NIRSpec overview

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

<table>
<thead>
<tr>
<th>Mode</th>
<th>Target Type</th>
<th>Corresponding Aperture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed slit spectroscopy</td>
<td>Single objects</td>
<td>0.2” x 3.2” slits (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4” x 3.65” slit</td>
</tr>
<tr>
<td>Bright Object Time Series</td>
<td>Exoplanet host stars</td>
<td>1.6” x 1.6” aperture</td>
</tr>
<tr>
<td>Integral-field spectroscopy</td>
<td>Moderately extended objects</td>
<td>3.0” x 3.0” IFU with 0.1” square spaxels</td>
</tr>
<tr>
<td>Multi-object spectroscopy (MOS)</td>
<td>Rich fields or extended objects</td>
<td>Selectable from ~250,000 0.2” x 0.46” micro-shutters</td>
</tr>
</tbody>
</table>

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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Glenn Wahlgren  
Emily Wislowski

**ESA IDT**
Pierre Ferruit (**ESA JWST project scientist**)  
Giovanna Giardino

**(red: commissioning leads)**

and many others in Europe, GSFC, & STScI

*team merging over the next few months*
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

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>
<thead>
<tr>
<th>Shutter State</th>
<th>CV3</th>
<th>%</th>
<th>OTIS %</th>
<th>Flight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional</td>
<td>193860</td>
<td>77.6</td>
<td>192065</td>
<td>76.9</td>
</tr>
<tr>
<td>Failed Closed</td>
<td>17746</td>
<td>7.1</td>
<td>13425</td>
<td>5.4</td>
</tr>
<tr>
<td>Masked Out</td>
<td>14330</td>
<td>5.7</td>
<td>20447</td>
<td>8.2</td>
</tr>
<tr>
<td>Vignetted</td>
<td>23705</td>
<td>9.5</td>
<td>23705</td>
<td>9.5</td>
</tr>
<tr>
<td>Failed Open</td>
<td>19</td>
<td>18</td>
<td>20</td>
<td>18</td>
</tr>
</tbody>
</table>
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)
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