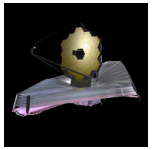

1254 - TNOs

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*
Dr. Alex Harrison Parker (PI)	**SETI Institute**

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
MAKEMAKE				
	1	MIRI LRS	MIRI Low Resolution Spectroscopy	(1) MAKEMAKE
	2	MIRI IMAGING LONG. 1	MIRI Imaging	(1) MAKEMAKE
	7	MIRI IMAGING BACKGROUND	MIRI Imaging	(3) MAKEMAKE-BACKGROUND
	4	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(1) MAKEMAKE
VARUNA				
	5	MIRI IMAGING	MIRI Imaging	(2) VARUNA
	55	MIRI IMAGING	MIRI Imaging	(2) VARUNA
	8	MIRI IMAGING BACKGROUND	MIRI Imaging	(4) VARUNA-BACKGROUND
	58	MIRI IMAGING BACKGROUND	MIRI Imaging	(4) VARUNA-BACKGROUND
	6	NIRSPEC IFU	NIRSpec IFU Spectroscopy	(2) VARUNA

ABSTRACT

Observation IDs: HAMMEL_2000, HAMMEL_3000, HAMMEL_3001, HAMMEL_4000, HAMMEL_4001, HAMMEL_5000, HAMMEL_6000, HAMMEL_7000

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

MAKEMAKE: MIRI/LRS observations are planned for the KBO and dwarf planet Makemake to obtain high SNR spectra at the shorter mid-infrared wavelengths. Makemake is too faint to make MRS observations at the longest wavelengths worthwhile. A TA is specified in order to accurately place Makemake in the thin LRS slit. MIRI imaging observations are planned using the F1800W and F2550W filters to increase the observed flux from the thermal peak at longer wavelengths. Imaging observations are planned for 2 different orbital phases of Makemake's satellite. We place representative phase constraints on the two MIRI imaging observations: 2, 3. These phase constraints are meant to represent observations of different orbital phases of Makemake's newly discovered satellite in order to obtain a better chance of observing the satellite. Accurate numbers will replace the placeholder phase constraints after a better determination of the orbit of the satellite is better-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. Medium resolution NIRSpec IFU observations are planned to obtain a very high SNR in the near-infrared. The NRSIRS2RAPID readout mode was chosen to further increase the SNR for these spectra.

VARUNA: PRISM observations will be made of the KBO Varuna with the NIRSpec IFU to obtain a high SNR. The NRSIRS2RAPID readout mode was chosen to increase the SNR of these observations. PRISM covers the full wavelength range in the near-infrared. MIRI imaging observations are designed to obtain 95% rotational coverage of Varuna during its 6.3418-hour rotation period. Observing Varuna for ~6 straight hours reduces overheads and complexity by trying to obtain observations of specific longitudes. The F2550W filter was chosen to maximize flux due to the thermal

peak at longer wavelengths.

Proposal 1254 - Targets - TNOs

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(1)	MAKEMAKE	STD=MAKEMAKE		
Comments: Extended=NO				
(2)	VARUNA	TYPE=ASTEROID,A=43.15373969368983,E=0.0506 7792508436809,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=1 03.5778068454335,EQUINOX=J2000,EPOCH=30- JUL-2015:00:00:00,EpochTimeScale=TDB		
Comments: Extended=NO				
(3)	MAKEMAKE- BACKGROUND	STD=MAKEMAKE	TYPE=POS_ANGLE,RAD=300,ANG=0,REF=NORT H	
Comments: Extended=NO				
(4)	VARUNA-BACKGROUND	TYPE=ASTEROID,A=43.15373969368983,E=0.0506 7792508436809,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=1 03.5778068454335,EQUINOX=J2000,EPOCH=30- JUL-2015:00:00:00,EpochTimeScale=TDB	TYPE=POS_ANGLE,RAD=300,ANG=0,REF=NORT H	
Comments: Extended=NO				

Observation

Proposal 1254, Observation 1: MIRI LRS Tue Feb 28 00:00:49 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)	MAKEMAKE	STD=MAKEMAKE		

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	4	1	1	11.1	

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	15	10	20	1	2	882.463	

Special Requirements	DEFAULT WINDOW: ANGULAR RATE MAKEMAKE FROM JWST LESS THAN 0.03

Observation

Proposal 1254, Observation 2: MIRI IMAGING LONG. 1

Tue Feb 28 00:00:49 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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)	MAKEMAKE	STD=MAKEMAKE		

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	F1800W	FASTR1	60	3	1	Dither 1	2	6	1010.115	
2	F2550W	FASTR1	20	9	1	Dither 1	2	18	1043.415	

Special Requirements

Phase 0.1 to 0.4 with period 22.48 Hours and zero-phase 2458109.9945361367 HJD

7 After 2 by 0 Hours to 24 Hours

DEFAULT WINDOW: ANGULAR RATE MAKEMAKE FROM JWST LESS THAN 0.03

Observation

Proposal 1254, Observation 7: MIRI IMAGING BACKGROUND

Tue Feb 28 00:00:49 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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
(3)	MAKEMAKE-BACKGROUND	STD=MAKEMAKE	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

7 After 2 by 0 Hours to 24 Hours

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

Observation

Proposal 1254, Observation 4: NIRSPEC IFU Tue Feb 28 00:00:49 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
(1)	MAKEMAKE	STD=MAKEMAKE		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	2-POINT-NOD				

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	15	2	false	true	NONE	2	4	933.689	
3	G395M/F290LP	NRSIRS2RAPID	60	1	false	true	NONE	2	2	1779.845	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE MAKEMAKE FROM JWST LESS THAN 0.03

Observation

Proposal 1254, Observation 5: MIRI IMAGING

Tue Feb 28 00:00:49 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(2)	VARUNA	TYPE=ASTEROID,A=43.15373969368983,E=0.0506 7792508436809,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=1 03.5778068454335,EQUINOX=J2000,EPOCH=30- JUL-2015:00:00:00,EpochTimeScale=TDB		

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	140	1	Dither 1	2	280	16311.685	

Special Requirements

No Parallel Attachments

Group Observations 5, 8, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE VARUNA FROM JWST LESS THAN 0.03

Observation

Proposal 1254, Observation 55: MIRI IMAGING Tue Feb 28 00:00:49 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 55:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(2)	VARUNA	TYPE=ASTEROID,A=43.15373969368983,E=0.0506 7792508436809,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=1 03.5778068454335,EQUINOX=J2000,EPOCH=30- JUL-2015:00:00:00,EpochTimeScale=TDB		

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	140	1	Dither 1	2	280	16311.685	

Special Requirements

No Parallel Attachments

Group Observations 55, 58, Non-interruptible

DEFAULT WINDOW: ANGULAR RATE VARUNA FROM JWST LESS THAN 0.03

Observation

Proposal 1254, Observation 8: MIRI IMAGING BACKGROUND

Tue Feb 28 00:00:49 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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
(4)	VARUNA-BACKGROUND	TYPE=ASTEROID,A=43.15373969368983,E=0.0506779250843680 9,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=103.5778068454335,EQUINOX=J2000,EPOCH=30-JUL-2015:00:00:00,EpochTimeScale=TDB	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 5, 8, Non-interruptible

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

Observation

Proposal 1254, Observation 58: MIRI IMAGING BACKGROUND Tue Feb 28 00:00:49 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 58:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Solar System Targets

#	Name	Level 1	Level 2	Level 3
(4)	VARUNA-BACKGROUND	TYPE=ASTEROID,A=43.15373969368983,E=0.0506779250843680 9,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=103.5778068454335,EQUINOX=J2000,EPOCH=30-JUL-2015:00:00:00,EpochTimeScale=TDB	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 55, 58, Non-interruptible

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

Observation

Proposal 1254, Observation 6: NIRSPEC IFU Tue Feb 28 00:00:49 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
(2)	VARUNA	TYPE=ASTEROID,A=43.15373969368983,E=0.0506 7792508436809,I=17.15766785383603 ,O=97.28027214938949,W=271.8079936902055,M=1 03.5778068454335,EQUINOX=J2000,EPOCH=30- JUL-2015:00:00:00,EpochTimeScale=TDB		

Comments: Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	2-POINT-NOD				

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	80	1	false	true	NONE	2	2	2363.4	

Special Requirements

DEFAULT WINDOW: ANGULAR RATE VARUNA FROM JWST LESS THAN 0.03