NIRISS AMI-Specific Treatment of Limiting Contrast

Treatment of limiting contrast (C_{limit}) is based on current information about telescope aberrations and the expected performance of JWST NIRISS/AMI.

Introduction

> *Parent article: JWST High-Contrast Imaging*
> *Main articles: NIRISS Aperture Masking Interferometry, NIRISS Bright Limits*
> *See also: NIRISS Non-Redundant Mask*

Limiting-contrast ($C_{limit}(s)$) is the companion-to-host flux ratio of the minimum detectable companion. It is the detection limit and the best that can be done.

See the article Contrast Considerations for JWST High-Contrast Imaging for a general treatment of "contrast" (C), including $C_{limit}(s)$ in particular.

$C_{limit}(s)$ is a function of essentially *everything* related to high contrast imaging (HCI): myriad eclectic technical factors and procedures, end-to-end.

This treatment of $C_{limit}(s)$ for NIRISS/AMI is based on Greenbaum et al. (2015).

Limiting contrast, $C_{limit}(s)$, for NIRISS/AMI

Figure 1 shows the best available treatment of $C_{limit}(s)$ for the NIRISS AMI. This graphic is adapted from Figure 6 in Greenbaum et al. (2015).

The "technical factors" or assumptions behind the curves in Figure 1 include:

- Theoretical binary target
- Good flat field measurements with sub-pixel accuracy by precise positioning
- No variation of sensitivity within a pixel (intra-pixel sensitivity, or IPS)
- Negligible phase-closure errors due to static piston in the pupil
- Companion-to-host flux ratio $C_{flux} = 10^{-2}$ (solid curves) and $C_{flux} = 10^{-3}$ (dashed curves)
- False-alarm probability (unknown)

- Currently available estimates of JWST aberrations (outdated)
- Filters F277M and F430M

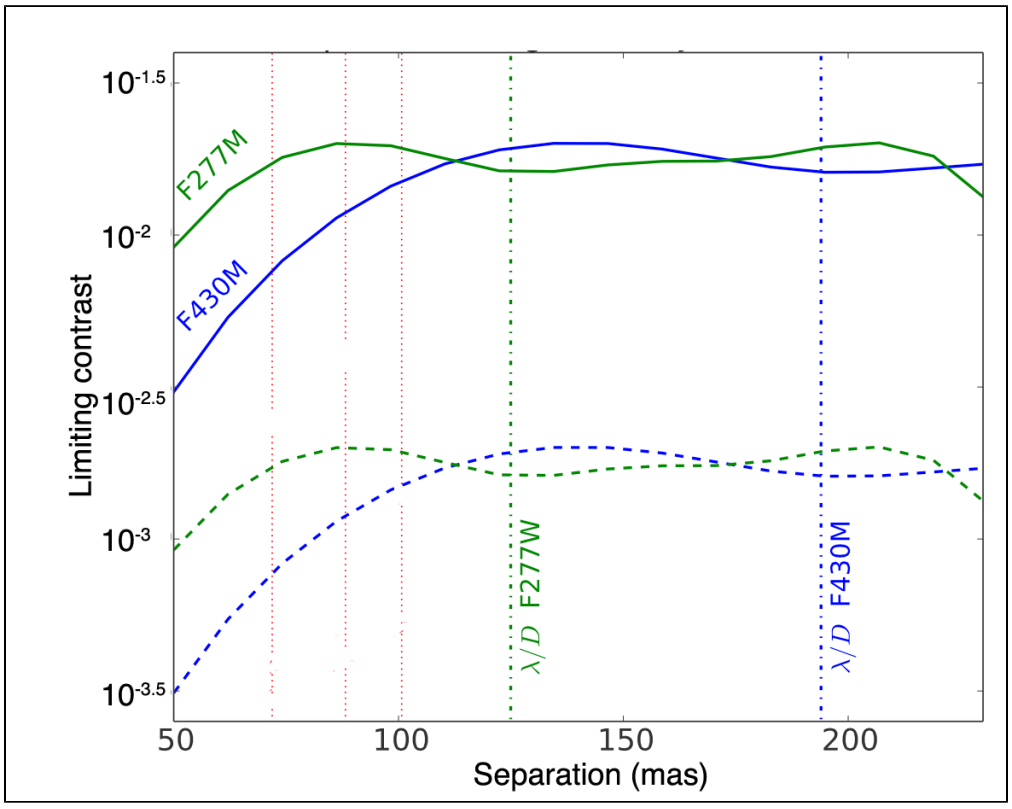
Under those assumptions, Figure 1 shows the estimated limiting contrast ratio for 5-sigma detection of a faint companion near a bright host as a function of their apparent separation *s* in mas.

If the user's operating point (s, C_{flux}) lies above a color curve, that source is detectable under the technical and procedural assumptions of Greenbaum et al. (2015).

This is the best information on limiting performance for NIRISS/AMI at the current time. In the future, with a better understandings of wavefront errors and other technical factors—or when users become interested in different combinations of technical factors—improved calculations of $C_{limit}(s)$ will be made available.

Meanwhile, users may be able to extrapolated estimates of $C_{limit}(s)$ using the Exposure Time Calculator (ETC) and other proposal tools.

Figure 1. NIRISS AMI limiting contrast example



Example of estimating HCI limiting performance for NIRISS/AMI. Adapted from Figure 16 in Greenbaum et al. (2015).

References

Greenbaum, A.Z., Pueyo, L., Sivaramakrishnan, A., et al. 2015, ApJ, 798, 68
An Image-Plane Algorithm for JWST's Non-Redundant Aperture Mask Data