THE JWST EXPOSURE TIME CALCULATOR

This Master Class homework package is intended to help you become familiar with the JWST Exposure Time Calculator and its basic functions. The exercise consists of step-by-step instructions, which will familiarize you with the ETC, followed by questions, which will test your understanding.

Exercise 1 exploration:
o What do you think the "out-of-date" field in the workbook list means?

I would assume that out-of-date would imply that changes have been made to the exposure time calculator tool (maybe new backgrounds or filter throughput, etc.) and the workbook and calculations were made with a previously released version of the ETC. Now that a new version of the ETC is available, those calculations may no longer be correct and I would need to load a copy of the old workbook into the new calculator to get updated values.

o Try to find out how you can share a workbook with a collaborator. Experiment with read and write permissions.

Did this

Exercise 2 exploration:
o Find the known issues under the help menu. Which one, if any, do you think could most affect your favorite science case?

I think the fact that dithers are not yet implemented will have the biggest impact of all known problems. I will definitely be dithering the object and it would be good to have an accurate calculation of the S/N for the combined exposures. But the work around seems fine.

I already know about the APT consistency issue from earlier HW and training, so I will remember that as I plan and teach since that will be part of the training I do.

Exercise 3 exploration:
o Note the two different slopes in the signal-to-noise ratio (SNR) for increasing the number of groups and increasing the number of integrations. What do you think causes this behavior?

We increased the number of groups, but we did not increase the number of integrations in the first case. All we did was take the original integration and one more group to that single integration. That resulted in maybe another 10 seconds of integration, so the increase in S/N was only a value of ~3 in each case to S/N.

But the second case, we actually increased the number of integrations. So instead of having 10 groups, we had 20 groups the second time (10 + 10), 30 the third time, etc. So when we added a second integration, we doubled the total time spent on target and increased S/N by a factor of about ~1.4.

That is why the slopes are different. Adding a single group is a small increase in exposure time to a given intergration. Adding a second integration is doubling the original exposure time.

o Experiment with other readout patterns (under the Detector Setup tab) to find the highest SNR for a total exposure time of about 1000 seconds. What is it?

Deep2 of Deep8 gives me the highest S/N for an exposure time of about 1000 seconds. That is because we are integrating longer, so we get the total S/N for one group of images in a single integration. (Note CR could be an issue) So we go deeper in one integration (longer exposure) with fewer coadds (integration) and by skipping frames we save on read-out overhead time. So in a given total exposure time the Deep fields will get a higher S/N.

Exercise 4 exploration
o A scene can contain multiple sources. Using the "Offset" parameter in the scene, determine the minimum unblended separation of a binary star for your chosen NIRCam imaging filter.

First I selected my two stars as the source for my calculations so I could see them in the Calculations pain. Then I played with the offset to see at what point did the two PSF appears to overlap in the Image pain of the Calculation. Looked like things were okay at 0.3 arceseconds, but as soon as I moved to 0.2 arcseconds the two stars overlapped at the edge and began to blend. So the minimum separation of this binary system in the filter I chose would be a little more than 0.2 arcseconds.

Exercise 5 exploration
o What is the faintest point source that will yield a "SOSS or AMI faint" target acquisition without a warning for NIRISS?

Keeping our settings of a M5 star from the Pheonix Stellar Models and normaling at 1.3 microns, the faintest source I could use for TA without getting a warning was 31 mJy. And note that saturated the other observation I was making in NIRCam!

Exercise 6 exploration
o What if you knew that the surface brightness of Pluto at 3 micron is 1000 MJy/sterad. How would you renormalize the spectrum to this value?

I would go into the shape and change it from Integrated Flux to Surface Brightness and then pick per Sterradian. Then I would go to the reorm tab and select normalize at wavelength and pick 3 microns for the wavelength and 1000 MJy/sr for the renormalization and save it.

Exercise 7 exploration

4. Why might the "IFU Nod Off Scene" be a better option for an extended source?

In the case of an extended source, your nod may not be large enough and you end up noding to a location on the detector that in the previous image had flux from the extended source. In that case you won't get a clean background subtraction. So for extended sources it is always better to nod off scene, and to nod in different directions if JWST can in order to not land on nearby stars.

o How can the "Groups Before Saturation" image help you quickly determine the optimal number of groups?

The groups before saturation image shows you the maximum number of groups you can specify before a given pixel will saturate. The zoom in button does not work, so that is frustrating. Really hard to scroll and get right on top of the central pixel, but when I do I see a z=17 value. That tells me I can take 17 groups before that pixel will saturate for this source. Neighboring pixels can have more groups before saturation. If I had done that before doing an expand search, I would have known 17 was max right away and not had to do the step by step search.

o How much exposure time is needed to observe Pluto with the NIRSpec IFU in high resolution at 2.7-5.2 micron with a minimum SNR of 20?

I would need 354 seconds – or 8 groups in the current configuration.

Exercise 8: Sharing the workbook

Done

Exercise 9: Copying and removing a workbook

Done

Exercise 8 and 9 exploration
o Create a new workbook and share it with a colleague. Now delete your version of the workbook. What happens with your colleagues' version?

They can still read the workbook, but since I gave them no other permissions other than read, they cannot make any changes to it. It is still a read only document.