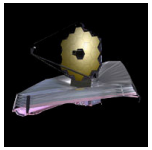

1273 - Kuiper Belt Science with JWST

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*
Prof. Jonathan I. Lunine (PI)	**Cornell University**

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
HAUMEA				
	1	MIRI/LRS	MIRI Low Resolution Spectroscopy	(1) HAUMEA
	9	MIRI/LRS	MIRI Low Resolution Spectroscopy	(1) HAUMEA
	3	MIRI/IMAGING	MIRI Imaging	(1) HAUMEA
	11	MIRI/IMAGING BACKGROUND	MIRI Imaging	(7) HAUMEA-BACKGROUND
	2	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(1) HAUMEA
	102	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(1) HAUMEA
	10	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(1) HAUMEA
	110	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(1) HAUMEA
QUAOAR				
	4	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(2) QUAOAR
CENTAURS				
	6	AMYCUS NIRSPEC IFU	NIRSpec IFU Spectroscopy	(4) AMYCUS
	7	2008 FC76 NIRSPEC IFU	NIRSpec IFU Spectroscopy	(5) 2008FC76
	8	CHIRON NIRSPEC IFU	NIRSpec IFU Spectroscopy	(6) CHIRON

ABSTRACT

Observation IDs: LUNINE_1000, LUNINE_1001, LUNINE_2000, LUNINE_3000, LUNINE_4000, LUNINE_5000, LUNINE_6000, LUNINE_7000, LUNINE_8000, LUNINE_9000, LUNINE_10000

We plan to exploit JWST's exquisite sensitivity in the 1-5 micron region to study the largest trans-Neptunian Objects and Kuiper Belt objects via reflectance spectroscopy. The composition of even the largest of these bodies is poorly constrained. We propose to use NIRSpec's IFU to obtain the first high-SNR, R > 100 spectra for a sample of these objects. MIRI spectra will also be obtained on some targets. These data can be expected to reveal the presence of previously unseen molecular ices, constrain their physical state (crystalline phase, solution with other species, temperature, grain-size), identify new organic species, and constrain isotopic ratios for some elements (H, O, C, N). MIRI MRS and Imaging data will also be used to study temperature variations on several targets, and will be interpreted in the context of existing Herschel and/or Spitzer thermal data. The targets represent a large fraction of the diversity of the Kuiper Belt in terms of collisional history (Pluto and Haumea underwent catastrophic impacts), effects of planetary migration (resonant, classical, Centaur and scattered objects), multiplicity (several host at least one moon), albedo, and major species composition (H2O, CH4, N2, NH3, CO). These objects represent the end-state of accretion and subsequent processing in the Kuiper Belt. This initial reconnaissance of their surface compositions will inform our understanding of the long history of processes in the outermost regions of the Sun's proto-planetary disk.

OBSERVING DESCRIPTION

HAUMEA: The keystone of the observing program of the KBO and dwarf planet Haumea are the MIRI imaging observations. These observations are designed to obtain a rotational light curve over one full rotation period of Haumea (~4 hours). Placing a time constraint on when particular observations are to be made would increase the total charged time through time critical overheads of 1 hour. Rather than do this, we chose to stare at Haumea for one entire rotation period to avoid the overheads. 14 different longitudes will be observed in the F2100W filter, and 2 longitudes, roughly corresponding to opposite hemispheres on Haumea, will be made through the F2550W filter. These filters were chosen to maximize the flux from Haumea due to the thermal peak at longer wavelengths. LRS observations are preferred over MRS observations because Haumea is too faint to make spectra at the longest MRS wavelengths worthwhile. A TA is specified in order to accurately place Haumea in the thin LRS slit. The NIRSpec IFU observations are planned with the medium resolution grating to obtain a high SNR in the near-infrared. The NRSIRS2RAPID readout mode was chosen to further increase the SNR of these spectra. We place representative phase constraints on the two groups of observations: 1, 2, & 3 and 9 & 10. These phase constraints are meant to represent observations of opposite hemispheres of Haumea, with one of those hemispheres containing the "dark spot." Accurate numbers will replace the placeholder phase constraints after a better determination of the zero-phase date is determined. These

phase constraints place a time window for the observations to occur less than 24 hours, but greater than 1 hour, so will not receive a 1-hour overhead in a future version of APT. The goal is to compare the NIR and MIR spectra of these two hemispheres to determine if the composition of Haumea's surface varies in these two distinct regions.

QUAOAR: Medium resolution and PRISM observations will be made of the KBO Quaoar with the NIRSpec IFU to obtain a decent SNR. The NRSIRS2RAPID readout mode was chosen to increase the SNR of these observations. Due to the relative faintness of Quaoar, observations at the longest near-infrared wavelengths, where flux from the object is lowest, will be made with the low-resolution PRISM mode instead of the medium resolution grating. PRISM also covers the full wavelength range and will contribute to a higher SNR at the shorter wavelengths.

2008 FC76: Medium resolution observations will be made of the red Centaur 2008 FC76 with the NIRSpec IFU to obtain a decent SNR. The NRSIRS2RAPID readout mode was chosen to increase the SNR of the 2008 FC76 spectra.

PHOLUS and 2002 KY14: Medium resolution and PRISM observations will be made of the red Centaurs Pholus and 2002 KY14 with the NIRSpec IFU to obtain a decent SNR. The NRSIRS2RAPID readout mode was chosen to increase the SNR of these observations. Due to the relative faintness of these two Centaurs, observations will be made with only the PRISM mode instead of the medium resolution grating. PRISM covers the full near-infrared wavelength range.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		
Comments: Extended=NO				
(2)	QUAOAR	TYPE=ASTEROID,A=43.47200381956696,E=0.0409 8702510897952,I=7.991232171849933 ,O=189.0902949942479,W=155.214428533145,M=29 6.2230021720905,EQUINOX=J2000,EPOCH=09-AUG-2022:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(4)	AMYCUS	TYPE=ASTEROID,A=25.18622013517917,E=0.3958 79819497841,I=13.33850101717285 ,O=315.5028978511376,W=239.5637619004689,M=4 1.7457803252649,EQUINOX=J2000,EPOCH=22-OCT-2017:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(5)	2008FC76	TYPE=ASTEROID,A=14.72001395282787,E=0.3087 676806342838,I=27.11782206622065 ,O=245.6824931756913,W=142.1003851234029,M=4. 454381391056318,EQUINOX=J2000,EPOCH=02-DEC-2014:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(6)	CHIRON	TYPE=ASTEROID,A=13.63715272851428,E=0.3823 199098011394,I=6.939929818074044 ,O=209.2657724892082,W=339.3695088977266,M=1 36.412052784437,EQUINOX=J2000,EPOCH=17-MAR-2015:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(7)	HAUMEA-BACKGROUND	STD=HAUMEA	TYPE=POS_ANGLE,RAD=300,ANG=0,REF=NORT H	
Comments: Extended=NO				

Observation

Proposal 1273, Observation 1: MIRI/LRS Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(MIRI/LRS (Obs 1)) Warning (Form): Record ETC Wkbk.Calc ID used to verify target acquisition.

(Exposure) Warning (Form): Record ETC Wkbk.Calc ID used to verify target acquisition.

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F560W	FAST	8	1	1	22.2	

Template

Subarray	Obtain Verification Image?
FULL	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	88	2	4	1	2	982.364	

Special Requirements	
	Phase 0.1 to 0.4 with period 3.9154 Hours and zero-phase 2457578.57786947 HJD Group Observations 1, 2, 3, 11, Non-interruptible DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 9: MIRI/LRS Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(MIRI/LRS (Obs 9)) Warning (Form): Record ETC Wkbk.Calc ID used to verify target acquisition.

(Exposure) Warning (Form): Record ETC Wkbk.Calc ID used to verify target acquisition.

(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F560W	FAST	8	1	1	22.2	

Template

Subarray	Obtain Verification Image?
FULL	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	88	2	4	1	2	982.364	

Special Requirements	
	Phase 0.6 to 0.9 with period 3.9154 Hours and zero-phase 2457578.57786947 HJD Group Observations 9, 10, Non-interruptible DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 3: MIRI/IMAGING Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	2-Point								DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2100W	FASTR1	30	6	1	Dither 1	2	12	1026.765	
2	F2550W	FASTR1	20	24	1	Dither 1	2	48	2791.69	
3	F2100W	FASTR1	30	6	1	Dither 1	2	12	1026.765	
4	F2550W	FASTR1	20	18	1	Dither 1	2	36	2092.38	

Special Requirements

No Parallel Attachments

Group Observations 1, 2, 3, 11, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 11: MIRI/IMAGING BACKGROUND Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(7)	HAUMEA-BACKGROUND	STD=HAUMEA	TYPE=POS_ANGLE,RAD=300,ANG=0,REF=NORTH	

Comments: Extended=NO

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	2-Point								DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F2550W	FASTR1	20	1	1	Dither 1	2	2	111.002	

Special Requirements

No Parallel Attachments

Group Observations 1, 2, 3, 11, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE HAUMEA-BACKGROUND FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 2: NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
2	G235M/F170LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
3	G395M/F290LP	NRSIRS2RAPID	40	1	false	true	NONE	2	2	1196.289	

Special Requirements

Group Observations 1, 2, 3, 11, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 102: NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 102:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
2	G235M/F170LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
3	G395M/F290LP	NRSIRS2RAPID	40	1	false	true	NONE	2	2	1196.289	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 10: NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
2	G235M/F170LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
3	G395M/F290LP	NRSIRS2RAPID	40	1	false	true	NONE	2	2	1196.289	

Special Requirements

Group Observations 9, 10, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 110: NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 110:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	HAUMEA	STD=HAUMEA		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
2	G235M/F170LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
3	G395M/F290LP	NRSIRS2RAPID	40	1	false	true	NONE	2	2	1196.289	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE HAUMEA FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 4: NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(2)	QUAOAR	TYPE=ASTEROID,A=43.47200381956696,E=0.0409 8702510897952,I=7.991232171849933 ,O=189.0902949942479,W=155.214428533145,M=29 6.2230021720905,EQUINOX=J2000,EPOCH=09-AUG-2022:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	20	1	false	true	NONE	2	2	612.733	
2	G235M/F170LP	NRSIRS2RAPID	60	1	false	true	NONE	2	2	1779.845	
3	PRISM/CLEAR	NRSIRS2RAPID	15	2	false	true	NONE	2	4	933.689	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE QUAOAR FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 6: AMYCUS NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(4)	AMYCUS	TYPE=ASTEROID,A=25.18622013517917,E=0.3958 79819497841,I=13.33850101717285 ,O=315.5028978511376,W=239.5637619004689,M=4 1.7457803252649,EQUINOX=J2000,EPOCH=22- OCT-2017:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	NRSIRS2RAPID	21	1	false	true	NONE	2	2	641.911	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE AMYCUS FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 7: 2008 FC76 NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(5)	2008FC76	TYPE=ASTEROID,A=14.72001395282787,E=0.3087676806342838,I=27.11782206622065,O=245.6824931756913,W=142.1003851234029,M=4.454381391056318,EQUINOX=J2000,EPOCH=02-DEC-2014:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	15	1	false	true	NONE	2	2	466.844	
2	G235M/F170LP	NRSIRS2RAPID	30	1	false	true	NONE	2	2	904.511	
3	G395M/F290LP	NRSIRS2RAPID	50	1	false	true	NONE	2	2	1488.067	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE 2008FC76 FROM JWST LESS THAN 0.03

Observation

Proposal 1273, Observation 8: CHIRON NIRSPEC IFU Wed Mar 15 20:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Diagnostics

(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(6)	CHIRON	TYPE=ASTEROID,A=13.63715272851428,E=0.3823199098011394,I=6.939929818074044,O=209.2657724892082,W=339.3695088977266,M=136.412052784437,EQUINOX=J2000,EPOCH=17-MAR-2015:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	2	

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2RAPID	10	1	false	true	NONE	2	2	320.956	
2	G235M/F170LP	NRSIRS2RAPID	25	1	false	true	NONE	2	2	758.622	
3	G395M/F290LP	NRSIRS2RAPID	36	1	false	true	NONE	2	2	1079.578	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE CHIRON FROM JWST LESS THAN 0.03