Chapter 60

Wavefront Sensing and Control Engineering

For an explanation of the colored text in this Limited Access Parameter version, see Section 1.2, "Special Note to Limited Access Parameter Version Users". Note that this entire chapter is Limited Access.

60.1 Introduction

Wavefront Sensing and Control will be executed using various methods of operations. Currently, three methods (WFSC Commissioning, WFSC Global Alignment, and WFSC Coarse Phasing) have been fully defined. As the additional methods mature, their specifications will be added to this chapter.

Also, Multi-Instrument, Multi-Field (MIMF) templates will be defined for each instrument. Currently, MIRI and NIRSpec have been fully defined. As the additional instruments mature, their specifications will be added to this chapter.

The parameters described in this section are used to specify the Observations needed during JWST commissioning. More complete descriptions of the detector readout parameters, filters/dispersers, detector characteristics, etc. are available in the MIRI, NIRCam, NIRSpec, NIRISS, and FGS Instrument Handbook.

The following fields are defined in Chapter 5: Observation Number (5.1), Observation Label (5.2), Observation Comments (5.3), Target Name (5.4), Observation-Level Special Requirements (5.5), and On Hold Comments (5.6), and will not be discussed in this Chapter.

The Wavefront Sensing and Control template **[WSC0xxx]** consists of the following parameters:

Field	Details	Values	Notes
WFSC Fine Phasing [WSC0001]			
TBD	TBD	TBD	TBD
WFSC Commissioning [WSC0002]			
Module **[WSC0003]**	select module	A, B, ALL **[WSC0004]**	
Filter(s) **[WSC0005]**	select filter name(s)	choose from list **[WSC0006]**	see Table 60-1
Number of Groups	specify number of groups	number **[WSC0008]**	

[WSC0007]			
Number of Integrations **[WSC0009]**	specify number of integrations	number **[WSC0010]**	
Reacquisition **[WSC0011]**	select reacquisition	REACQ, NOREACQ **[WSC0012]**	
WFSC Global Alignment [WSC0013]			
GA Iteration Type **[WSC0014]**	select type	ADJUST1, ADJUST2, BSCORRECT, CORRECT, CORRECT+ADJUST **[WSC0015]**	see Table 60-2
NIRCam Parameters **[WSC0016]**			
Module **[WSC0017]**	select module	A or B **[WSC0018]**	
Filter **[WSC0019]**	select filter name	choose from list **[WSC0020]**	see Table 60-3
Number of Groups **[WSC0021]**	specify number of groups	number (1-10) **[WSC0022]**	
Number of Integrations **[WSC0023]**	specify number of integrations	number (1-10) **[WSC0024]**	
FGS Parameters **[WSC0025]**			
Number of Groups **[WSC0026]**	specify number of groups	number **[WSC0027]**	
Number of Integrations **[WSC0028]**	specify number of integrations	number **[WSC0029]**	
WFSC {NIRCam}Coarse Phasing [WSC0030]			
NIRCam Parameters **[WSC0031]**			
Module **[WSC0032]**	select module	A or B **[WSC0033]**	
MIRI Multi-Instrument, Multi-Field (MIMF) Imaging [WSC0034]			
Target Name **[WSC0035]**	Select Target Name	choose from list **[WSC0036]**	
Pattern Type **[WSC0037]**	select Dither pattern	choose from list **[WSC0038]**	see Table 60-5
Starting Point **[WSC0039]**	select starting point for **CYCLING** pattern	1, 2, 3, …, 310, 311 **[WSC0040]**	
Number of Points **[WSC0041]**	select number of points for **CYCLING** pattern	3, 4, 5, … **[WSC0042]**	
Pattern Size **[WSC0043]**	select pattern size	choose from list **[WSC0044]**	see Table 60-6
Subpixel Sampling	select subpixel sampling	YES, NO	

[WSC0045]		[WSC0046]	
Filter [WSC0047]	select filter name	choose from list [WSC0048]	see Table 60-7
Readout Pattern [WSC0049]	select readout pattern	choose from list [WSC0050]	
Number of Groups [WSC0051]	specify number of groups	number [WSC0052]	
Number of Integrations [WSC0053]	specify number of integrations	number [WSC0054]	
NIRCam Multi-Instrument, Multi-Field (MIMF) Imaging [WSC00xx]			
TBD			
NIRSpec Multi-Instrument, Multi-Field (MIMF) Imaging [WSC0055]			
Readout Pattern [WSC0056]	select readout pattern	choose from list [WSC0057]	
Number of Groups [WSC0058]	specify number of groups	number [WSC0059]	
Number of Integrations [WSC0060]	specify number of integrations	number [WSC0061]	
Multi-Instrument, Multi-Field Search Option [WSC0061]	select MIMF search option	SQUARE_AP, MSAQ1, MSAQ2, MSAQ3, MSAQ4 [WSC0063]	
MSA Configuration Filename [WSC0064]	specify filename [WSC0065]		
NIRISS Multi-Instrument, Multi-Field (MIMF) Imaging [WSC0066]			
TBD			

60.2 WFSC Fine Phasing

TBD

60.3 WFSC Commissioning

This method will be used during any commissioning activity that uses the following sequence, containing NIRCam exposures alternating with mirror moves.

- o Take a NIRCam image
- o Perform a group of mirror moves
- o Take another NIRCam image
- o Perform the next group of mirror moves
  …
- o Take a final NIRCam image

The length of the sequence is determined by the contents of the Wavefront Control File. There can be multiple mirror move groups in a Wavefront Control File **[WSC00xx]**.

The following parameters are used to define Wavefront Sensing and Control Commissioning Operations. A Wavefront Control File (provided by the WFSC Scientist) will be attached to each visit by the PPS Operator.

Currently, this method is specified for the following commissioning steps:
1. Secondary Mirror Focus Sweep
2. Segment ID
3. Segment Image Array
4. Pupil Imaging
5. Coarse Phasing
6. Segment Piston Scan

Note: A NIRCam Image will be taken before and after each set of mirror moves. All images will be Full frames using the same parameters on all the specified NIRCam detectors.

60.3.1   Module

MODULE [MODULE] = A [WSC0067], B [WSC0068] ALL [WSC0069]

This parameter specifies the module(s) to be used to obtain the data.

60.3.2   Filters

60.3.2.1 Filter Name

Select the name of the **FILTER [FILTSHORT]** (see Table 60-1) you wish to use. The same filter will be used in both modules, if both modules are specified **[WSC0070]**.

Table 60-1 Filters Available for NIRCam Short Wavelength Cameras

Filter	Center Wavelength λ_0 (μm)	Filter Bandpass $\Delta\lambda$ (μm)	Comment
F200W **[WSC0071]**	2.00	0.500	
F212N **[WSC0072]**	2.12	0.021	H_2

Note: The long wavelength filter will be set to F356W **[WSC0073]**.

60.3.3   Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0074]**. If **MODULE = A [WSC0075]** or **B [WSC0076]**, the value must be between 1 and 10. If **MODULE = ALL [WSC0077]**, the value must be between 1 and 4.

60.3.4   Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0078]**. If **MODULE = A [WSC0079]** or **B [WSC0080]**, the value must be between 1 and 10. If **MODULE = ALL [WSC0081]**, the value must be 1.

60.3.5   Reacquisition

REACQUISITION [REACQ] = REACQ [WSC0082], NOREACQ [WSC0083]

This parameter specifies if the guide star is to be re-acquired after each mirror move group is executed.

Note for developers: Visits created from this template should be marked in the database as WFS visits by APT (visit.wavefront_sensing) **[WSC0084]** and as WFSC visit type in VSS.

60.4 WFSC Global Alignment

Wavefront Sensing and Control - Global Alignment will be executed several times during commissioning to reduce the observed segment level Wavefront Error by refining the Secondary Mirror position and making coarse corrections for all Primary Mirror Segment Arrays. Prior to the Global Alignment Measurements, the primary mirror segments are configured so that there is a separate image of the target star for each segment. There will be a total of 18 images per target placed in a pre-determined hexagonal array.

   A typical observation will include the following:

   a.   Enter FGS guide star tracking on one of the 18 guide star images
   b.   Take a NIRCam image
   c.   Perform the specified group of mirror moves
   d.   Optional Small Angle Maneuver (SAM) to compensate for boresight changes
        due to the mirror moves
   e.   Take another NIRCam image
   f.   Take an FGS image to record new guide star PSFs

The following parameters are used to define Wavefront Sensing and Control Global Alignment Operations. A Wavefront Control File (provided by the WFSC Scientist) will be attached to each visit by the PPS Operator.

60.4.1   Global Alignment Iteration Type

GA ITERATION TYPE [GATYPE] = ADJUST1 [WSC0086], ADJUST2 [WSC0087], BSCORRECT [WSC0088], CORRECT [WSC0089], CORRECT+ADJUST [WSC0090]

This field specifies the type of Global Alignment operation (see Table 60-2) to be executed in this observation. Select **ADJUST1 OR ADJUST2** to obtain more OTE status data. Select **BSCORRECT** to improve the wavefront error and modify the JWST boresight. Select **CORRECT** to improve the wavefront error without affecting the JWST boresight. Select **CORRECT+ADJUST** to improve the wavefront error followed by more OTE status data collection.

Table 60-2 Contents of Wavefront Control (WFC) Files for each GA type

GA Type	WFC file contents
ADJUST1	one group of diversity moves
ADJUST2	two groups of diversity moves, one positive and one negative
BSCORRECT	one group of SM tilt and/or translations and any necessary PMSA moves
CORRECT	one group of corrections (not including SM tilt and/or translations)
CORRECT+ADJUST	one group of corrections (not including SM tilt and/or translations) and one group of diversity moves

60.4.2   NIRCam Parameters

The parameters listed below will be used for all NIRCam images in this observation.

60.4.2.1 Module

MODULE [MODULE] = A [WSC0091], B [WSC0092]

This parameter specifies the **MODULE** to be used to obtain the data.

60.4.2.2 Filter

Select the name of the **FILTER [FILTSHORT]** (see Table 60-3) you wish to use.

Table 60-3 Filters Available for NIRCam Short Wavelength Cameras

Filter	Center Wavelength λ_0 (μm)	Filter Bandpass $\Delta\lambda$ (μm)	Comment
F200W **[WSC0093]**	2.00	0.500	
F212N **[WSC0094]**	2.12	0.021	H_2

Note: The long wavelength filter will be set to F323N/F356W **[WSC0095]**.

60.4.2.3 Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0096]**. The value must be between 1 and 10 **[WSC0097]**.

60.4.2.4 Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0098]**. The value must be between 1 and 10 **[WSC0099]**.

60.4.3   FGS parameters

The parameters listed below will be used for all FGS images in this observation.

60.4.3.1 Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0100]**.

60.4.3.2 Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0101]**.

Note for developers: Visits created from this template should be marked as WFS visits by APT **[WSC0102]** and as WFSC visit type in VSS.

60.5 WFSC {NIRCam} Coarse Phasing

The following parameters are used to define Wavefront Sensing and Control Coarse NIRCam Phasing Operations. A Wavefront Control File (provided by the WFSC Scientist) containing 3 mirror control groups must be uploaded prior to the execution of a Coarse Phasing visit.

Coarse Phasing measurements consist of a series of steps that collect NIRCam images of an isolated star, interspersed with mirror control groups. Each imaging step within the series consists of two exposures separated by a small (few pixel) dither **[WSC0157]**. There are three types of exposures: In-focus Imaging, DHS Imaging, and Plus/Minus 8 Defocus Imaging. All the exposures of a given type use the same exposure parameters **[WSC0158]**, and all three types of exposures must be specified **[WSC0159]**.

In addition to the following template parameters, this template will have the Special Requirement Wavefront Sensing added with a default value of **SENSING_CONTROL [WSC0160]** (see section 7.2.5 for options).

This template cannot be used in parallel **[WSC0161]** and cannot have parallels attached **[WSC0162]**.

Note for developers: the default PCS MODE should be TRACK **[WSC0163]**. If the user overrides this value, a warning should be given **[WSC0164]**.

60.5.1   Module

MODULE [MODULE] = A [WSC0103], B [WSC0104]

This parameter specifies the **MODULE** to be used to obtain the data.

60.5.2   In-Focus Imaging Parameters
[WSC0171]

60.5.2.1 Filters

The following filters will be used to obtain the data.

In-Focus Imaging				
Step	SW Pupil	SW Filter	LW Pupil	LW Filter	Subarray
1	CLEAR	F212N	F405N	F444W	SUBFP1x
	[WSC0165]				**[WSC0166]**

For Subarray, x = A or B, based on the Module selected.

60.5.2.2 Readout Pattern

READOUT PATTERN [READOUT PATTERN] = RAPID [WSC0167], BRIGHT1 [WSC0168]

This field specifies the readout pattern to be used to obtain the data.

60.5.2.3 Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0169]**.

60.5.2.4 Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0170]**.

60.5.3 DHS Imaging Parameters
[WSC0172]

60.5.3.1 Filters

The following filters will be used to obtain the data.

	DHS Imaging					
Step	SW Pupil	SW Filter	LW Pupil	LW Filter	Subarray	
2	GDHS0	F150W2	F405N	F444W	FULL	**[WSC0173]**
3	Execute WFC File group 1					
4	GDHS0	F150W2	F405N	F444W	FULL	**[WSC0174]**
5	Execute WFC file group 2					
6	GDHS60	F150W2	F405N	F444W	FULL	**[WSC0175]**
7	Execute WFC file group 3					
8	GDHS60	F150W2	F405N	F444W	FULL	**[WSC0176]**

60.5.3.2 Readout Pattern

> **READOUT PATTERN [READOUT PATTERN] = RAPID [WSC0177], BRIGHT1 [WSC0178]**

This field specifies the readout pattern to be used to obtain the data.

60.5.3.3 Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0179]**.

60.5.3.4 Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0180]**.

60.5.4 Plus/Minus 8 Waves Defocus Imaging Parameters
[WSC0181]

60.5.4.1 Filters

The following filters will be used to obtain the data.

	Plus/Minus 8 waves defocus Imaging					
Step	SW Pupil	SW Filter	LW Pupil	LW Filter	Subarray	
9	WLP8	F212N	F405N	F444W	FULL	**[WSC0182]**
10	WLM8	F212N	F405N	F444W	FULL	**[WSC0183]**

60.5.4.2 Readout Pattern

READOUT PATTERN [READOUT PATTERN] = RAPID [WSC0184], BRIGHT1 [WSC0185]

This field specifies the readout pattern to be used to obtain the data.

60.5.4.3 Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0186]**.

60.5.4.4 Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0187]**.

60.6 MIRI Multi-Instrument, Multi-Field (MIMF) Imaging

MIRI MIMF exposures are used to measure the PSF during wave-front sensing activities for commissioning of the JWST Optical Telescope Element (OTE). The MIRI MIMF observation will use a 5-points-of-light strategy to improve sampling of the PSF in multiple locations on the detector. Those points are described in Table 60-4 below. At each of these points, the entire Dither pattern selected below will be executed **[WSC0105]**.

Table 60-4 5 Points-of-Light for MIRI MIMF Observations

Image	X-Position (arcsec)	Y-Position (arcsec)	
1	0	0	**[WSC0106]**
2	-66.0	56.32	**[WSC0107]**
3	66.0	56.32	**[WSC0108]**

4	66.0	-56.32	**[WSC0109]**
5	-66.0	-56.32	**[WSC0110]**

Note for developers: This pattern will be implemented as a canned mosaic, and no further mosaic parameters should be allowed **[WSC0111]**. APT should default to include a **NO PARALLEL** special requirement when the template is created **[WSC0112]**, but the user should be allowed to remove it if necessary. **[WSC0113]**

The following parameters are used for MIRI MIMF exposures.

60.6.1   Target Name

Select the **TARGET NAME [TBD] [WSC0114]** from the list of targets previously entered (see Section 5.5).

60.6.2   Dither Pattern

MIRI MIMF Imaging observations with JWST will require dithering.   The following parameters define the dither patterns for MIRI MIMF Imaging observations. The dither pattern will be executed at each of the points-of-light defined above **[WSC0115]**.

60.6.2.1 Pattern Type

PATTERN TYPE **[PATTERN_TYPE]** = CYCLING **[WSC0116]**, REULEAUX **[WSC0117]**

This parameter specifies the primary pattern to be used for dithering (see Table 60-5).

Table 60-5 Dither Patterns Available for MIRI MIMF Imaging

Dither Pattern	Description
CYCLING	A table of 311 positions in which x- and y-offsets are randomly drawn from a Gaussian distribution, from which users can select their beginning position and the number of dithers they would like to use (see Figure 60.1)
REULEAUX	A table of 12 positions that define a Reuleaux triangle (see Figure 60.2)

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60.6.2.1.1 Cycling

The **CYCLING** pattern is shown in Figure 60.1, and can be used to obtain data optimized for self-calibration at arbitrary sky depths. The pattern consists of a list of 311 pointing positions where the x- and y-offset distributions (from the central position) are well-described by a Gaussian; the pattern is drawn from the Spitzer IRAC Cycling pattern. Observations may begin at any position in the cycling pattern and include an arbitrary number of dithers. Each contiguous block of four pointing positions provides some 0.5 pixel sub-sampling in both the x- and y-directions. However, to provide optimized sub-pixel sampling, this pattern should be used in conjunction with the sub-pixel sampling option.

Figure 60.1 The MIRI CYCLING Pattern
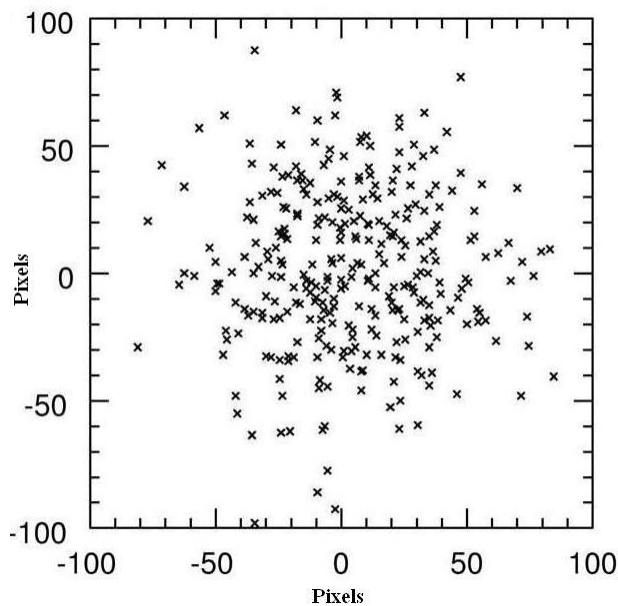
If the **CYCLING** pattern has been selected the following inputs are also required (along with **PATTERN SIZE**) **[WSC0118]**.

60.6.2.1.1.1 Starting Point

   STARTING POINT **[STARTING_POINT]** = 1, 2, 3, …, 310, 311 **[WSC0119]**

This parameter is used to determine the offset of the first dither position.

60.6.2.1.1.2 Number of Points

   NUMBER OF POINTS **[NUMBER_OF_POINTS]** = 3, 4, 5, … **[WSC0120]**

This parameter indicates the total number of dither positions in the pattern.

If the combination of **STARTING POINT** and **NUMBER OF POINTS** exceeds 311, the pattern cycles back to use points 1, 2, 3, etc **[WSC0121]**.

No explicit maximum is set on the number of points **[WSC0122]**. The number of points, however, is effectively limited by the maximum allowed visit duration.

60.6.2.1.2 Reuleaux

The **REULEAUX** pattern is shown in Figure 60.2, and is optimized to provide to obtain observations of compact point sources that are suitable for self-calibration. The pattern is a set of 12 dither positions that defines a Reuleaux triangle; the pattern is drawn from the Spitzer IRAC 12-point Reuleaux pattern. The Reuleaux pattern includes some 0.5 pixel sub-sampling in both the x- and y-directions. However, to provide optimized sub-pixel sampling, this pattern should be used in conjunction with the sub-pixel sampling option.

Figure 60.2 The MIRI REULEAUX Pattern
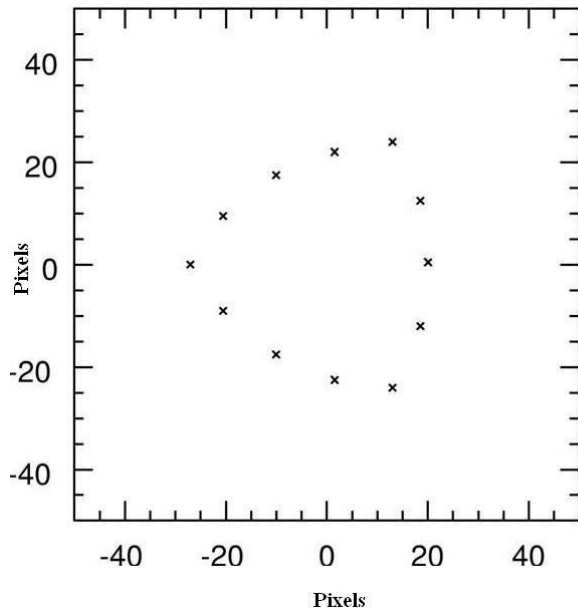
The origin is the aperture center.

If the **REULEAUX** pattern has been selected, you must also select a **PATTERN SIZE** **[WSC0123]**.

60.6.2.2 Pattern Size

PATTERN SIZE [PATTERN_SIZE] = DEFAULT [WSC0124] (default) [WSC0125], SMALL [WSC0126], MEDIUM [WSC0127], LARGE [WSC0128]

This parameter specifies that all exposures are to be done with the same dithering pattern (**SMALL**, **MEDIUM, or LARGE**). When the pattern size is not specified by the user the **DEFAULT** pattern will be used based upon the choice of filter and pattern as indicated in Table 60-6.

Table 60-6 Default Dithering Pattern Sizes for MIRI MIMF Observations

Filter	12-pt. Reuleaux	311-pt. Cycling
F560W	SMALL **[WSC0129]**	SMALL **[WSC0131]**
F770W	SMALL **[WSC0130]**	MEDIUM **[WSC0132]**

60.6.2.3 Subpixel Sampling

SUBPIXEL SAMPLING [SUBPIXEL_SAMPLING] = YES [WSC0133], NO [WSC0134]

This parameter specifies whether or not subpixel sampling (a Parallelogram pattern) will be performed.

Note for developers: see Appendix F1 for dithering details.

60.6.3   Filter Name

Select the name of one **FILTER [FILTER]** (see Table 60-7).

Table 60-7 Filters Available for MIRI MIMF

Filter	Central Wavelength λ_0 (μm)	Filter Bandpass $\Delta\lambda$ (μm)	Comment
F560W **[WSC0135]**	5.6	1.2	broad band
F770W **[WSC0136]**	7.7	2.2	PAH, broad band

60.6.4   Readout Pattern

READOUT PATTERN [READOUT PATTERN] = SLOW [WSC0137], FAST [WSC0138]

This field specifies the readout pattern to be used to obtain the data. **FAST** is used for bright targets and long wavelength imaging and **SLOW** is used for faint targets, deep imaging.

60.6.5　　Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0139]**.

60.6.6　　Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] field specifies the number of times the integration is repeated **[WSC0140]**.

60.7 NIRCam Multi-Instrument, Multi-Field (MIMF) Imaging
TBD

60.8 NIRSpec Multi-Instrument, Multi-Field (MIMF) Imaging

NIRSpec can handle 2 types of observations in support of Multi-Instrument, Multi-Field (MIMF) wave-front sensing. First, NIRSpec will obtain images of the PSF through the "large square" aperture (S1600A1, 1.6" X 1.6"), placing the star within a few tenths of an arcsecond from the aperture center in at least one image. Second, NIRSpec will obtain images through the "all-open" MSA, placing the star with +/- 1 pixel (0.1 arcsec) of the center of a MSA shutter in at least one image. A MSA configuration file can be used to close specific shutters if desired. The following parameters are used to define NIRSpec MIMF observations. These MIMF activities are intended to be used during commissioning of the OTE and not during normal NIRSpec science operations.

60.8.1　　Exposure Duration

The following parameters define an NIRSpec MIMF Imaging exposure.

60.8.1.1 Readout Pattern

READOUT PATTERN [READOUT PATTERN] = NRS [WSC0141] (default) [WSC0142], NRSRAPID [WSC0143]

This field specifies the readout pattern to be used to obtain the NIRSpec MIMF data. . **NRS** is used for faint targets, while **NRSRAPID** is used for bright targets.

60.8.1.2 Number of Groups

NUMBER OF GROUPS [NGROUPS] specifies the number of groups in an integration **[WSC0144]**.

60.8.1.3 Number of Integrations

NUMBER OF INTEGRATIONS [NINTS] specifies the number of times the integration is performed **[WSC0145]**.

60.8.2 NIRSpec Multi-Instrument, Multi-Field search

MIMF SEARCH [MIMFSEARCH] = SQUARE_AP [WSC0146], MSAQ1 [WSC0147], MSAQ2 [WSC0148], MSAQ3 [WSC0149], MSAQ4 [WSC0150]

This parameter specifies the NIRSpec detector area where the MIMF measurements will be taken: **SQUARE_AP** indicates that the target will be on the "large square" aperture (S1600, 1.6" X 1.6"), **MSAQ1** indicated that the target will be on quadrant 1 of the Micro-shutter array, **MSAQ2** indicates the target will be on quadrant 2 of the micro-shutter array, **MSAQ3** indicates the target will be on quadrant 3 of the micro-shutter array, and **MSAQ4** indicates the target will be on quadrant 4 of the micro-shutter array. Depending on the NIRSpec detector area specified using this parameter, the appropriate image searching pattern will be executed on-board.

Note for developers: IF MIMFSEARCH = SQUARE AP, then 13 images will be taken **[WSC0151]**, ELSE 10 images will be taken **[WSC0152]**.

60.8.3 MSA Configuration Filename

When obtaining NIRSpec MIMF data using one of the MSA quadrants (MIMFSEARCH = **MSAQ1**, **MSAQ2**, **MSAQ3** or **MSAQ4**), the default is to have all MSA shutters open **[WSC0153].** However, if there are bright stars in the field that you wish to mask out during the MIMF exposure, you can provide an optional **MSA CONFIGURATION FILENAME [WSC0154] [MSAFILE]** which describes the MSA mask to be used to block the light from these stars. This file should be generated by using the MSA Planning tool. If no file is specified, then all shutters will be open.

Note for developers: The SUBARRAY is not explicitly given, and its value is SUB32 for SQUARE_AP **[WSC0155]** and FULL for the MSA quadrants **[WSC0156]** for purposes for calculating photon collection time.

60.9 NIRISS Multi-Instrument, Multi-Field (MIMF) Imaging
TBD