



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

Instrument status: NIRSpec

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NIRSpec overview

near-infrared spectroscopy with wavelength coverage 0.6 – 5.3 microns, resolving powers $\sim 100, 1000, 2700$, available in 4 modes

Mode	Target Type	Corresponding Aperture
Fixed slit spectroscopy	Single objects	0.2" x 3.2" slits (3) 0.4" x 3.65" slit
Bright Object Time Series	Exoplanet host stars	1.6" x 1.6" aperture
Integral-field spectroscopy	Moderately extended objects	3.0" x 3.0" IFU with 0.1" square spaxels
Multi-object spectroscopy (MOS)	Rich fields or extended objects	Selectable from $\sim 250,000$ 0.2" x 0.46" micro-shutters

built for ESA by Airbus Defense and Space, with microshutter assembly (MSA) and detector subsystem provided by NASA/GSFC





The Team

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team merging over the next few months

and many others in Europe, GSFC, & STScI

A deep space photograph showing a vast field of stars and a prominent blue nebula. The nebula has a complex, filamentary structure with various shades of blue and purple. The stars are scattered throughout the field, with some appearing as bright, multi-pointed sources. The overall scene is a rich, multi-colored stellar environment.

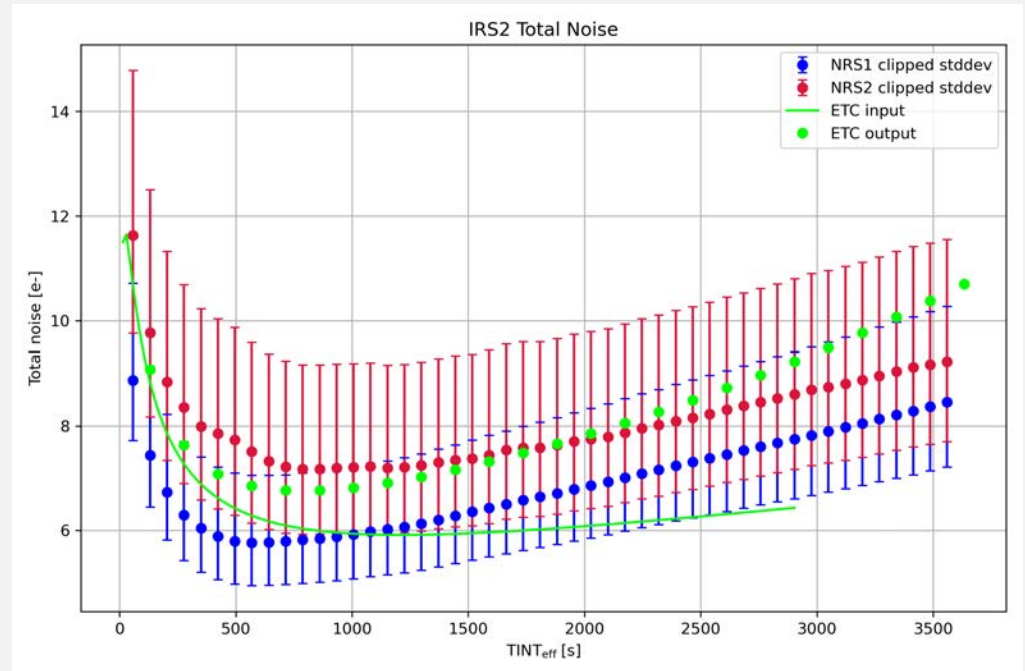
Post-Commissioning Status



Detector performance

NIRSpec is generally noise-limited

- total noise is consistent with if not slightly better than expectations
- significant increase in “snowball” events compared to the ground, but these can be at least partially corrected in the pipeline
 - new algorithm enhancements are already being evaluated



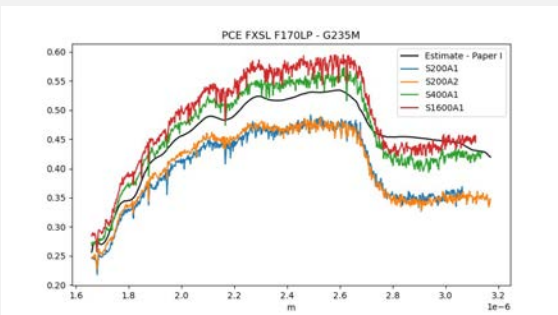
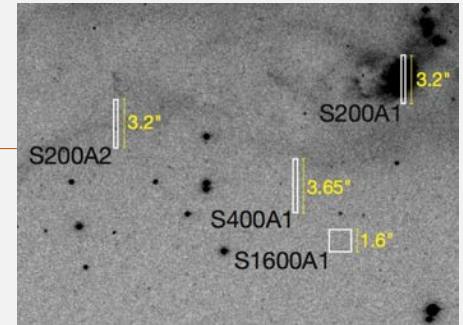
analysis by Stephan Birkmann



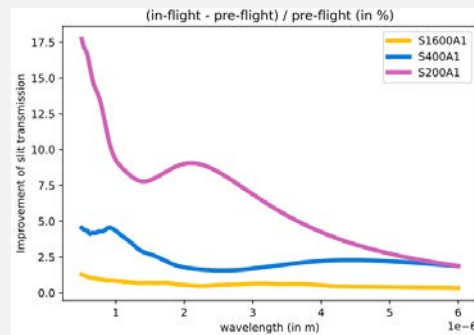
Fixed Slit Spectroscopy

5 high-contrast slits for single-object observations

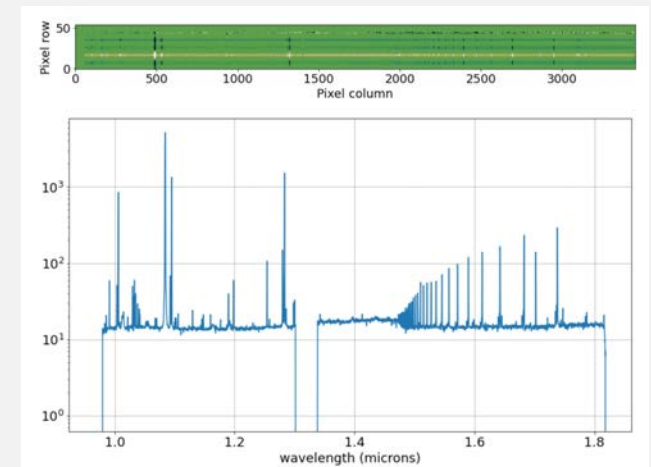
- throughput generally exceeds predictions
- telescope performance leads to improved slit transmission, esp. in the blue



pixel conversion efficiency for one disperser, all slits (not including slit loss)
(P. Ferruit)



comparison of modeled slit transmission using pre-flight and actual WFE (P. Ferruit)



Commissioning observation of unresolved PN (combination of 3 subtracted nods)



Wide-Aperture Target Acquisition (WATA)

TA using a single reference star with the S1600A1 slit

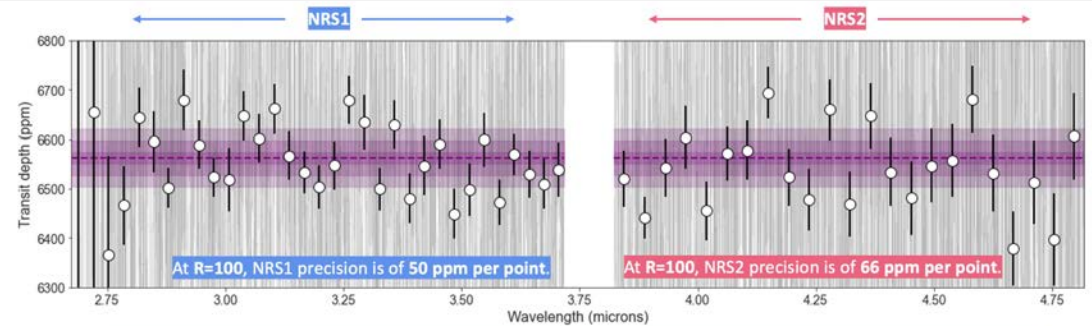
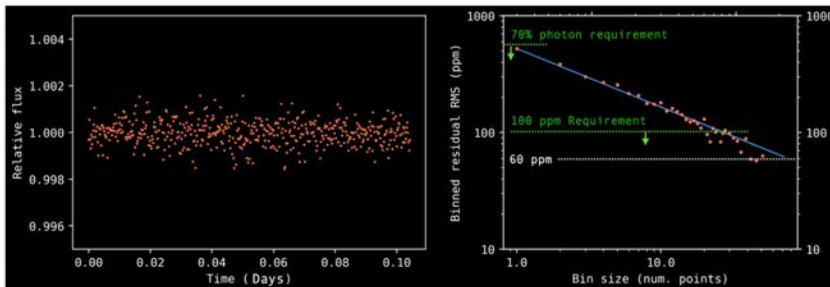
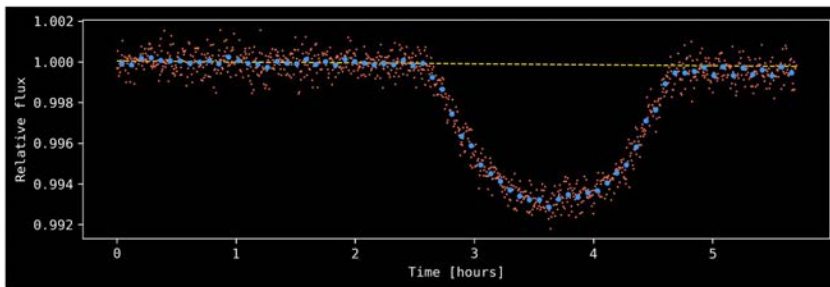
- multiple successful attempts during Commissioning, including WATA+FS, IFU, and MOS
- positioning accuracy significantly better than 20 mas
- given the superb telescope fine pointing accuracy, WATA will not be necessary for many IFU programs



Bright Object Time Series Spectroscopy

TSO using the S1600A1 aperture

- excellent stability and noise level demonstrated during Commissioning
- 3 BOTS cycle 1 visits executed so far



Combined NRS1 and NRS2 broadband transit depth: 6563 +/- 12 ppm
(6539 +/- 7 ppm if using weighted average)

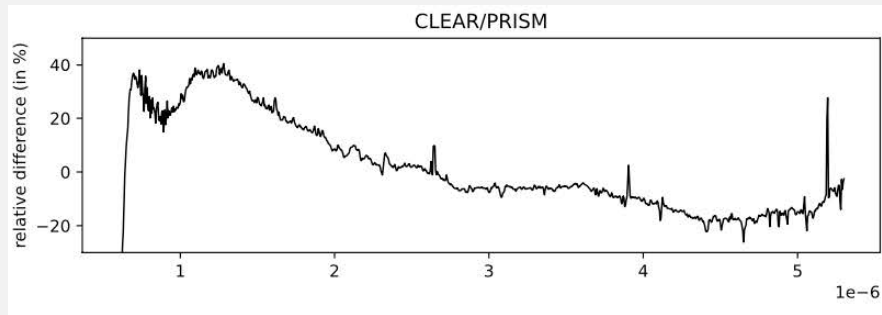
results from Commissioning obs of HAT-P-14b,
by N. Espinoza, Z. Rustamkulov, D. Sing, L. Ubeda
(P. Ferruit)



Integral Field Spectroscopy

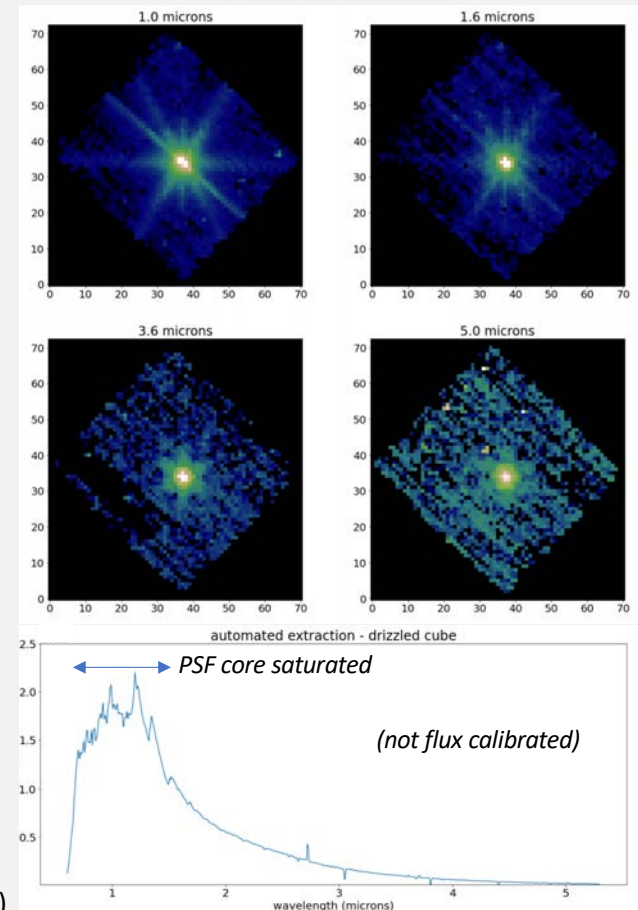
imaging spectroscopy of extended sources within a 3"x3" aperture

- throughput ~20-40% larger than predicted in the blue, ~10-20% lower in the red (mostly diffraction losses)



- pointing offset of ~0.2" along slices
 - adding new cycle 1 calibration observation to update astrometry

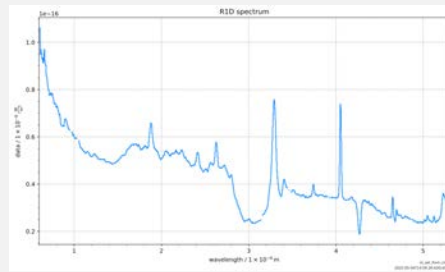
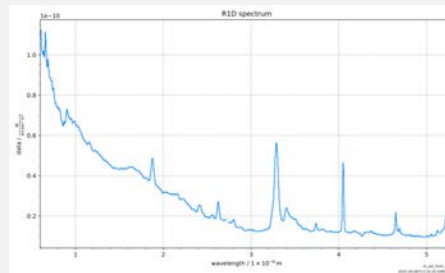
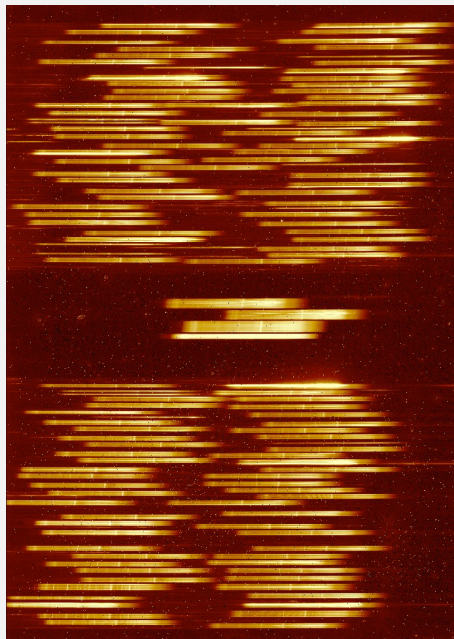
early Commissioning observation of an isolated bright star (combination of 4 unsubtracted nods)





Multi-object Spectroscopy

high complexity end-to-end, requiring accurate planning, good telescope pointing performance, metadata bookkeeping, and detailed calibration in order to deliver quality science products



part of full-frame NRS1 image and 2 example (uncalibrated) 1D extractions from Commissioning test obs near Galactic center (total of 235 1x3 shutter slitlets) (*P. Ferruit*)



Multi-object Spectroscopy

MSA shutter operability

- evolution post-launch consistent with expectations
 - allows multiplexing of up to ~200 targets per configuration with PRISM, ~60 with gratings
- masked shorts now the largest contributor
- will be closely monitoring throughout cycle 1, with biweekly operability checks
- FOT automated procedure for telemetry monitoring of strong electrical shorts, will also be checking for evidence of “optical” shorts as part of our quick look data analysis

Table 2: Net MSA Shutter Statistics

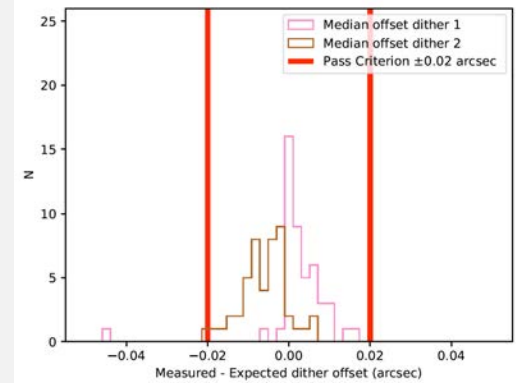
Shutter State	CV3	%	OTIS	%	Flight	%
Functional	193860	77.6	192065	76.9	188285	75.4
Failed Closed	17746	7.1	13425	5.4	14941	6.0
Masked Out	14330	5.7	20447	8.2	22709	9.1
Vignetted	23705	9.5	23705	9.5	23705	9.5
Failed Open	19		18		20	



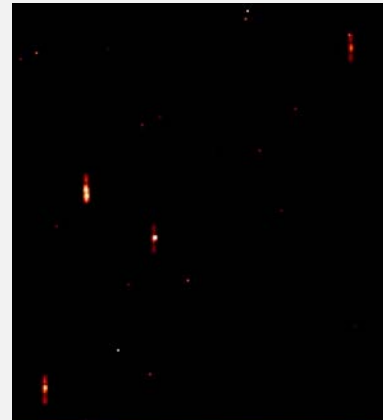
Multi-object Spectroscopy

MSA Target Acquisition (MSATA)

- after a few iterations, achieved excellent performance during Commissioning tests
 - critically depends on a well-vetted set of TA reference stars
 - must have good absolute and better relative astrometry of both science targets and reference stars
 - communicating with MOS observers to clarify requirements
 - extensive IS reviews of final MOS plans upon submission
- 3 successful instances of MSATA post-Commissioning, including 1 GTO and 2 GO programs; no failures
 - performance being analyzed
 - developing a TA monitoring tool as part of JWQL



Commissioning positioning accuracy
(P. Ferruit)



portion of TA confirmation
image from ERO obs



To Do

Observing liens

- observations with integrations using Ngroups = 2 are sensitive to saturation
 - communicating with affected observers
- loss of detector temperature control possible if WATA fails
 - could lead to lower data quality for subsequent exposures
 - ISIM FSW patch will allow detector mode switching
 - currently inserting short dark after each WATA instance -> invisible to users
- IFU pointing offset
 - programs requiring precise pointing delayed until astrometry is updated

Cycle 1 data monitoring & calibration

- quick look data quality checks & performance trending using JWQL tool
 - critical for monitoring shorts
- transfer/convert ESA Commissioning CAP scripts to use for cycle 1 calibration analysis & creation of new reference files