



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

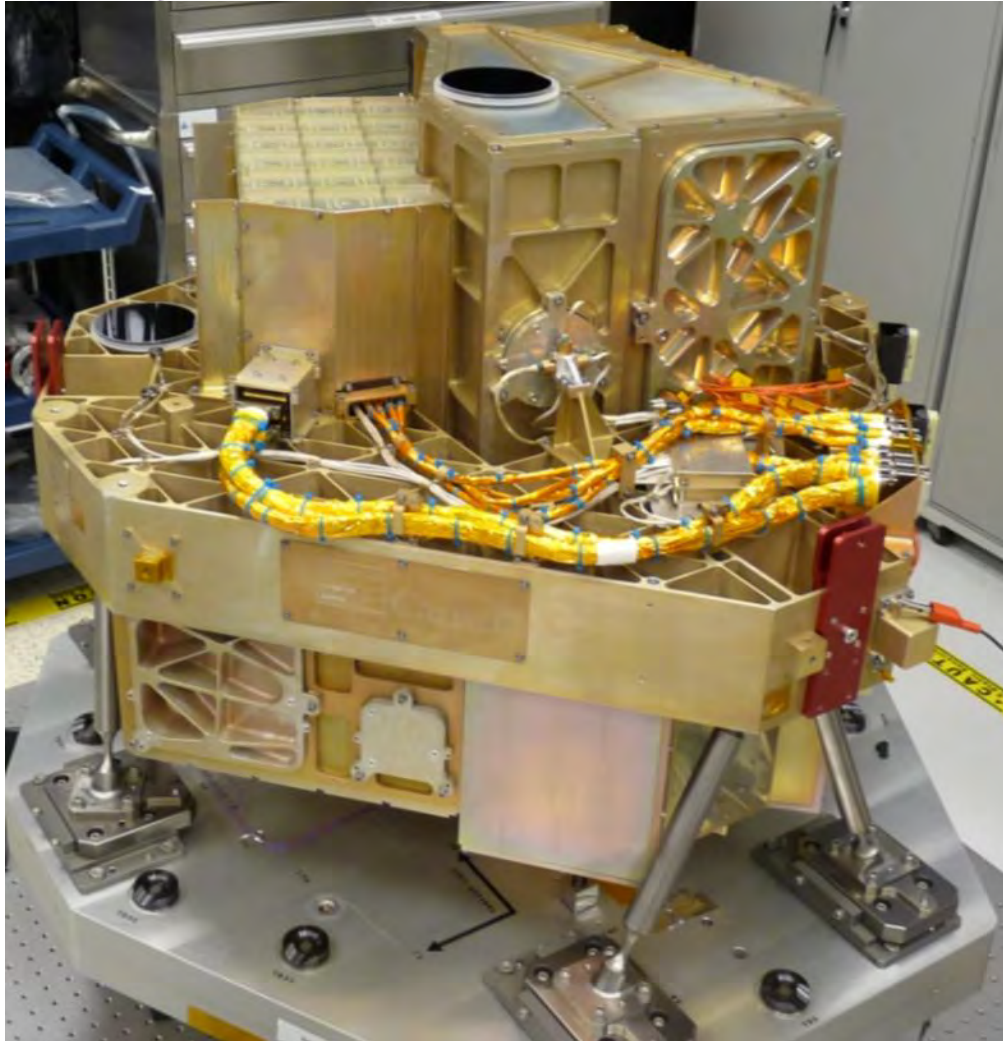
EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

Near Infrared Imager and Slitless Spectrograph (NIRISS)

Stephanie LaMassa

NIRISS Branch Manager

Canadian Space Agency Contribution to JWST



Developed / Provided By:
Canadian Space Agency



Principle Investigator:
Prof. René Doyon



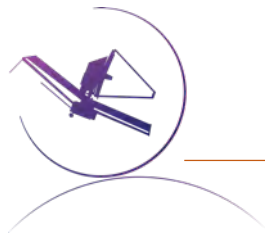
Prime Contractor:
Honeywell



Technical Development:
National Research Council
of Canada



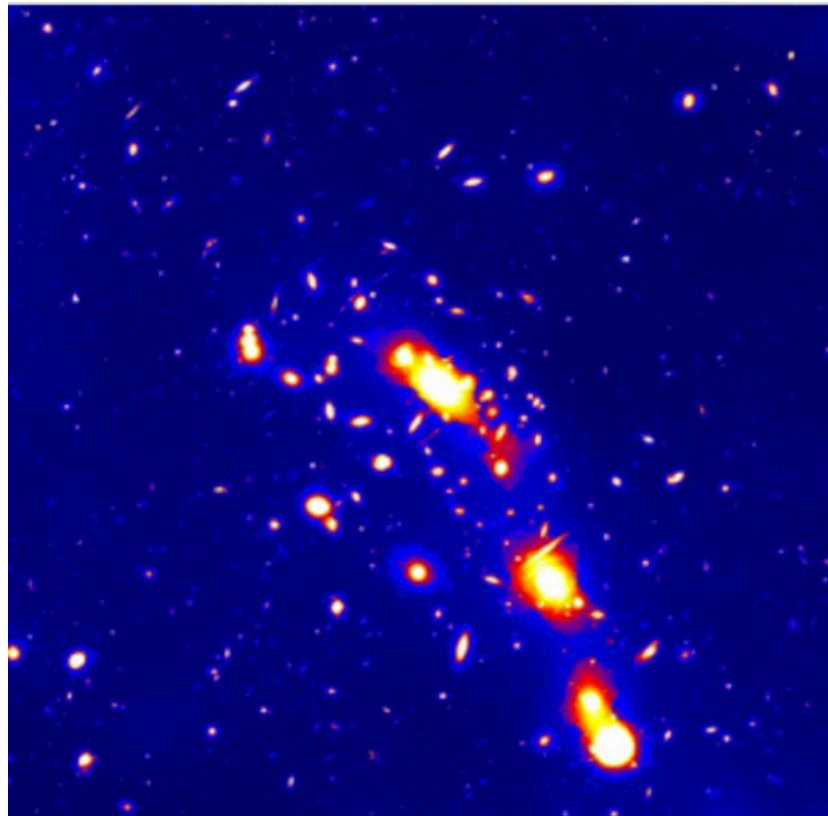
NIRISS is packaged with the Fine Guidance Sensor (FGS).
FGS is the camera used to acquire targets and guide
on them during observations. Purely functional.



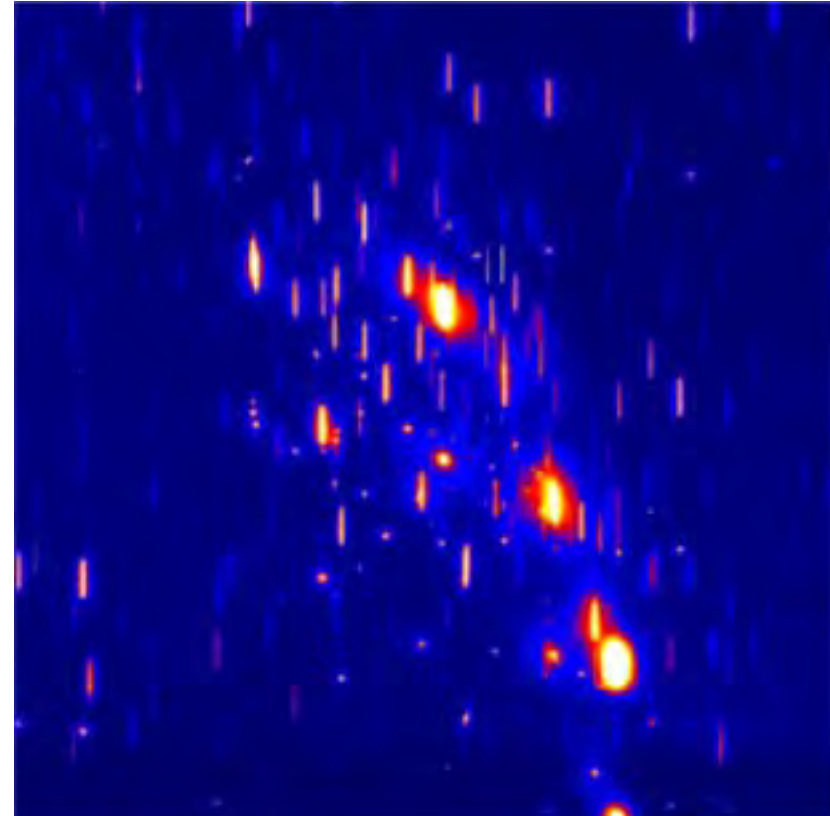
Wide Field Slitless Spectroscopy (WFSS)

- 0.8 – 2.2 μm
- $R \sim 150$

Direct Image



Spectral Image



simulations by Swara Ravindranath



Single Object Slitless Spectroscopy (SOSS)

- Time Series Observations mode
- 0.6 – 2.8 μm

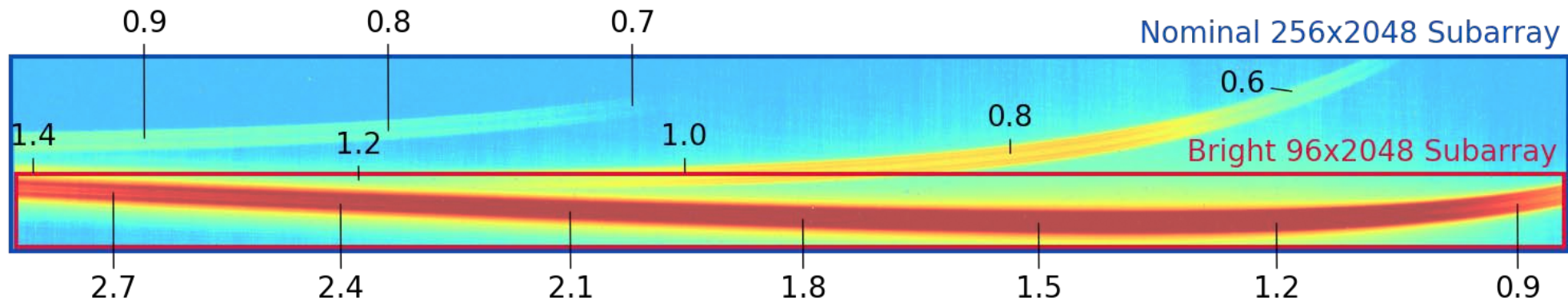
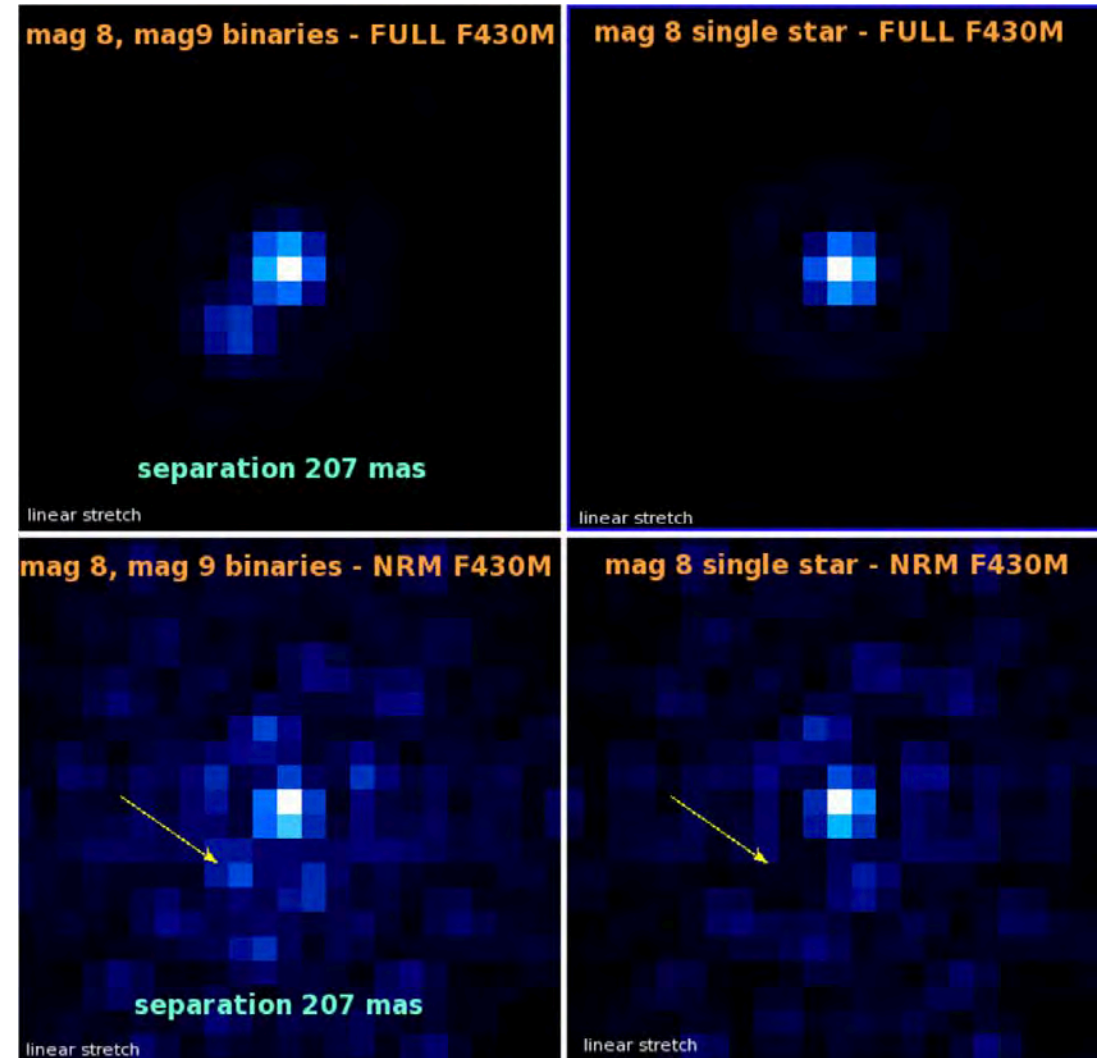


Figure credit Joe Filippazzo



Aperture Masking Interferometry (AMI)

- 2.8, 3.8, 4.3, 4.8 μm
- resolve separations of $\sim 70 - 400$ mas for contrast ratios of $\sim 10^{-4}$



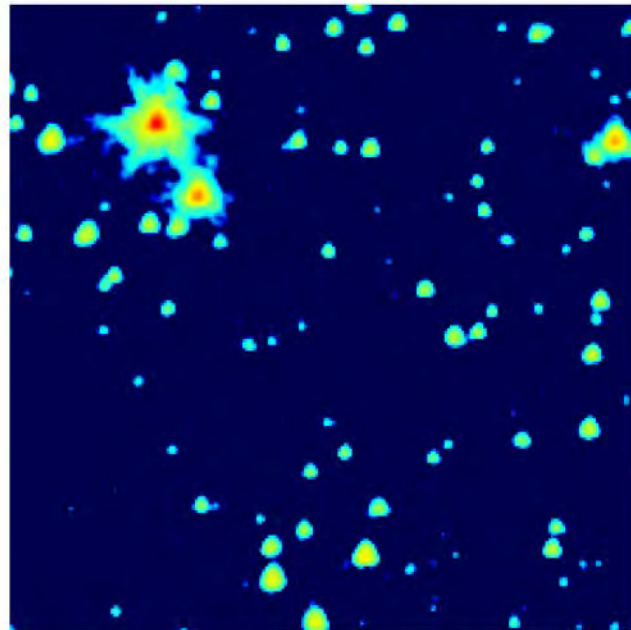
simulations by Deepashri Thatte & Anand Sivaramakrishnan



Imaging

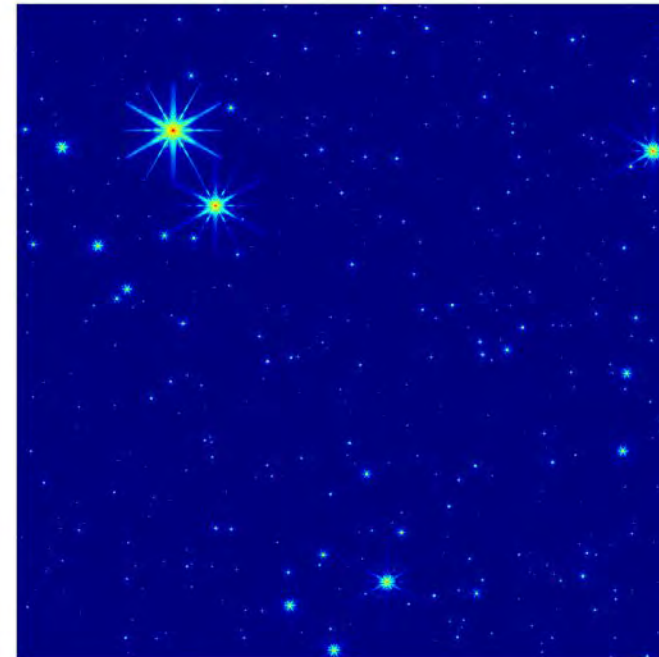
- 0.8 – 5.0 μm
- Direct imaging for WFSS
- Coordinated parallel to NIRCcam imaging
- Aim to support as prime mode for Cycles ≥ 2

Spitzer 3.6 μm



5 10 15 20 25
UKIDSS UDF Spitzer [3.6] Image

NIRISS F356W
























2000 4000 6000
Simulated NIRISS F356W Signal

simulations by Kevin Volk


















NIRISS@STScI Team

	 <p>Stephanie LaMassa PhD Astronomy JHU (2011)</p> <p>Branch Manager User Support Lead</p> 	 <p>Paul Goudfrooij PhD Astronomy U. Amsterdam (1994)</p> <p>Branch Deputy Ops/PPS Lead Commissioning Deputy</p>  		
 <p>Rachel Cooper BA Astronomy Vassar College (2017)</p> <p>AMI Reference Files</p>  	 <p>Néstor Espinoza PhD Astronomy PUC de Chile (2017)</p> <p>SOSS</p> <p>TSOWG Lead</p> 	 <p>Joe Filippazzo PhD Astronomy CUNY (2016)</p> <p>SOSS</p> <p>JWQL</p> 	 <p>André Martel PhD Astronomy UC Santa Cruz (1996)</p> <p>I&T Lead Commissioning Lead</p> 	 <p>Takahiro Morishita PhD Astronomy Tohoku University (2017)</p> <p>WFSS</p> 
 <p>Camilla Pacifici PhD Astronomy Sorbonne U. (2012)</p> <p>WFSS</p> <p>DAT Project Scientist</p> 	 <p>Swara Ravindranath PhD Astronomy IIA Bangalore (2000)</p> <p>WFSS Ops/PPS Deputy CalWG Deputy</p> 	 <p>Arpita Roy PhD Penn State (2017)</p> <p>SOSS TSOWG</p>	 <p>Anand Sivaramakrishnan PhD Astronomy UT Austin (1983)</p> <p>AMI TEL</p> 	 <p>Tony Sohn PhD Astronomy U. Virginia (2004)</p> <p>Astrometry/SIAF SIAF WG</p> <p>TEL</p> 
	 <p>Jo Taylor BS Astronomy U. Indiana (2012)</p> <p>WFSS Pipeline Testing</p> <p>ULLYSES</p> 	 <p>Deepashri Thatte MSc Physics U. South Carolina (2004)</p> <p>AMI Help Desk Lead ETC</p> 	 <p>Kevin Volk PhD Astronomy U. Calgary (1986)</p> <p>Calibration Pipeline Algorithms Reference Files</p>  <p>CalWG</p>	<p>Key:</p> <p>NIRISS Responsibility Cross-SI Working Group INS Matrix</p>



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	 <p>Stephanie LaMassa PhD Astronomy JHU (2011) Branch Manager User Support Lead AURA</p>	 <p>Paul Goudfrooij PhD Astronomy U. Amsterdam (1994) Branch Deputy Ops/PPS Lead Commissioning Deputy CLOWG AURA</p>		
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 <p>Camilla Pacifici PhD Astronomy Sorbonne U. (2012) WFSS DAT Project Scientist AURA</p>	 <p>Swara Ravindranath PhD Astronomy IIA Bangalore (2000) WFSS Ops/PPS Deputy CalWG Deputy AURA</p>	 <p>Arpita Roy PhD Penn State (2017) SOSS TSOWG AURA</p>	 <p>Anand Sivaramakrishnan PhD Astronomy UT Austin (1983) AMI TEL AURA</p>	 <p>Tony Sohn PhD Astronomy U. Virginia (2004) Astrometry/SIAF SIAF WG TEL AURA</p>
	 <p>Jo Taylor BS Astronomy U. Indiana (2012) WFSS Pipeline Testing ULLYSES AURA</p>	 <p>Deepashri Thatte MSc Physics U. South Carolina (2004) AMI Help Desk Lead ETC AURA</p>	 <p>Kevin Volk PhD Astronomy U. Calgary (1986) Calibration Pipeline Algorithms Reference Files CalWG AURA</p>	<p>Key: NIRISS Responsibility Cross-SI Working Group INS Matrix</p>



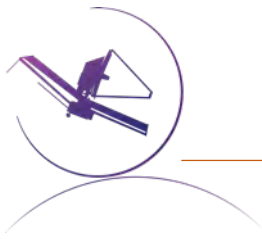
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Instrument Definition Team

- René Doyon (PI; UdeM)
- Chris Willott (NRC; WFSS, imaging, detector characterization)
- Loïc Albert (UdeM; SOSS, AMI)
- Etienne Artigau (UdeM; AMI)
- Anthony Soulain (Côte d'Azur; AMI)
- Neil Cook (UdeM; AMI)



Highlights: WFSS Team



Swara Ravindranath
(Lead)



Camilla Pacifici
(Data Analysis Tools
Project Scientist)



Takahiro Morishita



Jo Taylor

Delivered 4 data analysis notebooks:

NIRISS WFSS postpipeline

00 Optimal extraction of NIRISS WFSS spectrum;

01 Combine one-dimensional spectra;

02. Cross correlation to determine redshift;

03. Spatially resolved emission line map

Upcoming Efforts

- Incorporate contamination modeling in JWST pipeline
- Ghost identification post-pipeline tool (Community Released Software)



Highlights: SOSS Team



Joe Filippazzo



Néstor Espinoza



Arpita Roy

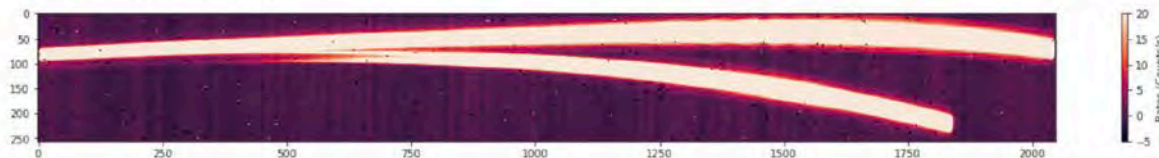
Delivered data analysis notebook:

so^{ss}-transit-spectroscopy

[Analyzing the JWST Pipeline products of HAT-P-1b observations with NIRISS/SOSS](#)

```
In [6]: plt.figure(figsize=(20, 2))
im = plt.imshow(median_image)
im.set_clim(-5, 20)
cb = plt.colorbar()
cb.ax.set_ylabel('Rates (Counts/s)')
```

```
Out[6]: Text(0, 0.5, 'Rates (Counts/s)')
```



Community Software Tool Release

- Advanced Webb Exposure SIMulator for SOSS ([awesimso^{ss}](#)) delivered

Upcoming Efforts

- Update extract-1D algorithm in JWST pipeline ([provided by U de Montréal](#))
- Continue development of independent algorithm: SPECTral Image Analysis for SOSS ([specialso^{ss}](#))



Highlights: AMI Team



Anand Sivaramakrishnan
(Lead)



Deepashri Thatte



Rachel Cooper

- Delivered new algorithm for
ami_analyze step in JWST pipeline
- Will be available in build 7.7

Upcoming Efforts

- Delivery of 3 JWST Data Analysis Notebooks for Observing Exoplanets Around a Host Star:
 1. Simulate AMI data
 2. Run AMI data through pipeline
 3. Analyze output
- 2/3 Notebooks are in review/revision stage: will be available by March 2021



Main Effort in 2021: Whole Team – Commissioning Prep



André Martel
(Commissioning Lead)



Paul Goudfrooij
(Commissioning Deputy)



Kevin Volk
(Calibration Lead)

- Responsibility: analyze commissioning data, assess science metrics, produce & deliver reference files, updates to PRD (*not* staffing MOC console)
- Finalizing Commissioning Analysis Plans (CAPs)
- Writing, reviewing, stress-testing commissioning analysis software
- Bi-weekly meetings with IDT to review CAPs, with additional mode or topic-specific meetings (either regularly or as-needed)
- CAP rehearsals to nominally start spring 2021
 - Exercise process of running through data analysis steps:
raw data → science readiness metrics analysis → reference file (if relevant)
 - Communicate and coordinate with team in similar manner as would happen during commissioning
 - Track progress with JIRA tickets