



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

JWST Master Class 2019

APT Mosaicking Module

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APT Mosaicking Level 2 Exercises:

Our exercises will concentrate on making mosaics using the large JWST imaging instruments (NIRCam and MIRI). Some other modes support mosaicking as well, but the functionality is similar to that of the imagers. Mosaics with very small apertures such as IFUs will be covered in the IFU Level 2 session as they are somewhat different. The text highlighted in BOLD directs you to the actionable items.

Start with the APT file *Mosaics_Level2_start_MC19.aptx* that will be provided, which has several targets and placeholder observation specifications as a starting point. To start, **load the APT file into APT and look at the target and observation sections** to see what is there. In some cases, a preliminary dither pattern has been selected, but users can change the assumed dither patterns as the exercises progress and visualize the changes in Aladin.

Exercise #1: Learning the Basics

1) **Select the observation folder “Exercise 1.”** There are three observations. **Select observation 1 and modify it to produce a simple NIRCam imaging mosaic of M83 that covers the bright part of the galaxy.** To do this, you will want to bring up the Aladin viewer and load a sky image for the target (DSS works well.) Since M83 is symmetrical, the rotation of the mosaics are of no consequence in this case. Then **select observation 2 and do the same for MIRI imaging.**

- a) What are the dimensions of your defined NIRCam mosaic?
- b) What are the dimensions of a MIRI mosaic that covers approximately the same region?
- c) When you mosaics are defined, **select each observation individually and run the visit planner** to verify the mosaics are schedulable.

2) **Open observation 3 for M82, and select the MIRI observation.** Then return to Aladin and **choose a new background image for the new target. Create an efficient MIRI mosaic that is rotated to align the larger dimension of the MIRI FoV with the major axis of the galaxy.**

- a) **Define your mosaic and rotate the MIRI FoV in Aladin into the desired orientation. Click the *Orient Ranges* button in the Aladin control window.** Note the angle on the green indicator. (You may need to zoom in to read it.)
- b) **Set a V3 position angle range Special Requirement with a +/-10 degree range around this value (to improve schedulability).**
- c) **Try moving/recentering your mosaic slightly** and note the pending coordinate change in the Aladin control window. **Commit the coordinate change back to your proposal.** (Optional: Look at the target entry for M82 and verify that the coordinate changed. Depending on how far you moved it, you may want to move it back and commit the corrected coordinates.)
- d) **Verify your mosaic is schedulable by running the visit planner.** If not, try a rotation angle 180 degrees away and try again. (If it worked the first time, as an exercise, try the angle rotated by 180 degrees and see if it works or not.) In a case where both orientations were schedulable, two ranges could be specified to increase the schedulability even more.

Exercise #2: Handling Limitations in position angle

1) Select the “Exercise 2” observation folder for NGC 891.

- a) **Select and display the simple MIRI imaging observation in Aladin using DSS as a background.**
- b) **Rotate the MIRI FoV so the shorter dimension aligns with the major axis of the galaxy.**
- c) **Read the green angle indicator in the Aladin display using the *Orient Ranges* button, and set the appropriate Special Requirement, as you did above.**
- d) **Now create a mosaic that covers the bright portion of the galaxy.** What did you use?
- e) **Run the Visit planner and inspect the results.** Oops. We got the big Red X indicating a problem.
- f) Still in the VP, **click on the observation and then open a visit** (any one) to see the detailed constraints. While there are a number of red X's, the lack of any schedulability on the Absolute Orient and Absolute Roll Constraint lines are the key here.

2) Let's try to fix it! We could go back and just try adjusting the position angle by rotating it 180 degrees from what we had, and run the Visit Planner again, as suggested in exercise #1. (Who knows? You might get lucky.) But there is a more deterministic way to fix the problem.

- a) **Remove the Special Requirement and re-run the VP.**
- b) Then **click the VP's *Reports* button and select the *Total roll report*** to diagnose the allowed angles.
 - i) The top plot shows that the available angles are indeed limited for this target.
 - ii) The bottom plot shows two ranges of V3PA availability.
- c) Let's choose the V3PA range from 75-90 degrees, which provides the best availability, and **set a new Special Requirement to this range. View in Aladin with the “Orient**

Ranges” button turned on. Now you can see the problem. The observation does not have availability when the rectangular mosaic FoV is aligned with the galaxy axis.

3) In a case like this, you can still cover the region of interest by “skewing” the mosaic tiles using the “Row shift” and/or “Column shift” controls in the Mosaic tool. **Play with these controls to build a mosaic that provides acceptable coverage of the target** for the new range of V3PA we set above. You might also want to **look at the tile overlaps**. What is your final configuration?

4) Once defined, **use the visit planner to check schedulability**. Does it work now?

Exercise #3: Adding or removing individual tiles in a mosaic

The purpose of this exercise is to make a MIRI mosaic of the main body of the galaxy M51 (aka M51a), remove an unwanted tile, and add an extra tile that covers the companion galaxy (M51b). **Open the Exercise 3 folder in the APT file.**

1) **Create a 4x4 MIRI imaging mosaic covering the bright spiral portion of target M51. Display your mosaic in Aladin and load the DSS image.** By default, the mosaic displays at a V3PA of 0 degrees, and (quite by chance) this covers the bright portion of the galaxy well. (If it didn't, one could choose a different angle.)

a) For the exercise, we will cheat a little bit and tell you that V3PA = 0 is not schedulable. But V3PA = 180 degrees is. So **set a Special Requirement to fix the angle to this value and confirm schedulability with the VP.** (You will see why we fixed the position angle below.)

2) Note that the tile in the upper right corner contains very little emission from the galaxy. So let's remove that one tile to save some time.

a) Figure out which visit corresponds to the upper right tile. **Open the observation to the individual visit level in the tree editor. Select the individual visits until you can confirm which visit is at upper right in the Aladin display.**

b) When you know which tile to remove, **highlight that tile in the *Mosaic Tiles* list at the bottom of the Mosaics tab and use the pull down menu to remove it.** Note the change in the Aladin display.

3) Now let's add a tile to cover the companion galaxy. Note in order to do this, the mosaic must be locked down to a specific position angle (which we did above in step 1).

a) **In Mosaic Properties tab, click “Insert New Observation into Mosaic” button** near the bottom right. Note the changes this makes in the tree editor. A new “Mosaic group” folder has been created that contains the original mosaic observation and a new observation for the added tile. A new target has also been added to the *Fixed Targets* list, with the original target position (center of the mosaic).

Note: The original “Exercise 3” folder is now empty and has become an orphan. You may delete it.

- b) **Select the inserted tile observation in the tree editor, and view in Aladin. In Aladin, grab the new tile and move it to the companion galaxy. Then commit the coordinate change back into the proposal.**
- c) **Now select the Mosaic Group folder and view the entire mosaic with the added tile.** If desired, you can adjust the position of the new tile, but note that it does not actually need to overlap the existing mosaic.
- d) **Check the schedulability of the resulting mosaic using the visit planner.**

A note about the “why” behind this: The added tile is a separate observation, but we want the data processing system to keep all of the tiles together as one mosaic. The Mosaic Group folder is special: all of the observations within that folder will be kept together for processing. So even if two or more extra tiles were added, they would all be processed as a single observation.

Reference materials:

Video Help

[See the APT Playlist of Video Help](#), and especially the [Specifying Mosaics in APT](#) video.

In JDOx:

[JWST Mosaic Overview](#) article

[APT Mosaic Planning](#) article

[APT Simple Mosaic Example](#) article, with an accompanying demonstration proposal; in APT, go to *File* → *JWST Demonstration Proposals* → *Mosaic Example* to load the file.

There is also an article on [How to Split Mosaic Tiles out to a separate observation](#).