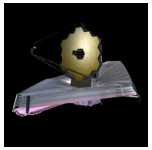

2061 - Nucleosynthesis, Astrophysics, and Cosmology with IR Observations of a Gravitational Wave Counterpart

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Epoch 1				
	1	MIRI	MIRI Imaging	(2) MAG24A
	2	NIRCam	NIRCam Imaging	(2) MAG24A
	3	NIRSpec	NIRSpec Fixed Slit Spectroscopy	(2) MAG24A
Epoch 2				
	4	MIRI	MIRI Imaging	(2) MAG24A
	5	NIRCam	NIRCam Imaging	(2) MAG24A

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	6	NIRSpec	NIRSpec Fixed Slit Spectroscopy	(2) MAG24A
Epoch 3				
	7	MIRI	MIRI Imaging	(2) MAG24A
	8	NIRCam	NIRCam Imaging	(2) MAG24A
	9	NIRSpec	NIRSpec Fixed Slit Spectroscopy	(2) MAG24A
Epoch 4				
	10	MIRI	MIRI Imaging	(2) MAG24A
	11	NIRCam	NIRCam Imaging	(2) MAG24A
	12	NIRSpec	NIRSpec Fixed Slit Spectroscopy	(2) MAG24A

ABSTRACT

The 2017 discovery of a binary neutron star (BNS) merger in gravitational waves (GWs) and light was a watershed moment. Using unique multi-messenger data, the community made major advances in a broad range of topics from r-process nucleosynthesis to compact-object formation to cosmology. While no other electromagnetic counterpart has yet been discovered, the second example will likely lead to new fundamental discoveries.

Cycle 1 and the next LIGO/Virgo/KAGRA observing run (O4) have high overlap. But simulations suggest that there will be only one O4 event visible to JWST - and it will likely be distant/faint. Nevertheless, the observations proposed here can answer several questions:

What fraction of the heaviest elements come from NS mergers?

What are the progenitors of BNS systems?

How fast is the Universe expanding?

NS mergers produce radioactive, r-process ejecta - a kilonova (KN) - whose spectral-energy distribution depends on its composition. Theory predicts that all KNe have a "red" component peaking in the IR, and tracking its evolution constrains the amount of heavy r-process material produced. The same observations can pinpoint the KN in its galaxy, possibly revealing the origin of the progenitor system, and constrain the system's inclination angle, breaking a degeneracy with distance in the GW data and improving the "standard siren" H0 measurement.

It will be at least 5 years between the first and second GW counterparts. We request a single ToO trigger to make these important JWST observations

for the entire community - with no proprietary period - including the first mid-IR observation of a GW counterpart, what will be a signature achievement for JWST.

OBSERVING DESCRIPTION

We request a disruptive target-of-opportunity trigger and a series of 4 epochs of NIRSpec, NIRCam, and MIRI observations of a single gravitational wave counterpart. We request long-term status to have full overlap with the 4th LIGO/Virgo/KAGRA observing run.

Based on detailed simulations, we believe the likelihood of triggering this program is ~66% (if the observing run is 1 year). However, that number depends solely on (1) the detection of a good gravitational wave source that (2) has a high-confidence electromagnetic counterpart and (3) is visible by JWST. If those three criteria are met, we will trigger our program.

We will observe with all 3 instruments in each epoch. With NIRCam, we will use F115W/F444W, F150W/F356W, and F200W/F277W. With MIRI, we will observe in F560W and F770W. The source's spectral features are expected to be broad and we wish to obtain broad spectral coverage, so the NIRSpec prism is appropriate for our observations. We have set exposure times so that we have at least 4 dithered exposures, get reasonable S/N for a variety of expected SEDs, and match between the SW and LW observations.

The cadence is chosen so that we get our first observation as quickly as possible, followed by two observations ~3 and ~7 days after the first (~6 and 10 days after the gravitational wave trigger) to cover the peak luminosity in each filter. An additional epoch ~17 days after the first epoch (20 days after the gravitational wave trigger) is used to track the fading rate.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	We trigger on a kilonova that is within 150 Mpc and can be triggered within 2 days of explosion	

Observation

Proposal 2061, Observation 1: MIRI

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(MIRI (Obs 1)) Warning (Form): Response time < 14.0 Days is disruptive to the scheduling process. Only a limited number of disruptive ToOs will be accepted.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
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	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	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	F560W	FASTR1	15	1	1	Dither 1	4	4	166.502	
2	F770W	FASTR1	60	1	1	Dither 1	4	4	666.01	

Special Requirements

On Hold ToO
Target Of Opportunity Response Time 3 Days, Carry-Over

4 After 1 by 2.5 Days to 3.5 Days
Group Observations 1, 2, 3, Non-interruptible

Observation

Proposal 2061, Observation 2: NIRCam

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

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
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	BRIGHT2	2	1	4	4	171.788	
2	F150W	F356W	RAPID	2	1	4	4	85.894	
3	F200W	F277W	RAPID	2	1	4	4	85.894	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold ToO

Group Observations 1, 2, 3, Non-interruptible

Observation

Proposal 2061, Observation 3: NIRSpec Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit 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
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPID	3	1	1	3.628	64218

Template

Slit	Subarray
S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	SPATIAL

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	3	1	1	NONE	6	6	350.133	

Special Requirements	
	On Hold ToO Group Observations 1, 2, 3, Non-interruptible

Observation

Proposal 2061, Observation 4: MIRI

Wed Apr 24 16:00:25 GMT 2024

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
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
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	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	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	F560W	FASTR1	15	1	1	Dither 1	4	4	166.502	
2	F770W	FASTR1	40	1	1	Dither 1	4	4	444.006	

Special Requirements

On Hold ToO

4 After 1 by 2.5 Days to 3.5 Days
7 After 4 by 3 Days to 5 Days
Group Observations 4, 5, 6, Non-interruptible

Observation

Proposal 2061, Observation 5: NIRCam Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	BRIGHT2	2	1	4	4	171.788	
2	F150W	F356W	RAPID	2	1	4	4	85.894	
3	F200W	F277W	RAPID	2	1	4	4	85.894	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold ToO

Group Observations 4, 5, 6, Non-interruptible

Observation

Proposal 2061, Observation 6: NIRSpec

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPID	3	1	1	3.628	64269

Template

Slit	Subarray
S200A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	SPATIAL

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	S200A1	NRSIRS2RAPID	3	1	1	NONE	6	6	350.133	

Special Requirements	
	On Hold ToO Group Observations 4, 5, 6, Non-interruptible

Observation

Proposal 2061, Observation 7: MIRI

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
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	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	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	F560W	FASTR1	50	1	1	Dither 1	4	4	555.008	
2	F770W	FASTR1	270	1	1	Dither 1	4	4	2997.043	

Special Requirements

On Hold ToO

7 After 4 by 3 Days to 5 Days
10 After 7 by 8 Days to 12 Days
Group Observations 7, 8, 9, Non-interruptible

Observation

Proposal 2061, Observation 8: NIRCam

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	BRIGHT1	7	1	4	4	558.312	
2	F150W	F356W	BRIGHT2	2	1	4	4	171.788	
3	F200W	F277W	RAPID	2	1	4	4	85.894	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold ToO

Group Observations 7, 8, 9, Non-interruptible

Observation

Proposal 2061, Observation 9: NIRSpec Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	SUB2048	CLEAR	NRSRAPID	3	1	1	3.628	64271

Template

Slit	Subarray
S1600A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	SPATIAL

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	S1600A1	NRSIRS2RAPID	9	1	1	NONE	6	6	875.333	

Special Requirements	
	On Hold ToO Group Observations 7, 8, 9, Non-interruptible

Observation

Proposal 2061, Observation 10: MIRI

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
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	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	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	F560W	FASTR1	190	2	1	Dither 1	4	8	4229.161	

Special Requirements

On Hold ToO

10 After 7 by 8 Days to 12 Days
Group Observations 10, 11, 12, Non-interruptible

Observation

Proposal 2061, Observation 11: NIRCam

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	MEDIUM8	7	1	4	4	2920.401	
2	F150W	F277W	SHALLOW4	8	1	4	4	1674.936	
3	F200W	F356W	BRIGHT2	4	1	4	4	343.577	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold ToO

Group Observations 10, 11, 12, Non-interruptible

Observation

Proposal 2061, Observation 12: NIRSpec

Wed Apr 24 16:00:25 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec Fixed Slit Spectroscopy

Diagnostics

(Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	MAG24A	RA: 07 56 5.6000 (119.0233333d) Dec: -22 53 54.00 (-22.89833d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[Neutron stars]
Extended=NO

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	FULL	CLEAR	NRSRAPIDD6	3	1	1	171.788	64273

Template

Slit	Subarray
S1600A1	FULL

Dithers

#	Primary Dither Positions	Sub-Pixel Pattern
1	3	SPATIAL

Spectral Elements

#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	S1600A1	NRSIRS2RAPID	29	1	1	NONE	6	6	2626.0	

Special Requirements	
	On Hold ToO Group Observations 10, 11, 12, Non-interruptible