ESAC 2017 JWST Workshop
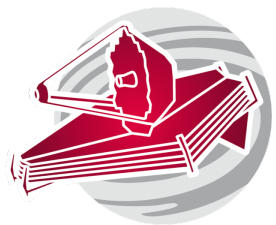
Photometry of Nearby Galaxies: NIR-MIR structure of Arp220
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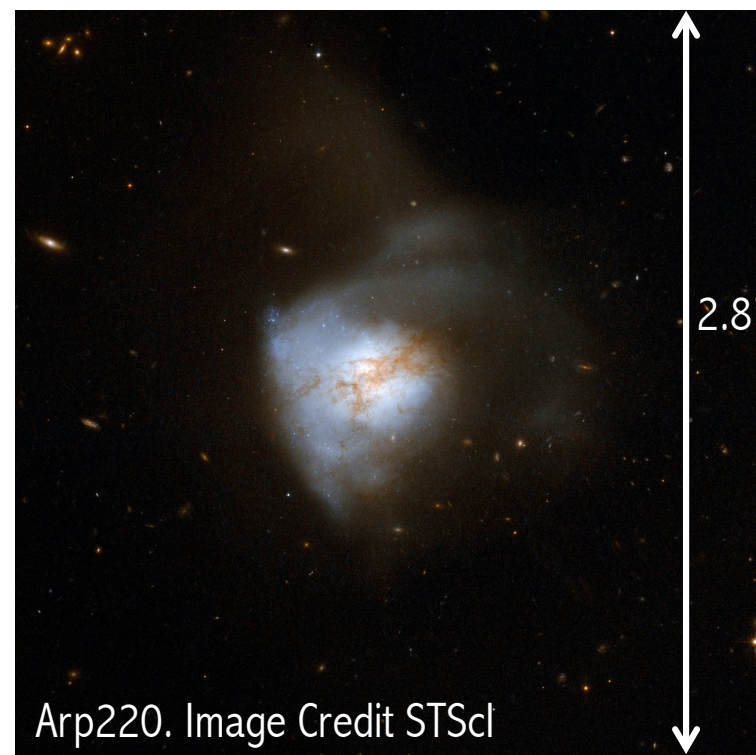
IMAGING

Science Case #2.4

Overview

Goal: This program aims at obtaining NIR imaging data to perform accurate multi-component galaxy model fitting, measure surface brightness fluctuations and radial stellar population gradients. Mid-IR observations will detect the presence of a significant intermediate-age component or warm ISM. The program focuses on unresolved emission, as opposed to detecting individual stars.

Methodology: Obtain Near-IR and Mid-IR imaging of Arp220 using a set of filters that will allow studies of the stellar populations and ISM.

Planned Observations: NIRCam and MIRI imaging in several filters.

Source type: Extended

Analysis technique: Photometry

2.8'

Arp220. Image Credit STScI

ESA Sky

Use ESA Sky to display NIRCam and MIRI on Arp220.

Identify the science aperture (NIRCam/MIRI imaging). Is the use of one NIRCam module justified? Can you cover the galaxy with single pointings of both instruments?

ESA Sky can also be used to download already reduced files of the target from all ESA missions.

Instrument Configuration

NIRCam: Choose a module sufficiently large to image the entire galaxy. Remember you may need to adjust your choice once the subarray is chosen.

MIRI: Imaging.

The detector readout patterns and subarray should be decided when running the ETC. Find readout pattern details in JDocs.

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Instrument Configuration: Filters Selection

NIRCam filters:

- For stellar populations studies: F090W and F115W. They give good color separation between hot and cold stars.
- For ISM studies: F335M for PAHs & F444W for general hot dust continuum. Those are also good filters for additional stellar studies (dusty stars, especially).

MIRI filters:

- For ISM studies: F770W, F1130W and F1280W to trace dust and PAHs.

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Exposure Time Calculator

Arp220 is the closest ULIRG at z=0.018. It is a bright target and hence there is risk of saturation.

Sources and scenes

Source 1: Arp220 template

Create a new source and in the continuum tab select the Arp220 galaxy spectra. Do not renormalize it. Define a extended source and assign a profile and size. Arp200 Is small and the peak in its molecular gas surface density is at radii less than 0.5 kpc

Source 2: Flat source

This will represent the more extended diffuse emission. Define a source with a flat continuum and renormalize it to 28 Abmag, JohsonV.

Scene: Add the two defined sources in a single scene.

Calculations:

Use the define scene to estimate exposure times for NIRCam and MIRI filters below. Aim for SNR of 50 or more.

NIRCam: F090W, F115W, F335M and F444W. Remember you have to use them by pairs.

- **MIRI:** F770W, F1130W and F1280W

Choose a detector configuration that does no saturate. Remember both NIRCam and MIRI have different subarrays that can be used in bright targets to avoid saturation. Use the background region strategy. In these type of detectors mild saturation is not that critical because you can select working the initial unsaturated part of the ramp. However, it can lead to persistence issues and can be problematic in short ramps.

Hints: The number of exposures in ETC can be translated later as the number of dithers *or* exposures in APT. This assumes the coverage achieved through dithers is even, though not all NIRCam dither patterns give uniform coverage.

Astronomer's Proposal Tool

Target: Arp220. Define target using the fix target resolver

Templates:

- Use two templates: NIRCam imaging and MIRI imaging. No parallel observations involved. You will need one observation per instrument.

- For each observation choose the detector subarray used in the ETC

- If needed, choose a dither pattern that will cover the short-wavelength detector gaps (the primary pattern) and a subpixel dither pattern (which will provide good PSF sampling).

- For both MIRI and NIRCam, select the readout pattern and the number of groups, integrations, and exposures that were chosen using the ETC.

Mosaic: If needed define a mosaic to cover similar areas of the main galaxy structure with both instruments. Note the area covered by the different subarrays. Remember that mosaics and dithers will likely not yield 100% redundancy in all pixels, thus the ETC SNR estimation will not apply all over the FOV.

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Astronomer's Proposal Tool

Data Volume Considerations: Are the individual visits running into data volume issues? If so, what are the possible solutions?

Special Requirements: Do you need to impose some (scientifically justified) time or position angle (PA) constraint?

Aladdin Visualization: Use Aladdin to visualize instrument footprints/coverage/dithers. You can play with the orientation there.

Visit Planner: Verify that the program is schedulable, and run smart accounting to remove unnecessary overheads.

Does APT issue any error or warning? If yes, are they acceptable?