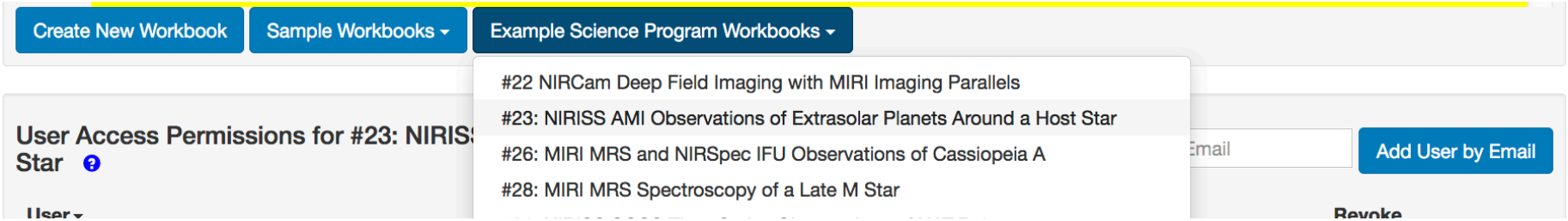
NIRISS AMI hands-on exercises

Example science program in JWST ETC

1. Log in to JWST ETC and Open program #23



Create a scene with another target with spectral type F0V, vegamag=6.5, normalized in NIRISS F430M. Name the source 'Target 2' and name the scene 'Target 2 Scene'

i. Create a Target Acquisition calculation for this source
ii. Create a new calculation to use this scene
iii. Calculate NGROUPS for an observation with NRM + F430M
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel
vi. What contrast can you reach with 10^9 total photons?

AMI calculations in JWST ETC

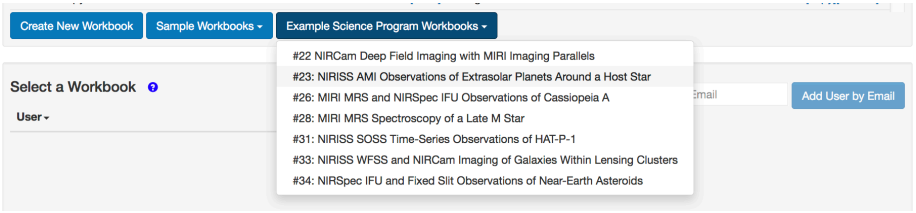
2. What is the magnitude (Vegamag) of the brightest F0V star that you can observe with NGROUPS=7 in F480M, F380M?

3. Create calculations to calculate NGROUPS and NINT required to get 10^7 photons from HD37093. Use Vegamag = 5.47 normalized in F380M and vegamag=5.46 normalized in F430M and F480M

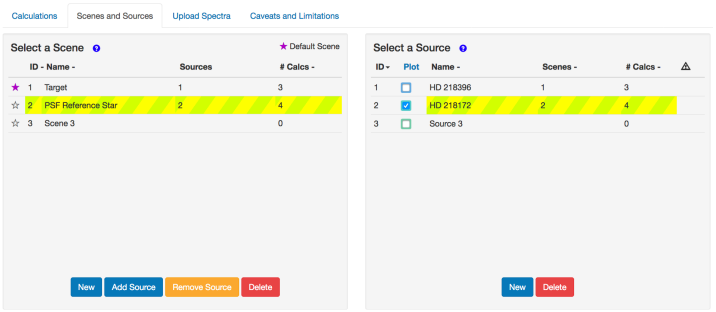
4. Calculate NGROUPS=1 and NGROUPS=2 bright limits (Vegamag) for a A0V star observed with F380M.

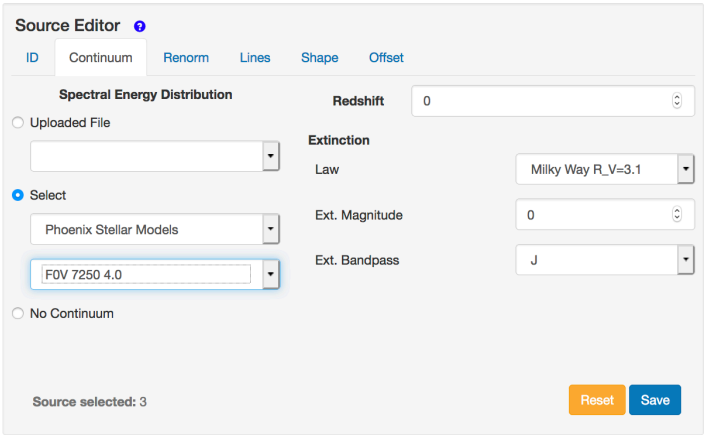
AMI calculations in JWST ETC
Answers to questions

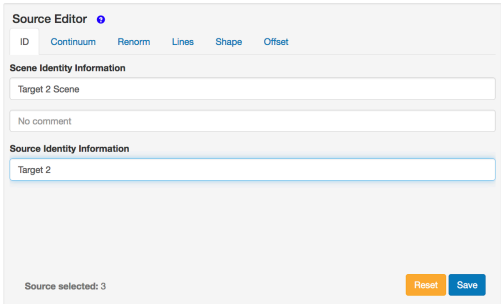
1. Log in to JWST ETC and Open program #23



2. Create a scene with another target with spectral type F0V, vegamag=6.5, normalized in NIRISS F430M. Name the source 'Target 2' and name the scene 'Target 2 Scene'

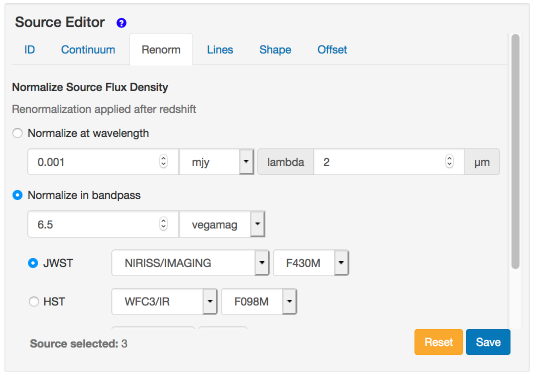


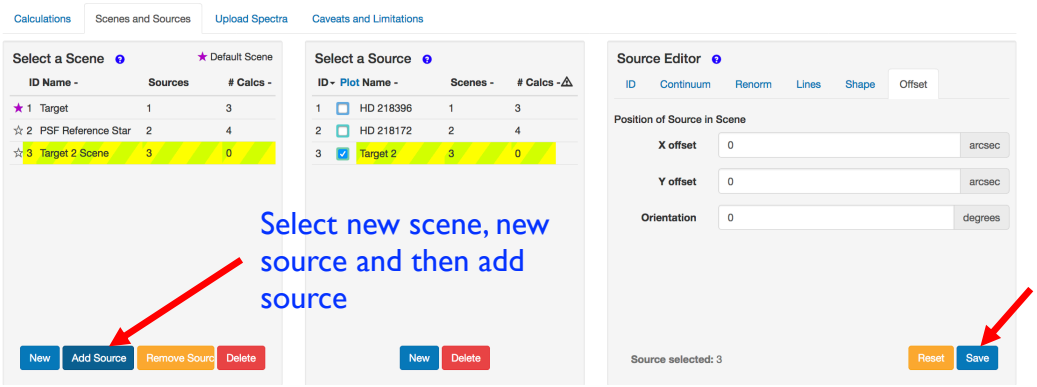


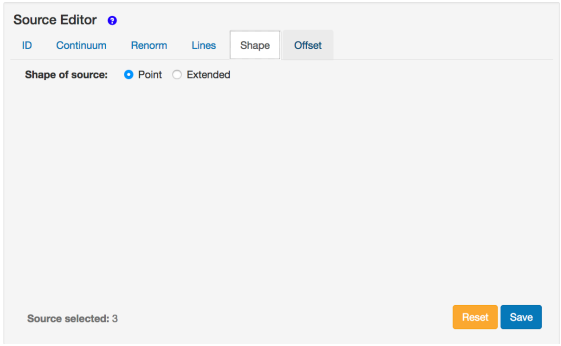


AMI calculations in JWST ETC
Answers to questions

2. Create a scene with another target with spectral type F0V, vegamag=6.5, normalized in NIRISS F430M. Name the source 'Target 2' and name the scene 'Target 2 Scene' continued…







AMI calculations in JWST ETC

Answers to questions

i. Create a Target Acquisition calculation for this source

ii. Create a new calculation to use this scene

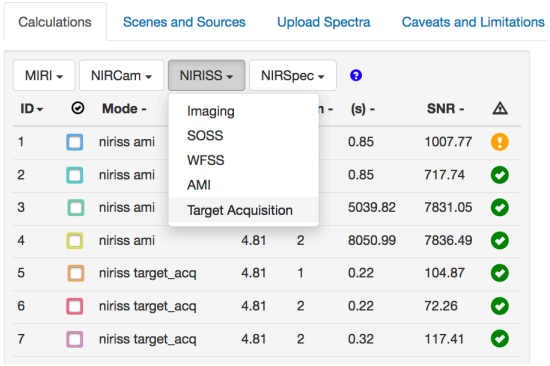
iii. Calculate NGROUPS for an observation with NRM + F430M

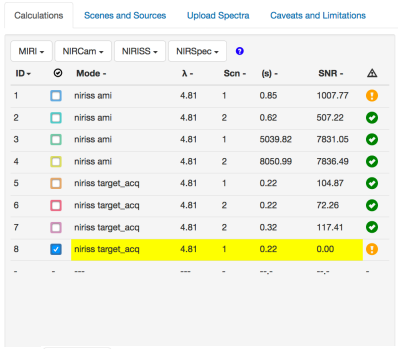
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image

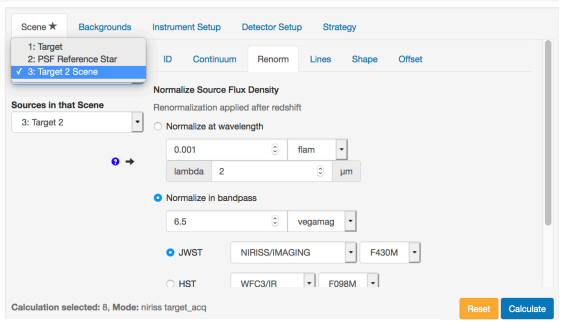
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel

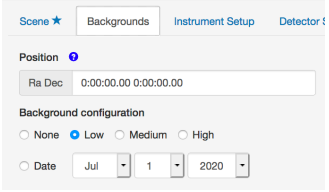
vi. What contrast can you reach with 10^9 total photons?

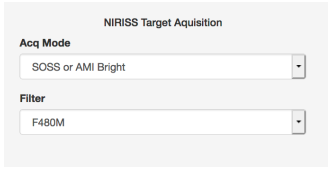
i

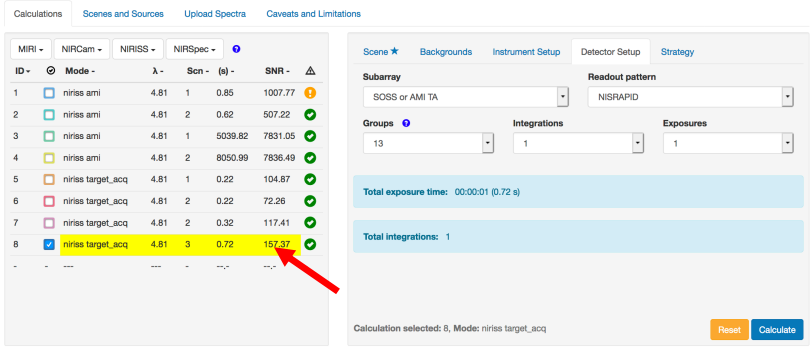












AMI calculations in JWST ETC

Answers to questions

i. Create a Target Acquisition calculation for this source

ii. Create a new calculation to use this scene

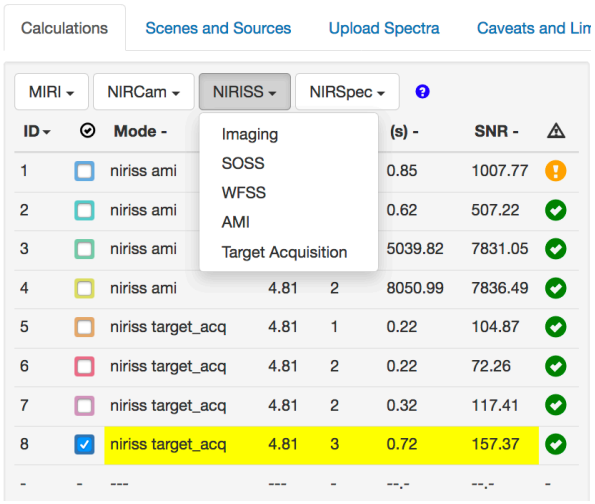
iii. Calculate NGROUPS for an observation with NRM + F430M

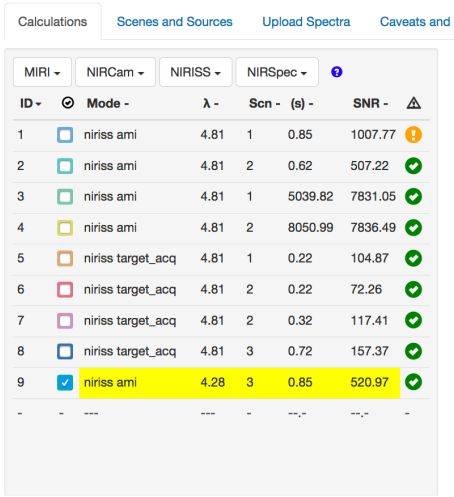
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image

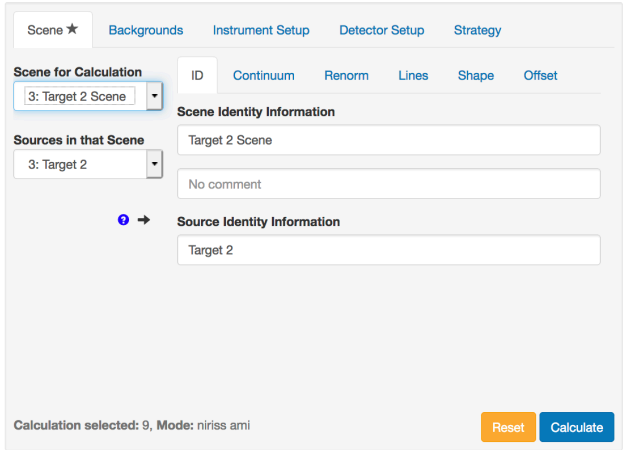
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel

vi. What contrast can you reach with 10^9 total photons?

ii







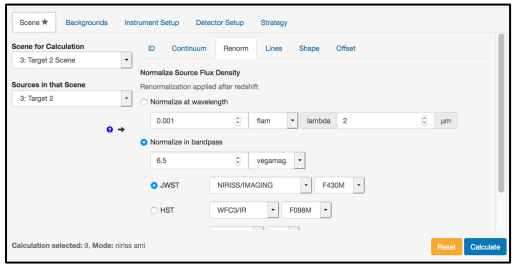
AMI calculations in JWST ETC

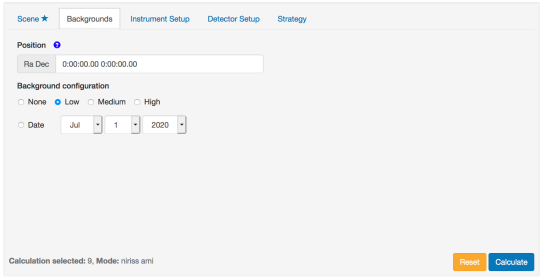
Answers to questions

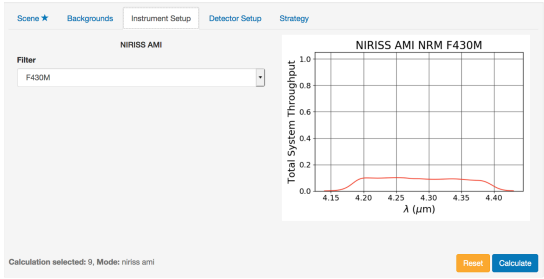
i. Create a Target Acquisition calculation for this source
ii. Create a new calculation to use this scene
iii. Calculate NGROUPS for an observation with NRM + F430M
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel
vi. What contrast can you reach with 10^9 total photons?

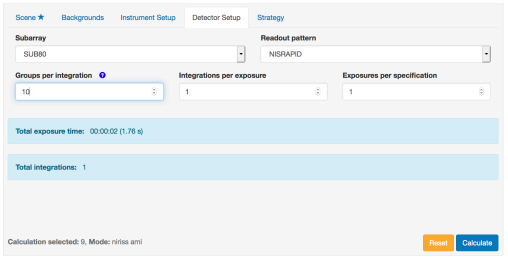
iii

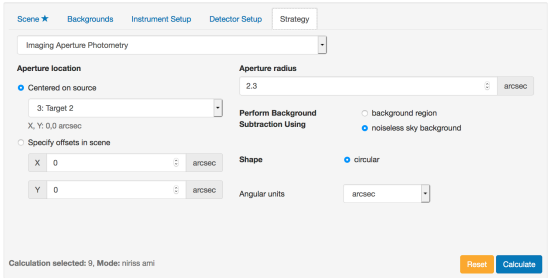
Update Scene, background, Instrument Setup and Strategy and run the calculation with default Detector Setup







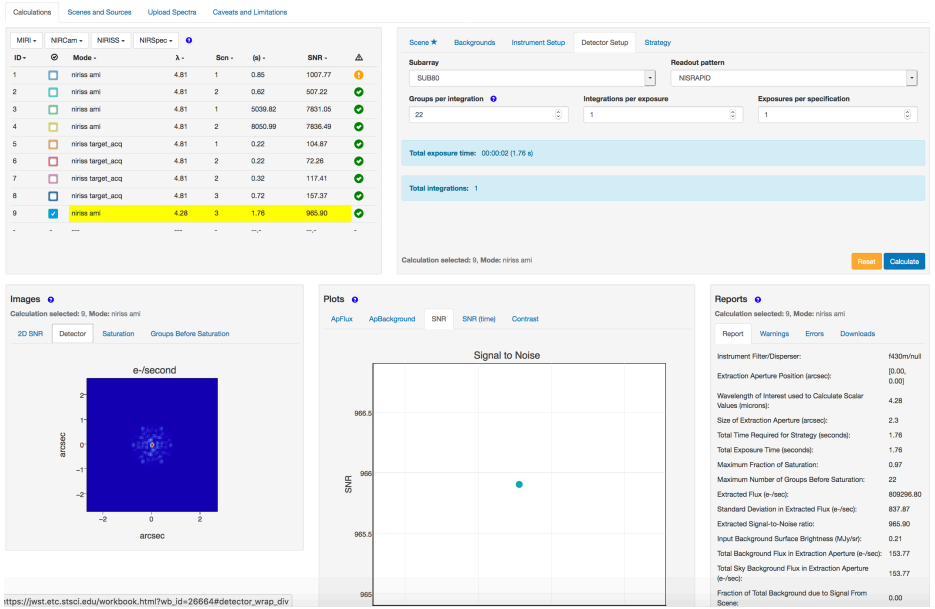




AMI calculations in JWST ETC
Answers to questions

i. Create a Target Acquisition calculation for this source
ii. Create a new calculation to use this scene
iii. Calculate NGROUPS for an observation with NRM + F430M
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel
vi. What contrast can you reach with 10^9 total photons?

iii
continued



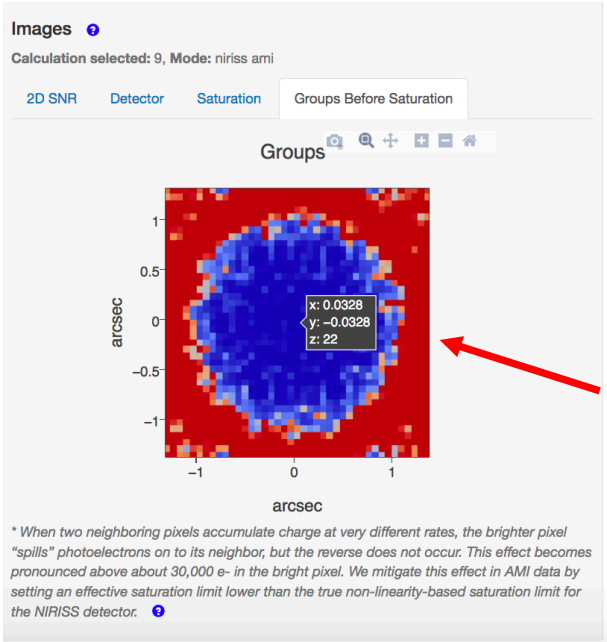
Maximum Number of Groups Before saturation value is 22 from the Reports panel. Therefore set Groups per integration to 22. (NGROUPS)

AMI calculations in JWST ETC

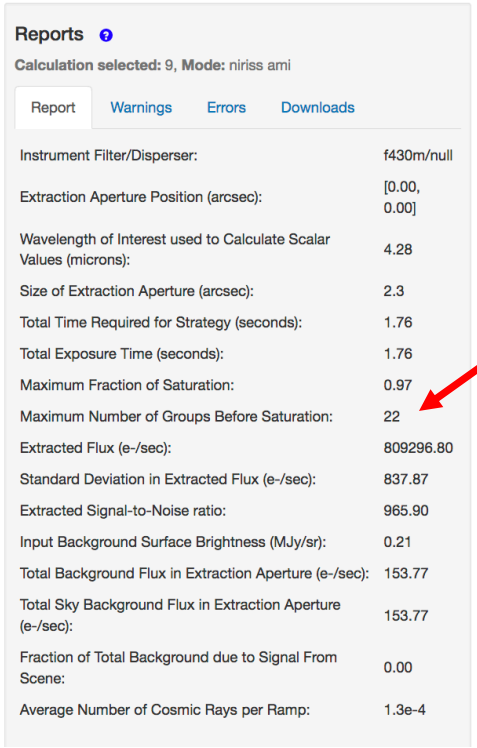
Answers to questions

i. Create a Target Acquisition calculation for this source
ii. Create a new calculation to use this scene
iii. Calculate NGROUPS for an observation with NRM + F430M
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel
vi. What contrast can you reach with 10^9 total photons?

iv



*



Maximum number of Groups Before *saturation in the brightest pixel of AMI PSF.

AMI calculations in JWST ETC
Answers to questions

i. Create a Target Acquisition calculation for this source
ii. Create a new calculation to use this scene
iii. Calculate NGROUPS for an observation with NRM + F430M
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel
vi. What contrast can you reach with 10^9 total photons?

v

Total Time Required for Strategy (seconds):	1.76
Total Exposure Time (seconds):	1.76
Maximum Fraction of Saturation:	0.97
Maximum Number of Groups Before Saturation:	22
Extracted Flux (e-/sec):	809296.80
Standard Deviation in Extracted Flux (e-/sec):	837.87
Extracted Signal-to-Noise ratio:	965.90
Input Background Surface Brightness (MJy/sr):	0.21

Total photons = flux × NGROUPS × NINT × TFRAME
NINT = Total photons/(flux × NGROUPS × TFRAME)
= 10^9 / (809296.80 e−/sec × 22 × 0.07544 sec)
= 744.5 –→ Round up to 745

AMI calculations in JWST ETC
Answers to questions

i. Create a Target Acquisition calculation for this source
ii. Create a new calculation to use this scene
iii. Calculate NGROUPS for an observation with NRM + F430M
iv. Compare the 'Maximum number of Groups Before Saturation' value with the central pixel value in Groups Before Saturation image
v. Calculate NINT to get 10^9 total photons in the exposure.
   - Use photon collect time formula and Extracted Flux in the Reports panel
vi. What contrast can you reach with 10^9 total photons?

vi

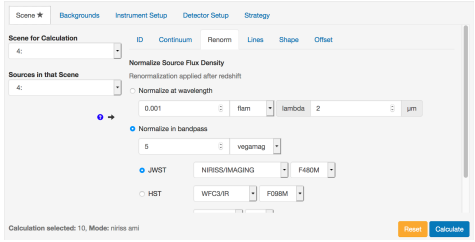
sqrt(100/(10**9)) = 0.0003

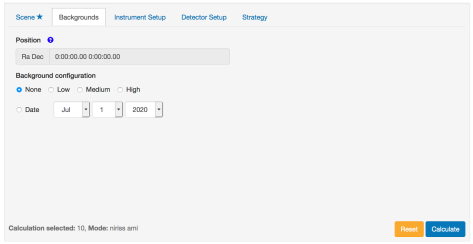
AMI calculations in JWST ETC
Answers to questions

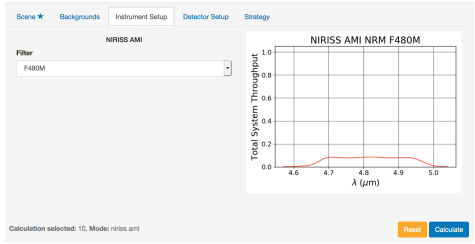
2. What is the vegamag magnitude of the brightest F0V star that you can observe with NGROUPS=7 in F480M, F380M?

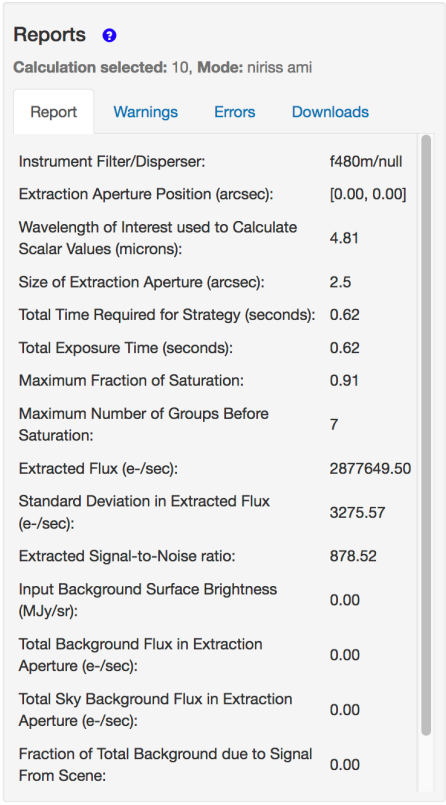
- F480M

Vegamag =5 gives maximum number of Groups Before Saturation as 7.
Vegamag = 5.1 gives maximum number of Groups Before Saturation as 8.
Therefore vegamag=5 is the NGROUP=7 bright limit for F480M









- F380M

vegamag = 6
for NGROUPS=7

AMI calculations in JWST ETC

Answers to questions

3. Create calculations to calculate NGROUPS and NINT required to get 10^7 photons from HD37093. Use Vegamag = 5.47 normalized in F380M and vegamag=5.46 normalized in F430M and F480M

Answer:
This is similar to calculations 2, 3 and 4 in NIRISS AMI Examples sample workbook. The only difference is in the total number of photons which will change the number of integrations.

F480M NGROUPS=11, NINT = 7
F430M NGROUPS=8, NINT = 8
F380M NGROUPS=4, NINT = 11

AMI calculations in JWST ETC
Answers to questions

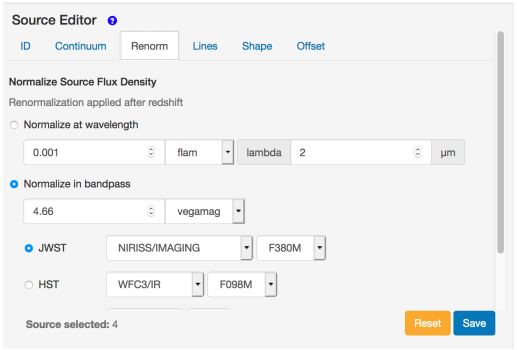
4. Calculate NGROUPS=1 and NGROUPS=2 bright limits (Vegamag) for A0V star observed with F380M.

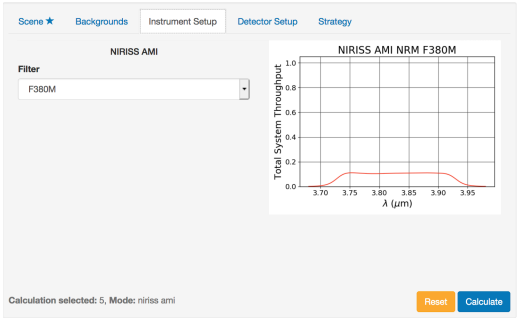
This is similar to Example 3 in NIRISS AMI Examples. Only the filter is different.

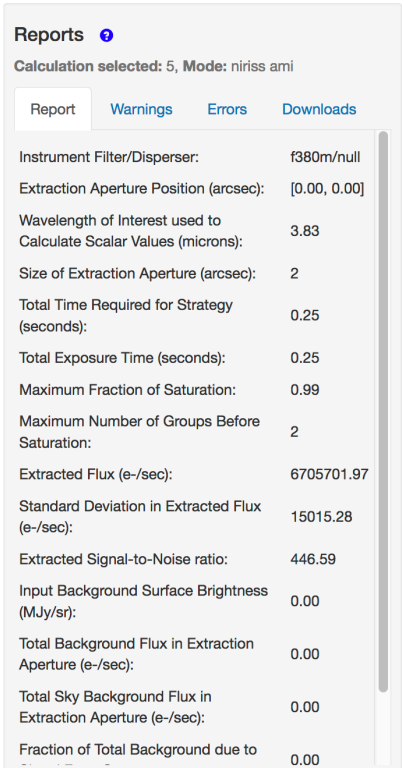
NGROUPS=2 bright limit
For F380M

4.66

Change the magnitude to 4.65 and look at the warning message







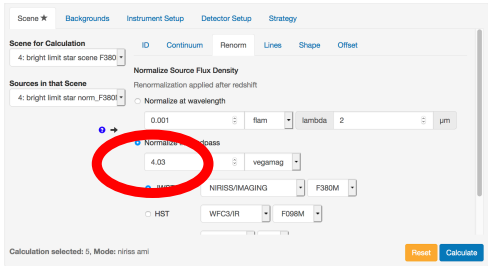
AMI calculations in JWST ETC

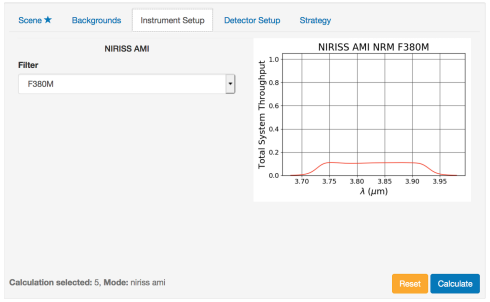
Answers to questions

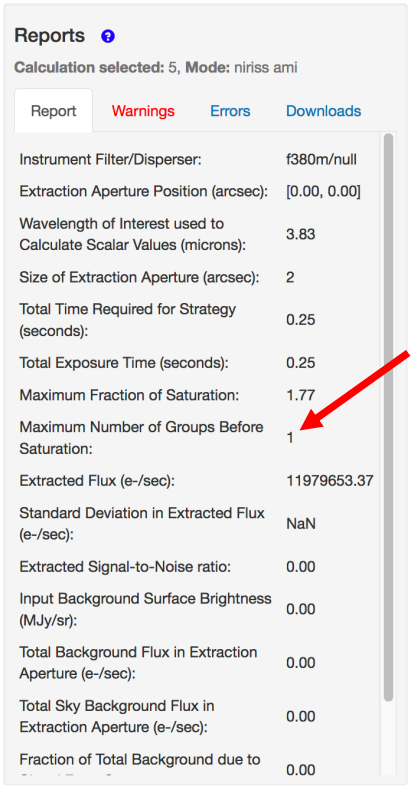
4. Calculate NGROUPS=1 and NGROUPS=2 bright limits (Vegamag) for A0V star observed with F380M.

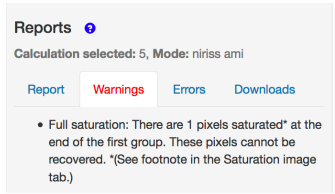
This is similar to Example 3 in NIRISS AMI Examples. Only the filter is different.

NGROUPS=1 bright limit for F380M is 4.03. Change the magnitude to 4.02 and look at the central pixel in Groups Before Saturation image.

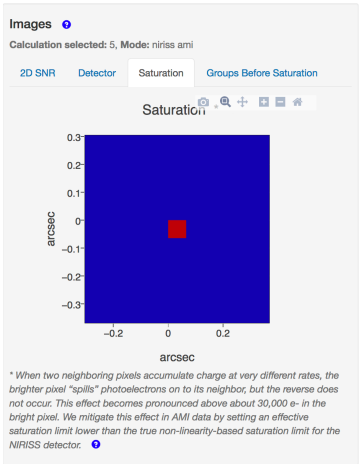




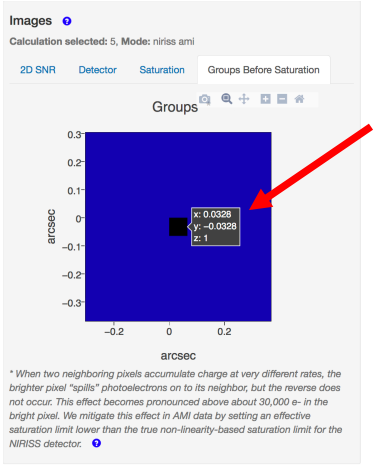




Signal limit exceeded in group 2 but not in group 1



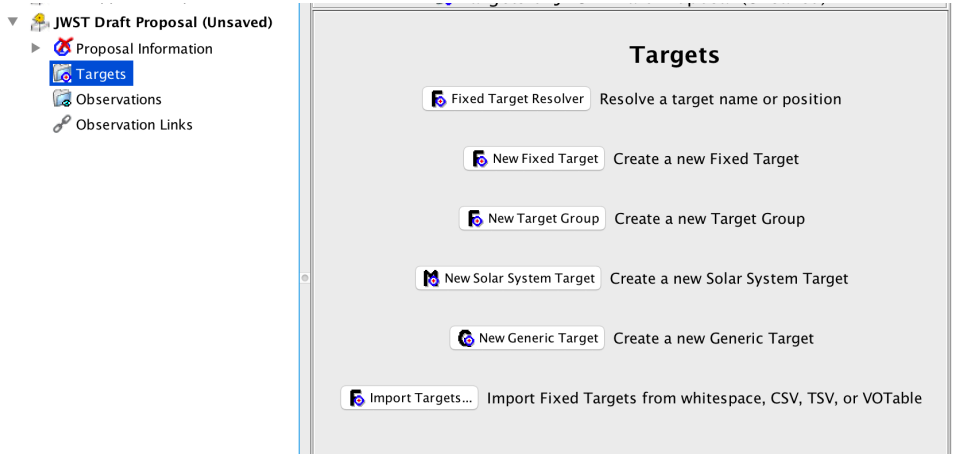
Saturation image



Groups Before Saturation image

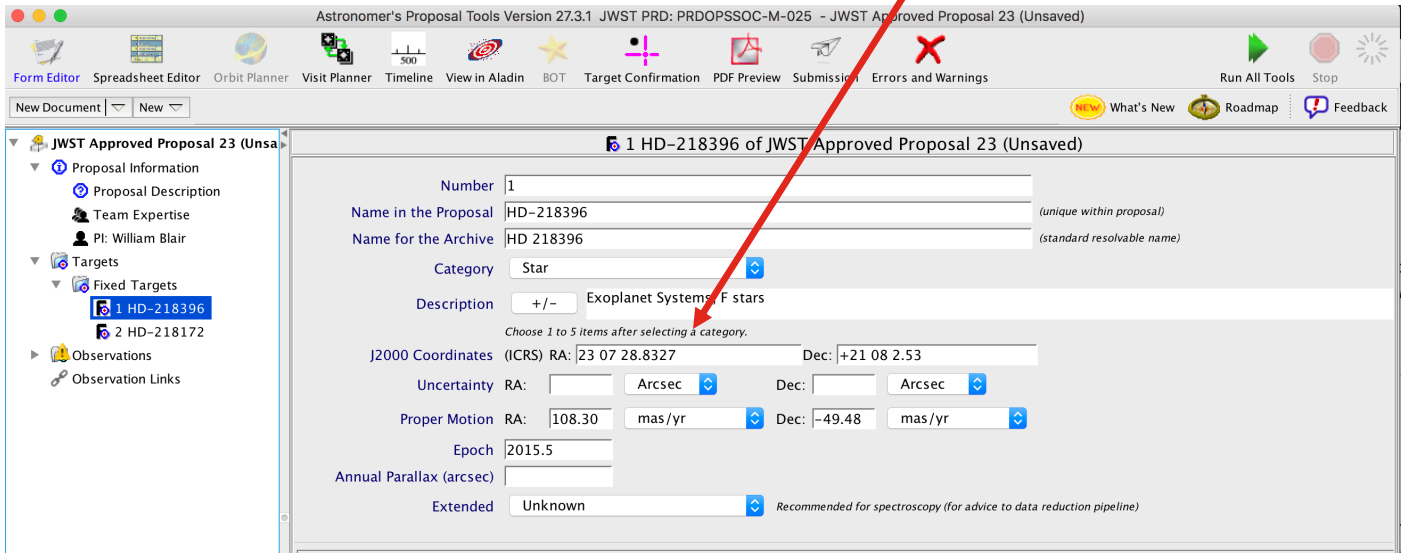
Example science program in JWST APT

AMI Specific strategies

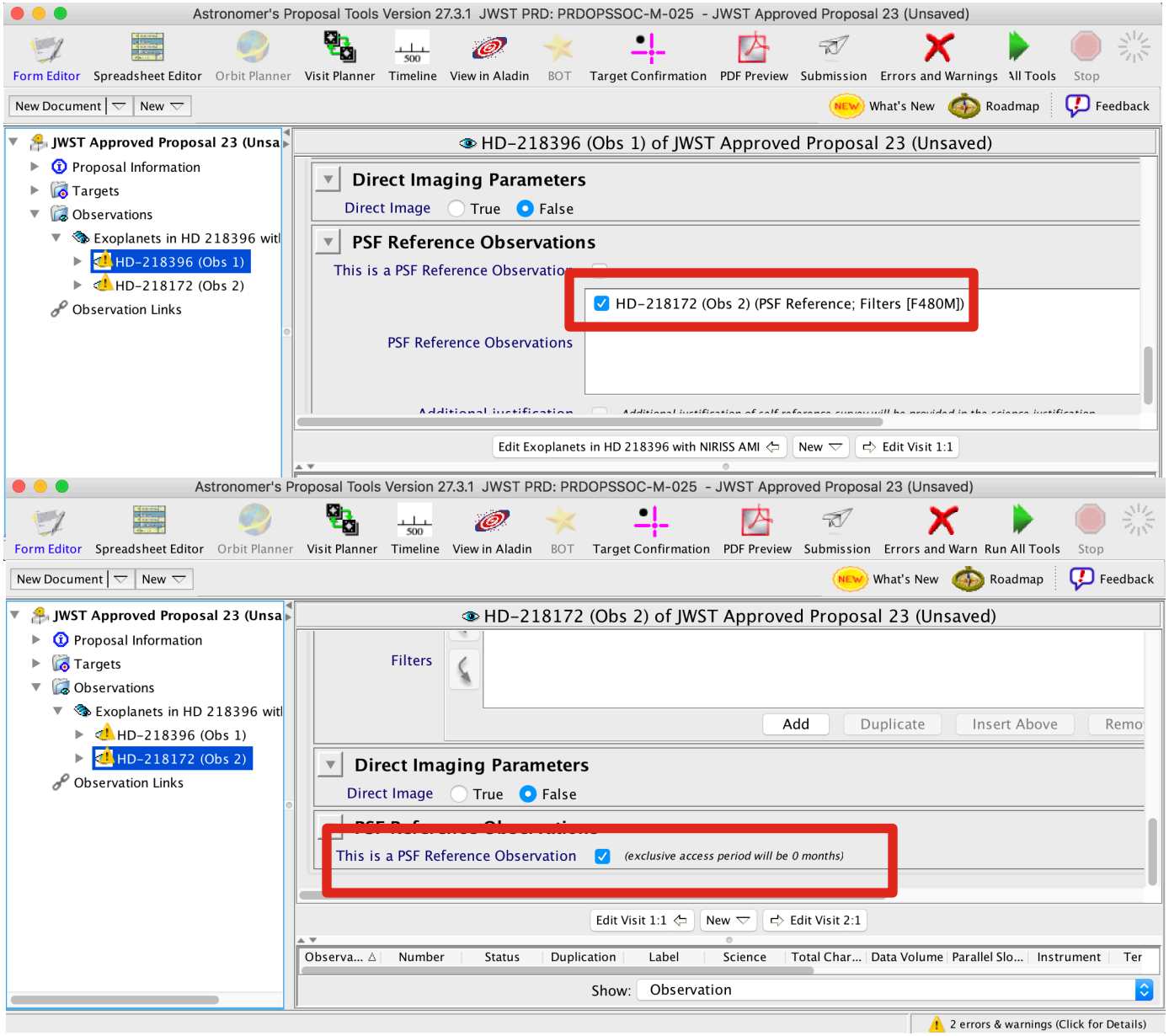


Get coordinates from GAIA DR2 archive, enter epoch as 2015.5

- Use Fixed Target Resolver to search for target and then manually update coordinates OR
- Select New Fixed target and update information.

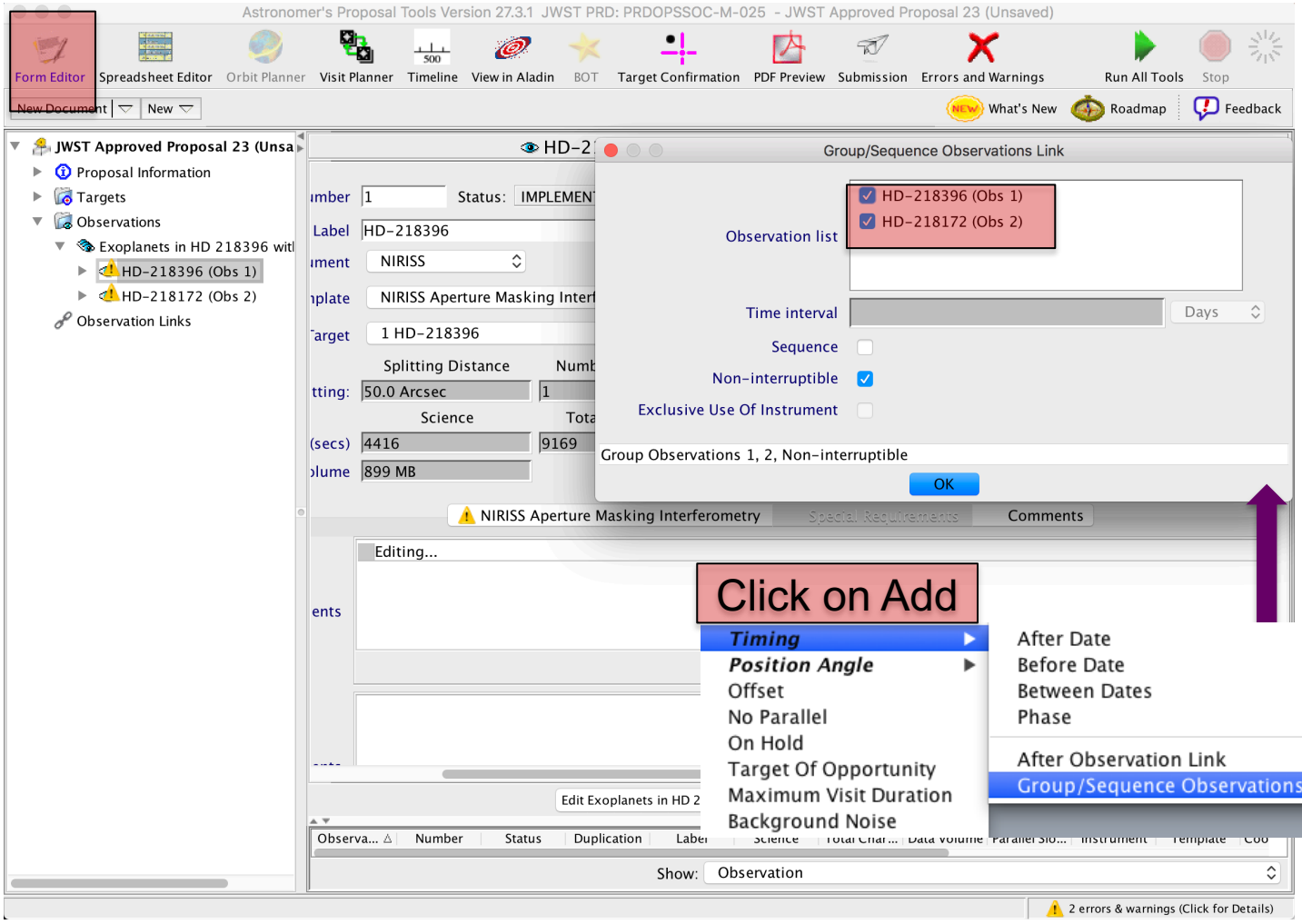


Example science program in JWST APT



Example science program in JWST APT
AMI Specific strategies

Adding Special Requirements



Example science program in JWST APT
AMI Specific strategies

Create 'NIRISS AMI Observations of Extrasolar Planets around a Host Star' proposal and compare with the existing program.

- Select target HR8799(or HD218396) and calibrator (HD218172).
- Enter/update coordinates, proper motion using information from Gaia DR2 archive, use 2015.5 epoch.
- Create observations for each source using NIRISS AMI template.
- Update exposure parameters using calculations 5 and 7 for Target Acquisition and calculations 3 and 4 for science observations in JWST ETC example science program workbook #23: NIRISS AMI Observations of Extrasolar Planets Around a Host Star.
- Create Group non-interruptible Special Requirement for the target and the calibrator.
- Update PSF Reference Observations field for the target and the calibrator.
- Run visit planner
- Run Smart accounting
- Create the times report (via APT File – Export) to look at an ASCII listing of charged times
- Create Target Confirmation Charts and view the observations in Aladin.