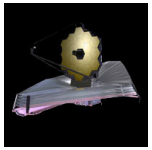

6550 - When worlds collide: formation and evolution of a synestia

Cycle: 2, Proposal Category: DD

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
NIRSPEC and MIRI				
	1	G235H/F170LP and G395H/F290LP	NIRSpec Fixed Slit Spectroscopy	(1) ASASSN--21qj
	2	MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) ASASSN--21qj

ABSTRACT

We propose to confirm and characterise a candidate 'synestia', the self-luminous transient produced by a collision that occurred between two ice giant exoplanets orbiting a Sun-like star, ASASSN-21qj. The occurrence rate of these giant impact events is still highly uncertain so this is a unique, time-limited opportunity for the JWST to obtain a spectrum of this extraordinary type of planetary body. The proposed observation will inform us about the nature of the end stages of planet formation and collisions between (giant) planets around solar type stars, and provide a unique insight into the

composition of the collision remnant through spectral analysis.

Our science goals are:
- Confirm and constrain the photospheric size and temperature of the synestia by measuring the spectral energy distribution from 1.7 to 28 micron.
- Quantify the presence of water vapour, silicates and/or other refractory materials in the synestia's photosphere with NIRSpec FS high resolution spectroscopy from 1.7 to 5.1 micron, and MIRI MRS from 4.8 to 27.9 micron.

The collision, which occurred in 2019, was detected by the NEOWISE mission and was reported on in October 2023. The latest NEOWISE IR photometry shows that the synestia’s flux is rapidly fading below the NEOWISE noise limit; JWST is the only telescope that can obtain a mid-infrared spectrum of the photosphere of this astronomical object before it fades below detectability in the second half of 2024. Depending on the temporal evolution of the source, this DDT may be the only and final opportunity to observe the body before it fades below the sensitivity limit.

OBSERVING DESCRIPTION

We propose to observe the star ASASSN-21qj and its orbiting synestia that is formed out of a recent collision between planetary mass objects. We have two scientific goals for our program: to confirm and constrain the photospheric size and temperature of the synestia, and to determine the abundances of the molecules in the synestia's photosphere. To reach these goals, we request to observe the system in the 4.8-27.9 micron range with the four channels of the MIRI Medium Resolution Spectrometer and the 1.7-5.1 micron range with the NIRSpec fixed slits S200A1 and S200A2 and gratings G235H/F170LP and G395H/F290LP. The required NIRSpec science time is 1.87 hours, and the charged time is 4.04 hours. The required MIRI science time is 2.96 hours, and the charged time is 4.54 hours. As ASASSN-21qj has a nearby visual companion and is therefore not suitable for target acquisition (TA), for both NIRSpec and MIRI, TA will be performed on an isolated star 28” away.

Due to the rapidly decreasing flux of the synestia, we have set two timing constraints. The observation must take place before February 16, 2024. The visibility of ASASSN-21qj is currently in the Micrometeroid Avoidance Zone, so this constraint effectively means that the observations must take place between January 15 and February 16. The second timing constraint is that the MIRI and NIRSpec observations are set as a non-interruptible sequence.

For the NIRSpec observations, a PA constraint has been set to not have the nearby visual companion located 3.7 arcseconds away from the target in the slit.

Proposal 6550 - Targets - When worlds collide: formation and evolution of a synestia

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	ASASSN--21qj	RA: 08 15 23.2863 (123.8470263d) Dec: -38 59 23.19 (-38.98978d) Equinox: J2000	Proper Motion RA: -9.692 mas/yr Proper Motion Dec: 7.349 mas/yr Parallax: 0.00176313505" Epoch of Position: 2016	
Comments: Target coordinates pulled from Gaia ESA archive (Gaia DR3) 08h15m23.28633256s -38d59m23.18687749s Category=Star Description=[G dwarfs]				
(2)	TA-target	RA: 08 15 21.4280 (123.8392833d) Dec: -38 59 41.01 (-38.99473d) Equinox: J2000	Proper Motion RA: -2.360 mas/yr Proper Motion Dec: -5.159 mas/yr Parallax: 0.00106700943" Epoch of Position: 2016	
Comments: Gaia DR3 5539970601632030208 Target coordinates pulled from Gaia ESA archive (Gaia DR3) 08h15m21.42800705s -38d59m41.00970402s VOSA fit Teff=3500K Category=Star Description=[M stars] Extended=NO				

Observation

Proposal 6550, Observation 1: G235H/F170LP and G395H/F290LP Tue Dec 26 18:01:32 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Comments: PA constraint to avoid a nearby star at 3.7"

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	ASASSN--21qj	RA: 08 15 23.2863 (123.8470263d) Dec: -38 59 23.19 (-38.98978d) Equinox: J2000	Proper Motion RA: -9.692 mas/yr Proper Motion Dec: 7.349 mas/yr Parallax: 0.00176313505" Epoch of Position: 2016	

Comments: Target coordinates pulled from Gaia ESA archive (Gaia DR3)
08h15m23.28633256s -38d59m23.18687749s
Category=Star
Description=[G dwarfs]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 TA-target	WATA	SUB32	CLEAR	NRSRAPID	3	1	1	0.08	181904

Template

Slit	Subarray
S200A1 and S200A2	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	5	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	G235H/F170LP	S200A1	NRSIRS2RAPID	9	2	1	NONE	5	10	1458.889	181904
2	G235H/F170LP	S200A2	NRSIRS2RAPID	9	2	2	NONE	5	10	1458.889	
3	G395H/F290LP	S200A2	NRSIRS2RAPID	14	2	3	NONE	5	10	2188.334	
4	G395H/F290LP	S200A1	NRSIRS2RAPID	14	2	4	NONE	5	10	2188.334	181904

Special Requirements	
	Before Date 16-FEB-2024:00:00:00 Aperture PA Range 80 to 240 Degrees (V3 301.15809631 to 101.15809631) Aperture PA Range 260 to 60 Degrees (V3 121.15809631 to 281.15809631) Group Observations 1, 2, Non-interruptible

Observation

Proposal 6550, Observation 2: MIRI MRS Tue Dec 26 18:01:32 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Comments: Data excess for both MIRI MRS individually, and the linked MIRI and NIRSpec observation is below the middle threshold. It is not possible to further reduce data excess without negatively affecting the science goals.

Diagnostics

(Visit 2:1) Warning (Form): Data Excess over lower threshold

(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)	ASASSN--21qj	RA: 08 15 23.2863 (123.8470263d)	Proper Motion RA: -9.692 mas/yr	
		Dec: -38 59 23.19 (-38.98978d)	Proper Motion Dec: 7.349 mas/yr	
		Equinox: J2000	Parallax: 0.00176313505"	
			Epoch of Position: 2016	

Comments: Target coordinates pulled from Gaia ESA archive (Gaia DR3)
08h15m23.28633256s -38d59m23.18687749s
Category=Star
Description=[G dwarfs]

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 TA-target	F560W	FAST	8	1	1	22.2	180945

Template

Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
All MRS	YES	FULL	NEUTRAL

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	POINT SOURCE	NEGATIVE

Spectral Elements

#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		IMAGER	F770W	FASTR1	50	1	1	Dither 1	4	4	555.008	
1	SHORT(A)	MRSLONG		FASTR1	40	8	1	Dither 1	4	32	3629.752	180945
1	SHORT(A)	MRSSHORT		FASTR1	40	8	1	Dither 1	4	32	3629.752	180945
2		IMAGER	F770W	FASTR1	50	1	1	Dither 1	4	4	555.008	
2	MEDIUM(B)	MRSLONG		FASTR1	40	8	1	Dither 1	4	32	3629.752	180945
2	MEDIUM(B)	MRSSHORT		FASTR1	40	8	1	Dither 1	4	32	3629.752	180945
3		IMAGER	F770W	FASTR1	50	1	1	Dither 1	4	4	555.008	
3	LONG(C)	MRSLONG		FASTR1	40	8	1	Dither 1	4	32	3629.752	180945
3	LONG(C)	MRSSHORT		FASTR1	40	8	1	Dither 1	4	32	3629.752	180945

Special Requirements	
	Before Date 16-FEB-2024:00:00:00 Group Observations 1, 2, Non-interruptible