



# 3468 - Measuring the Hubble constant with the next multiple-imaged lensed supernova

Cycle: 2, Proposal Category: GO

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Prof. Ariel Goobar (PI) (ESA Member)</b>	<b>Stockholm University</b>
Dr. Nikki Arendse (CoI) (ESA Member)	Stockholm University
Dr. Suhail Dhawan (CoI) (ESA Member)	University of Cambridge
Prof. Edvard Mortsell (CoI) (ESA Member)	Stockholm University
Dr. Joel Pearson Johansson (CoI) (ESA Member)	Stockholm University
Dr. Lin Yan (CoI) (US Admin CoI)	California Institute of Technology
Dr. Jakob Nordin (CoI) (ESA Member)	Humboldt Universitat zu Berlin
Ana Sagues Carracedo (CoI) (ESA Member)	Stockholm University
Dr. Christoffer Fremling (CoI)	California Institute of Technology
Dr. Mickael Rigault (CoI) (ESA Member)	Institut des deux Infinis de Lyon
Dr. Mathew Smith (CoI) (ESA Member)	Institut des deux Infinis de Lyon
Dr. Angela Adamo (CoI) (ESA Member)	Stockholm University
Dr. Adelaide Marie Claeysens (CoI) (ESA Member)	Stockholm University
Dr. T. Emil Rivera-Thorsen (CoI) (ESA Member)	Stockholm University
Ms. Alice Townsend (CoI) (ESA Member)	Humboldt Universitat zu Berlin
Dr. Stephen Thorp (CoI) (ESA Member)	Stockholm University
Mr. William D'Arcy Kenworthy (CoI) (ESA Member)	Stockholm University
Igor Andreoni (CoI)	NASA Goddard Space Flight Center
Dr. Steve Schulze (CoI)	Northwestern University

**OBSERVATIONS**

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
imaging				
	1	imaging visit	NIRCam Imaging	(1) ZTFSN
spectroscopy				
	2	position 1	NIRSpec IFU Spectroscopy	(1) ZTFSN

**ABSTRACT**

Spectroscopic time-delay measurements of multiply-imaged supernovae offer a very efficient way to measure the expansion rate of the universe. NIRCam and NIRSpec follow-up observations with JWST upon the next lensed supernova (SN) discovered by the Zwicky Transient Facility (ZTF) could pave the way for a novel technique to measure the Hubble constant and address the "Hubble tension". Unlike any other time-delay measurement, spectroscopic dating of multiple SN images can be done without repeated observations. We propose to select a suitable lensed survey for ToO observations and anticipate a 5% (or better) measurement of  $H_0$ , with only 3 hours of JWST time.

**OBSERVING DESCRIPTION**

We propose to carry out non-disruptive ToO observations of a strongly lensed, multiply-imaged, supernova discovered by the ZTF. Thanks to the unique combination of near-IR sensitivity, throughput and angular resolution, JWST observations will allow us to measure positions and the spectroscopic time-delays between resolved multiple images, the latter with an accuracy of about half a day. We will accomplish this through SED dating of the individual resolved SN images, with the aim to establish a novel and powerful technique to measure the Hubble constant with strongly lensed supernovae. The requested observations will allow us to measure  $H_0$  with 5% accuracy or better. This is particularly timely given the "Hubble tension", arguably the hottest issue in cosmology today.

Proposal 3468 - Targets - Measuring the Hubble constant with the next multiple-imaged lensed supernova

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	ZTFSN	RA: 00 00 0.0000 (.0000000d)	Dec: +00 00 0.00 (.00000d)	Equinox: J2000
<i>Comments:</i> Category=Star Description=[Type Ia supernovae] Extended=YES					

Proposal 3468 - Observation 1 - Measuring the Hubble constant with the next multiple-imaged lensed supernova

Mon Jul 01 16:00:20 GMT 2024

<b>Observation</b>	<p>Proposal 3468, Observation 1: imaging visit</p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCam Imaging</p>									
<b>Diagnostics</b>	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>		<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>		
	(1)	ZTFNS	RA: 00 00 0.0000 (.0000000d) Dec: +00 00 0.00 (.00000d) Equinox: J2000							
	<p><i>Comments:</i>  <i>Category=Star</i>  <i>Description=[Type Ia supernovae]</i>  <i>Extended=YES</i></p>									
<b>Template</b>	<b>Module</b>		<b>Subarray</b>			<b>Target Placement</b>				
	ALL		FULL			Module Gap				
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>		<b>Dither Size</b>	<b>Subpixel Positions</b>		
	1	INTRAMODULEBOX		2	SMALL-GRID-DITHER			2		
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F200W	F277W	RAPID	2	1	4	4	85.894	63898
	2	F150W	F277W	RAPID	2	1	4	4	85.894	63898
<b>Special Requirements</b>	Target Of Opportunity Response Time 21 Days, Carry-Over									

Proposal 3468 - Observation 2 - Measuring the Hubble constant with the next multiple-imaged lensed supernova

Mon Jul 01 16:00:20 GMT 2024

<b>Observation</b>	<p><b>Proposal 3468, Observation 2: position 1</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
<b>Diagnostics</b>	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
<b>Fixed Targets</b>	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous			
	(1)	ZTFNS	RA: 00 00 0.0000 (.0000000d) Dec: +00 00 0.00 (.00000d) Equinox: J2000									
	<p><i>Comments:</i>  <i>Category=Star</i>  <i>Description=[Type Ia supernovae]</i>  <i>Extended=YES</i></p>											
<b>Acquisition</b>	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	1 ZTFNS	WATA	FULL	F110W	NRSRAPID	3	1	1	42.947	141127	
<b>Dithers</b>	#	Dither Type		Size	Starting Point		Number of Points		Points			
	1	2-POINT-NOD										
<b>Spectral Elements</b>	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G140M/F100LP	NRS	10	4	false	true	NONE	2	8	3521.661	