2017-10-23 JWST Bright Object Target Acquisition

Primary:

1) What are the bright limits (saturation) for each of our instruments — preferably in Kmag to compare with host stars on Simbad.
2) What are the major TA operations choices that each team made? (i.e. binning size, number of dithers, size of centering sub-frame.)
3) What is expected pointing accuracy on the final science target position? Same question for offset target acquisition?
4) Are there any other known limitations that an observer should know before proposing for specific targets?

Tom: Note if there are any issues in each

Tony: how do we get around the current limitations

Not all solutions apply

JF: 1st: we can discuss the settings

2nd: we can discuss solutions

3rd: discuss if these solutions are useful for everyone

SK: It can be difficult to find the above information. If there is a good page (i.e. confluence) we should link them here

PG: will send the links to be posted here

TG: NIRCAM settings

Bright star limits: JDox page has simplified table. K ~ 4.5 for spectral observations. But the TA saturates at K~7.2

Filter Choice: F335M

Group choices: 3 - 65

Readout Pattern: RAPID

Secondary options: offset target acquisition – need to find nearby target

Issues: pointing accuracy could be larger than expected, depending on the splitting distance to offset target ~ 10 mas (JF: <20 mas)

– If offsetting target may have poorly constrained proper motion and positing

Other known limitations: not many GTO targets have nearby (< 30 mas) splitting distance. NIRCam GTO cannot acquire on GJ 436 (and other) GTO targets.

– If we could open up new filters or less reads than we can acquire on all of our targets

JS: Submitted PR to add narrowband filters

KS: Does this include all instruments?

JS: just NIRCam

CP: Is that for the next build or future than that

TG: JS brought up: how well can we do saturated pixels

– NIRCam is undersampled with F335M filter. Saturated pixels may be a larger issue than others

PG: If the psf is "reasonably well sampled" then we could saturate 4 or 5 pixels and still acquire well enough

– if the saturation occurs in the last 3rd of the groups.

KS: Is this based off current centroiding routine: previous estimates claim only 1 pixel can be saturated

PG: the routine does not track saturation of pixels. I you saturate before the 3rd group, then the CDS will have a zero value for the saturated pixels.

– It also depends on the exact distance between the PSF and the center of the pixel

NIRCam uses 1 dither for the target acquisition

TG: NIRcam sampling is not great with one dither; but may not be a critical problem. This needs an analysis

JS: Dithers were included to address bad pixels. Dithers are expected to be integer pixel dithers to 'replace' bad pixels. This will not improve PSF sampling.

NIRCam SUBTA was selected to be in a clean section of the NIRCam detectors. Hot pixels may be an issue, but less likely.

Centroiding: uses 9x9

------- NIRISS ------

PG: 2 target acq modes for SOSS and AMI modes

to pupil+filter combinations: F480M is used for both

Pupil wheel choices are either CLEAR or NRM (reduces the flux by ~7x)

For NRM: Can observe science targets at Kmag > 3.

Can observe science targets at Kmag > 8.X

– SOSS science will saturate K~5 or 6. So TA saturation is better than science saturation

DH: when you say saturate, do you mean 1st read up the ramp?

PG: we could saturate anywhere in the ramp

DH: So you could still saturate and compute the CDS?

SK: PG sent a report on saturation of pixels. SK will send it to DH

PG: can saturate on the last 3rd of the groups up the ramp to get enough accuracy

Centroiding: we use 5x5 window for centroiding

We use dithers because we could not find a 'very clean' 64x64 patch for either mode.

JF: Are there any known issues to address with this group:

PG: NIRISS specific: we have difference limits for FAINT to BRIGHT acq mode is because the 2 sample different parts of the primary mirror.

– in the AMI mode (NRM mdoe) we can use the same part of the mirror and detector for target acq and science exposures

– For SOSS, we want to go as bright as possible on the CLEAR aperture, because that is the part of the pupil that the grism is seeing.

JF: when we spoke before, there was a possible issue for the offset between the position of the target in the NRM pupil than the CLEAR pupil

PG: Tried to experiment on this with the webbpsf to determine this

– on the order of a 10th or a few 10ths of a pixel

JF: will that be tested during commissions

PG: yes.

----- MIRI ----

SK: Currently have TA for slitless spectroscopy and coronagraph.

- We Have 4 filters that are available for TA. 5um, 10 um, 15 um, FND (specifically for TA; ~1000x reduction in flux).
- MIRI is not limited by saturation for target acquistion.
- Feature: last frame "pull down" effect. Science pipeline will drop this last frame for that reason. But that is not in the TA routine.
- SK is working on ground test data to test the effect of the pull down on the TA frame – especially for short ramps (i.e. TSOs).
- MIRI may need to specify a higher required SNR for TA.

DH: right now we require 30 and we are suggesting 40

SK: ETC might say 20.

DH/KS: 30 is current. 40 is recommended

DH: requirement on the FND filter is to acquire on VEGA.

JF: are there any prelim on the pull down test fo target acq?

SK: it's a work in progress. there is data that show it may not be an issue. but there is more data to look at

DH: i concur with SK. at SNR=40, this should not be an issue.

PG: how much is the last frame being attenuated?

SK: it depends on the illumination of the adjacent rows. it's difficult to predict the magnitude of the effect to measrue these differences.

- we have seen some data sets that have a large effect. but there is other ground tests that show this may not be an issue.

PG: luckily, if you need a short ramp for brightness, you will likely get a good snr

KS: can we make a requirement of groups>5 to confirm that there are 3 'good reads'.

SK: that is an option, but this would require ETC, APT, OSS, etc. to make that change.

KS: We could make a recommendation on the JDox pages to suggest that users take 5 groups.

SK: i agree

DH: this is also a potential test at JPL testbed

JF: what else needs to happen to add more requirements

SK: OSS does not allow to routine to drop any frames for TA.

SK/JF: they may need to make a special build

DH: they used to drop the 1st and last, but MIRI removed that required.

SK: there may be a need for offset targets

DH: there is a 50" limit. be careful with those calculations. if the splitting distance is nearby 50", then small errors could make a problem.

CP: OPTS is working on specifying those requirements.

----- NIRSPEC -----

CP: spectrsocopy can work up to Kmag ~ 5.5 (depending on the grating)

TA acquisition itself is Kmag ~ 10.7. This is with SUB32 and broad filter. F110W.

– only 3 filters for TA: F110W, F140X, CLEAR.

KS: was K~10.7 limit for ngroups=1

CP: we take the min-combined ramps to reject cosmic rays; then we run a 3x3 pixel check box over that.

– original algorithms were developed for MSA mode. This does not work with BOTS

– MSA TA may not work with BOTS template.

– BOTS was designed for bright objects in the 1.6"x1.6" slit, BOTS TA does not include any dithers to avoid missing the slit.

– the brightness limits are set for ngroups=3.

JF: do you use the same algorithm?

CP: it uses GENTALOCATE in the background.

PG: there is an option for ngroups=2

MG: not for nirspec

DH: not for miri

PG: there is an option that we can ask for with OSS

CP: if OSS does not ask for it, then it will not be active

MG: for nirspec we could use 'verify only'. this does not runt he TA algorithm. it takes an image after the fact to pinpoint the position after the fact.

CP: so we would be relying on the blind telescope motion.

JF: can we ask for more filters to reduce the brightness limit

CP: there are not many filters. 3 filter options for TA and only 4 other filters to cutoff the wavelengths.

KS: are any of those redder thanthe F110?

CP: they are not narrower. There is a F290LP. It has not been calculated to see if this will improve the TA use.

KS: this would be good to test

KS: Do we need to use ngroups = 1?

CP: the short term solution is to use offset targeting

– tony suggested using ngroups=1 and hope you don't get cosmic rays

– you would need a wider checkbox to determine how clean the obs is.

TK: We considered ngroups=1, but then you would be centering on the wings of the PSF

– our simulations show that we ngroups=3; if we can live with saturating a few pixels and center on the wings.

– we think the current settings are preferred at this point

KS: do you have any measurement of hte improvement to use saturated centroiding with ngroups=3?

TK: not of the top of my head

KS: could you email jonathan (jfraine@stsci.edu)

PG: to clarify: gentalocate currently allows ngroups=2.

– For Cycle-2: it could be an option to consider using to improve saturation limtis

KS: could

TK: ngroups of 2 only gains a factor of 2 for incidents of saturation.

– using ngroups=2 on a saturated image could be helpful. It may not avoid saturation, but it could improve the centering on the saturated images

– it would need to be in conjunction with widening the integration box

PG: not left with the hole in the middle. even if it saturates in the 1st group, it would result in small numbers in the saturated regions.

TK: that could be useful.

KS: is this something that we could shoot for for cycle 2

PG: it should be pretty easy to do some testing on this

TK: for MG: we could use more simulations to test if that's the appropriate direction. or stick with ngroups=3 with saturated pixels

– we will still need to ame set of parameters. but it would be a relatively

MG: That also implies changed APT and ETC which could take a while.

PG: Even though all things

DH: is this an issue?

JF: yes. we have 20 high value targets

TG: This seems to be a intrinsic problem that is an issue. as an outsider, I want to be helpful to get the resources that we need.

– TA is just a microcosm, but this is a big issue as well

– I want to find a way to help you

DH: This seems like a serious issue that we should write up and discuss with the SWIG

TG: there are probably other issues outside of exoplanets

DH: there may even be issues with bright AGN and other sub-fields.

TG: I'll discuss this with the SWIG

JS: We should discuss this with Marcia too

DH: There may be many other science fields such as AGN and eclipsing binaries that this coudl be an issue with.

TK: why not use point and shoot?

MG: that's for verify only.

DH: the requirement is 1", but that is probably not good and we won't know for certain until we are on the sky

DH: For MIRI, with a 1" pointing, you will fall off the target a third of the time.

TG: This gets worse are shorter wavelengths

TK: With nirspec, we only have a 1.6" apertue

DH: so 3rd of the time you will miss the target

TK: that applies to any target acqusition

SK: in Jdox, we already say .45"

DH: the .45" comes from accuracy of guide star catalog. not from the estimated accuracy of the observatory.

DH: GSC comes from 2MASS, not GAIA.

KS: does NIRSpec use 1.6" mask during target acq?

CP: yes. it's the biggest hole in the grid that we have

KS: what happens, with 1", when the point and shoot falls off the slit?

DH: 1.6" is not the one third of the time

KS: What happens when it does fall outside?

CP: with the currnet WATA mode, this would not be good.

– we may want to use the MSA instead

JF: can we do WATA and then follow with MSA if we miss it?

CP: that is not hte current setup. it might be better to just use MSA now.

TK : if we really only get 1" pointing accuracy, we need to find a new option, like PEAKUP stage.

JF: I will look into what happens if you miss the TA

DH: if you miss your TA (2 chances) then JWST will move onto the next visit and cancel the current visit

KS: for TSO, there is only 1 TA at the beginning of the visit

TK: NIRspec only tries once

DH: good point, MIRI does it twice.

PG: NIRISS also only tries once.

JS: check this: NIRCam might also only TA once

DH: be careful: the 2 tries to do not change the telescope pointing

– it is meant to address a cosmic ray event (or some such)

– it does not change the pointing

– if the TA cannot find something, then

JF: history of exoplnets .....

DH: for Spitzer, the intrapixel was the issue

JF:

KS: slit loss for nirspec could be a major issue for TSO

JF: survey of conversion ...

DH: 2 and 1 are not allowed. ngroups=3,5,7, ...

– the user can specify whichever they want. but APT will only do odd number

JF: MIRI can add JDox suggestion to use ngroups>=5 for TA.

KS: There may not be issues with ngroups>5 for MIRI

DH: it could be an issue for some targets, even with FND

SK: for stability, there may be an issue with dwelling while changing from TA filter to prism.

The FND TA filter is the further away from prism, which has the longest time to get the LRS prism.

– photons can hit the detector in that time frame

DH: We are in the Rayleigh-jeans, so Kmag may not reflect actual photons the detector

KS (after): we might want to use MSATA first, to ensure that the science target is inside the BOTS mask for WATA to have a target

JS: (via email): the PR is 89005, and the related APT PR is 89141 slated for APT 26.0.

SK: (via email): the dwell time for MIRI's filter wheel is 8 seconds.