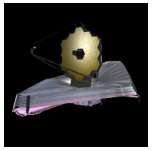

2757 - Understanding the origin of Boyajian's Star occultations

Cycle: 2, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	2	NIRSpec	NIRSpec Fixed Slit Spectroscopy	(1) GSC-03162-00665
	3	MIRI LRS	MIRI Low Resolution Spectroscopy	(1) GSC-03162-00665
	4	MIRI Imaging	MIRI Imaging	(1) GSC-03162-00665

ABSTRACT

KIC 8462852 (Boyajian's Star) displays an extraordinary light curve, showing both deep "dipping" events and long-term changes. We propose observations of this object in the wavelength range 1.7 to 25 microns in order to measure the thermal emission from the circumstellar material causing the observed light curve variations. We will obtain spectra in the 1.66-11 microns wavelength range, and imaging at 15, 18, 20, and 25 microns with orders of magnitude better sensitivity than existing observations. The first goal of these observations is to distinguish among competing models for the star's behavior: a detection would confirm the circumstellar nature of the occulting material; a non-detection would be highly constraining, and motivate further development of alternative models for the star's light curve, such as dense knots of material in the interstellar medium, or an intervening cold disk of a dark object such as a black hole. The second goal of these observations, in the event of a detection, is to determine the temperature and luminosity of the circumstellar dust to better understand this extraordinary object. These observations will be sensitive to any debris disk in the 10th percentile of those around similar old stars. These observations also have a chance of measuring the emission spectrum

of warm dust during the close passage of the occulting material, allowing it to be conclusively identified and studied via its silicate features. We waive the exclusive access period for these observations.

OBSERVING DESCRIPTION

We will measure the spectral energy distribution (SED) of Boyajian’s Star using a combination of NIRSpec and MIRI spectroscopy, and MIRI imaging. For the NIRSpec observations, we will use the S200A1 fixed slit spectroscopic mode on the SUB200A1 subarray with the G235M and G395M dispersers to collect two spectra, covering 1.66um to 5.1um. We will take a sequence of dithered integrations with both dispersers, using a combined set of two primary nods and the ``spectral'' sub-pixel pattern to give the cleanest possible results. For the G235M data we will use two groups per integration and two integrations per exposure, with six total dithered exposures. For the G395M data we will use four groups per integration, and again two integrations per exposure with six dithered exposures.

For the MIRI imaging observations we will take a set of dithered images using the F2100W and F2550W filters and the FULL subarray. Again, the goal with these images is to have the SNR of the stellar flux measurement exceed SNR=100. At F2100W we will use twelve groups per integration and a single integration per exposure. The F2550W images use the less sensitive Channel 4 detector, and so require 18 groups per integration and 20 integrations per exposure to match the F2100W SNR. In both filters we will use a single 4-point dither -- starting at Set 5 to place the images near the center of the subarray -- giving us four dithered exposures in each filter.

Unlike NIRSpec, it is possible for MIRI to acquire the target directly for the spectroscopic observations. We will use the F1000W filter on the full subarray with the FAST readout mode and 4 groups per integration. This will give the TA image a SNR of 380. For the MIRI imaging observations, no target acquisition is necessary, since the blind point of the telescope is sufficient to place Boyajian’s Star in the field of view.

Finally, we note that there is a faint companion star to Boyajian's star located approximately 2" away. For the NIRSpec observations this is far enough away that the companion will be outside the S200A1 slit, even if it were aligned exactly along the position angle of the companion. For MIRI imaging we expect the FWHM of the images in both filters to be approximately 0".7 to 0".8, which will allow the two stars to be well separated. The MIRI LRS slit is large enough to also include the companion if it were oriented towards the companion, so for the LRS observations we have included mild orient constraints to ensure this does not happen. These constraints remove approximately three weeks from the seven month visibility window for Boyajian’s Star.

We waive the exclusive access period for these observations.

Proposal 2757 - Targets - Understanding the origin of Boyajian's Star occultations

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GSC-03162-00665	RA: 20 06 15.4371 (301.5643212d)	Proper Motion RA: -0.00103748 mas/yr	
		Dec: +44 27 24.63 (44.45684d)	Proper Motion Dec: -0.0102731 mas/yr	
		Equinox: J2000	Epoch of Position: 2016.0	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. updated RA, DEC, and proper motion from GAIA DR3. *Category=Star* *Description=[F dwarfs]*				
(2)	20061592+4427494	RA: 20 06 15.9237 (301.5663487d)	Proper Motion RA: 0.8728 mas/yr	
		Dec: +44 27 49.39 (44.46372d)	Proper Motion Dec: -2.2050 mas/yr	
		Equinox: J2000	Epoch of Position: 2016.0	
Comments: This object was generated by the targetselector and retrieved from the 2MASS database. updated coordinates to GAIA DR 3 and added proper motions. *Category=Star* *Description=[M stars]*				

Observation

Proposal 2757, Observation 2: NIRSpec Mon May 08 15:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GSC-03162-00665	RA: 20 06 15.4371 (301.5643212d)	Proper Motion RA: -0.00103748 mas/yr	
		Dec: +44 27 24.63 (44.45684d)	Proper Motion Dec: -0.0102731 mas/yr	
		Equinox: J2000	Epoch of Position: 2016.0	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. updated RA, DEC, and proper motion from GAIA DR3.
Category=Star
Description=[F dwarfs]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 20061592+4427494	WATA	SUB32	F110W	NRSRAPID	3	1	1	0.08	122679

Template

Slit	Subarray
S200A1	SUBS200A1

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	NONE

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G235M/F170LP	S200A1	NRSRAPID	2	4	1	NONE	3	12	56.334	58204
2	G395M/F290LP	S200A1	NRSRAPID	4	5	2	NONE	3	15	117.157	58204

Observation

Proposal 2757, Observation 3: MIRI LRS Mon May 08 15:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GSC-03162-00665	RA: 20 06 15.4371 (301.5643212d)	Proper Motion RA: -0.00103748 mas/yr	
		Dec: +44 27 24.63 (44.45684d)	Proper Motion Dec: -0.0102731 mas/yr	
		Equinox: J2000	Epoch of Position: 2016.0	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. updated RA, DEC, and proper motion from GAIA DR3.
Category=Star
Description=[F dwarfs]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	1 GSC-03162-00665	F1000W	FAST	4	1	1	11.1	58204

Template

Subarray	Obtain Verification Image?
FULL	true

Dithers

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

Pointing Verification

#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
1	FASTR1	5	1	1	1	1	13.875		F1000W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	11	10	20	1	2	660.46	58204

Special Requirements

Aperture PA Range 112 to 262 Degrees (V3 107.24203 to 257.24203)
Aperture PA Range 292 to 82 Degrees (V3 287.24203 to 77.24203)

Observation

Proposal 2757, Observation 4: MIRI Imaging Mon May 08 15:00:27 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	GSC-03162-00665	RA: 20 06 15.4371 (301.5643212d)	Proper Motion RA: -0.00103748 mas/yr	
		Dec: +44 27 24.63 (44.45684d)	Proper Motion Dec: -0.0102731 mas/yr	
		Equinox: J2000	Epoch of Position: 2016.0	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. updated RA, DEC, and proper motion from GAIA DR3.
Category=Star
Description=[F dwarfs]

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	1	3						DEFAULT
2	CYCLING	1	4		5	1			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	F1500W	FASTR1	5	1	1	Dither 2	4	4	55.501	58204
2	F1800W	FASTR1	10	1	1	Dither 2	4	4	111.002	58204
3	F2100W	FASTR1	12	1	1	Dither 2	4	4	133.202	58204
4	F2550W	FASTR1	18	20	1	Dither 2	4	80	4206.961	58204