NIRCam WFSS Recommended Strategies

Guidance is provided for astronomers preparing JWST NIRCam WFSS observations using the Astronomers' Proposal Tool (APT).

Introduction

Below we provide guidance for preparing NIRCam wide field slitless spectroscopy (WFSS) observations in APT. This complements the step-by-step instructions given in the NIRCam Wide Field Slitless Spectroscopy Template APT Guide.

Here, we give advice on how to choose amongst the available grisms, cross filters (for use with the grisms), imaging filters (for the mandatory accompanying imaging of the field), and mosaicking strategies.

Similarity with NIRCam imaging

Several NIRCam Imaging Recommended Strategies are relevant and applicable to NIRCam WFSS observations. In particular, **one should follow the same practice for Dither Pattern, Readout Pattern, Data Volume and Overheads** as NIRCam Imaging Recommended Strategies.

Below we give additional WFSS-specific recommended strategies.

Cross filter

The choice of cross filter affects the effective field of view. Any filter that is not close to 4μm will result in a reduction of the effective field of view (FOV). Also, objects that are slightly out of the FOV of the detector itself but are within the FOV of the pick off mirror will produce a spectrum. The following shows an example for F250M crossed with the GrismR (spectra dispersed along the row direction) and GrismC (spectra dispersed along the column direction). The NIRCam WFSS Field of View page shows all the possible cases.

Figure 1. NIRCam WFSS effective field of view with F250M filter
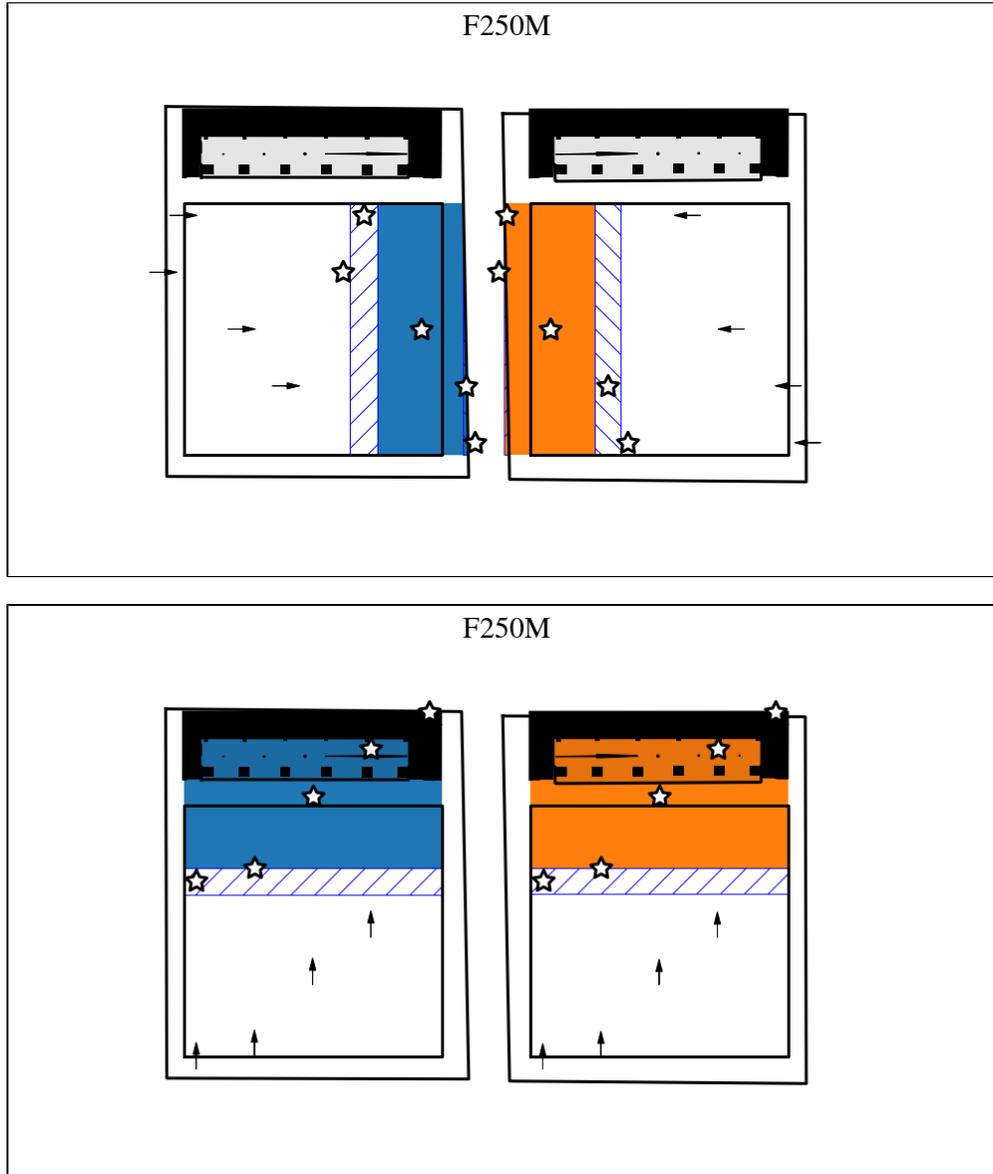
Effective field of view when the F250M filter is combined with Grism R (top) and Grism C (bottom). Each star represents a source yielding a spectrum illustrated by a corresponding arrow. The spectrum is dispersed along the length of the arrow with wavelength increasing toward the arrow head. Sources are within the full spectrum field of view if their spectra fall completely within a detector's field of view (black square outlines). The full spectrum field of view is shaded blue for module A (left) and orange for module B (right). However, note that for Grism C, the coronagraph masks (illustrated at top) may impact some spectra. Sources within the regions with diagonal stripes yield partially truncated spectra. The effective field of view includes both the striped and shaded regions. The outer black rectangles indicate the full regions that receive incoming light from NIRCam's pick off mirrors. Sources outside those regions do not yield spectra.

The choice of a very wide filter will result in many truncated spectra. For example, using F322W2 only provides full wavelength coverage for a narrow region near the center of the bandpass.

Grism

Observations with both grisms are useful to mitigate confusion from overlapping spectra. Observations obtained using multiple orientations can also be essential to unambiguously identify emission lines. However, complete spectra from both grisms are only obtained for sources within the optimal fields (see NIRCam WFSS Field of View).

When using GrismC, the coronagraph substrate will affect the observations in two ways: 1) objects occulted by the neutral density filter or coronagraph features will not produce a spectrum. 2) Other objects within the coronagraph will be affected by the reduced transparency of the coronagraph substrate. This will make modeling and extracting these spectra more complicated. Note however that the redder filters (F444W, F460M and F480M) are not affected by the coronagraph when used with the GrismC. This can be see in the NIRCam WFSS Field of View page.

The GrismC mode will in general result in a higher background level than the GrismR mode. This is because of additional sky area that is picked up by the pick off mirror around the coronagraph. Using medium band filters can result in a significantly lower dispersed background, which may be essential to reach faint emission lines or continuum light. The page NIRCam WFSS Backgrounds shows the structure of the background when GrismR and GrismC are used with different filters and lists the expected level of dispersed background in each case.

Imaging filter

In principle, APT allows to choose, for the mandatory pre-imaging, a filter that is different from the one chosen for the following grism observation(s). It is generally preferable to use the same filter, e.g., F356W coupled with F356W/GrismR. There are two reasons for this: The first is that modeling of the field (to compute contamination) will be more accurate if the broadband photometry matches the bandpass of the grism observations. The second is that there might be "wedge offsets" between different filters. As of now, this is believed to be a small effect, but the use of a different filter for imaging might result in a small offset between the grism observations and the broadband observations. This will affect the assumed location of the trace and for small unresolved objects can be important even if these offsets are small (<0.1 pixel). These offsets would also affect the wavelength calibration of the spectra.

Mosaic

Designing a mosaic using WFSS is not a very efficient process. It necessarily involves choosing between continuity of the field of view and possible overlap of grism observations taken using diffent grisms and/or orientation of the sky. Several mosaic examples are shown in the NIRcam WFSS Deep Galaxy Observations page.