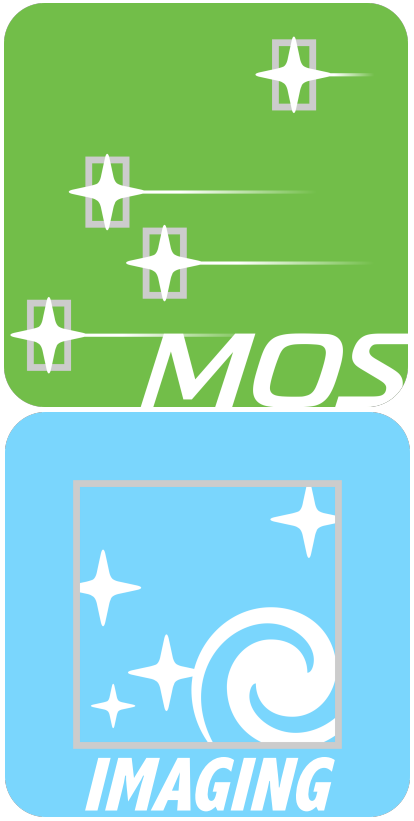
ESAC 2017 JWST Workshop



Brown-dwarfs in star-forming clusters

Catarina Alves de Oliveira (ESA)

Science Case #3.1

Overview

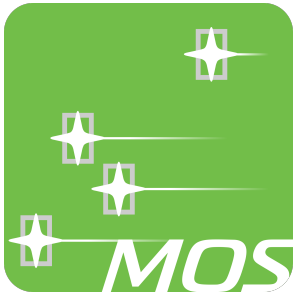
Goal: To improve constraints on the minimum mass of the IMF and search for a spectroscopic signature of formation mechanism by obtaining near-IR spectra of known and candidate brown dwarfs in the nearby star-forming cluster IC 348 in Perseus.

Methodology: Obtain NIRCam images of the center of IC 348 to identify new candidate planetary-mass brown dwarfs. Follow-up candidates by acquiring NIRSpec low-resolution spectra from 0.6 to 5.3μm to assess their (i) youth and membership to the cluster, (ii) surface gravity, (iii) temperature, and (iv) investigate the presence of heavy elements enrichment as a clue to the formation process.

Planned observations: NIRCam imaging and NIRSpec MOS

Source Type: Point source (occasionally extended source)

Analysis technique: Photometry and Spectroscopy



Instruments configuration

NIRCam: Imaging, Two modules, FULL array, 2rows x 1column mosaic

NIRSpec: MOS, 4 pointings

Detector readout pattern of choice should be decided when running the ETC.

Dithering strategy should be decided when running the ETC, and investigating NIRCam footprint on-sky.

Find readout patterns and dither details in JDox.

Instruments configuration: filters and dispersers selection

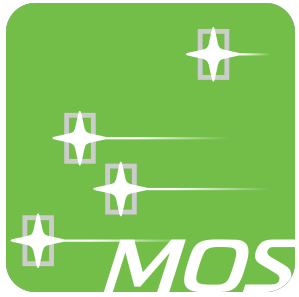
NIRCam: candidate brown dwarfs will be selected based on positions in various colour-magnitude diagrams. Selected filters are, e.g.:

Short wavelength channel: F140M / F162M+F150W2 / F182M

Long wavelength channel: F277W / F360M / F444W

NIRSpec: spectroscopic follow-up will be done at low resolution. Selected disperser is:

Low resolution: PRISM



Target: IC 348

Name: IC 348

Coordinates: RA 03:44:34.28 Dec +32:09:43.10

Exercise catalogue: Luhman+2016_CensusCatalogue_RADecOnly.txt

(Reference: Luhman et al. 2016)

Model prediction of low-mass brown-dwarf magnitude *(e.g.)*:

JWST NIRCam/SW_IMAGING F162M+F150W2 ~ 24 mag (Vega)

Approx. expected temperature: ~1000K

Visibility tool

Target's visibility: Run the target visibility tool to find out when this target is visible and which orients will be available.

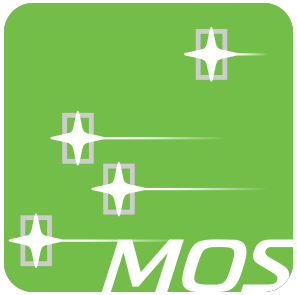
Use that information to check in ESA sky, or in Aladin/APT, how the NIRCam and NIRSpec footprints map the cluster for the allowed orients.

ESA Sky

Use ESA Sky to find the cluster of interest, and display the JWST instruments footprint on it.

Identify the science apertures (NIRCam and NIRSpec).

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



Exposure Time Calculator

Requirements: NIRCam S/N>5 in all filters

NIRSpec S/N>10 @ 1.6μm

Implementation: Set up a scene with a ~1000K blackbody as a source and normalize it using the information provided before. Derive Ngroups, Nints and Nexp necessary to achieve the above S/N. Choose an adequate detector readout mode for each instrument. Consider which dither pattern will be used for each instrument.

Hints:

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

Astronomer's Proposal Tool

Name: IC 348

Coordinates: RA 03:44:37.00 Dec +32:07:14.00

Template:

NIRCam imaging: plan a mosaic to image the central parts of the cluster

NIRSpec MultiObject Spectroscopy: use the MPT and the auxiliary catalogue provided to create 4 sample MSA plans, and add them as 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 add information to highlight that imaging observations will be taken in the same cycle? What about the MSA orient?

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.

Add-on: Try adding additional NIRCam imaging observations as a parallel to the NIRpec MOS observations.