JWST Pointing Performance

JWST's in-orbit predicted performance for slewing accuracy and pointing stability are based on structural, thermal, and optical models. Actual values will be obtained during commissioning activities.

Introduction

> *Parent page: Observatory Hardware*
> *See also: JWST Slew Times and Overheads*

The spacecraft's attitude control system (ACS) controls the pointing and slewing of JWST. This page summarizes the *predicted* pointing performance, based on structural, thermal, and optical models of the Observatory Hardware. Actual performance will be characterized after launch during the commissioning period.

Definitions and units

Pointing accuracy is expressed as the 1-σ uncertainty per axis, meaning the two orthogonal axes in the plane of the sky. However, the 1-σ radial uncertainty, which is larger than the per-axis uncertainty by a factor of 1.52, is often more relevant to users. In either case, the units are arcseconds or milliarcseconds (mas).

Absolute pointing accuracy

The absolute fine pointing accuracy, without a science target acquisition, is expected to be 0.45" to 0.30" (1-σ radial error), depending on the distance between the guide star and the science instrument aperture. This uncertainty is dominated by guide star catalog position errors and pointing errors due to roll control.

Target acquisitions, which are needed for spectrographic fixed slits, IFUs, and coronagraphic observations, further refine the pointing to the level of accuracy for offset slews, as shown in Table 1.

Pointing stability

For fixed targets, the pointing stability is evaluated as the root-mean-square (RMS) error in the guide star position in any 15 s interval, compared to the mean position over a 10,000 s observation. The predicted stability varies slightly from instrument to instrument, from 6.0 mas (NIRCam and NIRISS) to 6.7 mas (MIRI), 1-σ error per axis. The pointing stability includes several forms of "image motion" that determine the overall optical image quality and the telescope point spread function.

For Solar System (i.e., moving) targets, the line-of-sight pointing stability is evaluated as the RMS mean over a 1,000 s observation, for a linear rate of motion of 3.0 mas/s. This is estimated to be 6.2 to 6.7 mas, 1-σ per axis, depending on the instrument. This is much better than the required stability (16.7 mas, 1-σ per axis). At the maximum permitted rate of motion, 30 mas/s, models indicate that the pointing stability will be very similar to the slower 3.0 mas/s case.

Offset slew accuracy

Instrument field of view offsets, after guide star reacquisition, are predicted to be very accurate, generally less than 5 mas, 1-σ, per axis. This type of offset is used for dithers and target acquisitions.

Table 1. Offset angle uncertainties

Offset angle (arcseconds)	Uncertainty (mas, 1-σ, per axis)	Uncertainty (mas, 1-σ, radial)
0.0–0.5	4.0	6.1
0.5–2.0	4.2	6.4
2.0–20	4.6	7.0
20–45	5.3	8.1

References

Coe, D. 2009, arXiv:0906.4123v1 [astro-ph.IM]
Fisher Matrices and Confidence Ellipses: A Quick-Start Guide and Software