JWST TECHNICAL REPORT

Title: A Summary of the Commissioning of JWST NIRISS	Doc #: JWST-STScI-008232, SM-12 Date: 4 Aug 2022 Rev: -
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1 Abstract

We summarize the on-orbit activities and results of the commissioning of the science instrument Near-Infrared Imager and Slitless Spectrograph (NIRISS) during the six-month period following the launch of the James Webb Space Telescope (JWST). The activities were grouped into four categories as the commissioning campaign progressed: engineering, instrument focus, astrometry, and science. We present the timeline and execution of the activities, anomalies that were encountered and resolved, and updates made to items of the Project Reference Database (PRD) and to the reference files of the calibration pipeline. We also summarize the usage of the internal lamps and the wheel and focus mechanisms. The instrument successfully met all its performance criteria and was declared ready for all future calibration and science activities.

2 Scope and Goals

After the launch of JWST on Dec 25, 2021, the NIRISS activities officially began on Jan 28, 2022 when the instrument was powered on. As discussed in the detailed pre-launch commissioning plan prepared by Martel (2021a), the primary goals of the commissioning of NIRISS were to:

a. Verify the health and safety of NIRISS and monitor the relevant telemetry to ensure that the instrument subsystems are operating as expected.
b. Verify the operations of all the engineering and science modes of NIRISS by exercising the templates of the Astronomer's Proposal Tool (APT) with instrument configurations that closely match those of the calibration and science programs.
c. Verify all aspects of the coordinated and pure parallels by including NIRCam and MIRI in parallel to NIRISS, NIRISS in parallel to another science instrument (SI), and by attaching dark exposures from other SIs to NIRISS exposures (and vice-versa).

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d. Ensure that the Data Management Subsystem (DMS) and the JWST calibration pipeline produce accurate and complete output products in the Mikulski Archive for Space Telescopes (MAST) in a timely fashion.
e. Update the relevant reference files for the calibration pipeline.
f. Update the relevant items in the PRD, if necessary, including uploads to the Observatory before the start of the science programs in Cycle 1.

The science and calibration modes of NIRISS are described in in Goudfrooij (2021).

3 Launch Configuration

The launch configuration of NIRISS was straightforward. The Pupil Wheel (PW) and Filter Wheel (FW) were in the GR700XD and CLEAR positions, the default configuration for the SOSS mode. This choice ensured that NIRISS could remain scientifically productive if the wheels could not be moved to other positions. The position of the Coarse Focus Mechanism (CFM) was $+0.338$ OTE mm (or $+3.603$ CFM mm) as measured in the CV3 ground cryo campaign at the Goddard Space Flight Center (GSFC) and adjusted for $0g$. The environment flag from the On-board Script Subsystem (OSS) was set to VARIABLE to prevent the wheels from moving during the cooldown and violating their thermal constraints. The NIRISS Flight Software (FSW) was Build 7.1 as part of the ISIM IFSW 14.54.

4 The Activities

The details of the NIRISS activities were captured in Commissioning Activity Requests (CARs) that were developed and updated over several years after consultation with the relevant stakeholders (STScI, Université de Montréal, Honeywell, and CSA). The activities were implemented as APT programs or with Real Time Control Procedures (RTCPs) or both.

The commissioning activities encompassed four broad categories:

a. Detector performance: glow rate, read noise, bias level, cross talk, persistence, intra pixel response, IPC, bad pixel population, gain, rate of cosmic ray hits and snowballs
b. Optical performance: wavelength and field dependence of the PSF metrics, focus, imaging and spectroscopic ghosts (Martel 2018), flat fields, alignment, vignetting, rogue paths, and stray light
c. Absolute, relative, and differential photometry and spectrophotometry between the NIRISS modes, full frames and subarrays, and cross-SIs (and possibly cross-observatory, e.g., Hubble Space Telescope (HST) and Spitzer) for common targets
d. Wavelength calibration of the grisms

Most quantities were measured directly as part of the primary analysis of the different programs and when possible, monitored for trends, but some were also measured as secondary products.

Throughout the commissioning campaign, an Excel spreadsheet of all the activities, observations, exposures, dates and times, instrument configuration, and mechanism usage was maintained. A total of 351 observations were made and 2171 exposures were collected for a grand total of 5.85 days in exposure time. This spreadsheet is available on the STScI Outerspace site (https://outerspace.stsci.edu/display/NC) or upon request from Martel.

4.1 NIRISS as Prime

The main activities designed by the NIRISS team and executed in the commissioning campaign are listed in Table 4-1 in chronological order of their execution. The unique number of the CAR assigned by the STScI and NGAS teams, the ID of the APT program, if applicable, and the title and brief description of the activities are tabulated. The programs were naturally divided into four parts: Engineering, Focus, Astrometry, and Science. NIRISS is the prime instrument and in the two GR150C/R programs (NIS-015 and NIS-016), observations were made with NIRCam and MIRI as coordinated parallels. The two astrometry programs also included parallel imaging with the two FGS channels.

Table 4-1. NIRISS Prime – NIRISS Team Programs

STScI CAR	NGAS CAR	APT	Title	Description
Part 1: Engineering				
NIS-000	820	–	Power On	NIRISS is powered on.
NIS-001	340	–	Instrument Initialization	Initialize NIRISS for all future calibration and science activities.
NIS-002	341	1078	Aliveness and Functional Tests	Ensure that NIRISS is ready for operations by collecting full-frame and subarray exposures in the DW launch configuration in the NIS and NISRAPID readouts and with the four internal lamps.
NIS-004	343	1079	PW Calibration	Determine if the PW moves to its expected position by triggering the VR sensor when landing at position 1 (F090W).
NIS-005	344	1080	FW Calibration	Determine if the FW moves to its expected position by triggering the VR sensor when landing at position 1 (GR150R).
NIS-024	757	–	FPA Heater On	Activate the FPA heater control loop once the nominal operating temperature of NIRISS has been reached and increase the FPA temperature by the default value of +0.5 K.
NIS-006	345.1 to 345.6	1081	Darks	Measure and trend the detector properties for full frames and subarrays in the allowed readout modes.
NIS-007	346	1082	Calibration Lamps Verification	Verify the health and performance of the four internal calibration lamps at their nominal power level and at one additional level.
NIS-008	347	1083	Internal Flat Fields	Collect internal flat field exposures through all the medium- and broad-band filters of the DW as well as the GR700XD grism.
NIS-009	348	1084	Detector Gain and Linearity	With internal flat fields, measure the detector gain of each channel of the detector with the photon transfer method as well as the saturation and linearity correction coefficients of each pixel.
Part 2: Focus				
NIS-010	373.3	1085	CFM Focus Sweep	Collect confirmation exposures in the different science modes at best focus.
Part 3: Astrometry				
NIS-011	374	1086	External Flat Fields (L-flats) and Distortion	Update the low-frequency component (L-flat) of the high S/N-ratio ground flats by observing a mosaic of the LMC astrometric field. Also measure the geometric scale factors and distortion coefficients as well as the relative gain and photometry between the full frame and subarrays. FGS is in parallel.

STScI CAR	NGAS CAR	APT	Title	Description
NIS-013	376	1088	NIRISS-FGS Alignment and SIAF Update	Measure the relative positions of FGS1, FGS2, and NIRISS and update the SIAF file in the PRD. Also measure the filter-to-filter offsets.
Part 4: Science				
NIS-021	705	1095	Stray Light Contamination	Evaluate the presence and intensity of glints and scattered light by observing a bright source along the edges and outside the FOV with imaging and GR150C/R spectroscopy.
NIS-022	706	1096	PSF Characterization	Characterize the core and extended wings of the PSF of a bright, isolated star over a large dynamic range.
NIS-020	707.1	1094	Photometric Zeropoints	Measure the photometric zeropoints of NIRISS in all the permitted imaging combinations of the PW and FW, including the NRM. Characterize the stability of the photometry at two epochs.
NIS-015	699	1089	GR150C/R Flux Calibration	Characterize the sensitivity of the different spectral orders of the GR150C and GR150R grisms of the WFSS mode with a JWST flux standard star. NIRCam imaging is a coordinated parallel.
NIS-018	702	1092	GR700XD Wavelength Calibration	Derive the wavelength dispersion solution of the GR700XD grism by observing an M-type star as a wavelength calibrator.
NIS-019	703	1093	NRM Performance	Characterize the performance of the NRM with a known binary system and reference stars.
NIS-016	700	1090	GR150C/R Wavelength Calibration	Derive the wavelength dispersion solution of the GR150C/R grisms by observing an emission-line source as a wavelength calibrator. MIRI imaging is a coordinated parallel.
NIS-017	701	1091	GR700XD Flux Calibration	Characterize the location, orientation, and sensitivity of the different spectral orders of the GR700XD grism with a JWST standard flux star. Also characterize the stability of the SOSS mode with a TSO.
NIS-020	707.2	1094	Photometric Zeropoints	Measure the photometric zeropoints of NIRISS in all the permitted imaging combinations of the PW and FW, including the NRM. Characterize the stability of the photometry at two epochs.
NIS-034	910	1541	Sensitivity and Stability for Transiting Exoplanet Observations	Characterize the sensitivity and stability of the SOSS mode by observing the primary transit of a known exoplanet.

The Wavefront/Optical Telescope Element (OTE) team also made use of NIRISS as a prime instrument. Their executed programs are listed in Table 4-2. The two FGS channels alternated as parallel to NIRISS in OTE-011, as in NIS-013.

Table 4-2. NIRISS Prime – OTE Programs

STScI CAR	NGAS CAR	APT	Title	Description
OTE-011	853.1	1145	SIAF PRD Update (NIRISS-FGS Alignment)	Empirically determine the field angle location, orientations, scale (and other low-order distortions), and update the SOC PRD's NIRISS_SIAF.xml file to capture these measurements.
OTE-028	193	1165	Pre-MIMF In-Focus PSF Check – 1	Examine the PSF quality across all the SI FOVs prior to conducting a round of MIMF sensing.

STScI CAR	NGAS CAR	APT	Title	Description
OTE-028	69.10	1464	Pre-MIMF In-Focus PSF Check – 2	Examine the PSF quality across all the SI FOVs prior to conducting a round of MIMF sensing.
OTE-029	68	1166	MIMF Measurement – 1	Measure the multi-field errors using NIRCam, NIRSpec, FGS, NIRISS, and MIRI.
OTE-029	84	1465	MIMF Measurement – 2	Measure the multi-field errors using NIRCam, NIRSpec, FGS, NIRISS, and MIRI.

Lastly, NIRISS helped address some important issues at the Observatory level, such as the pointing dependence of the stray light and background and moving targets. These activities are listed in Table 4-3.

Table 4-3. NIRISS Prime – Observatory Programs

STScI CAR	NGAS CAR	APT	Title	Description
FGS-015	164.2	1021	Moving Target Test with NIRCam and NIRISS	Demonstrate that the Observatory can point and track a moving target in a NIRISS aperture and that the ground system can handle and process such data.
FGS-017	774.5	1022	Giant Planet Scattered Light	Characterize any scattered light from Jupiter at different locations around the FOV of NIRISS.
STL-02	754.1 754.2 754.3	1448	Stray Light Model Correlation	Evaluate the stray light performance of the Observatory from the near-IR to the mid-IR at five different pointings and characterize the background in the NIRISS GR150C/R grisms.

4.2 NIRISS as a Coordinated Parallel

NIRISS was included as a coordinated parallel instrument in two programs, listed in Table 4-4.

Table 4-4. NIRISS as a Coordinated Parallel

STScI CAR	NGAS CAR	APT	Title	Description
THS-02	819.3	1446	Thermal Slew - Hot Attitude Activities	Measure the roll and pointing stability of the Observatory after slewing to the hot attitude by imaging a star field with NIRCam and NIRISS in parallel. The APT template is NIRCam Imaging – NIRISS Imaging.
NRC-010	120.1 120.2 120.3 120.4 120.5	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	In parallel to NIRCam, observe the zodiacal light along the ecliptic plane to assemble flat fields in some NIRISS filters. The APT template is NIRCam Imaging – NIRISS Imaging.

4.3 Additions, Withdrawals, and Modifications

New observations were added to some programs to investigate problematic issues while others were withdrawn because they were deemed unnecessary in light of the on-orbit results. In a few cases, simple modifications or adjustments were made to the nominal observations of the programs listed in Sections 4.1 and 4.2.

4.3.1 Additions

The additions that were made to the programs are tabulated Table 4-5 and summarized in the following. The observation numbers are given in Section 7.

a. Early in the cooldown period, observations with dark exposures were added to some programs to force a flush of the Solid State Recorder (SSR) so the exposures could be processed and delivered to the archives in a timely manner. Some of these darks served to characterize the elevated count rates attributed to radiation from the MIRI Heat Exchanger Stage Assembly (HSA) leaking into the NIRISS cavity (Martel 2022d). With these new observations, this contaminating background was measured before and after the HSA was turned off.
b. Early measurements of the throughput with two flux standard stars were made in coordination with NIRCam and NIRSpec teams.
c. The background in GR700XD was measured with a mosaic on the zodiacal light.
d. After the unexpected discovery of "claws" and "wisps" in the NIRCam zodiacal flat fields, additional observations were added to NRC-010 to investigate a potential rogue light path into NIRCam (AR-753). Many NIRISS exposures were therefore added in parallel to the NIRCam exposures. For some of these observations, the temperature of the NIRISS FPA was not yet stable, the SIAF had not been updated, and the CFM had not been adjusted to its final value.
e. After the position of the FGS Fine Focus Mechanism (FFM) was adjusted, confirmation observations were taken with NIRISS and FGS as a coordinated parallel.
f. Additional executions of NIS-024 FPA Heater On were performed during the recovery of NIRISS after the Observatory or ISIM failed on three separate occasions (AR-963, AR-1000, AR-1457).
g. Observations were added to map the region of susceptibility along the V2 and V3 axes on the sky inside which a bright star produces the light saber feature on the NIRISS detector (AR-833). These observations were added to NIS-011 (1086 and a copy of it, 2740).
h. NIRISS exposures in a 2 × 2 mosaic were added to NRC-005 (1059) to characterize any possible vignetting by observing the zodiacal background in the ecliptic plane.

Table 4-5. Addition of Observations

Addition	Programs
SSR buffer flush and elevated count rates from the MIRI HSA	NIS-004 PW Calibration (1079) NIS-005 FW Calibration (1080) OTE-010 SIAF PRD and Onboard Updates for NIRCam and FGS (1144) OTE-011 SIAF PRD Update (NIRISS-FGS Alignment) (1145)
Early measurements of the throughput	NIS-005 FW Calibration (1080)
Background in GR700XD from the zodiacal light	NIS-034 Sensitivity and Stability for Transiting Exoplanets (1541)
Imaging flat fields on the zodiacal light	NRC-010 NIRCam (and NIRISS) External Flats (Zodiacal Light)
Confirmation after adjustment of the FGS FFM	FGS-011 FGS Geometric Distortion and Scale (1018)

Addition	Programs
FPA heater turnon in recovery from safe haven	NIS-024 FPA Heater On
Map the susceptibility region of the light saber feature	NIS-011 External Flat Fields (L-flats) and Distortion (1086, 2740)
Vignetting check on the zodiacal background	NRC-005 NIRCam Pre-Coarse Phasing Vignetting Check

4.3.2 Withdrawals

Several observations were withdrawn or skipped. They are tabulated in Table 4-6 and summarized here:

a. Since the first instance of OTE-011 SIAF PRD Update (NIRISS-FGS Alignment) (1145) showed that the SIAF alignment offset was only (ΔV2, ΔV3) = $(-0.014, +0.072)$ arcsec, much smaller than the wavefront team's threshold of 1″, the second instance of this program was withdrawn.
b. Since the Observatory and the SIs were declared to be in focus after OTE-029 MIMF Measurement – 2 (1465), the third instance of this program was retired.
c. The two instances of NIS-032 MIMF SI Focus (1289) were removed as well as the CFM focus sweep and adjustment in NIS-010 CFM Focus Sweep (1085) since the OTE activities showed that NIRISS was already at best focus and no adjustment of the CFM was necessary.
d. In one of the instances of THS-02 Thermal Slew – Hot Attitude Activities (1446), NIRISS was substituted with FGS2.

Table 4-6. Withdrawn Observations

Withdrawal	Programs
Excellent SIAF alignment offset	OTE-011 SIAF PRD Update (NIRISS-FGS Alignment) (1145)
Observatory and SIs in focus	OTE-029 MIMF Measurement – 3 (1474)
NIRISS in focus	NIS-032 MIMF SI Focus – 1, 2 (1289) NIS-010 CFM Focus Sweep (1085) (full sweep and adjustment)
NIRISS substituted for FGS2	THS-02 Thermal Slew – Hot Attitude Activities (1446)

4.3.3 Modifications

The majority of the modifications were minor, such as changing the number of integrations and/or groups in some programs because of the improved in-flight throughputs. In other cases, one or more filters were also changed. In the third execution of OTE-028 Pre-MIMF In-Focus PSF Check – 3 (1473), after the best focus was achieved, the astrometric field was observed with NIRISS in parallel to NIRCam for a Press Release on Apr 28, 2022. The program NIS-018 GR700XD Wavelength Calibration (1092), initially scheduled in the cold attitude, was instead executed after this period because of the more favorable target visibility.

4.4 Contingency Activities

Several contingency activities were developed by the NIRISS team (Table 4-7). These were concerned with the loss of the PW or FW position, adjustment of the tilt of the grism traces, the ASIC tuning, and the clock timing. They require the load of configuration tables on-board and/or manual commanding of the wheels and so make heavy use of RTCPs, sometimes interleaved with exposures collected with an APT program. Although most relevant in the early part of commissioning, these programs are valid for the entire lifetime of NIRISS.

None of these contingency activities were necessary and were therefore withdrawn. After the analysis of the NIS-005 FW Calibration (1080) data, NIS-025-C, NIS-026-C, NIS-028-C, NIS-033-C, and NIS-031-C were retired on Feb 21, 2022. The contingency for ASIC tuning was retired on Apr 18, 2022 after analyzing the long darks from the first observation of NIS-006 Darks (1081). The NIS-029-C contingency was not formally withdrawn but it was never needed at any point in the commissioning campaign.

Table 4-7. NIRISS Contingency Activities

STScI CAR	NGAS CAR	APT	Title	Description
NIS-025-C	–	–	PW Sine Wave Table Load	Contingency activity to load new sine wave data tables if the PW VR sensor is not detected.
NIS-026-C	–	–	FW Sine Wave Table Load	Contingency activity to load new sine wave data tables if the FW VR sensor is not detected.
NIS-028-C	–	1101	PW VR Sensor Search	Contingency activity to trigger the VR sensor with a full revolution if the PW position is completely lost.
NIS-033-C	–	1418	FW VR Sensor Search	Contingency activity to trigger the VR sensor with a full revolution if the FW position is completely lost.
NIS-030-C	–	1103	GR700XD Tilt Adjustment	Contingency activity to adjust the tilt of the GR700XD spectral traces (PW).
NIS-031-C	–	1104	GR150C/R Tilt Adjustment	Contingency activity to adjust the tilt of the GR150C/R spectral traces (FW).
NIS-029-C	–	–	External Clock	Contingency activity to switch NIRISS to the external clock and sync.
NIS-027-C	–	1100	ASIC Tuning	Contingency activity to optimize the ASIC parameters with a series of darks if the on-orbit dark rate, noise, IPC, etc... are significantly different from their pre-launch values.

The OTE team also wrote a contingency program to verify vignetting early in the commissioning campaign (Table 4-8). It is essentially a simplified version of NRC-010, in which NIRISS imaging is parallel to NIRCam imaging at low ecliptic latitudes. Vignetting would have manifested itself as a rolloff of the relatively high zodiacal background along the detector edges. Damaged hardware, i.e., loose cables, could also have produced vignetting. This contingency was retired since there was no evidence of vignetting.

Table 4-8. OTE Contingency Activity

STScI CAR	NGAS CAR	APT	Title	Description
OTE-016-C	–	1443	Contingency Vignetting Investigation	The zodiacal light is used to provide background images intended to detect vignetting.

5 Flow of Activities

The final flow of the activities when NIRISS was the prime instrument (Tables 4-1, 4-2, and 4-3) is depicted in Fig. 5-1. The fill color represents the method of commanding and the perimeter, the Observatory pointing, i.e., the target can be in the annulus of the cold attitude or of the hot attitude, which encompasses the Continuous Viewing Zones (CVZs), or anywhere else on the sky (see Section 6). The main activities that led to the science readiness of each mode are linked with solid arrows while the activities that complement or help inform the performance of a mode are connected with dashed arrows.

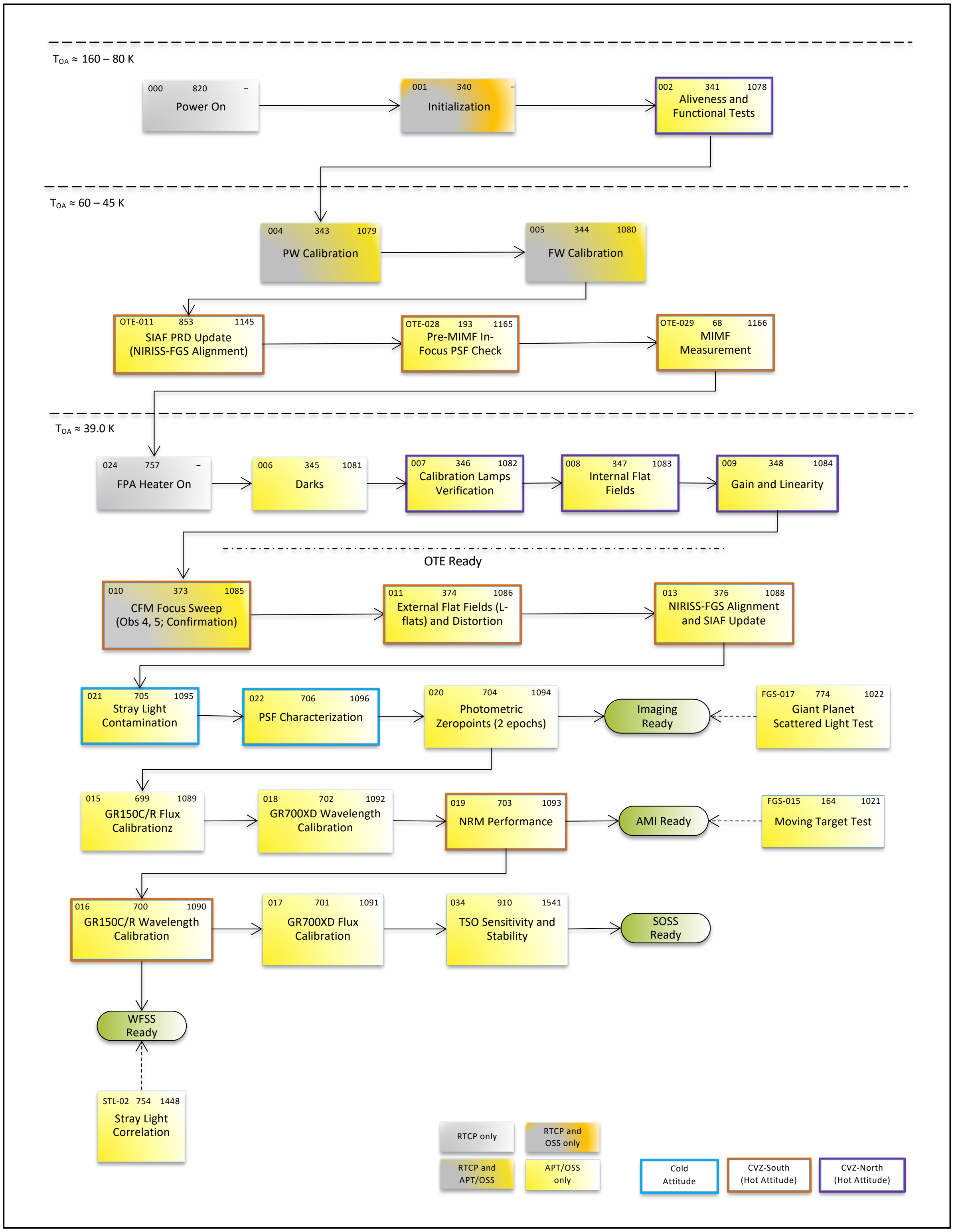

Figure 5-1. The flow of NIRISS activities is shown. The fill color represents the commanding method and the perimeter color, the pointing. The STScI CAR number, the NGAS CAR number, and the APT program ID are listed at the top of each box. The green ovals indicate the science readiness. Only the first instance of OTE-028 and OTE-029 are shown.

6 Timeline

The day of execution of a particular NIRISS activity was intimately tied to the cooling profile of the Observatory as well as the instrument's bench and detector temperatures. The spacecraft was first commissioned over L + 0 − 30 days, ending with the MCC2 (Mid-Course Correction 2; NGAS CAR 55) on Jan 24, 2022, the thruster burn that placed the Observatory into the halo orbit around L2. This was followed by a transition period of nine days, which included the FGS and NIRISS Power On. The OTE commissioning began on Feb 2, 2022 with CAR OTE-01 WF – Initial Image Mosaic (NGAS CAR 66) and ended on Apr 22, 2022 when the Observatory alignment was declared complete at the MIMF-2 Consent-to-Proceed meeting. The commissioning of the science instruments then proceeded until the end of the campaign.

The NIRISS engineering activities occurred during the cooldown, starting in the transition period and then in parallel to the OTE commissioning. To maintain the temperature of the NIRISS optical assembly (OA) above the water band (160 – 140 K), the IRSU contamination control heaters (CCH) in zones 1 – 4 were cycled on/off thus producing a sawtooth pattern in the OA temperatures. A Consent-to-Proceed meeting (CP#2A) was held on Jan 13, 2022 to approve the contingency CCH 5 K stepped cooldown (as in the ground cryo campaigns) so that all the instruments would cool down within 5 K of each other through the water band (160 – 140 K). This gradual step down began when the MIRI OA reached 165 K on Jan 17, 2022.

The power on (NIS-000) and initialization (NIS-001) then occurred on Jan 28, 2022 (L + 34.2 days) when the OA was at a temperature of 156 K. These two activities needed to take place above 80 K to avoid the potential ASIC "latch-up" below this temperature (NIRISS-L-4407). See Martel (2022a) for more details. The heaters were disabled later on Jan 29, 2022 as part of the activity IRSU CCH Zone 1 – 4 Heaters Disabled (NGAS CAR 33) as agreed at the CP#2B meeting on Jan 26, 2022. This triggered the rapid and passive cooldown of the NIRISS bench.

The remaining NIRISS activities were then carried out. After the FSM heater was turned off (NGAS CAR 814) on Jan 30, 2022 when the near-IR instrument temperatures and the MIRI shield upper rail reached about 140 K, as agreed at the CP#3 meeting on Jan 26, 2022, the aliveness activity (NIS-002) was executed on Feb 8, 2022 (L + 44.7 days). The health of the detector and the lamps, as well as the entire data flow through the ground subsystems, was then verified as early as possible. The PW and FW were rotated for the first time after the program LOS-002 ACS Fine Guidance Control Verification (NGAS CAR 840.1) was successful and the constraints on the thermal gradients across the wheels were met (NIRISS-C-4402). After the MIRI Cryocooler Transition to State 4, 5, and 6, the NIRISS bench dropped to its final operating plateau. The FPA heater was enabled (NIS-024), bringing the FPA to a stable temperature of 39.0 K for the remainder of the mission. The remaining activities were then performed, starting with the darks in the science and calibration arrays (NIS-006). Since there was no need to move the CFM, the confirmation exposures of NIS-010 were collected after the end of the OTE commissioning.

At the cold plateau, the Observatory was slewed between the extreme pointings of the hot and cold attitudes to characterize its thermal decay rate. These important pointing constraints greatly impacted the NIRISS schedule and the target selection:

a. At L + 132 days, the Observatory was pointed for about five days to the hot attitude (pitch of 0 ± 5 deg), a great annulus that spans the ecliptic poles and hence the north and south CVZs (Fig. 6-1). Since the LMC astrometric field is located in the CVZ-South, the focus, L-flat, distortion, and SIAF programs are scheduled immediately before or during this period.

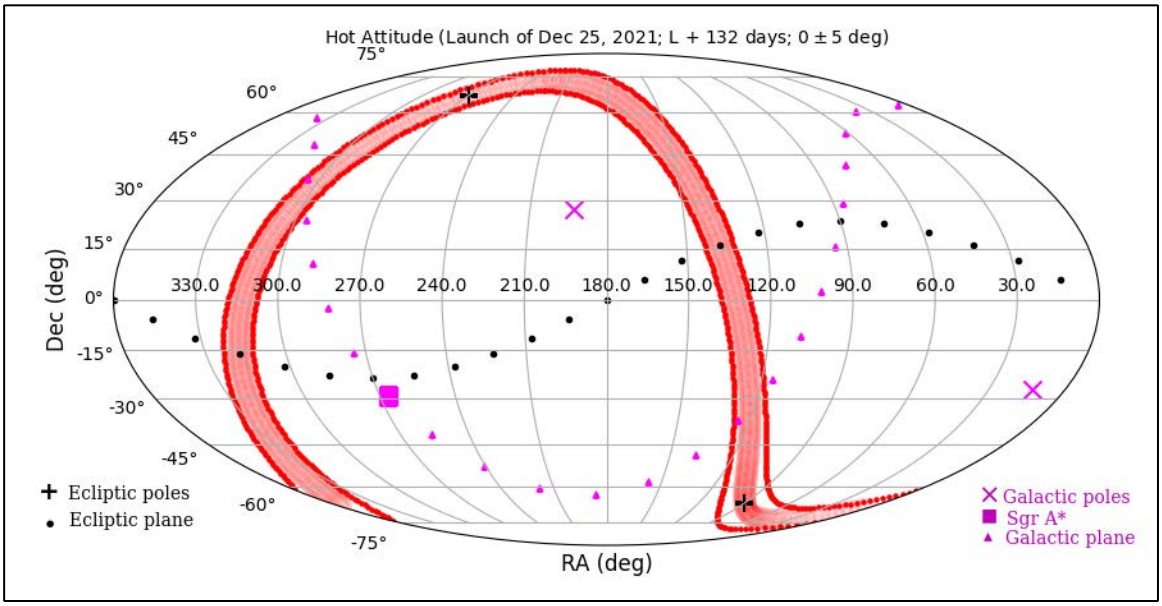

Figure 6-1. The annulus at the beginning (L + 132 days) of the hot attitude is shown in red for a launch date of Dec 25, 2021. The Observatory pitch is $0 \pm 5°$. The RA and DEC are expressed in the equatorial system. The + symbols mark the location of the two ecliptic poles while the black dots define the ecliptic plane. The pink Xs denote the Galactic poles while the pink triangles trace the Galactic plane. The pink square box marks the Galactic center (Sgr A*).

b. After the hot five-day period, the Observatory was slewed to the cold attitude (pitch of -40 ± 5 deg) and maintained there for about eight days. At this attitude, the Observatory covered an annulus that slowly migrated along the ecliptic plane (Fig. 6-2). All the NIRISS activities up to and including NIS-013 had to be completed before this change in pitch, since in this cold attitude, the science activities began. These required that the PW, FW, and detector were operating nominally, the best focus had been achieved, and the SIAF file had been updated for accurate target acquisitions, SAMs, dithers, etc…

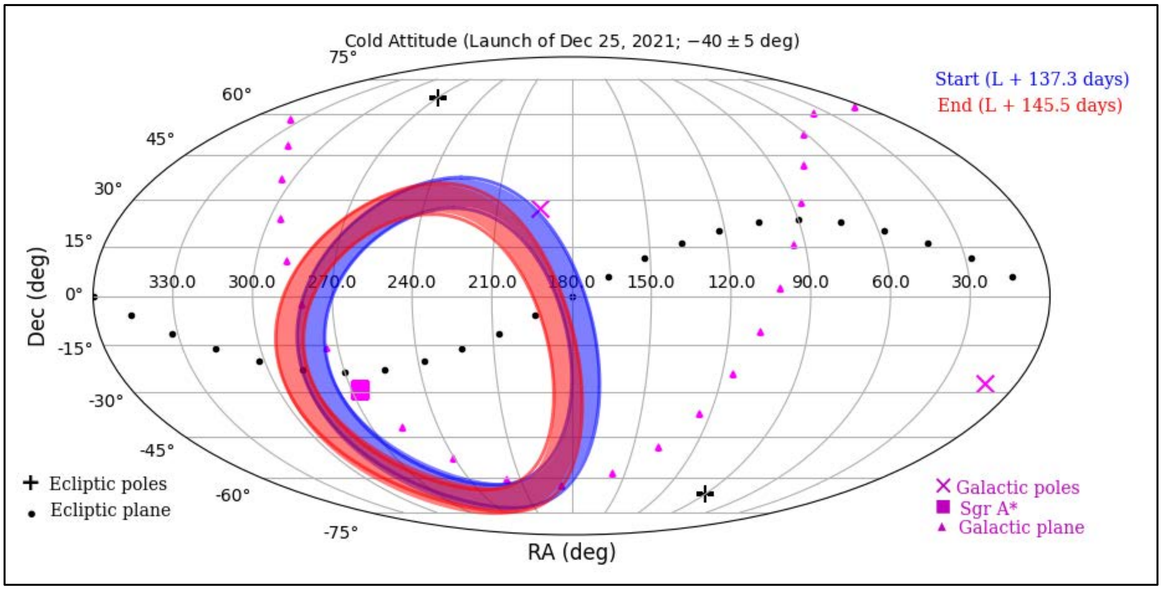

Figure 6-2. The annuli at the beginning (L + 137 days) and end (L + 145 days) of the cold attitude are shown in blue and red, respectively, for a launch date of Dec 25, 2021. The Observatory pitch is $-40 \pm 5°$.

To visualize the relationship between the temperature of the NIRISS OA and the timeline of the activities, we plot the cooling curve in Figs 6-3 ($L + 0 - 105$ days) and 6-4 ($L + 105 - 192$ days). This cooling curve is the mean of the temperature of the four IRSU sensors SI_GZCTS12A, SI_GZCTS13A, SI_GZCTS58A, and SI_GZCTS59A. At the end of commissioning, the OA temperature showed a constant value of 38.5 K. The day of execution of the activities when NIRISS is the prime instrument are labeled with vertical lines. The day of the science readiness reviews at STScI of the four science modes are marked in green in Fig. 6-4. All the modes of NIRISS were declared science-ready before the end of the six-month commissioning campaign. Only the FGS-017 Giant Planet Scattered Light (1022) program was executed after the end of the nominal six-month campaign.

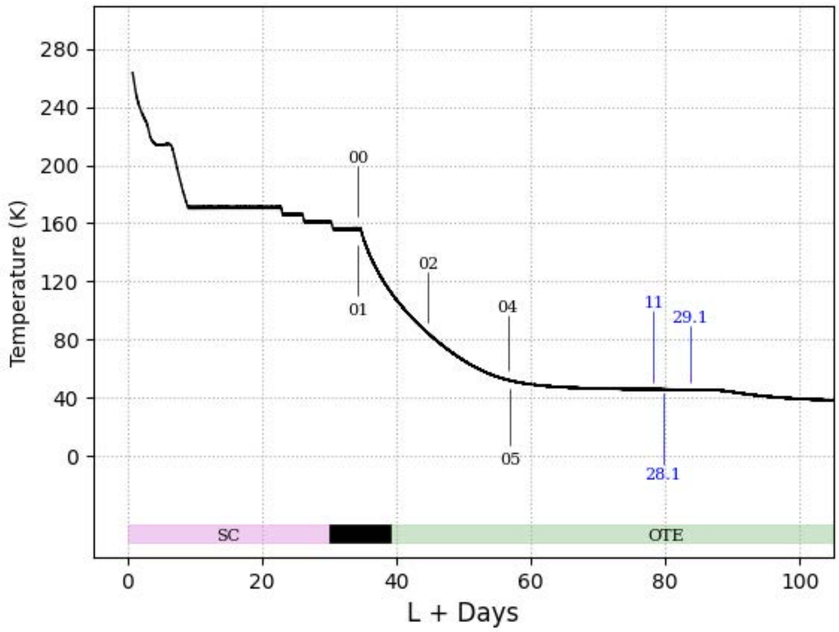

Figure 6-3. The cooling curve of the NIRISS OA is plotted in black up to $L + 105$ days. The period of the SC commissioning is represented at the bottom in pink, the transition in black, and the OTE commissioning in green. The day of execution of the prime NIRISS activities are labeled as vertical solid lines with the CAR number (black for the NIRISS team activities and blue for the OTE activities).

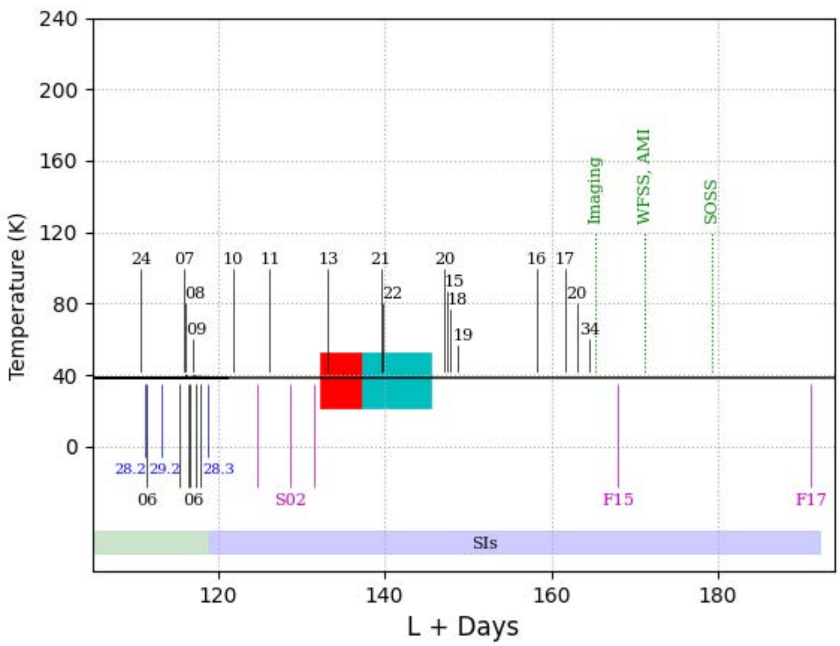

Figure 6-4. The cooling curve of the NIRISS OA is plotted in black at 38.5 K for $L + 105 - 192$ days. The period of the OTE commissioning is represented at the bottom in green and the SI commissioning in purple. The day of execution of the prime NIRISS activities are labeled as vertical solid lines with the CAR number (black for the NIRISS team activities, blue for the OTE activities, and magenta for the three Observatory activities). Multiple instances of an activity are included, such as the two epochs of NIS-020. The red box denotes the period of the five-day hot attitude and the cyan box, that of the eight-day cold attitude. The vertical dotted green lines mark the day when a science mode was declared ready.

Before launch, a detailed timeline of all the commissioning activities of the Observatory and the science instruments had been developed by the Timeline Coordinators. But as the commissioning campaign progressed, the date of execution of the NIRISS activities had to be shuffled as unexpected changes or problems in the cooling rate, the Observatory, or the other science instruments were encountered. We can therefore examine how closely the final on-orbit timeline adhered to the pre-launch timeline.

In Fig. 6-5, we plot the difference in days between the on-orbit and pre-launch dates of execution of the main activities developed by the NIRISS team (Table 4-1). The power on and initialization occurred on schedule at L + 34 days. But the initialization and PW and FW calibrations were delayed up to 6 days (L + 57 days for NIS-005 FW Calibration (1080)). The remaining engineering activities (FPA heater on, six instances of the darks, and the three internal lamp activities) were all postponed to the end of the OTE activities and therefore show the most significant delay, L + 15 – 25 days. The observations of the focus confirmation followed immediately as scheduled at L + 122 days. The remaining science activities (SOSS and WFSS flux and wavelength calibrations, NRM performance, photometric zeropoints, etc…) show a variety of offsets in their execution days with respect to the pre-launch timeline, from –2 days to 12 days over a period of 37 days. It is interesting to note that the next-to-last activity, the second epoch NIS-020 Photometric Zeropoints (1094), was executed exactly on schedule, as for the first activity, the NIS-000 NIRISS Power On.

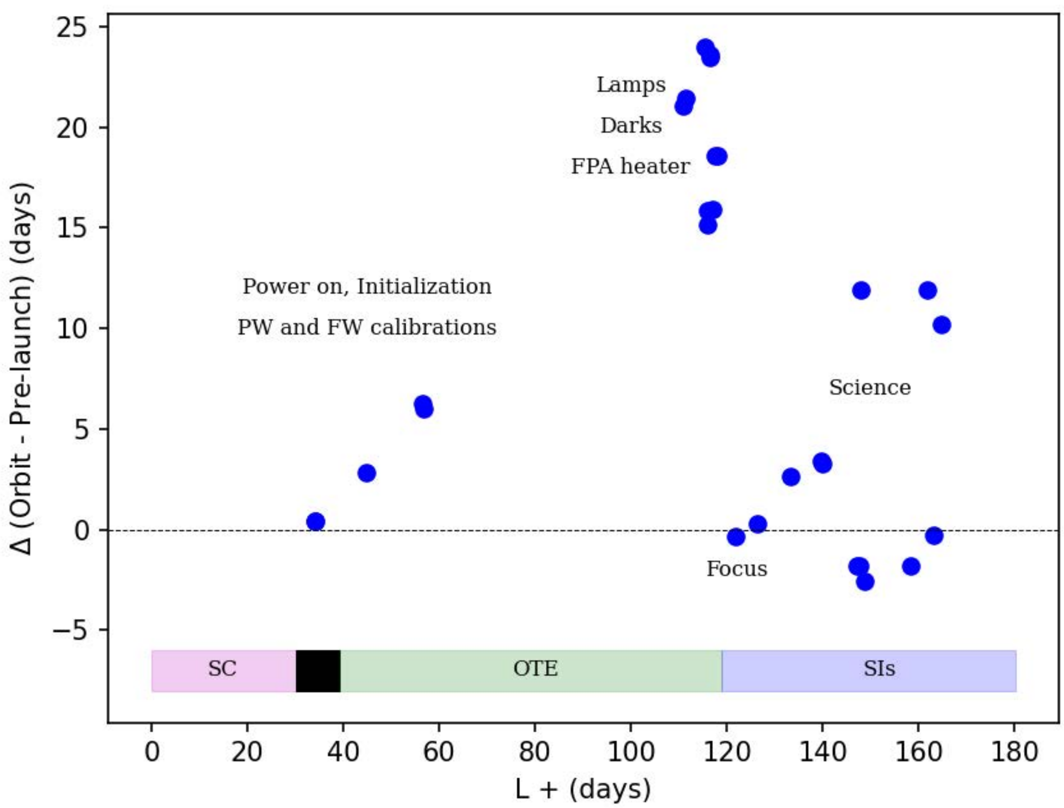

Figure 6-5. The difference in days between the on-orbit execution of the NIRISS primary activities with respect to the pre-launch timeline is plotted.

7 Targets

In Table 7-1, we list the astronomical targets of the commissioning programs designed by the NIRISS team (Table 4-1). The four different parts generally required targets with different properties (brightness, spectral type, etc…) and locations on the sky, although in general, we strived to find targets in the two continuous viewing zones for availability and ease of scheduling. Although the original target for the NIS-004 and NIS-005 programs was the Time Domain Field, it was changed to a target of the concurrent OTE programs to avoid any disturbances in the OTE configuration and to minimize slew times.

Table 7-1. Targets1 – NIRISS Team Programs

STScI CAR	Title	Target	Type
Part 1: Engineering			
NIS-002	Aliveness and Functional Tests	Time Domain Field	Blank
NIS-004	PW Calibration	2MASS-J10372186-6939563	Bright Star
NIS-005	FW Calibration	2MASS-J10372186-6939563	Bright Star
NIS-007	Calibration Lamps Verification	Time Domain Field	Blank
NIS-008	Internal Flat Fields	Time Domain Field	Blank
NIS-009	Detector Gain and Linearity	Time Domain Field	Blank
Part 2: Focus			
NIS-010	CFM Focus Sweep	Focus Field	Stars
Part 3: Astrometry			
NIS-011	External Flat Fields (L-flats) and Distortion	Astrometric Field	Dense star field
NIS-013	Coordinate System Update (SIAF)	Astrometric Field	Dense star field
Part 4: Science			
NIS-015	GR150C/R Flux Calibration	WD1657+343, P330E	DA.9, G2V
NIS-016	GR150C/R Wavelength Calibration	SMP LMC 58	Compact PN
NIS-018	GR700XD Wavelength Calibration	TWA 33	M5.5e
NIS-017	GR700XD Flux Calibration	BD+601753	A1V
NIS-019	NRM Performance	AB Doradus (binary) Reference stars	K0V
NIS-020	Photometric Zeropoints	LDS749B, P330E	DB4, G2V
NIS-021	Stray Light Contamination	P330E	G2V
NIS-022	PSF Characterization	SDSS J125701.95+220415.5, GD153	Unknown, DA1.2
NIS-034	NIRISS Sensitivity and Stability for Transiting Exoplanet Observations	HAT-P-14	F5V (Exoplanet)

1. Target location: purple: CVZ-North (hot attitude), red: CVZ-South (hot attitude), blue: cold attitude, green: no pointing constraints

8 Activity Details

When possible, the commissioning programs were designed to reflect the typical usage of the calibration and science modes of NIRISS in the Cycle 1 programs. Hence, a variety of APT templates, dither patterns, and mosaics were exercised, as well as the two target acquisition capabilities.

In Table 8-1, we list the programs associated with the different APT templates. In the activities of Parts 1, 2, and 3, the Internal Flat, External Calibration, Dark, and Focus templates were used. As expected, in Part 4, the templates of the science modes (WFSS, SOSS, and AMI) were used. The External Calibration template figured prominently because of the great flexibility it offers in choosing non-standard combinations of readouts, subarrays, wheel elements, and apertures. Details such as target name and coordinates, hold times for data analysis, special requirements, etc… can also be found in the APT programs. We note that the earliest activities like the power on and initialization were commanded with real-time commands, i.e., Command and Control Simulation Interface Language (CECIL) scripts.

All the NIRISS templates were successfully exercised except for the WFSS template with no parallels. But this is of no concern since it performed flawlessly with the more complicated case of NIRCam and MIRI imaging as coordinated parallels.

Table 8-1. APT Templates

APT Template	Programs
External Calibration	NIS-002 Aliveness and Functional Tests (1078) NIS-004 PW Calibration (1079) NIS-005 FW Calibration (1080) NIS-010 CFM Focus Sweep (1085) NIS-011 External Flat Fields (L-flats) and Distortion (1086) NIS-013 NIRISS-FGS Alignment and SIAF Update (1088) NIS-015 GR150C/R Flux Calibration (1089) NIS-016 GR150C/R Wavelength Calibration (1090) NIS-017 GR700XD Flux Calibration (1091) NIS-018 GR700XD Wavelength Calibration (1092) NIS-020 Photometric Zeropoints (Epochs 1 and 2) (1094) NIS-021 Stray Light Contamination (1095) NIS-022 PSF Characterization (1096) NIS-034 Sensitivity and Stability for Transiting Exoplanet (1541) OTE-010 SIAF PRD and Onboard Updates for NIRCam and FGS (1144) OTE-011 SIAF PRD Update (NIRISS-FGS Alignment) (1145) OTE-028 Pre-MIMF In-Focus PSF Check – 1 (1165) OTE-028 Pre-MIMF In-Focus PSF Check – 2 (1464) OTE-029 MIMF Measurement – 1 (1166) OTE-029 MIMF Measurement – 2 (1465) NRC-005 NIRCam Pre-Coarse Phasing Vignetting Check (1059) STL-002 Stray Light Model Correlation (1448)
Internal Flat	NIS-002 Aliveness and Functional Tests (1078) NIS-004 PW Calibration (1079)

APT Template	Programs
	NIS-005 FW Calibration (1080) NIS-007 Calibration Lamps Verification (1082) NIS-008 Internal Flat Fields (1083) NIS-009 Detector Gain and Linearity (1084)
Dark	NIS-005 FW Calibration (1080) NIS-006 Darks (1081)
Single Object Slitless Spectroscopy	NIS-017 GR700XD Flux Calibration (1091) NIS-034 Sensitivity and Stability for Transiting Exoplanets (1541)
Wide Field Slitless Spectroscopy	–
Aperture Masking Interferometry	NIS-019 NRM Performance (1093) FGS-015 Moving Target Test with NIRCam and NIRISS (1021)
Imaging	NIS-011 External Flat Fields (L-flats) and Distortion (1086, 2740) FGS-017 Giant Planet Scattered Light (1022)
NIRISS WFSS – NIRCam Imaging	NIS-015 GR150C/R Flux Calibration (1089)
NIRISS WFSS – MIRI Imaging	NIS-016 GR150C/R Wavelength Calibration (1090)
NIRISS External Calibration – FGS External Calibration	NIS-013 NIRISS-FGS Alignment and SIAF Update (1088) OTE-011 SIAF PRD Update (NIRISS-FGS Alignment) (1145) FGS-011 FGS Geometric Distortion and Scale (1018)

Thirteen different dither patterns were exercised. They are listed in Table 8-2. As expected, the most varied patterns were for the WFSS and AMI modes (the SOSS mode does not support dithers).

Table 8-2. Dither Patterns

Dither Pattern	Programs
IMAGING 4-pt	NIS-013 NIRISS-FGS Alignment and SIAF Update (1088) NIS-021 Stray Light Contamination (1095) OTE-011 SIAF PRD Update (NIRISS-FGS Alignment) (1145) OTE-028 Pre-MIMF In-Focus PSF Check – 2 (1464) FGS-011 FGS Geometric Distortion and Scale (1018)
IMAGING 2-pt	NIS-011 External Flat Fields (L-flats) and Distortion (1086) NIS-019 NRM Performance (1093) NIS-020 Photometric Zeropoints (Epochs 1 and 2) (1094)
WFSS LARGE 4-pt	NIS-015 GR150C/R Flux Calibration (1089) OTE-028 Pre-MIMF In-Focus PSF Check – 1 (1165)
WFSS MEDIUM 8-pt	NIS-010 CFM Focus Sweep (1085)
WFSS MEDIUM 4-pt	NIS-010 CFM Focus Sweep (1085) NIS-016 GR150C/R Wavelength Calibration (1090)

Dither Pattern	Programs
WFSS MEDIUM 2-pt	NIS-005 FW Calibration (1080) NIS-022 PSF Characterization (1096)
WFSS SMALL 4-pt	NIS-016 GR150C/R Wavelength Calibration (1090)
WFSS SMALL 2-pt	NIS-015 GR150C/R Flux Calibration (1089)
AMI: Primary = NONE, Subpixel = NONE	NIS-019 NRM Performance (1093)
AMI: Primary = 2-pt, Subpixel = NONE	NIS-019 NRM Performance (1093) FGS-015 Moving Target Test with NIRCam and NIRISS (1021)
AMI: Primary = NONE, Subpixel = 5-pt	NIS-019 NRM Performance (1093)
AMI: Primary = NONE, Subpixel = 25-pt	NIS-019 NRM Performance (1093)
MIMF 2-pt	OTE-029 MIMF Measurement – 1 (1166) OTE-029 MIMF Measurement – 2 (1465)

In Table 8-3, we list the mosaic patterns and their corresponding programs. The mosaic in NIS-034 served to construct an image of the background in GR700XD by combining different pointings on the zodiacal light, as mentioned in Section 4.3.1. NIRISS was also part of mosaics as a coordinated parallel to NIRCam in that instrument's investigation of the "claws" and "wisps".

Table 8-3. Mosaics

Mosaic	Programs
1 × 3	NIS-021 Stray Light Contamination (1095)
2 × 2	NIS-022 PSF Characterization (1096) NRC-005 NIRCam Pre-Coarse Phasing Vignetting Check (1059)
3 × 1	NIS-021 Stray Light Contamination (1095)
3 × 3	NIS-011 External Flat Fields (L-flats) and Distortion (1086)
6 × 3	NIS-034 Sensitivity and Stability for Transiting Exoplanets (1541)
8 × 1	NIS-011 External Flat Fields (L-flats) and Distortion (1086)

Target acquisitions were performed on 26 different occasions with the SUBTAAMI subarray, primarily in NIS-019 NRM Performance (1093), and eight times with SUBTASOSS. The programs with target acquisitions are tabulated in Table 8-4.

Table 8-4. Target Acquisitions

Subarray	Programs
SUBTASOSS	NIS-015 GR150C/R Flux Calibration (1089) NIS-017 GR700XD Flux Calibration (1091) NIS-018 GR700XD Wavelength Calibration (1092) NIS-034 Sensitivity and Stability for Transiting Exoplanets (1541)
SUBTAAMI	NIS-019 NRM Performance (1093)

	NIS-020 Photometric Zeropoints (Epochs 1 and 2) (1094) FGS-015 Moving Target Test with NIRCam and NIRISS (1021)

9 Execution of the Activities

9.1 Dates

In Table A-1 of Appendix A, we list the day and time of execution of all the observations that involved NIRISS in chronological order.

9.2 TSRs and OSCRs

A well-defined process was followed to execute observations from an APT program. Over several years of preparation before launch, all the observations of NIRISS were sequenced in chronological order in the Commissioning Activity Sequence Timeline (CAST), taking into account thermal constraints, pre-requisites, pointing restrictions, analysis time, etc… To carry out one or multiple observations in orbit, the NIRISS team first completed a Timeline Schedule Request (TSR), a JIRA issue on the Flight Operations Subsystem (FOS) at STScI. The TSR was usually generated a few hours before the planned execution of the observation(s) in the CAST. After the TSR was reviewed and approved by the different subsystem teams, the Observation Plan (OP) was produced. Upon receiving an e-mail from the scheduling team, the NIRISS team reviewed the contents of the OP and communicated its findings to the operator on the FGS/NIRISS console in the Mission Operations Center (MOC) at STScI over the voice loop on the Quintron application. The operator then relayed the information to the SI Lead in the MOC who made the final approval. The OP was then loaded to the Observatory and the observation(s) executed.

Starting with FGS-011 FGS Geometric Distortion and Scale (1018), the NIRISS TSRs were bundled with TSRs of the other science instruments into a single master TSR to generate an OP that spanned several days of observations instead of a single 8-hour shift. To add, remove, or update observations in the CAST, an Operations Schedule Change Request (OSCR), also a JIRA issue, was completed and approved.

For future reference, the identification numbers of the NIRISS TSRs and OSCRs are listed in Table B-1 of Appendix B. The rationale for an OSCR is also provided.

9.3 Anomalies

Anomalies that directly involved NIRISS were tracked with JIRA issues on FOS and are tabulated in Table 9-1. The activity that triggered the anomaly as well as its date are listed. A brief summary of the resolution of the issue is also provided.

Table 9-1. Anomalies

JIRA	Title	Activity	Date	Resolution
AR-368	CAST Update: Reduced Complication of Power-on of NIRCAM and FGS/NIRISS	Update to the CAST to ensure that NIRCam and FGS/NIRISS are powered on before the ASICs reach 80 K to avoid latchup of the electronics.	Jan 25, 2022	Closed on Feb 8, 2022. The NIRISS Power On (NIS-000) was re-scheduled in the weekly CAST replan to meet the thermal constraints.
AR-833	NIRISS Stray Light Concern (Light Saber)	APT 1063, Obs 164 (NIRISS in parallel to NIRCam to assemble	Apr 13, 2022	Labeled as Ops Notes on May 29, 2022 until the documentation for the users is updated. Observations were executed to map the

		a flat field in F150W with the zodiacal background).		susceptibility region in V2 and V3.
AR-914	Dark observations do not produce slots in which parallels can be scheduled	APT 1081, Obs 186 (parallel NIRCam dark attached to a prime NIRISS dark)	Apr 22, 2022	Closed on Jun 16, 2022. Future S&OC enhancement will include darks parallel to darks.
AR-1273	NIRISS Targ Acq Misplacement	APT 1094, Obs 2 (Targ Acq in SUB80 on P330E)	May 22, 2022	Closed on Jun 3, 2022. The relevant OSS script was updated.

In the following, we provide more details on each anomaly:

AR-368: Because of the changes in the schedule of the turnon/turnoff of the Contamination Control Heaters (CCHs), which affected the cooldown rate of the NIRISS bench, the power on of NIRISS had to be slightly adjusted in the timeline so it would occur at a temperature well above 80 K to avoid the latchup of the ASICs.

AR-833: During the investigation of the NIRCam "wisps" and "claws" features (AR-753), NIRISS collected parallel exposures on the zodiacal background. In some filters, a broad, low-level, nearly horizontal feature, dubbed the light saber, was observed across the full-frame detector. This feature was presented at the JWST Daily Briefing on Apr 14, 2022. At a meeting on Apr 19, 2022, S. Rohrbach (GSFC) presented his FRED model of a thin rectangular region on the sky inside which a bright star(s) (or high background) can produce the light saber through a rogue path that doesn't go through the full optics of the telescope and reflects off the inner wall of NIRISS after the Pick Off Mirror (POM). A follow-up meeting was held on Apr 26, 2022. To confirm the location and size of this susceptibility region on the sky, a bright star was scanned along the V2 and V3 axes (APT 1086, Obs 100 and APT 2740, Obs 101 – 109). This AR was not closed but labeled as Ops Notes until the required changes are made to APT and the online documentation.

AR-914: An attempt was made to attach a NIRCam dark in parallel to a prime NIRISS dark. But in commissioning, this combination was not permitted since parallel calibration darks can only be attached to non-dark prime visits, as in normal operations. A future, low-priority enhancement will include this combination.

AR-1273: The final location of the target in the two NIRISS Targ Acq subarrays was found to be displaced by about 4 pixels from the central pixel. A review of the relevant OSS scripts by P. Goudfrooij revealed that the the (correct) values of the pixel column and row offsets for the TA dithers in the script NISDEFTA were not correctly translated into ideal coordinate offsets in the script NISDEFTADITHER, so that the on-board combination of the dithered TA images was done using incorrect pixel shifts. The script NISDEFTADITHER was then updated (JWSTOSS-7736) and a review of the Level-2 certification products was conducted on May 29, 2022. After consent, a PRD update was made and the corrected scripts were loaded to the Observatory as part of OSS Build 8.4.5.1 on May 31, 2022 (FSCR-2382 and OSCR-2383). An observation in SUBTASOSS in APT 1092, Obs 10 confirmed that the revised script was successful in producing the correct final position of the target in the subarray.

10 Results

The results and documentation of the analysis of the different activities are described in the following sections.

10.1 JIRA Epics and Tasks

All the commissioning data collected in programs developed by the NIRISS, OTE, and Observatory teams were analyzed by NIRISS branch members at STScI as well as members of the Instrument Definition Team (IDT). The analysis steps and results were tracked with JIRA epics and tasks on the internal network at STScI. An epic consisted of a single or multiple JIRA tasks. The creation and delivery of the reference files were also assigned specific JIRA tasks. The flow of tasks of a given activity, from beginning to end, could be visualized in a Kanban board. The analyses were largely based on NIRISS Analysis Plans (NAPs) that were developed before launch and are available online on the NIRISS commissioning pages on the STScI Outerspace site and/or as technical reports in SOCCER, e.g., Martel (2021b, c, d, e, f, g) for the early engineering activities.

10.2 Calibration Pipeline and Reference Files

An important goal of the commissioning campaign is the update of the large suite of reference files that serve to process and calibrate the NIRISS exposures with the JWST calibration pipeline and produce accurate science products in MAST. Before launch, the majority of the reference files had been assembled from ground-based data collected in the CV3 and OTIS cryo campaigns.

In Table C-1 of Appendix C, we list the reference files that were updated with the commissioning data and delivered to the Calibration Reference Data System (CRDS). There are 178 files. The origin and history of each file are provided in the Description section in CRDS, including the exposures and programs that went into their creation. Some reference files, such as the flat fields, consist of a combination of ground (CV3) and on-orbit reference files.

10.3 PRD Updates

The commissioning activities resulted in six PRD updates to the S&OC and Loads repositories. They are listed in Table 10-1. Before launch, the NIRISS team had identified four PRD items that were most likely to require a revision. These were documented as JSOCOPS issues on the STScI JIRA system. But only two of those required an update, JSOCOPS-34 TargAcq Flat Field Update and JSOCOPS-40 SIAF Update (Col 2). No action was taken for JSOCOPS-41 Subarray Updates (S&OC) and JSOCOPS-42 Dither Tables Update (S&OC). For some items, the OSS team documented its progress in a JWSTOSS issue in JTAR (Col 5). Most of the items in the Loads repository were loaded to the Observatory as part of an OSS Build update which had its own PRD CR (Col 4). The load to the Observatory was made with the standard process of transferring the relevant files to the MOC with a File System Change Request (FSCR) and adding the real-time commands to the timeline with an OSCR (Col 7). Only one item was part of an anomaly (AR-1273; see Section 9.3). The changes to the OSS scripts underwent Level 1 and 2 certification on the Observatory Test Bed (OTB) and were reviewed and approved by the NIRISS team.

Table 10-1. PRD Updates

Issue	JSOCOPS	Repository	PRD CR	JWSTOSS	AR	FSCR, OSCR	Resolution
TargAcq Flat Field Update	34	OPSLOADS	5342	–	–	2074, 2075	Update of NISFLAT.pc
SIAF Update	40	OPSSOC OPSLOADS	5401, 5402, 5403	7591 (also JWSTSIAF-239)	–	2261, 2262	Multiple files. Included in OSS Build 8.4.4 Updates.
Targ Acq Misplacement	–	OPSLOADS	5438, 5439	7736	1273	2382, 2383	Update of NISDEFTADITHER.jse. Included in OSS Build 8.4.5.1 Updates.
Increase the precision of the frame read time to five decimals in NISDEFSUB	–	OPSLOADS	5513, 5514	7663	–	2501, 2502	Update of NISDEFSUB.jse. Included in OSS Build 8.4.9 Updates. The FITS header keyword DURATION has correct decimal values.
Update the frame read time of the 64 × 64 subarrays	–	OPSSOC OPSLOADS	5498, 5525, 5526	7749	–	2645, 2644	Update of NIRISS_Subarrays.xml and NISDEFSUB.jse. Included in OSS Build 8.4.10 Updates.
Update position 2 of the AMI primary dithers	–	OPSSOC	5501	–	–	–	Update of NirissAmiPrimary.txt.

10.4 Mechanism Usage

The mechanisms of NIRISS (PW, FW, CFM, and internal lamps) are considered limited lifetime items. Hence, throughout the ground cryo campaigns, the six-month commissioning campaign, and normal science operations, their usage is monitored and compared to their allocation, as defined in Vila Costas (2015). These allocations were established well before the operation of the science modes of NIRISS were defined and before the commissioning activities were finalized and so they may not reflect an entirely realistic use of the instrument in orbit. Although the NIRISS activities were initially designed to minimize the usage of the mechanisms, the unexpected reshuffling and addition of new exposures increased the total usage.

The cumulative usage of the PW and FW is compiled in Table 10-2 in the chronological order of the execution of all the programs that involved NIRISS, either as the prime or parallel instrument. The target acquisitions as well as the Early Release Observations (ERO) programs are included. A detailed breakdown is given in the master commissioning spreadsheet maintained by Martel and in Martel (2022h). We find that the PW usage (49%) was about half of its allocation. But the FW usage surpassed its allocation by about 8%. We attribute this excess to the design of the science modes, especially the WFSS and AMI. For WFSS, for a single blocking filter in the PW, the FW steps repeatedly through a sequence of [CLEAR, GR150C, GR150R]. Similarly, for AMI, when the NRM is in the light path in the PW, the FW steps through a sequence of [F380M, F430M, F480M]. Hence for a fixed position of the PW, multiple steps of the FW are accrued.

Table 10-2. PW and FW Usage

	PW		FW	
	Steps	Rotations	Steps	Rotations
Allocation	927	103	576	64
Usage	454	50.4	621	69.0
% of Allocation	49%		108%	

Note: One 360° rotation of a wheel consists of nine steps.

As mentioned in Section 4.3.2, the CFM was not moved in the NIS-032 and NIS-010 programs and therefore remained at its launch position. Hence, the usage of the CFM was null and this is summarized in Table 10-3.

Table 10-3. CFM Usage

	Actuations	OTE mm
Allocation	46	55
Usage	0	0
% of Allocation	0%	0%

The internal lamps were activated in six separate programs (NIS-002, NIS-004, NIS-005, NIS-007, NIS-008, and NIS-009) and their usage is summarized in Table 10-4. The FLAT1, FLAT2, and LINE1 lamps were all within their allocations but not LINE2. This was our default, go-to lamp because of its more uniform and brighter illumination and so its extensive use is not surprising. We also note that the allocations for the lamps were not realistic. For example, in NIS-008 Internal Flat Fields (1083), we collected internal flats in all twelve imaging filters and in the GR700XD grism with the LINE2 lamp, for a total of thirteen On/Off activations. This program alone therefore exceeded the On/Off allocation.

Table 10-4. Lamps Usage

	FLAT1		FLAT2		LINE1		LINE2	
	On/Off	Hours	On/Off	Hours	On/Off	Hours	On/Off	Hours
Allocation	9	0.7	9	0.7	9	0.7	9	0.7
Usage	3	0.14	3	0.14	3	0.14	26	2.67
% of Usage	33%	20%	33%	20%	33%	20%	290%	380%

11 Performance and Science Readiness

The overarching goal of the commissioning campaign was to characterize all aspects of the performance of NIRISS and declare its science modes ready for ERS, GO, and GTO observations in Cycle 1. The performance criteria were defined by the PIs of the instrument teams before launch and are summarized in Friedman & Kimble (2021).

Stability and trending measurements were not considered because of their possibly limited reliability over the short duration of the commissioning campaign.

As the commissioning campaign progressed, the NIRISS team regularly presented the results of the analyses of the incoming data at the JWST Daily Briefing. The slide material of these daily briefings formed the basis of the presentations shown at the science readiness reviews by the NIRISS PI (R. Doyon) near the end of the commissioning campaign. The dates of the meetings are listed in Table 11-1. NIRISS easily met all its performance criteria and the science modes were declared ready.

Table 11-1. Science Readiness Reviews

Mode	Meeting	Outcome
Imaging	Jun 8, 2022	Approved
WFSS	Jun 14, 2022	Approved
AMI	Jun 14, 2022	Approved
SOSS	Jun 22, 2022	Approved

In this report, we do not delve into the details of the science performance of NIRISS since comprehensive presentations are available elsewhere, in particular the slide packages of the science readiness reviews and of the Post-Launch Assessment Review (PLAR) held at STScI on Jul 14 and 15, 2022. A summary is also publicly available in Rigby et al. (2022). The data processing, methods, Python scripts, measurements, and metrics that helped assess the performance criteria were captured in a series of technical reports written by the NIRISS team at STScI. They are listed in Table 11-2. At the time of writing of this report, three reports were still in progress.

Table 11-2. Technical Reports

STScI CAR	Program Title	Technical Report
NIS-000	Power On	JWST-STScI-008121 (Martel et al. 2022a)
NIS-001	Instrument Initialization	
NIS-002	Aliveness and Functional Tests	JWST-STScI-008132 (Martel et al. 2022b)
NIS-004	PW Calibration	JWST-STScI-008157 (Martel et al. 2022c)
NIS-005	FW Calibration	JWST-STScI-008158 (Martel et al. 2022d)
NIS-006	Darks	JWST-STScI-008397 (Cooper et al. 2023a)
NIS-007	Calibration Lamps Verification	JWST-STScI-008179 (Martel et al. 2022e)
NIS-008	Internal Flat Fields	JWST-STScI-008180 (Martel et al. 2022f)
NIS-009	Detector Gain and Linearity	JWST-STScI-008277 (Cooper et al. 2023b)
NIS-011	External Flat Fields (L-flats) and Distortion	JWST-STScI-008297 (Taylor et al. 2022) JWST-STScI-008323 (Sohn et al. 2023a)
NIS-013	NIRISS-FGS Alignment and SIAF Update	JWST-STScI-008352 (Sohn et al. 2023b) JWST-STScI-008239 (Goudfrooij et al. 2022a)
NIS-015	GR150C/R Flux Calibration	JWST-STScI-008328 (Ravindranath et al. 2022) JWST-STScI-008386 (Ravindranath et al. 2023)

STScI CAR	Program Title	Technical Report
NIS-016	GR150C/R Wavelength Calibration	JWST-STScI-008296 (Pacifici et al. 2022)
NIS-017	GR700XD Flux Calibration	JWST-STScI-008270 (Volk et al. 2022a)
NIS-018	GR700XD Wavelength Calibration	In progress
NIS-019	NRM Performance	JWST-STScI-008334 (Sivaramakrishnan et al. 2023)
NIS-020	Photometric Zeropoints	JWST-STScI-008267 (Goudfrooij et al. 2022b) JWST-STScI-008269 (Volk et al. 2022b)
NIS-021	Stray Light Contamination	In progress
NIS-022	PSF Characterization	JWST-STScI-008324 (Goudfrooij et al. 2022c)
NIS-024	FPA Heater On	JWST-STScI-008167 (Martel et al. 2022g)
NIS-034	Sensitivity and Stability for Transiting Exoplanet Observations	In progress

12 Conclusions

The commissioning of NIRISS was successful. At the end of the campaign, the hardware was healthy and the telemetry showed nominal green values. All the planned pre-launch activities were performed albeit with some useful modifications or additions to some programs. All the APT templates were exercised including coordinated parallels and a variety of dither patterns and mosaics. Pure calibration parallels from other SIs were not attached to NIRISS exposures (or vice-versa). Updates to the S&OC and Loads repositories of the PRD were made when necessary. A preliminary suite of new reference files was delivered to CRDS and the MAST products were verified. A few anomalies were identified and addressed. The detector and the science modes were characterized and calibrated with standard flux and wavelength calibrators and a preliminary assessment of the field dependence of many quantities, such as the PSF parameters, was made. At the end of the commissioning campaign, NIRISS was declared ready for all Cycle 1 calibration and science activities.

Some issues were not addressed comprehensively during the relatively short commissioning period and need further attention. These are: the impact of solar flares on the detector background and cosmic-ray flux, the image persistence on the detector, the zodiacal level at different observatory pointings, and changes in the quality of the AMI mode data when the wavefront is distorted by micro-meteoroid hits on the primary mirror. These issues should be addressed more extensively as NIRISS data accumulates in a variety of space weather at L2.

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Appendix A. Dates of Execution

All the observations that involved NIRISS are tabulated in Table A-1. The format of the Start and End dates is year:day of year: UTC time in hours:min:sec. Up to March 13, 2022, Eastern Standard Time (EST or ET) was UTC time – 5 hours and after that date, Eastern Daylight Time (EDT) was UTC time – 4 hours. These intervals include the initial spacecraft slew to the target, the guide star acquisition, if applicable, small angle maneuvers (SAMs), and the NIRISS exposures. The L + column refers to the number of days after launch (Dec 25, 2021 at 7:20 EST) of the start of the observation(s). Some observations were executed during an outage of the Deep Space Network (DSN), so no telemetry was available during that period.

Table A-1. Dates of Execution

STScI CAR	NGAS CAR	APT	Title	Observations	Start (UTC)	End (UTC)	L + (Days)
NIS-000	820	–	Power On	–	2022:028:18:09:00	2022:028:18:20:00	34.242
NIS-001	340	–	Instrument Initialization	–	2022:028:18:21:00	2022:028:18:48:00	34.251
NIS-002	341	1078	Aliveness and Functional Tests	1, 2	2022:039:04:49:41.046	2022:039:06:27:28.167	44.687
NIS-004	343	1079	PW Calibration	3, 4	2022:051:02:45:37.229	2022:051:03:34:48.230	56.601
NIS-005	344	1080	FW Calibration	1 to 3 4, 5	2022:051:10:12:24.518 2022:053:14:38:38.014	2022:051:11:15:26.998 2022:053:15:01:53.505	56.911 59.096
OTE-010	181.1 181.2	1144	SIAF PRD and Onboard Updates for NIRCam and FGS	19 26 29	2022:056:20:53:35.704 2022:057:11:31:27.355 2022:058:03:56:18.474	2022:056:21:14:24.818 2022:057:11:40:16.984 2022:058:04:07:19.055	62.357 62.966 63.650
NRC-005	60	1059	NIRCam Pre-Coarse Phasing Vignetting Check	121	2022:058:21:31:12.979	2022:058:22:39:14.279	64.383
OTE-011	853.1	1145	SIAF PRD Update (NIRISS-FGS Alignment)	1 to 7, 12	2022:072:18:38:24.782	2022:072:21:45:22.783	78.263
OTE-028	193	1165	Pre-MIMF In-Focus PSF Check – 1	4	2022:074:03:00:11.421	2022:074:04:04:36.068	79.611
OTE-029	68	1166	MIMF Measurement – 1	28 to 32 72 to 76	2022:078:02:51:21.231 2022:079:00:58:21.168	2022:078:05:39:12.505 2022:079:03:39:24.928	83.605 84.527
NIS-005	344	1080	FW Calibration	6 to 9	2022:085:06:25:44.660	2022:085:11:14:03.441	90.754
NRC-010	OSCR-1678,	1063	NIRCam (and NIRISS) External	103 104, 107	2022:088:04:01:00.000 2022:089:00:39:56.424	2022:088:06:23:34.764 2022:089:07:24:20.752	93.653 94.514

STScI CAR	NGAS CAR	APT	Title	Observations	Start (UTC)	End (UTC)	L + (Days)
	1714, 1878		Flats (Zodiacal Light)	109 to 111	2022:089:22:19:34.719	2022:090:06:10:06.096	95.416
				112	2022:091:01:43:09.902	2022:091:04:46:22.681	96.558
				108	2022:091:17:02:48.658	2022:091:20:07:26.868	97.196
				113	2022:092:12:14:59.264	2022:092:15:32:46.701	97.997
				114	2022:093:06:33:38.639	2022:093:09:48:27.630	98.759
				115 to 117	2022:094:05:50:17.268	2022:094:14:26:39.916	99.729
				155, 151	2022:102:13:29:16.016	2022:102:15:19:54.703	108.048
				156, 157	2022:103:09:01:30.475	2022:103:10:48:36.305	108.900
				164	2022:103:13:40:17.649	2022:103:14:42:35.893	109.056
				174	2022:103:17:37:47.578	2022:103:18:41:10.040	109.221
NIS-024	757	–	FPA Heater On	–	2022:105:06:32:00.000	2022:105:07:03:00.000	110.758
OTE-028	69.10	1464	Pre-MIMF In-Focus PSF Check – 2	4	2022:105:17:16:31.763	2022:105:18:13:38.806	111.206
NIS-006	345.1	1081	Darks	1	2022:106:00:43:45.874	2022:106:05:15:57.665	111.517
OTE-029	84	1465	MIMF Measurement – 2	28 to 32 72 to 76	2022:107:20:25:05.735 2022:108:22:55:08.459	2022:109:01:24:35.744 2022:109:01:24:35.744	113.337 114.441
NIS-034	910	1541	Sensitivity and Stability for Transiting Exoplanet Observations	5	2022:109:14:04:14.674	2022:109:17:06:23.990	115.072
NRC-010	OSCR-1878	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	180 to 182	2022:109:17:25:50.185	2022:109:20:41:40.116	115.212
NIS-006	345.2	1081	Darks	2 to 13, 62 to 67, 92 to 116	2022:109:22:28:53.519	2022:110:10:48:42.729	115.423

STScI CAR	NGAS CAR	APT	Title	Observations	Start (UTC)	End (UTC)	L + (Days)
NIS-007	346	1082	Calibration Lamps Verification	1	2022:110:10:59:18.030	2022:110:12:59:10.103	115.944
NIS-008	347	1083	Internal Flat Fields	1	2022:110:13:48:19.083	2022:110:16:48:39.939	116.061
NIS-006	345.3	1081	Darks	14 to 23	2022:110:22:11:04.158	2022:111:02:19:16.447	116.410
NIS-006	345.4	1081	Darks	24 to 34, 68 to 73	2022:111:02:19:20.492	–	116.583
NIS-009	348	1084	Detector Gain and Linearity	1	2022:111:11:30:00.000	–	116.965
NIS-006	345.5	1081	Darks	35 to 49, 74 to 79, 117 to 121, 182 to 191	2022:111:23:33:51.031	2022:112:09:40:13.632	117.468
NIS-006	345.6	1081	Darks	50 to 61, 80 to 91, 127 to 131, 192 to 196, 207 to 211, 197 to 201, 147 to 151, 202 to 206, 157 to 181	2022:112:11:27:25.030	2022:113:04:10:19.751	117.963
OTE-028	751.10	1473	Pre-MIMF In-Focus PSF Check – 3	14	2022:113:08:26:00.288	2022:113:09:37:07.911	118.838
NIS-024	757	–	FPA Heater On (Safe Haven #4)	–	2022:115:19:27:52.098	2022:115:19:28:00.064	121.297
NRC-010	OSCR-1878	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	183, 184	2022:116:05:14:56.825	2022:116:09:43:42.309	121.705
NIS-010	373.3	1085	CFM Focus Sweep	11, 12	2022:116:09:52:46.853	–	121.898
STL-02	754.1	1448	Stray Light Model Correlation	12	2022:119:07:31:03.889	2022:119:08:27:05.450	124.799

STScI CAR	NGAS CAR	APT	Title	Observations	Start (UTC)	End (UTC)	L + (Days)
NIS-011	374	1086	External Flat Fields (L-flats) and Distortion	1, 2	2022:120:17:44:08.728	2022:121:11:04:46.455	126.225
STL-02	754.2	1448	Stray Light Model Correlation	15	2022:123:04:58:10.000	2022:123:05:40:50.591	128.693
NIS-024	757	–	FPA Heater On (Safe Haven #5)	–	2022:124:19:04:46.900	2022:124:19:07:43.136	130.281
STL-02	754.3	1448	Stray Light Model Correlation	13 14 16	2022:126:00:42:16.011 2022:126:03:42:55.078 –	2022:126:01:38:11.001 2022:126:04:38:09.875 2022:126:10:50:33.655	131.515 131.641 –
FGS-011	98	1018	FGS Geometric Distortion and Scale	5, 6	2022:126:15:49:44.663	2022:126:16:51:22.714	132.146
NIS-013	376	1088	NIRISS-FGS Alignment and SIAF Update	1 to 3	2022:127:18:30:24.248	2022:127:21:25:15.207	133.257
THS-02	819.3	1446	Thermal Slew - Hot Attitude Activities	3	2022:130:20:14:50.166	–	136.330
NIS-021	705	1095	Stray Light Contamination	1 to 9	2022:134:02:23:23.118	2022:134:07:18:38.495	139.586
NIS-022	706	1096	PSF Characterization	1 to 3	2022:134:08:56:27.891	2022:134:14:01:45.202	139.859
NIS-011	374	1086	External Flat Fields (L-flats) and Distortion	100	2022:135:16:39:41.153	2022:135:19:30:12.728	141.180
NRC-010	120.1 120.2 120.3 120.4 120.5	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	1, 2 3, 4 6	2022:136:04:39:55.090 2022:137:02:16:32.108 2022:138:23:13:42.911	2022:136:23:40:54.215 2022:137:17:46:35.488 2022:139:06:52:36.302	141.680 142.922 144.454

STScI CAR	NGAS CAR	APT	Title	Observations	Start (UTC)	End (UTC)	L + (Days)
NIS-020	707.1	1094	Photometric Zeropoints – 1	1, 2	2022:141:16:27:44.937	2022:142:01:43:57.876	147.172
NIS-015	699	1089	GR150C/R Flux Calibration	1 to 3	2022:142:01:44:01.921	–	147.558
NIS-018	702	1092	GR700XD Wavelength Calibration	1, 2	2022:142:10:41:04.140	2022:142:13:39:16.758	147.931
NIS-011	374	2740	External Flat Fields (L-flats) and Distortion	101 to 109	2022:143:01:55:53.338	2022:143:06:26:49.796	148.567
NIS-019	703	1093	NRM Performance	1 to 11	2022:143:06:26:53.588	2022:143:16:06:14.106	148.755
NIS-016	700	1090	GR150C/R Wavelength Calibration	1, 2	2022:152:17:25:13.371	–	158.212
NIS-018	702	1092	GR700XD Wavelength Calibration	10	2022:152:23:51:00.000	2022:153:00:49:16.620	158.480
NIS-017	701	1091	GR700XD Flux Calibration	1, 2	2022:156:03:58:43.418	2022:156:12:15:44.918	161.652
NIS-019	703	1093	NRM Performance	12 to 23	2022:156:12:15:49.216	2022:156:20:26:36.053	161.997
NIS-020	707.2	1094	Photometric Zeropoints – 2	3, 4	2022:157:14:04:31.591	–	163.073
NIS-034	910	1541	Sensitivity and Stability for Transiting Exoplanet Observations	1	2022:159:02:45:24.166	2022:159:13:16:11.000	164.601
FGS-015	164.2	1021	Moving Target Test with NIRCam and NIRISS	5	2022:162:13:23:07.671	2022:162:15:12:42.400	168.044
NIS-024	757	–	FPA Heater On	–	2022:177:19:02:34.156	2022:177:19:05:04.014	183.280
NIS-005	344	1080	FW Calibration	10	2022:177:19:44:15.231	2022:177:20:06:03.506	183.309
FGS-017	774.5	1022	Giant Planet Scattered Light	27 to 30	2022:185:16:30:28.478	–	191.174

Appendix B. TSRs and OSCRs

The TSRs and OSCRs of the NIRISS activities are listed in Table B-1.

Table B-1. TSRs and OSCRs

STScI CAR	NGAS CAR	APT	Title	Observations	TSR	OSCR
NIS-000	820	–	Power On	–	–	794: acknowledge the transient alarms between the power on and the alarm initialization
NIS-001	340	–	Instrument Initialization	–	–	
NIS-002	341	1078	Aliveness and Functional Tests	1, 2	916	–
NIS-004	343	1079	PW Calibration	3, 4	1147	1077: added Obs 2 for SSR flush 1150: copy of Obs 1, 2 to Obs 3, 4 with new target
NIS-005	344	1080	FW Calibration	1 to 3 4, 5	1088 1182	1078: added Obs 3 for SSR flush 1181: added Obs 4, 5 to characterize the elevated detector background measured in Obs 1, 2
OTE-010	181.1 181.2	1144	SIAF PRD and Onboard Updates for NIRCam and FGS	19 26 29	1215 1257 1262	1203: addition to characterize the elevated detector background with an SSR flush 1256: Same 1268: Same
NRC-005	60	1059	NIRCam Pre-Coarse Phasing Vignetting Check	121	1278	1276: addition to check vignetting in one filter on the zodiacal background in the ecliptic plane
OTE-011	853.1	1145	SIAF PRD Update (NIRISS-FGS Alignment)	1 to 7, 12	1234	1495: addition of Obs 12 to characterize the elevated detector background with an SSR flush
OTE-028	193	1165	Pre-MIMF In-Focus PSF Check – 1	4	1518	–
OTE-029	68	1166	MIMF Measurement – 1	28 to 32 72 to 76	1570 1577	–
NIS-005	344	1080	FW Calibration	6 to 9	1654	1653: addition for early measurements of the throughput and to verify that the high background is absent after turning off the MIRI HSA
NRC-010	OSCR-1678, 1714, 1878	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	103 104, 107	1700 1706	1678, 1714, 1878: flat fields on the zodiacal background as a coordinated parallel to NIRCam. Obs 155 and later are part of the investigation of the NIRCam rogue path (AR-753).

STScI CAR	NGAS CAR	APT	Title	Observations	TSR	OSCR
				109 to 111 112 108 113 114 115 to 117 155, 151 156, 157 164 174	1721 1734 1742 1750 1758 1762 1882 1902 1902 1902	
NIS-024	757	–	FPA Heater On	–	–	1926: change the FPA temperature setpoint to 39.0 K. Settled at 39.03 K after 30 min.
OTE-028	69.10	1464	Pre-MIMF In-Focus PSF Check – 2	4	1927	–
NIS-006	345.1	1081	Darks	1	1934	–
OTE-029	84	1465	MIMF Measurement – 2	28 to 32 72 to 76	1945 1949	–
NIS-034	910	1541	Sensitivity and Stability for Transiting Exoplanet Observations	5	1939	1922: addition to measure the background in GR700XD with a mosaic on the zodiacal light
NRC-010	OSCR-1878	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	180 to 182	1962	1878: flat fields on the zodiacal background as a coordinated parallel to NIRCam. Part of the investigation of the NIRCam rogue path (AR-753).
NIS-006	345.2	1081	Darks	2 to 13, 62 to 67, 92 to 116	1965	1666: re-arrange the observations between the last five CAST steps of 1081

STScI CAR	NGAS CAR	APT	Title	Observations	TSR	OSCR
NIS-007	346	1082	Calibration Lamps Verification	1	1967	1968: waive the pre-requisite that the darks (1081) should be completed
NIS-008	347	1083	Internal Flat Fields	1	1969	–
NIS-006	345.3	1081	Darks	14 to 23	1973	1666: re-arrange the observations between the last five CAST steps of 1081
NIS-006	345.4	1081	Darks	24 to 34, 68 to 73	1977	1666: re-arrange the observations between the last five CAST steps of 1081
NIS-009	348	1084	Detector Gain and Linearity	1	1978	–
NIS-006	345.5	1081	Darks	35 to 49, 74 to 79, 117 to 121, 182 to 191	1990	1666: re-arrange the observations between the last five CAST steps of 1081
NIS-006	345.6	1081	Darks	50 to 61, 80 to 91, 127 to 131, 192 to 196, 207 to 211, 197 to 201, 147 to 151, 202 to 206, 157 to 181	1992	1666: re-arrange the observations between the last five CAST steps of 1081
OTE-028	751.10	1473	Pre-MIMF In-Focus PSF Check – 3	14	2008	2005: added Obs 14 to observe the astrometric field in F090W, F150W, and F200W for a press release
NIS-024	757	–	FPA Heater On (Safe Haven #4)	–	–	2014: recovery from safe haven (AR-963)
NRC-010	OSCR-1878	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	183, 184	2022	1878: flat fields on the zodiacal background as a coordinated parallel to NIRCam. Part of the investigation of the NIRCam rogue path (AR-753).
NIS-010	373.3	1085	CFM Focus Sweep	11, 12	2019	2018: copy Obs 4, 5, to Obs 11, 12 for a Special Requirement on the PA
STL-02	754.1	1448	Stray Light Model Correlation	12	2010	–

STScI CAR	NGAS CAR	APT	Title	Observations	TSR	OSCR
NIS-011	374	1086	External Flat Fields (L-flats) and Distortion	1, 2	2106	–
STL-02	754.2	1448	Stray Light Model Correlation	15	2011	–
NIS-024	757	–	FPA Heater On (Safe Haven #5)	–	–	2014: recovery from safe haven (AR-1000)
STL-02	754.3	1448	Stray Light Model Correlation	13 14 16	2012	–
FGS-011	98	1018	FGS Geometric Distortion and Scale	5, 6	2171 2168 (master)	2166: addition of Obs 5, 6
NIS-013	376	1088	NIRISS-FGS Alignment and SIAF Update	1 to 3	2173 2175 (master)	–
THS-02	819.3	1446	Thermal Slew - Hot Attitude Activities	3	2200	–
NIS-021	705	1095	Stray Light Contamination	1 to 9	2219 2223 (master)	2218: waive the pre-requisite of the SIAF update
NIS-022	706	1096	PSF Characterization	1 to 3	2235 2237 (master)	–
NIS-011	374	1086	External Flat Fields (L-flats) and Distortion	100	2241 2248 (master)	2240: add new observation to scan the danger zone of the light saber in V3 (AR-833)
NRC-010	120.1 120.2 120.3 120.4 120.5	1063	NIRCam (and NIRISS) External Flats (Zodiacal Light)	1, 2 3, 4 6	2253, 2254 2255 (master) 2257, 2260 (master) 2264, 2267 (master)	–

STScI CAR	NGAS CAR	APT	Title	Observations	TSR	OSCR
NIS-020	707.1	1094	Photometric Zeropoints – 1	1, 2	2288 2290 (master)	–
NIS-015	699	1089	GR150C/R Flux Calibration	1 to 3	2289 2290 (master)	–
NIS-018	702	1092	GR700XD Wavelength Calibration	1, 2	2302 2307 (master)	–
NIS-011	374	2740	External Flat Fields (L-flats) and Distortion	101 to 109	2301 2307 (master)	2298: add new observations to scan the danger zone of the light saber in V2 (AR-833)
NIS-019	703	1093	NRM Performance	1 to 11	2303 2307 (master)	–
NIS-016	700	1090	GR150C/R Wavelength Calibration	1, 2	2405	–
NIS-018	702	1092	GR700XD Wavelength Calibration	10	2404	2357: addition with updated TargAcq procedure (JWSTOSS-7736, AR-1273)
NIS-017	701	1091	GR700XD Flux Calibration	1, 2	2441 2437 (master)	–
NIS-019	703	1093	NRM Performance	12 to 23	2448 2444 (master)	2429: addition with updated TargAcq procedure (JWSTOSS-7736, AR-1273)
NIS-020	707.2	1094	Photometric Zeropoints – 2	3, 4	2447 2444 (master)	–
NIS-034	910	1541	Sensitivity and Stability for Transiting Exoplanet Observations	1	2462 2458 (master)	–
FGS-015	164.2	1021	Moving Target Test with NIRCam and NIRISS	5	2495 2491 (master)	–
NIS-024	757	–	FPA Heater On	–	–	2014: recovery (AR-1457)
NIS-005	344	1080	FW Calibration	10	2642	2637: addition of a dark to investigate AR-1457)

STScI CAR	NGAS CAR	APT	Title	Observations	TSR	OSCR
FGS-017	774.5	1022	Giant Planet Scattered Light	27 to 30	2604 2608 (master)	–

Appendix C. Updated Reference Files

The reference files that were updated with commissioning data and delivered to CRDS are listed in Table C-1.

Table C-1. Updated Reference Files

Description	Name	Filters	Array
Aperture Correction	jwst_niriss_apcorr_0005.fits	All	All
Pixel Area Map	jwst_niriss_area_0023.fits jwst_niriss_area_0012.fits jwst_niriss_area_0019.fits jwst_niriss_area_0021.fits jwst_niriss_area_0018.fits jwst_niriss_area_0017.fits jwst_niriss_area_0015.fits jwst_niriss_area_0020.fits jwst_niriss_area_0014.fits jwst_niriss_area_0022.fits jwst_niriss_area_0016.fits jwst_niriss_area_0013.fits	F090W, CLEAR F115W, CLEAR F140M, CLEAR F150W, CLEAR F158M, CLEAR F200W, CLEAR CLEARP, F277W CLEARP, F356W CLEARP, F380M CLEARP, F430M CLEARP, F444W CLEARP, F480M	All
Darks	jwst_niriss_dark_0169.fits jwst_niriss_dark_0179.fits jwst_niriss_dark_0180.fits jwst_niriss_dark_0174.fits jwst_niriss_dark_0177.fits jwst_niriss_dark_0178.fits jwst_niriss_dark_0170.fits jwst_niriss_dark_0171.fits jwst_niriss_dark_0181.fits jwst_niriss_dark_0183.fits jwst_niriss_dark_0175.fits jwst_niriss_dark_0173.fits jwst_niriss_dark_0172.fits jwst_niriss_dark_0182.fits jwst_niriss_dark_0176.fits jwst_niriss_dark_0185.fits jwst_niriss_dark_0184.fits	F158M, F430M	FULL (NIS) FULL SUB128 SUB256 SUB64 SUB80 SUBAMPCAL SUBSTRIP256 SUBSTRIP96 SUBTAAMI SUBTASOSS WFSS128C WFSS128R WFSS64C WFSS64R SUBTAAMI (NIS) SUBTASOSS (NIS)
Distortion	jwst_niriss_distortion_0017.asdf jwst_niriss_distortion_0012.asdf jwst_niriss_distortion_0018.asdf	F090W, [CLEAR, GR150C/R] F115W, [CLEAR, GR150C/R] F140M, [CLEAR, GR150C/R]	All

Description	Name	Filters	Array
	jwst_niriss_distortion_0023.asdf jwst_niriss_distortion_0019.asdf jwst_niriss_distortion_0013.asdf jwst_niriss_distortion_0015.asdf jwst_niriss_distortion_0022.asdf jwst_niriss_distortion_0016.asdf jwst_niriss_distortion_0021.asdf jwst_niriss_distortion_0014.asdf jwst_niriss_distortion_0020.asdf	F150W, [CLEAR, GR150C/R] F158M, [CLEAR, GR150C/R] F200W, [CLEAR, GR150C/R] CLEARP, F277W CLEARP, F356W CLEARP, F380M CLEARP, F430M CLEARP, F444W CLEARP, F480M	
Filter Offsets	jwst_niriss_filteroffset_0002.asdf	F090W, CLEAR F115W, CLEAR F140M, CLEAR F150W, CLEAR F158M, CLEAR F200W, CLEAR CLEARP, F277W CLEARP, F356W CLEARP, F380M CLEARP, F430M CLEARP, F444W CLEARP, F480M	All
Flat Fields	jwst_niriss_flat_0260.fits jwst_niriss_flat_0261.fits jwst_niriss_flat_0270.fits jwst_niriss_flat_0282.fits jwst_niriss_flat_0274.fits jwst_niriss_flat_0268.fits jwst_niriss_flat_0258.fits jwst_niriss_flat_0267.fits jwst_niriss_flat_0280.fits jwst_niriss_flat_0257.fits jwst_niriss_flat_0259.fits jwst_niriss_flat_0277.fits jwst_niriss_flat_0275.fits jwst_niriss_flat_0278.fits jwst_niriss_flat_0264.fits jwst_niriss_flat_0279.fits jwst_niriss_flat_0273.fits jwst_niriss_flat_0262.fits jwst_niriss_flat_0272.fits jwst_niriss_flat_0265.fits jwst_niriss_flat_0266.fits jwst_niriss_flat_0269.fits jwst_niriss_flat_0263.fits jwst_niriss_flat_0281.fits	F090W, CLEAR F115W, CLEAR F140M, CLEAR F150W, CLEAR F158M, CLEAR F200W, CLEAR [CLEARP, NRM], F277W CLEARP, F356W [CLEARP, NRM], F380M [CLEARP, NRM], F430M CLEARP, F444W [CLEARP, NRM], F480M GR700XD, CLEAR GR700XD, F277W F090W, GR150C F115W, GR150C F140M, GR150C F150W, GR150C F158M, GR150C F200W, GR150C F090W, GR150R F115W, GR150R F140M, GR150R F150W, GR150R	All

Description	Name	Filters	Array
	jwst_niriss_flat_0276.fits jwst_niriss_flat_0271.fits	F158M, GR150R F200W, GR150R	
Detector Linearity Correction Coefficients	jwst_niriss_linearity_0016.fits	All	All
Bad Pixel Mask	jwst_niriss_mask_0016.fits	All	All
JumpStep Runtime Parameters	jwst_niriss_pars-jumpstep_0032.asdf jwst_niriss_pars-jumpstep_0035.asdf jwst_niriss_pars-jumpstep_0034.asdf jwst_niriss_pars-jumpstep_0031.asdf jwst_niriss_pars-jumpstep_0033.asdf jwst_niriss_pars-jumpstep_0016.asdf jwst_niriss_pars-jumpstep_0020.asdf jwst_niriss_pars-jumpstep_0027.asdf jwst_niriss_pars-jumpstep_0009.asdf jwst_niriss_pars-jumpstep_0019.asdf jwst_niriss_pars-jumpstep_0010.asdf jwst_niriss_pars-jumpstep_0028.asdf jwst_niriss_pars-jumpstep_0008.asdf jwst_niriss_pars-jumpstep_0006.asdf jwst_niriss_pars-jumpstep_0022.asdf jwst_niriss_pars-jumpstep_0002.asdf jwst_niriss_pars-jumpstep_0029.asdf jwst_niriss_pars-jumpstep_0012.asdf jwst_niriss_pars-jumpstep_0015.asdf jwst_niriss_pars-jumpstep_0005.asdf jwst_niriss_pars-jumpstep_0021.asdf jwst_niriss_pars-jumpstep_0030.asdf jwst_niriss_pars-jumpstep_0026.asdf jwst_niriss_pars-jumpstep_0024.asdf jwst_niriss_pars-jumpstep_0003.asdf jwst_niriss_pars-jumpstep_0007.asdf jwst_niriss_pars-jumpstep_0004.asdf jwst_niriss_pars-jumpstep_0013.asdf jwst_niriss_pars-jumpstep_0023.asdf jwst_niriss_pars-jumpstep_0011.asdf	F090W, CLEAR F115W, CLEAR F140M, CLEAR F150W, CLEAR F158M, CLEAR F200W, CLEAR GR700XD, CLEAR CLEARP, F277W GR700XD, F277W NRM, F277W CLEARP, F356W CLEARP, F380M NRM, F380M CLEARP, F430M NRM, F430M CLEARP, F444W CLEARP, F480M NRM, F480M F090W, GR150C F115W, GR150C F140M, GR150C F150W, GR150C F158M, GR150C F200W, GR150C F090W, GR150R F115W, GR150R F140M, GR150R F150W, GR150R F158M, GR150R F200W, GR150R	All
OutlierDetection Step Runtime Parameters	jwst_niriss_pars-outlierdetectionstep_0013.asdf jwst_niriss_pars-outlierdetectionstep_0006.asdf jwst_niriss_pars-outlierdetectionstep_0003.asdf jwst_niriss_pars-outlierdetectionstep_0010.asdf jwst_niriss_pars-outlierdetectionstep_0012.asdf jwst_niriss_pars-outlierdetectionstep_0002.asdf jwst_niriss_pars-outlierdetectionstep_0004.asdf jwst_niriss_pars-outlierdetectionstep_0005.asdf	F090W, CLEAR F115W, CLEAR F140M, CLEAR F150W, CLEAR F158M, CLEAR F200W, CLEAR CLEARP, F277W CLEARP, F356W	All

Description	Name	Filters	Array
	jwst_niriss_pars-outlierdetectionstep_0008.asdf jwst_niriss_pars-outlierdetectionstep_0009.asdf jwst_niriss_pars-outlierdetectionstep_0011.asdf jwst_niriss_pars-outlierdetectionstep_0007.asdf	CLEARP, F380M CLEARP, F430M CLEARP, F444W CLEARP, F480M	
Spec2Pipeline Runtime Parameters	jwst_niriss_pars-spec2pipeline_0003.asdf jwst_niriss_pars-spec2pipeline_0005.asdf	(TSOVISIT) (WFSS)	All
TweakRegStep Runtime Parameters	jwst_niriss_pars-tweakregstep_0033.asdf jwst_niriss_pars-tweakregstep_0029.asdf jwst_niriss_pars-tweakregstep_0027.asdf jwst_niriss_pars-tweakregstep_0032.asdf jwst_niriss_pars-tweakregstep_0026.asdf jwst_niriss_pars-tweakregstep_0030.asdf jwst_niriss_pars-tweakregstep_0034.asdf jwst_niriss_pars-tweakregstep_0031.asdf jwst_niriss_pars-tweakregstep_0036.asdf jwst_niriss_pars-tweakregstep_0025.asdf jwst_niriss_pars-tweakregstep_0035.asdf jwst_niriss_pars-tweakregstep_0028.asdf	F090W, CLEAR F115W, CLEAR F140M, CLEAR F150W, CLEAR F158M, CLEAR F200W, CLEAR CLEARP, F277W CLEARP, F356W CLEARP, F380M CLEARP, F430M CLEARP, F444W CLEARP, F480M	All
Absolute Calibration	jwst_niriss_photom_0035.fits jwst_niriss_photom_0034.fits jwst_niriss_photom_0041.fits	NIS_AMI, NIS_IMAGE NIS_SOSS NIS_WFSS	All
Read Noise	jwst_niriss_readnoise_0005.fits	All	All
Saturation	jwst_niriss_saturation_0014.fits	All	All
GR700XD Grism Spectrum Kernel File	jwst_niriss_speckernel_0004.fits jwst_niriss_speckernel_0005.fits	GR700XD, CLEAR GR700XD, F277W	All
GR700XD Grism Trace Profile Mapping File	jwst_niriss_specprofile_0021.fits jwst_niriss_specprofile_0023.fits jwst_niriss_specprofile_0022.fits jwst_niriss_specprofile_0024.fits jwst_niriss_specprofile_0020.fits jwst_niriss_specprofile_0019.fits	GR700XD, CLEAR GR700XD, F277W GR700XD, CLEAR GR700XD, F277W GR700XD, CLEAR GR700XD, F277W	FULL FULL SUBSTRIP256 SUBSTRIP256 SUBSTRIP96 SUBSTRIP96
GR700XD Grism Trace Centre Table	jwst_niriss_spectrace_0024.fits jwst_niriss_spectrace_0021.fits jwst_niriss_spectrace_0023.fits jwst_niriss_spectrace_0019.fits jwst_niriss_spectrace_0022.fits jwst_niriss_spectrace_0020.fits	GR700XD, CLEAR GR700XD, F277W GR700XD, CLEAR GR700XD, F277W GR700XD, CLEAR GR700XD, F277W	FULL FULL SUBSTRIP256 SUBSTRIP256 SUBSTRIP96 SUBSTRIP96
GR700XD Grism Wavelength Mapping File	jwst_niriss_wavemap_0021.fits jwst_niriss_wavemap_0019.fits jwst_niriss_wavemap_0022.fits jwst_niriss_wavemap_0023.fits jwst_niriss_wavemap_0020.fits	GR700XD, CLEAR GR700XD, F277W GR700XD, CLEAR GR700XD, F277W GR700XD, CLEAR	FULL FULL SUBSTRIP256 SUBSTRIP256 SUBSTRIP96

Description	Name	Filters	Array
	jwst_niriss_wavemap_0024.fits	GR700XD, F277W	SUBSTRIP96
Superbias	jwst_niriss_superbias_0183.fits jwst_niriss_superbias_0180.fits jwst_niriss_superbias_0177.fits jwst_niriss_superbias_0179.fits jwst_niriss_superbias_0182.fits jwst_niriss_superbias_0187.fits jwst_niriss_superbias_0181.fits jwst_niriss_superbias_0178.fits jwst_niriss_superbias_0188.fits jwst_niriss_superbias_0175.fits jwst_niriss_superbias_0184.fits jwst_niriss_superbias_0185.fits jwst_niriss_superbias_0186.fits jwst_niriss_superbias_0176.fits	All	FULL SUB128 SUB256 SUB64 SUB80 SUBAMPCAL SUBSTRIP256 SUBSTRIP96 SUBTAAMI SUBTASOSS WFSS128C WFSS128R WFSS64C WFSS64R
WFSS Master Background	jwst_niriss_wfssbkg_0026.fits jwst_niriss_wfssbkg_0023.fits jwst_niriss_wfssbkg_0017.fits jwst_niriss_wfssbkg_0025.fits jwst_niriss_wfssbkg_0024.fits jwst_niriss_wfssbkg_0021.fits jwst_niriss_wfssbkg_0020.fits jwst_niriss_wfssbkg_0019.fits jwst_niriss_wfssbkg_0018.fits jwst_niriss_wfssbkg_0016.fits jwst_niriss_wfssbkg_0022.fits jwst_niriss_wfssbkg_0027.fits	F090W, GR150C F115W, GR150C F140M, GR150C F150W, GR150C F158M, GR150C F200W, GR150C F090W, GR150R F115W, GR150R F140M, GR150R F150W, GR150R F158M, GR150R F200W, GR150R	All