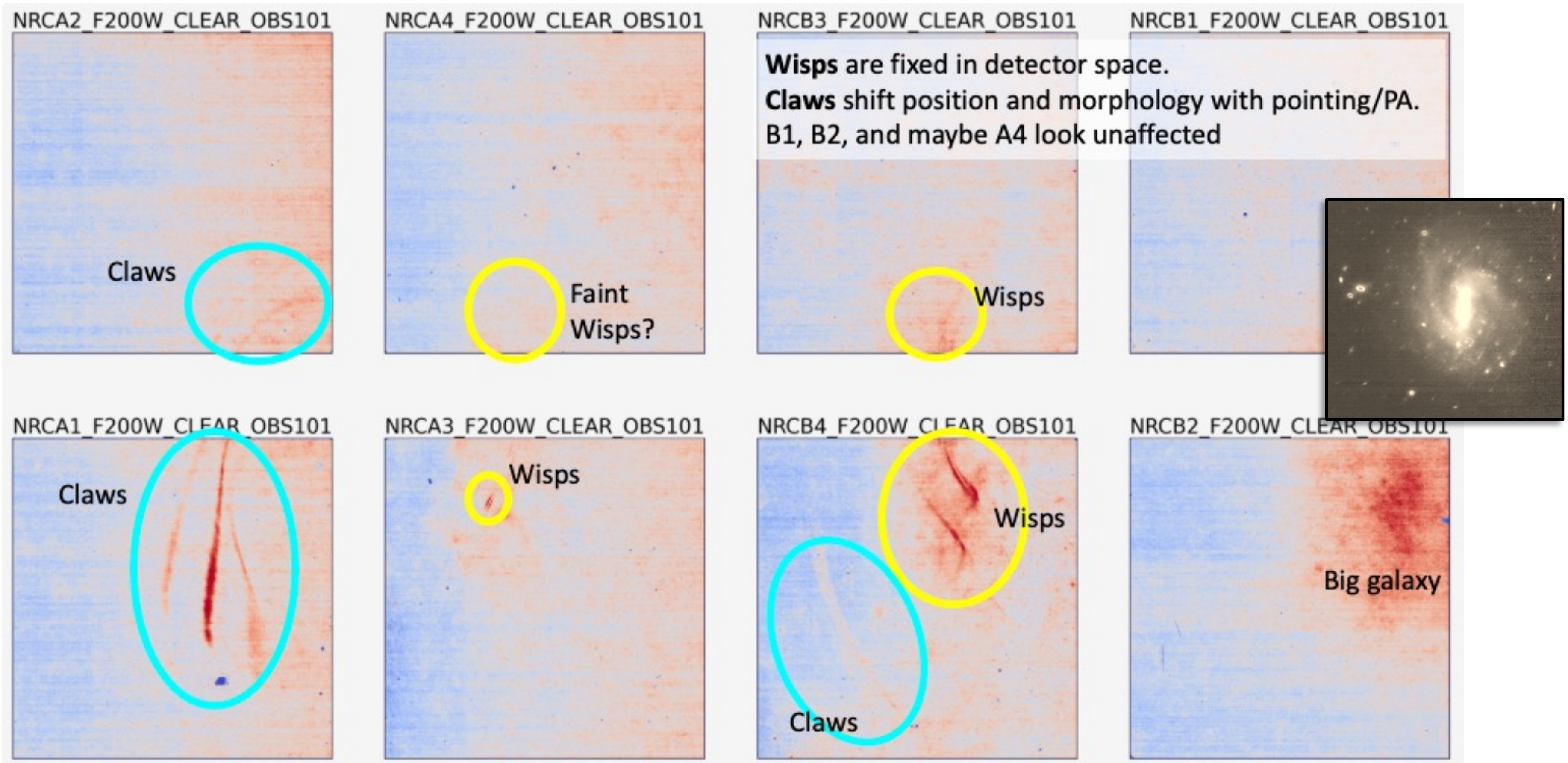
Horizontal stripes and 1/f noise correction



Various filtering algorithms being developed and tested. In progress

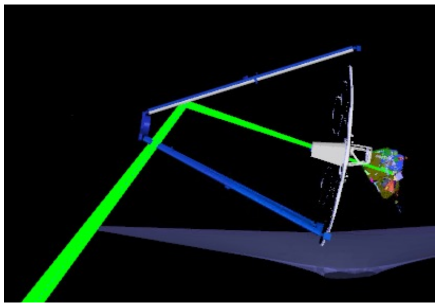
Very rare features: Claws & Wisps

✶ Imaging
WFSS
Time Series
Coronagraphy

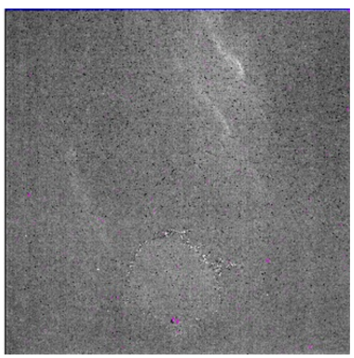


Claw & wisp analysis: Mario Gennaro, Ben Sunnquist, Martha Boyer, Marcia Rieke, John Stansberry, Christopher Willmer

Claws and Wisps mitigation strategies



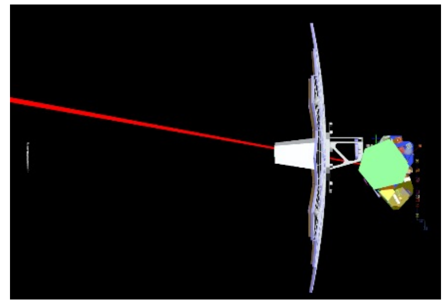
Wisps result from off-axis light bouncing off the top secondary mirror support and entering into the aft-optics-system (AOS) mask



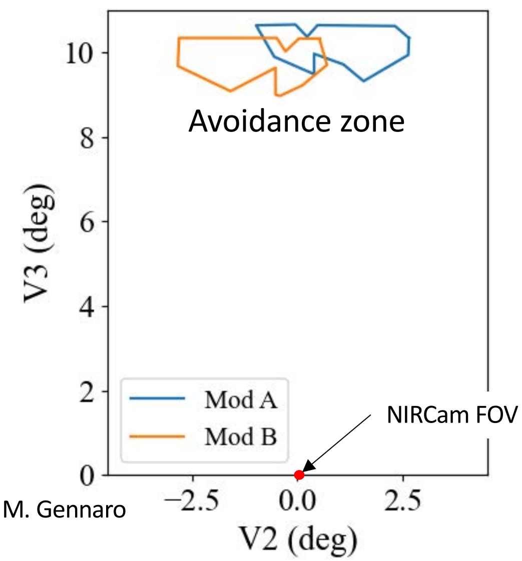
C Willmer

Wisps can be subtracted using a universal wisp template by scaling the strength to match the observed wisps

Optical modeling by Scott Rohrbach

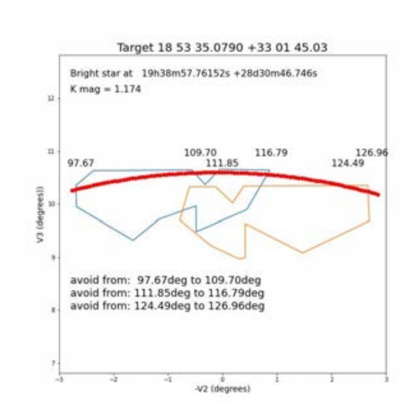


Claws are caused by a very bright source far from the NIRCam FOV, whose light enters directly into the AOS mask.

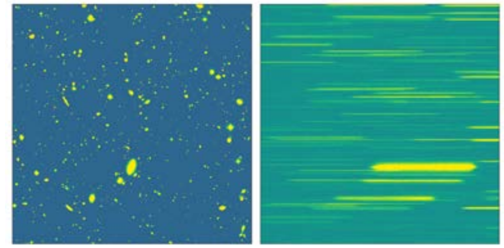


M. Gennaro

Claws can be prevented by avoiding placing very bright stars in an avoidance zone

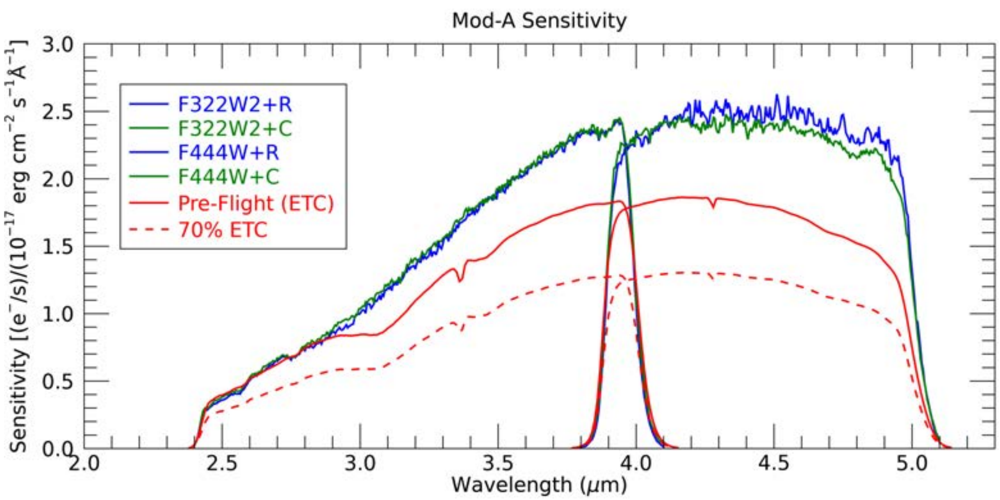


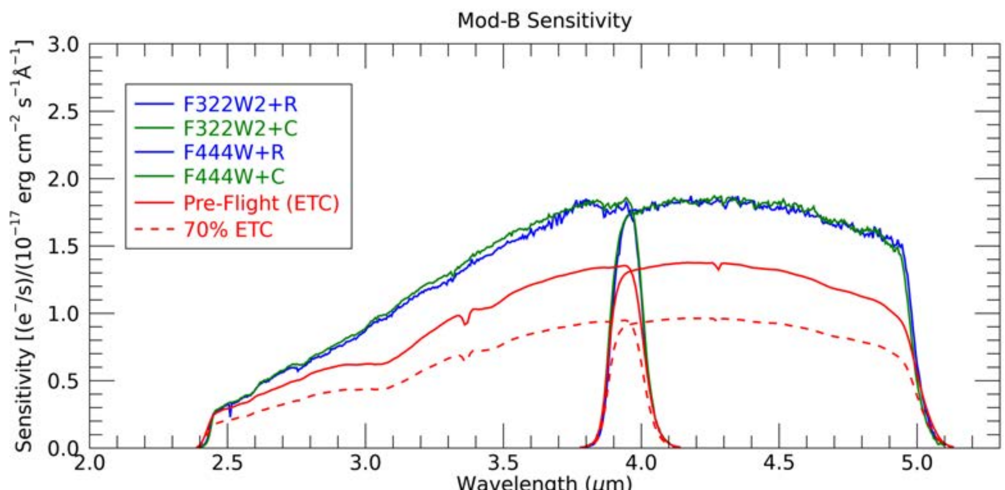
WFSS Sensitivity is Excellent



Imaging
✶ WFSS
Time Series
Coronagraphy

Measured sensitivities exceed the pre-flight ETC predictions by a significant margin





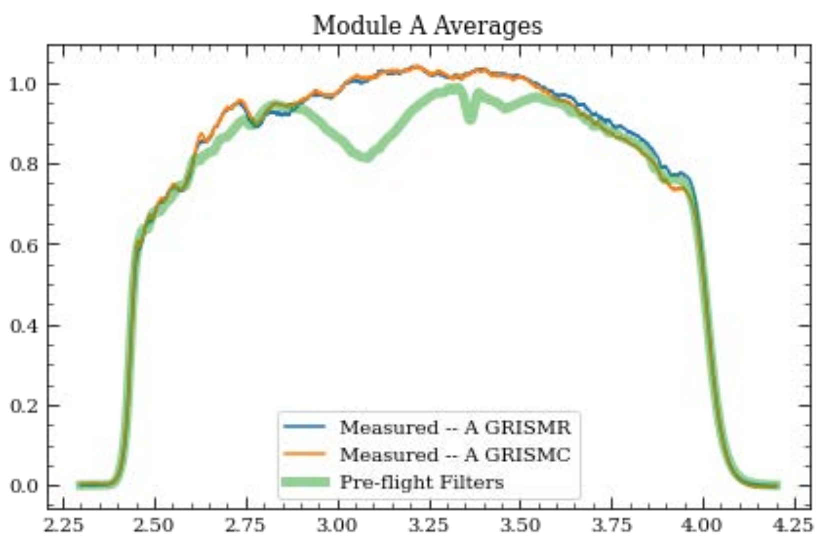
Eiichi Egami

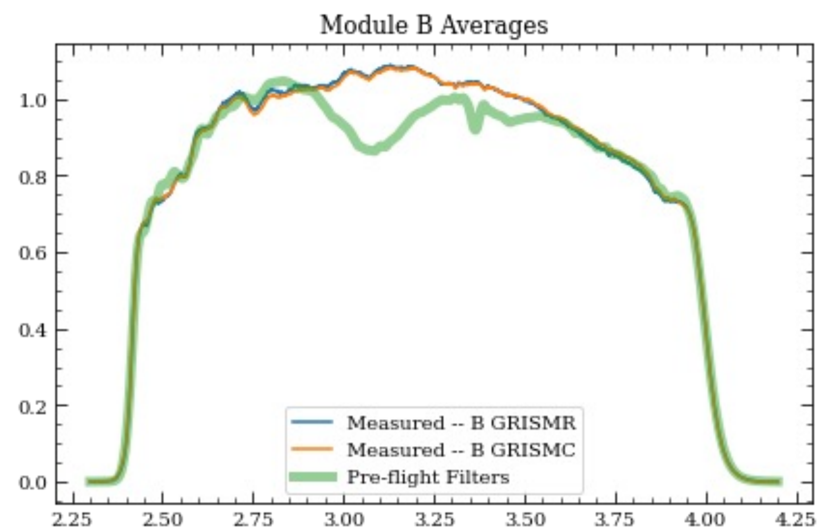
Measured NIRCam/Grism sensitivities are ~20-40% higher than the pre-flight ETC predictions for much of the 2.5-5 μm range and as much as ~50-60% higher in the red end.

WFSS Core Analysis Team: Eiichi Egami, Nor Pirzkal, Fengwu Sun, Jarron Leisenring, Everett Schlawin

Hunting for Ice with NIRCam

	Requirement	5-sigma upper limit
Water ice on the OTE	< 130 Å layer	< 35 Å layer
NVR in NIRCam	< 2800 Å layer	< 50 Å layer



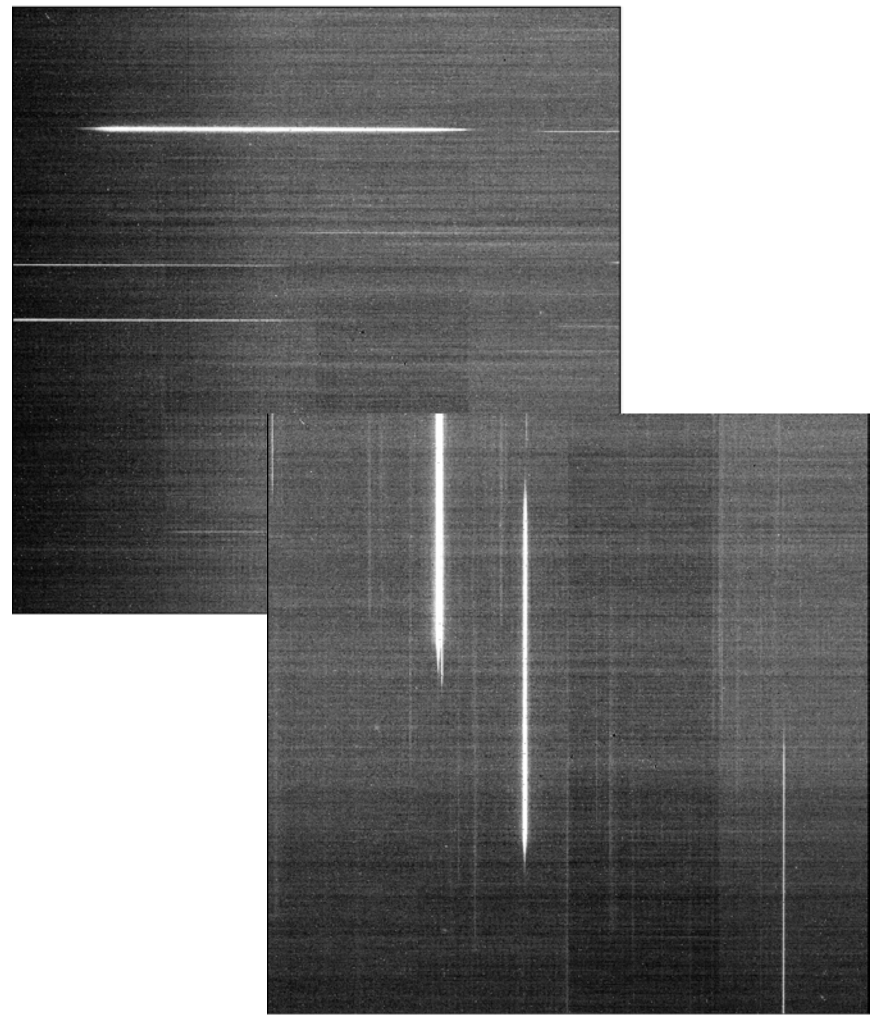


Analysis by Jarron Leisenring, Everett Schlawin, Nor Pirzkal, Tom Greene, Randy Kimble

NIRCam WFSS

- New field dependent WFSS files delivered
  - Based on module A/B Grism R/C Cross filters F444W/F322W2 traces and dispersions
  - Field dependence valid for a large fraction of the FOV (more observations needed to fully calibrate)
  - New sensitivities estimates.
- Out of Field Imaging dither offsets adjusted. Improved overlap between imaging and the WFSS observations.

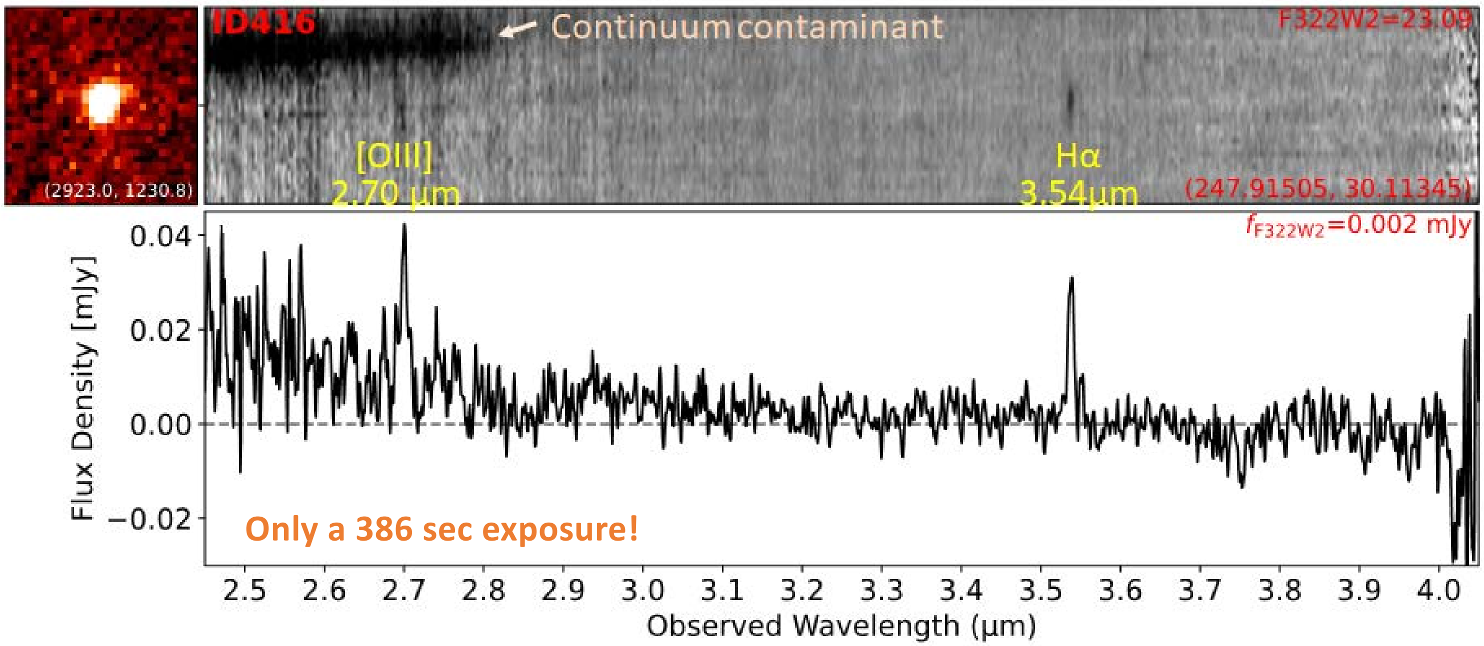
From Nor Pirzkal



Wide Field Slitless Surveying

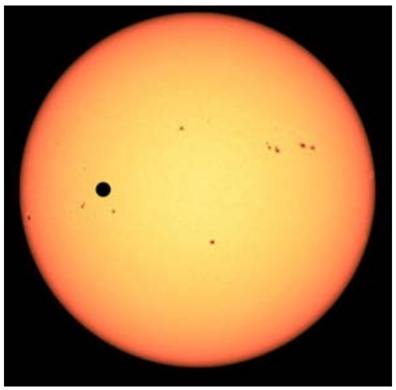
Imaging
✶ WFSS
Time Series
Coronagraphy

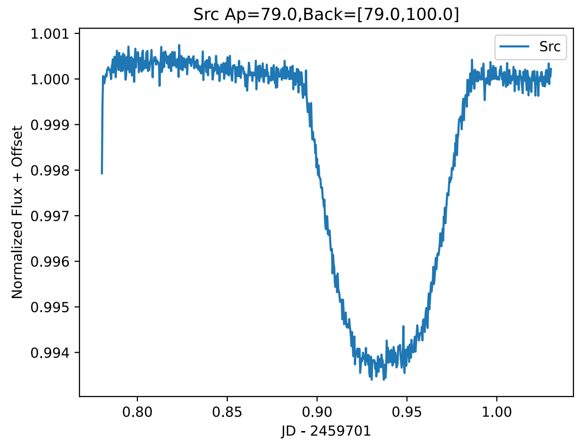
Serendipitous detection of a line-emitting galaxy at z=4.39



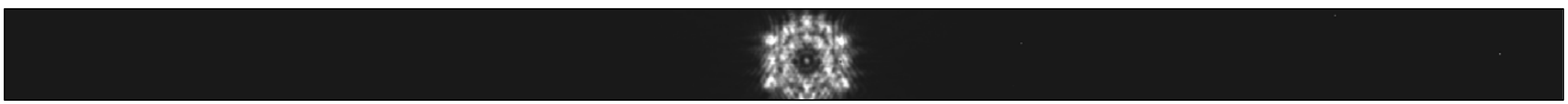
Fengwu Sun

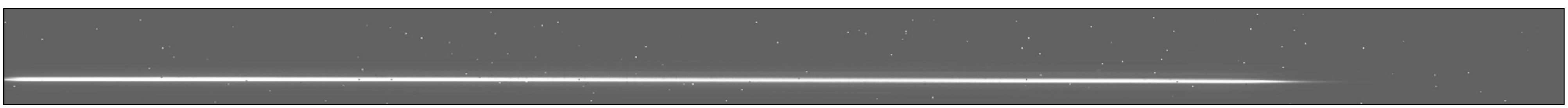
NIRCam Grism Time Series





- Mode uses a grism in the LW channel for a spectrum and a weak lens in the SW channel for monitoring
- Commissioning test observed a transit of HATP-14





Contributions from Thomas Beatty, Everett Schlawin, Nikolay Nikolov, Brian Brooks, Néstor Espinoza, Tom Greene, Marshall Perrin, Laurent Pueyo, Lee Feinberg, Jarron Leisenring, Alicia Canipe, Bryan Hilbert, Mario Gennaro, John Stansberry, Martha Boyer and others

Excellent Grism TS Performance

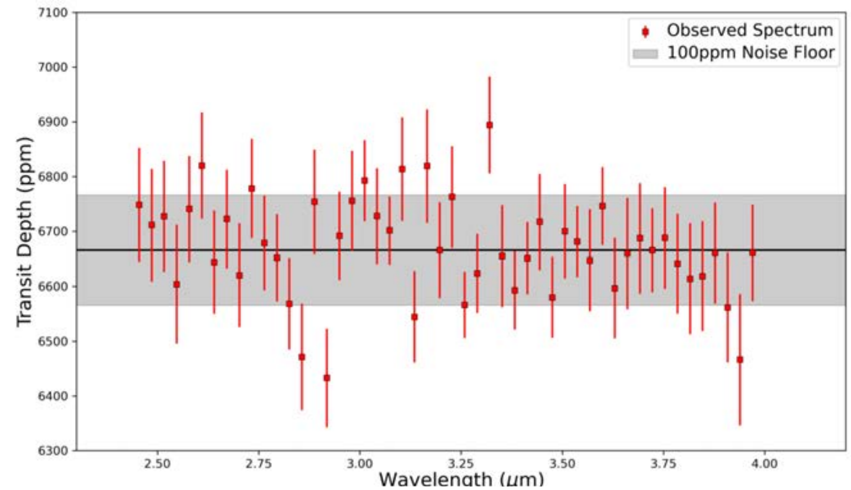
Noise Floor Requirement

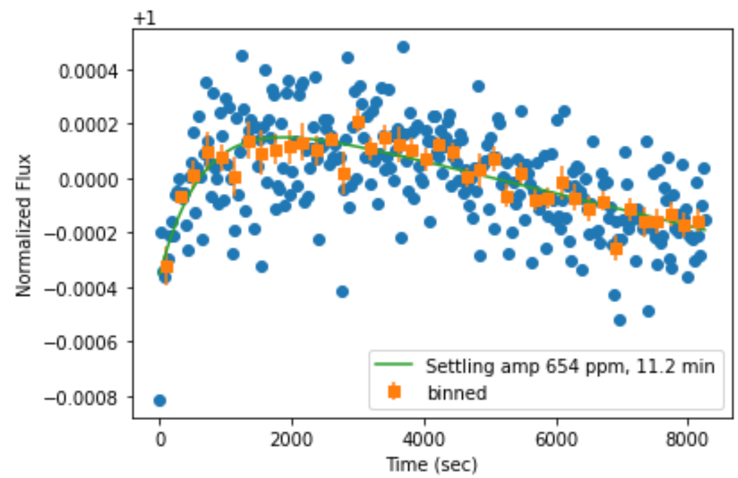
- Initial analysis gives a standard deviation of 91 ppm at R=100, below our 100 ppm requirement.

- The median transit depth is 6670 ppm, consistent with TESS's depth of 6520 +/- 170 ppm, expected to be constant across all wavelengths due to the planet's high surface gravity.

Settling

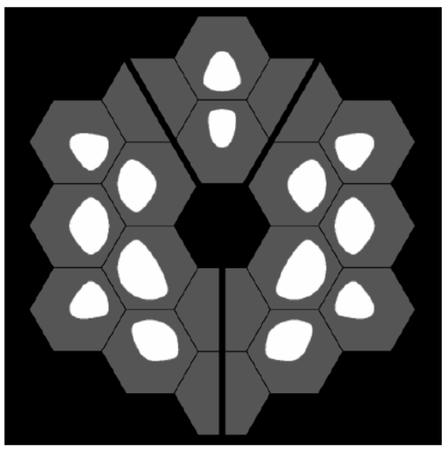
- The SW detector settling time is ~11min
- The LW detector settling time is near-instantaneous

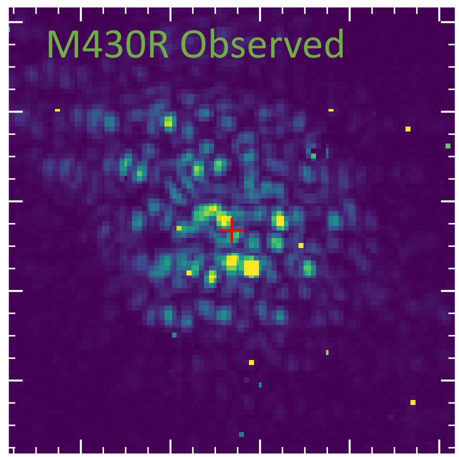




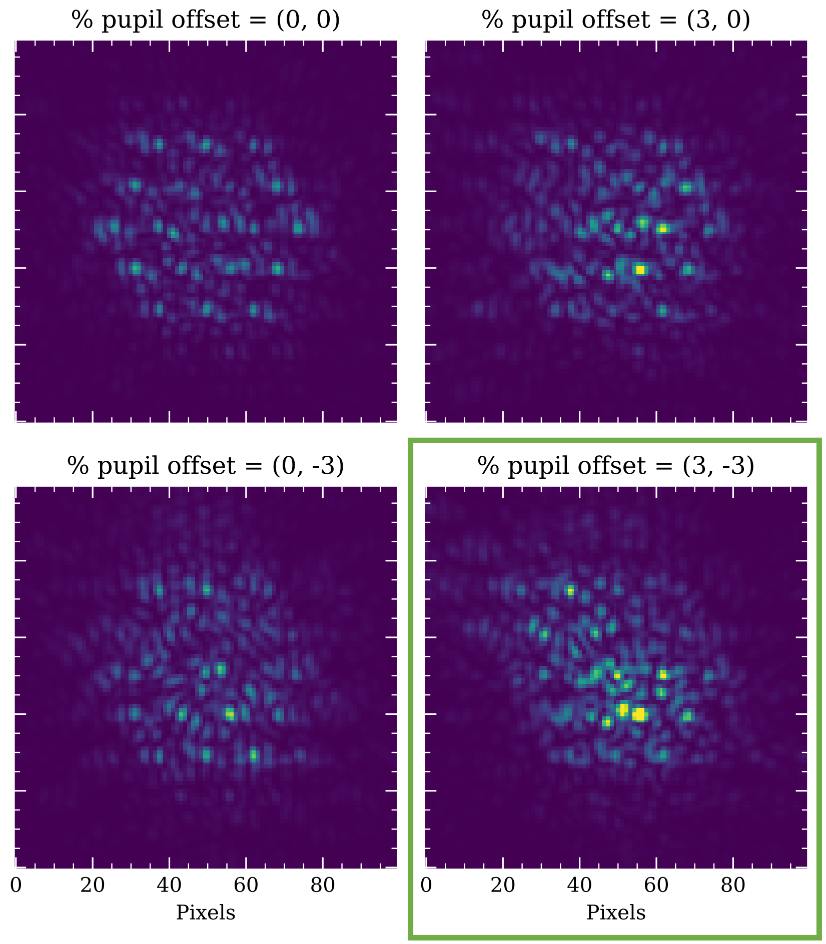
Figs. from Thomas Beatty

Coronagraph Pupil Shift





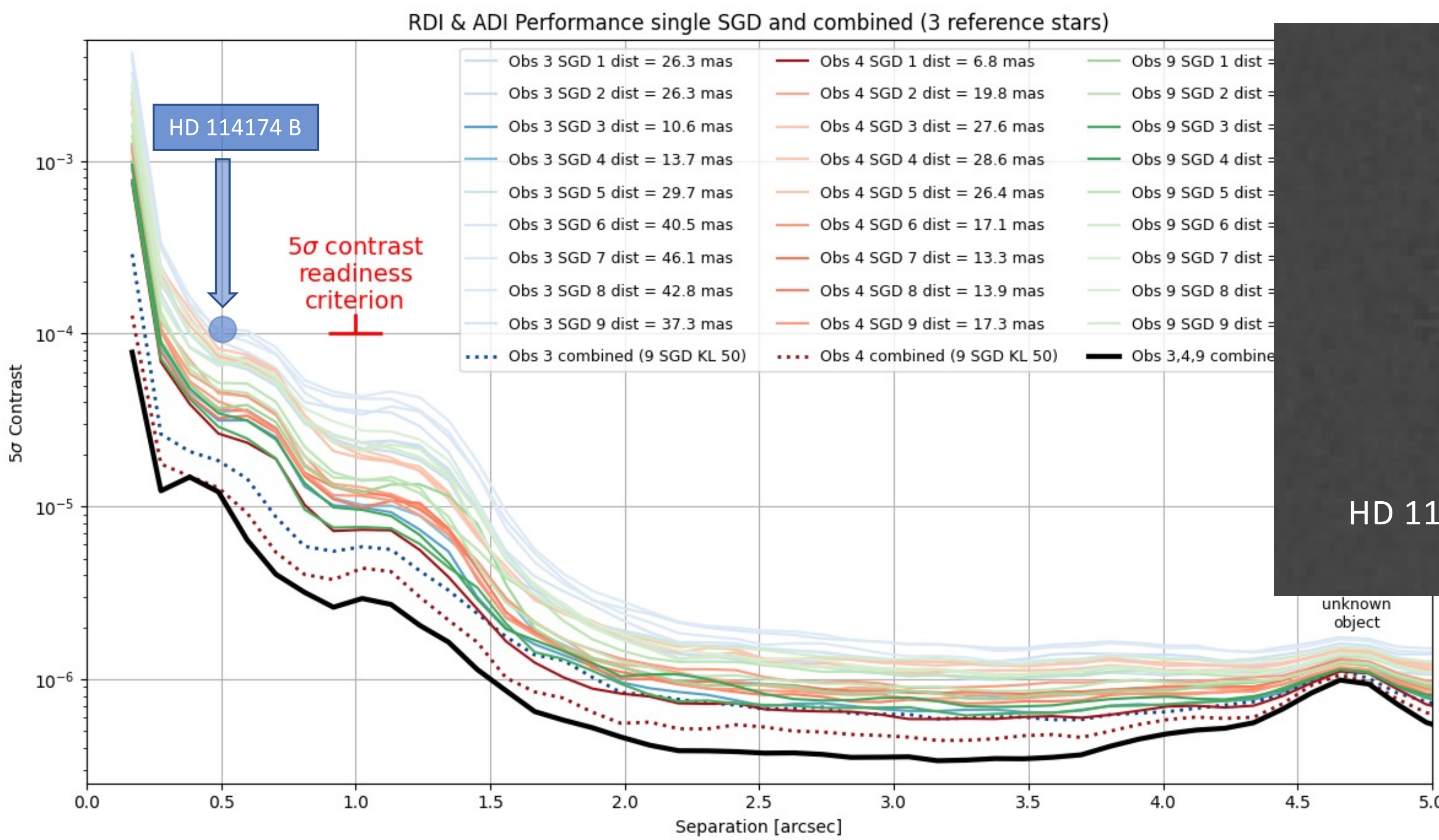
MASK430R / F430M

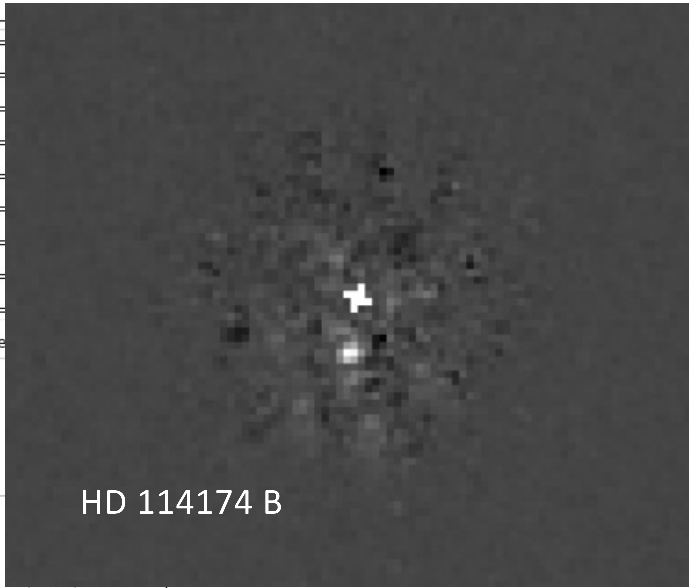


- Observed PSF reproduced w/ Lyot stop offsets in WebbPSF
- Direction corresponds to a ~3% Mod-A LW pupil wheel offset

Jarron Leisenring, Julien Girard, Armin Rest, Mario Gennaro, Bryan Hilbert, Doug Kelly

Contrast Performance is Excellent





Jens Kammerer
Julien Girard
Jarron Leisenring

Summary

1) All NIRCam modes exceed requirements

2) Commissioning data being analyzed, e.g.
- Absolute astrometry
- Absolute photometry/zero points
- Flat fields
- Detector features
- Reference files & pipeline

3) PIs may be contacted as needed regarding
- Increased sensitivity => saturation
- possible presence of scattered light
- WFSS geometry