

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

Cycle: 1, Proposal Category: GO

INVESTIGATORS

Name	Institution	E-Mail
Maria Drout (PI) (CSA Member)	University of Toronto	maria.drout@utoronto.ca
Dr. Charles Kilpatrick (CoI)	Northwestern University	ckilpatrick@northwestern.edu
Dr. Alexander Pung Ji (CoI)	University of Chicago	alexji@uchicago.edu
Aaron Tohuvavohu (CoI) (CSA Member)	University of Toronto	aaron.tohu@gmail.com
Prof. Daryl Haggard (CoI) (CSA Member)	McGill University	daryl.haggard@mcgill.ca
Prof. Ryan Foley (CoI)	University of California - Santa Cruz	foley@ucsc.edu
Dr. Armin Rest (CoI) (US Admin CoI)	Space Telescope Science Institute	arest@stsci.edu
Dr. Ryan Ridden-Harper (CoI)	The Johns Hopkins University	rridden@stsci.edu
Dr. Tea Temim (CoI)	Princeton University	temim@astro.princeton.edu
Dr. Joshua D. Simon (CoI)	Carnegie Institution of Washington	jsimon@carnegiescience.edu
Dr. James Annis (CoI)	Fermi National Accelerator Laboratory (FNAL)	annis@fnal.gov
Mr. Patrick David Aleo (CoI)	University of Illinois at Urbana - Champaign	paleo2@illinois.edu
Dr. Iair Arcavi (CoI)	Tel Aviv University	arcavi@gmail.com
Dr. Annalisa Calamida (CoI)	Space Telescope Science Institute	calamida@stsci.edu
Deep Chatterjee (CoI)	MIT Kavli Institute for Astrophysics and Space Research	deep1018@mit.edu
Prof. Jeff Cooke (CoI)	Swinburne University of Technology	jcooke@astro.swin.edu.au
David Coulter (CoI)	University of California - Santa Cruz	dcoulter@ucsc.edu
Dr. Georgios Dimitriadis (CoI) (ESA Member)	University of Dublin, Trinity College	dimitrig@tcd.ie
Dr. Ori Dosovitz Fox (CoI)	Space Telescope Science Institute	ofox@stsci.edu
Mr. Alexander Thomas Gagliano (CoI)	University of Illinois at Urbana - Champaign	gaglian2@illinois.edu
Dr. Suvi Gezari (CoI)	Space Telescope Science Institute	sgezari@stsci.edu

JWST Proposal 2091 (Created: Wednesday, January 4, 2023 at 6:01:04 PM Eastern Standard Time) - Overview

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Name	Institution	E-Mail		
Dr. Daichi Hiramatsu (CoI)	Center for Astrophysics Harvard & Smithsonian	daichi.hiramatsu@cfa.harvard.edu		
Dr. Dale Andrew Howell (CoI)	Las Cumbres Observatory Global Telescope Network	ahowell@lco.global		
Dr. Saurabh W. Jha (CoI)	Rutgers the State University of New Jersey	saurabh@physics.rutgers.edu		
David Oscar Jones (CoI)	NOIRLab - Gemini North (HI)	david.jones@noirlab.edu		
Dr. Daniel Kasen (CoI)	University of California - Berkeley	kasen@berkeley.edu		
Prof. Robert P. Kirshner (CoI)	Harvard University	kirshner@cfa.harvard.edu		
Nora Luetzgendorf (CoI)	Space Telescope Science Institute - ESA - JWST	nluetzgendorf@stsci.edu		
Dr. Phillip Macias (CoI)	University of California - Santa Cruz	pmacias@ucsc.edu		
Dr. Curtis McCully (CoI)	Las Cumbres Observatory Global Telescope Network	cmccully@lco.global		
Prof. Gautham Narayan (CoI)	University of Illinois at Urbana - Champaign	gsnarayan@gmail.com		
Dr. Antonella Palmese (CoI)	University of California - Berkeley	palmese@berkeley.edu		
Yen-Chen Pan (CoI)	National Central University	ycpan@gm.astro.ncu.edu.tw		
Dr. Anthony Piro (CoI)	Carnegie Institution of Washington	piro@carnegiescience.edu		
Dr. Enrico Ramirez-Ruiz (CoI)	University of California - Santa Cruz	enrico@ucolick.org		
Mr. Cesar Rojas-Bravo (CoI)	University of California - Santa Cruz	crojasbr@ucsc.edu		
Dr. Russell E. Ryan Jr. (CoI)	Space Telescope Science Institute	rryan@stsci.edu		
Prof. David J. Sand (CoI)	University of Arizona	dave.j.sand@gmail.com		
Matthew Ryan Siebert (CoI)	Space Telescope Science Institute	msiebert@stsci.edu		
Marcelle Soares-Santos (CoI)	University of Michigan	mssantos@umich.edu		
Dr. Louis-Gregory Strolger (CoI)	Space Telescope Science Institute	strolger@stsci.edu		
Kirsty Taggart (CoI)	University of California - Santa Cruz	kltaggar@ucsc.edu		
Dr. Samaporn Tinyanont (CoI)	University of California - Santa Cruz	stinyano@ucsc.edu		
Dr. Stefano Valenti (CoI)	University of California - Davis	stfn.valenti@gmail.com		
Mr. Qinan Wang (CoI)	The Johns Hopkins University	qwang75@jhu.edu		

OBSERVATIONS

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

JWST Proposal 2091 (Created: Wednesday, January 4, 2023 at 6:01:04 PM Eastern Standard Time) - Overview

Folder	Observation	Label	Observing Template	Science Target
	4	MIRI	MIRI Imaging	(1) KILONOVA
Epoch 3	3			
	5	NIRCam	NIRCam Imaging	(1) KILONOVA
	6	MIRI	MIRI Imaging	(1) KILONOVA
Epoch 4	ļ		-	
	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).

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

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

<u>Pro</u>	posal 2	<u> 2091 - Observation </u>	on 1 - Detectin	g the Synthesi	s of the Hea	<u>aviest Elements</u>	with Photom	etry of a Kild	<u>onova in the O</u>	ptically Thin .
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Generic Targets	# (1)	Name KILONOVA	Criteria Kilonova Associated	l with and LVK GW eve	ent at < 150 Mpc	Description				
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Dithers	1		Primary Dither Type NONE	Primary Di	thers	Subpixel Dither Ty STANDARD	pe Dithe	er Size	Subpixel P 4	ositions
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Spectral Elements	1 2	F090W F150W2	F444W F322W2	SHALLOW4 SHALLOW4	5 5	1 1	4 4	4 4	1030.73 1030.73	
Special Requirements	On Hold	5.0 arcsec, 35.0 arcsec until kilonova associated by 28 Days to 32 Days by 38 Days to 42 Days bservations 5, 6, Non-integral of the control o	I with NS merger is identific	ed						

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Generic Targets	(1)	Name KILONOVA	Criteria Kilonova Associated	with and LVK GW even	ent at < 150 Mpc	Description				
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rs	#		Primary Dither Type	Primary Di	thers	Subpixel Dither Ty	ype Dithe	er Size	Subpixel P	ositions
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Spectral Elements	2	F150W2	F322W2	SHALLOW4	5	1	4	4	1030.73	
Special Requirements	On Hold	0.0 arcsec, 35.0 arcsec until kilonova associated by 38 Days to 42 Days bservations 7, 8, Non-inter	with NS merger is identifie	d						

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Generic Targets	(1)	KILONOVA	Kilonova Associa	ted with and LV	K GW event at < 150 M	Л рс					
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