ESAC 2017 JWST Workshop

Metallicity gradients in M87, a Virgo giant elliptical. Francesca Annibali, Martha Boyer, Macarena Garcia Marin

Science Case #1.2

Overview

Goal: This program aims at deriving the **spatial metallicity gradient on M87**, one of the largest elliptical galaxies in the Virgo cluster, **using NIR colors of stars as** resolved with JWST NIRCam and NIRISS.

Methodology: Perform stellar photometry and construct NIR color-magnitude diagrams (CMDs). The CMDs will provide information on the metallicity of the stellar populations.

The **NIRCam + NIRISS** configuration has sufficient spatial coverage to study, with just 1 pointing, the metallicity gradients in M87.

Planned observations: NIRCam Imaging (both channels), NIRISS in parallel

Source type: Point sources (stars)

Analysis technique: Photometry

ESASky

Use ESA Sky to find the source of interest, and display the JWST instruments footprint on it.
Identify the science aperture (NIRCam/NIRISS imaging in this case). Are there any gaps in the coverage? Dithers can be used to obtain full spatial coverage, slightly enlarge the FOV, mitigate detector effects etc. Note that in general dithers are mandatory in the APT templates.

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

Instruments Configuration

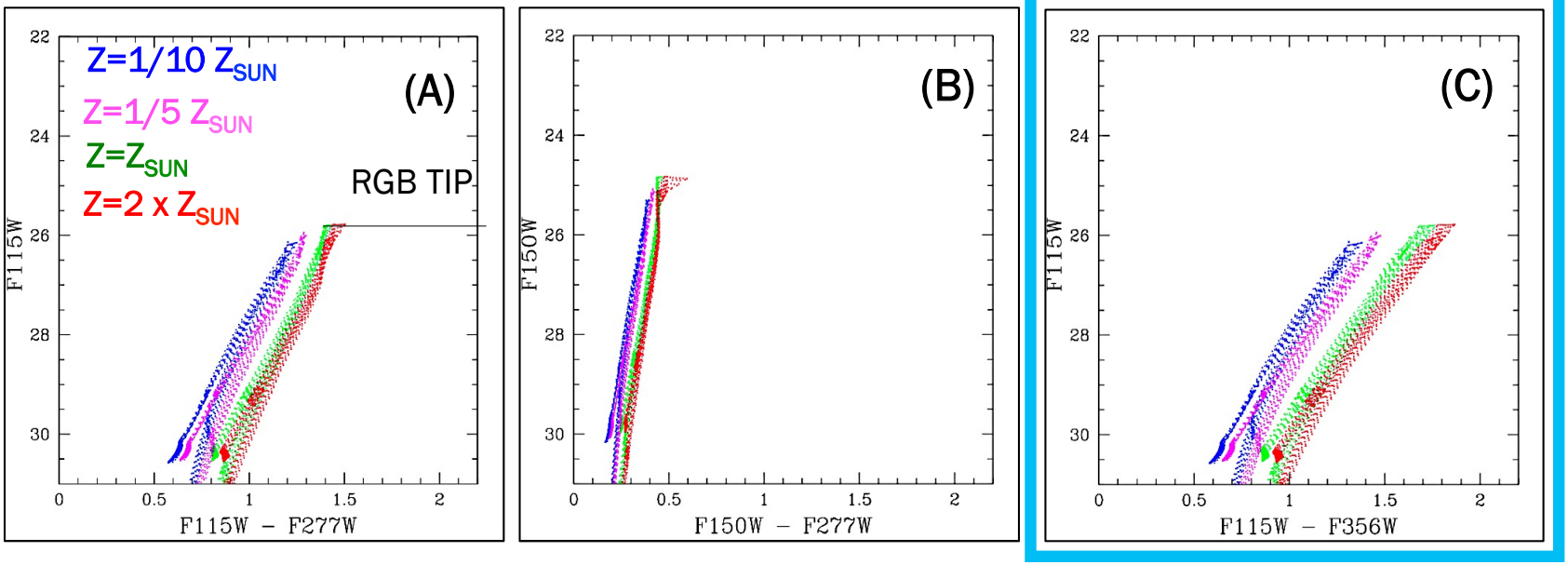
NIRCam: Two modules, FULL array.

NIRISS: In parallel, FULL array.

Detector readout pattern should be decided when running the ETC. Find readout patterns details in JDox.

IMAGING

Instruments Configuration: Filters Selection



- Assumed **D=17 Mpc** , or $(m\text{-}M)_0$=31.15
- Parsec isochrones (Bressan et al 2012) for age > 5 Gyr and different metallicities in the JWST/ NIRCam filters
- Combine a filter in the NIRCam short wavelength channel + a filter in the long wavelength channel to optimize observations
- Filter combination needs to provide a large color separation for different metallicities; for instance, case (B) is not a good choice, while (A) and (C) potentially are. We will use (C), F115W and F356W in both instruments.

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Exposure Time Calculator

Requirements: Photometric error better than 0.1 mag (SNR≈10) down to ≈2 mag below the TRGB (i.e., F115W≈28, K5III star).

Implementation: Set up a scene with a K5III star, and derive the Ngroups, Nints and Nexp necessary to achieve SNR ≈10 or higher in F356W and F115W in both NIRCam and NIRISS. Choose an adequate detector readout pattern.

Set up another scene using a K5III bright star (F115W=21.5 mag). Balance the planned observations so there is not saturation in the bright star but the faint one is measurable to the desired SNR. These observations do not require an offset background, as information can be obtained from the data itself.

Hints: The Nexp. defined in the ETC can be translated later as Number of dithers/ exposures to be implemented later in APT. The SNR given by the ETC assumes full redundancy in the dithers per pixel.

- For NIRCam in general do not use integrations longer than ~1500 seconds, to avoid cosmic rays issues.
- NIRCam is prime, hence the NIRISS exposure time cannot go longer than the NIRCam one. Is that imposing any penalty in the expected NIRISS SNR?

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Astronomer's Proposal Tool

Target Coordinates:

RA: 12:30:46.7 DEC: +12:21:20.3 (Note this is not the galaxy nucleus)

Template:

- NIRCam Imaging with NIRISS imaging in parallel (coordinated).
- Both NIRCam modules in FULL array mode. Select an adequate readout mode.
- Choose a dither pattern that will cover the inter-module gap. Use NIRISS in FULL array and the detector readout pattern used in the ETC. NIRISS does not have two modules but we want to use two filters. So you will have to define different observations.

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 constraint?

For this case we don't require PA constraints.

Aladdin Visualization (*): Use Aladdin to visualize instruments footprints/ coverage/dithers. You can also play with the orientation.

Visit planner: Verify when the program can be scheduled.

Do you have error or warnings in APT? If yes are they acceptable?

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