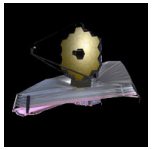

2091 - Detecting the Synthesis of the Heaviest Elements with Photometry of a Kilonova in the Optically Thin Phase

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Epoch 1				
	1	NIRCam	NIRCam Imaging	(1) KILONOVA
	2	MIRI	MIRI Imaging	(1) KILONOVA
Epoch 2				
	3	NIRCam	NIRCam Imaging	(1) KILONOVA

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	4	MIRI	MIRI Imaging	(1) KILONOVA
Epoch 3				
	5	NIRCam	NIRCam Imaging	(1) KILONOVA
	6	MIRI	MIRI Imaging	(1) KILONOVA
Epoch 4				
	7	NIRCam	NIRCam Imaging	(1) KILONOVA
	8	MIRI	MIRI Imaging	(1) KILONOVA

ABSTRACT

Approximately half of all elements heavier than iron form through rapid-neutron capture. Yet the cosmic origin of these “r-process” elements has been debated for over 60 years. In 2017, the discovery of a kilonova associated with the gravitational wave source GW170817 partially unraveled this mystery---firmly establishing that neutron star mergers do synthesize r-process elements. However, in this discovery's wake many questions remain. In particular, it is unclear whether GW170817 synthesized any of the heaviest “third peak” or actinide elements. As a result, we are still uncertain whether NS mergers are the only – or even the dominant – site of r-process production. We propose to use JWST/NIRCam and JWST/MIRI to tackle this open question by observing a new kilonova discovered during LIGO/Virgo/KAGRA Observing Run 4. We will carry out our observations between ~30-120 days post-merger when the ejecta is optically thin. During this nebular phase, the bolometric luminosity will trace the instantaneous heating rate due to radioactive decay; with decline rates that vary depending how far up the periodic table the r-process proceeded. Constraining the bolometric luminosity at these epochs requires broad-band coverage between ~1-10 microns to depths of ~25-28 mag (AB). Hence, JWST is the only facility capable of carrying out these observations.

OBSERVING DESCRIPTION

This proposal will perform NIRCam and MIRI photometry of a new kilonova discovered within 150 Mpc during LIGO/Virgo/KAGRA Observing Run 4. Observations will be carried out at +30, +50, +80 and +120 days post-merger. This is a non disruptive ToO, with observations starting at least 20 days post-activation. At each epoch, images will be obtained in F090W, F150W2, F322W2, and F444W (NIRCam) as well as F770W (MIRI). Finally, a set of references images in the same filters will be obtained during Cycle 2 once the kilonova has faded (~250 days post-merger).

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

Observation

Proposal 2091, Observation 1: NIRCam

Wed Jan 04 23:01:04 GMT 2023

Diagnostic Status: Error

Observing Template: NIRCam Imaging

Diagnostics

(NIRCam (Obs 1)) Error (Form): Observations using Generic targets must have an On Hold special requirement.

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

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

Template

Module	Subarray
ALL	FULL

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	F090W	F444W	BRIGHT2	3	1	4	4	257.682	
2	F150W2	F322W2	BRIGHT2	3	1	4	4	257.682	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
Target Of Opportunity response time 20 Days Long-Term ToO

3 After 1 by 18 Days to 22 Days
Group Observations 1, 2, Non-interruptible

Observation

Proposal 2091, Observation 2: MIRI

Wed Jan 04 23:01:04 GMT 2023

Diagnostic Status: Error

Observing Template: MIRI Imaging

Diagnostics

(MIRI (Obs 2)) Error (Form): Observations using Generic targets must have an On Hold special requirement.

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

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

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	F770W	FASTR1	40	1	1	Dither 1	4	4	444.006	

Special Requirements

Target Of Opportunity response time 20 Days Long-Term ToO

Group Observations 1, 2, Non-interruptible

Observation

Proposal 2091, Observation 3: NIRCam

Wed Jan 04 23:01:04 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

Template

Module	Subarray
ALL	FULL

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	F090W	F444W	BRIGHT1	6	1	4	4	472.418	
2	F150W2	F322W2	BRIGHT1	6	1	4	4	472.418	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold until kilonova associated with NS merger is identified

3 After 1 by 18 Days to 22 Days
5 After 3 by 28 Days to 32 Days
Group Observations 3, 4, Non-interruptible

Observation

Proposal 2091, Observation 4: MIRI

Wed Jan 04 23:01:04 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.

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

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	F770W	FASTR1	110	1	1	Dither 1	4	4	1221.018	

Special Requirements

On Hold Until Kilonova Associated with NS Merger is Identified.

Group Observations 3, 4, Non-interruptible

Observation

Proposal 2091, Observation 5: NIRCam

Wed Jan 04 23:01:04 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

Template

Module	Subarray
ALL	FULL

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	F090W	F444W	SHALLOW4	5	1	4	4	1030.73	
2	F150W2	F322W2	SHALLOW4	5	1	4	4	1030.73	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold until kilonova associated with NS merger is identified

5 After 3 by 28 Days to 32 Days
7 After 5 by 38 Days to 42 Days
Group Observations 5, 6, Non-interruptible

Observation

Proposal 2091, Observation 6: MIRI

Wed Jan 04 23:01:04 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

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

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

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	F770W	FASTR1	170	1	1	Dither 1	4	4	1887.027	

Special Requirements

On Hold Until Kilonova Associated with NS Merger is Identified.

Group Observations 5, 6, Non-interruptible

Observation

Proposal 2091, Observation 7: NIRCam

Wed Jan 04 23:01:04 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

Template

Module	Subarray
ALL	FULL

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	F090W	F444W	SHALLOW4	5	1	4	4	1030.73	
2	F150W2	F322W2	SHALLOW4	5	1	4	4	1030.73	

Special Requirements

Offset 55.0 arcsec, 35.0 arcsec
On Hold until kilonova associated with NS merger is identified

7 After 5 by 38 Days to 42 Days
Group Observations 7, 8, Non-interruptible

Observation

Proposal 2091, Observation 8: MIRI

Wed Jan 04 23:01:04 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.

Generic Targets

#	Name	Criteria	Description
(1)	KILONOVA	Kilonova Associated with and LVK GW event at < 150 Mpc	

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	F770W	FASTR1	170	1	1	Dither 1	4	4	1887.027	

Special Requirements

On Hold Until Kilonova Associated with NS Merger is Identified.

Group Observations 7, 8, Non-interruptible