



# 12684 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

Cycle: 19, Proposal Category: GO  
(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Mr. Bruce McCollum (PI)</b>	<b>California Institute of Technology</b>	<b>mccollum@ipac.caltech.edu</b>
Dr. Seppo J. Laine (CoI)	California Institute of Technology	seppo@ipac.caltech.edu
Dr. Frederick C. Bruhweiler (CoI)	Catholic University of America	bruhweiler@cua.edu
Dr. Glenn M. Wahlgren (CoI)	Catholic University of America	wahlgren@milkyway.gsfc.nasa.gov
Lee Rottler (CoI)	University of California - Santa Cruz	rottler@lick.ucsc.edu

## VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) NOVA-SCO-2008	WFC3/IR	1	05-Aug-2011 21:12:22.0	yes
02	(1) NOVA-SCO-2008	WFC3/IR	1	05-Aug-2011 21:12:45.0	yes
03	(1) NOVA-SCO-2008	WFC3/UVIS	1	05-Aug-2011 21:12:52.0	yes

3 Total Orbits Used

## ABSTRACT

The 2008 eruption of V1309 Sco was recently proved to have resulted from the merger of two nondegenerate stars. Such mergers have long been thought to occur, but they are so rare that this is the first one ever observed while it happened. Stellar mergers are predicted to produce pre-merger mass loss in addition to mass loss from the outburst at the time of merger. We have discovered a ~3.5 arcsecond elongated feature at 3.6 and 4.5 microns in archival Spitzer/IRAC survey images, which extends directly from V1309 Sco. The images were obtained 11 months before the outburst.

## Proposal 12684 (STScI Edit Number: 0, Created: Friday, August 5, 2011 8:12:55 PM EST) - Overview

At the estimated distance of V1309 Sco, the extended material is  $\sim 10,000$  AU in size. High resolution imaging presents the first opportunity to determine important information about both pre-merger and merger-outburst mass loss, which will be valuable in testing and refining merger models and will have general implications for stellar cluster evolution models. Spitzer/IRAC resolution is insufficient to learn details of this feature's morphology. This object has never been imaged at subarcsecond resolution. Ground-based spectra suggest that the extended material should have a complex morphology influenced by multiple mass ejections and possibly a jet. Our observations will test theoretical predictions that mergers should have significant pre-merger mass loss. We select filters to resolve and measure emission from shocked features, which we will use in conjunction with shock models and diagnostics to determine or put limits on the densities, speeds, and temperatures of both the pre-merger and post-merger ejecta which are expected to be now colliding.

### **OBSERVING DESCRIPTION**

We will take images.

Proposal 12684 - Visit 01 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

Sat Aug 06 01:12:55 GMT 2011

Visit	<b>Proposal 12684, Visit 01</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: PCS MODE FINE					
	#	Primary Pattern	Secondary Pattern	Exposures		
Patterns	(2)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false	(1), (3)		
	(3)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false	(2), (4), (5), (6)		
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	NOVA-SCO-2008	RA: 17 57 32.9300 (269.3872083d) Dec: -30 43 10.10 (-30.71947d) Equinox: J2000		V=19.0 I = 19.0	Reference Frame: ICRS
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						

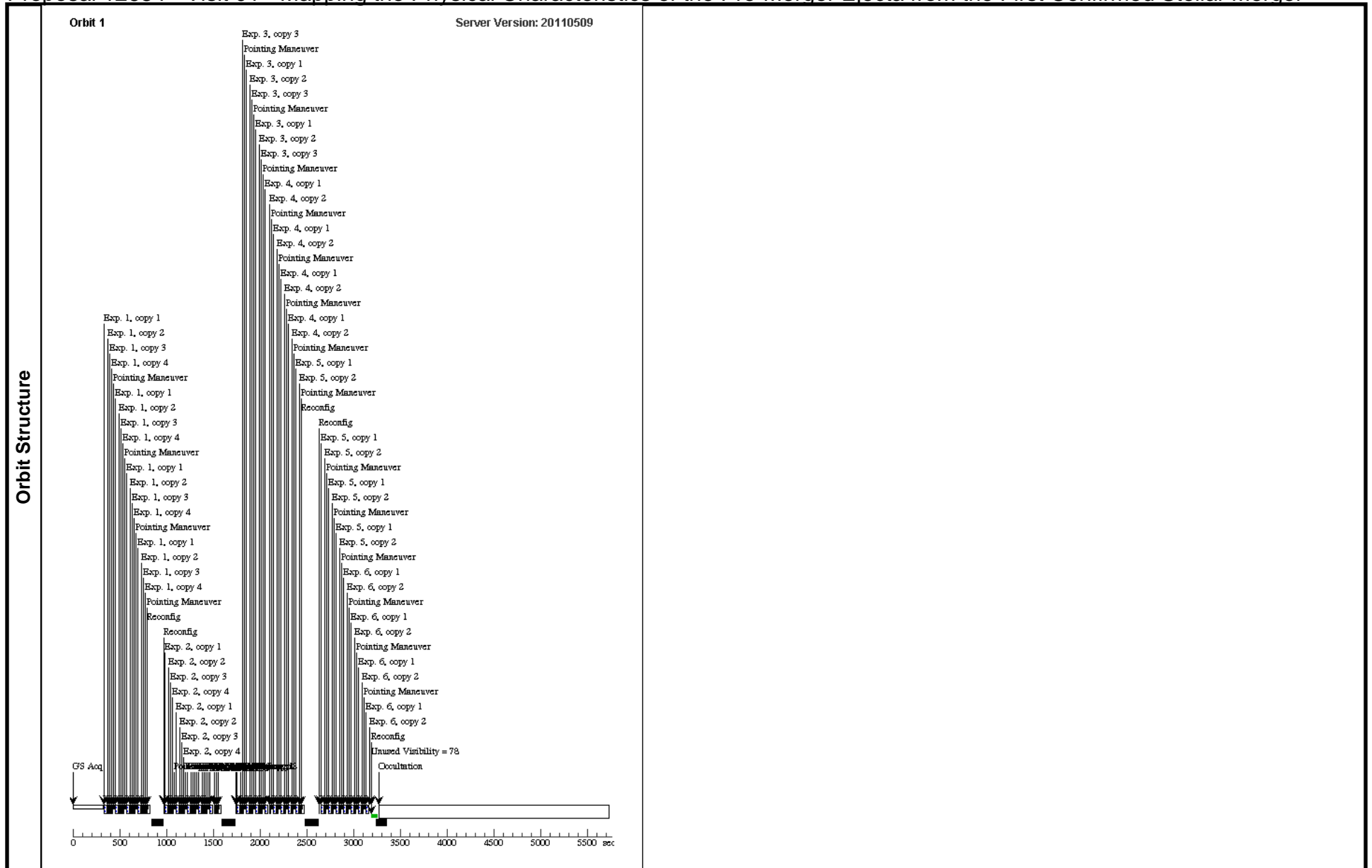
Proposal 12684 - Visit 01 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures	1	V1309-Sco-H-band-1	(1) NOVA-SCO-200 8	WFC3/IR, MULTIACCUM, IRSUB128	F160W	NSAMP=15; SAMP-SEQ=RAPID	Pattern 2, Exps 1-1 in Visit 01 (2)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)]	[1]
	2	V1309-Sco-H-band-4	(1) NOVA-SCO-200 8	WFC3/IR, MULTIACCUM, IRSUB128	F160W	NSAMP=15; SAMP-SEQ=RAPID	Pattern 3, Exps 2-2 in Visit 01 (3)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)]	[1]

Proposal 12684 - Visit 01 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

3	V1309-Scot-H-band-2	(1) NOVA-SCO-2008	WFC3/IR, MULTIACCUM, IRSUB128	F160W	NSAMP=15; SAMP-SEQ=RAPID	Pattern 2, Exps 3-3 in Visit 01 (2)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)]	[1]
4	V1309-Scot-H-band-3	(1) NOVA-SCO-2008	WFC3/IR, MULTIACCUM, IRSUB128	F160W	SAMP-SEQ=RAPID; NSAMP=15	Pattern 3, Exps 4-4 in Visit 01 (3)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)]	[1]
5	V1309-Scot-H-band-3	(1) NOVA-SCO-2008	WFC3/IR, MULTIACCUM, IRSUB128	F160W	SAMP-SEQ=RAPID; NSAMP=15	Pattern 3, Exps 5-5 in Visit 01 (3)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)]	[1]
6	V1309-Scot-H-band-3	(1) NOVA-SCO-2008	WFC3/IR, MULTIACCUM, IRSUB128	F160W	SAMP-SEQ=RAPID; NSAMP=15	Pattern 3, Exps 6-6 in Visit 01 (3)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)]	[1]

Proposal 12684 - Visit 01 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger



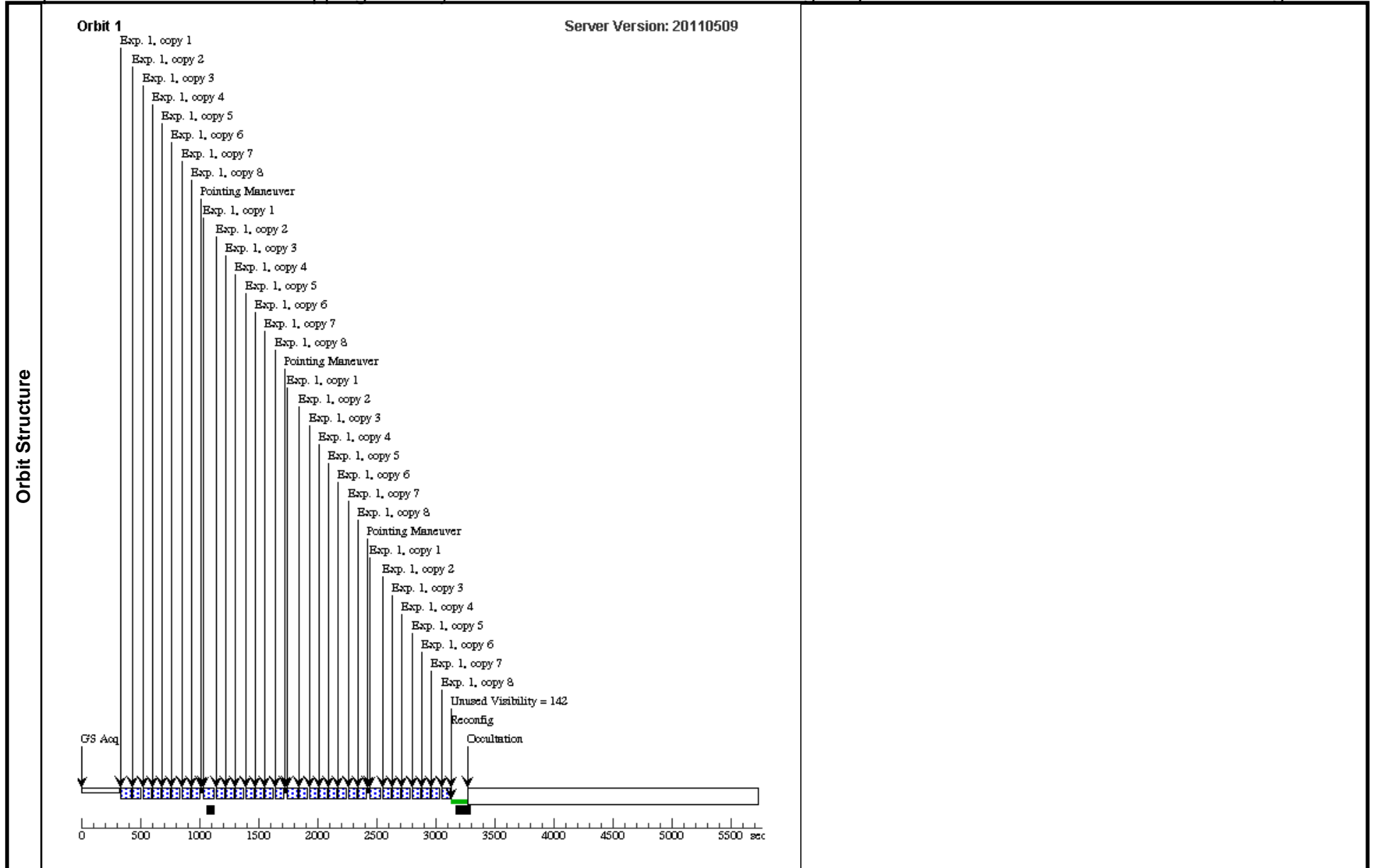
Proposal 12684 - Visit 02 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

Sat Aug 06 01:12:58 GMT 2011

<b>Visit</b>	<b>Proposal 12684, Visit 02</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: (none)					
	<b>Patterns</b>	# (2)	<b>Primary Pattern</b> Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	<b>Secondary Pattern</b> Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false	<b>Exposures</b> (1)	
<b>Fixed Targets</b>	# (1)	<b>Name</b> NOVA-SCO-2008	<b>Target Coordinates</b> RA: 17 57 32.9300 (269.3872083d) Dec: -30 43 10.10 (-30.71947d) Equinox: J2000	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b> V=19.0 I = 19.0	<b>Miscellaneous</b> Reference Frame: ICRS
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						

Proposal 12684 - Visit 02 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures	1	(1) NOVA-SCO-200 8	WFC3/IR, MULTIACCUM, IRSUB128	F164N	NSAMP=10; SAMP-SEQ=SPAR S10		Pattern 2, Exps 1-1 i n Visit 02 (2)	[==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 1, Copy 3)] [==>(Pattern 1, Copy 4)] [==>(Pattern 1, Copy 5)] [==>(Pattern 1, Copy 6)] [==>(Pattern 1, Copy 7)] [==>(Pattern 1, Copy 8)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 2, Copy 3)] [==>(Pattern 2, Copy 4)] [==>(Pattern 2, Copy 5)] [==>(Pattern 2, Copy 6)] [==>(Pattern 2, Copy 7)] [==>(Pattern 2, Copy 8)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 3, Copy 3)] [==>(Pattern 3, Copy 4)] [==>(Pattern 3, Copy 5)] [==>(Pattern 3, Copy 6)] [==>(Pattern 3, Copy 7)] [==>(Pattern 3, Copy 8)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)] [==>(Pattern 4, Copy 3)] [==>(Pattern 4, Copy 4)] [==>(Pattern 4, Copy 5)] [==>(Pattern 4, Copy 6)] [==>(Pattern 4, Copy 7)] [==>(Pattern 4, Copy 8)]	[1]



Proposal 12684 - Visit 03 - Mapping the Physical Characteristics of the Pre-Merger Ejecta from the First Confirmed Stellar Merger

Sat Aug 06 01:12:59 GMT 2011

Visit	<b>Proposal 12684, Visit 03</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(4)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	NOVA-SCO-2008	RA: 17 57 32.9300 (269.3872083d) Dec: -30 43 10.10 (-30.71947d) Equinox: J2000		V=19.0 I = 19.0	Reference Frame: ICRS				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) NOVA-SCO-2008	WFC3/UVIS, ACCUM, UVIS	F673N				Pattern 4, Exps 1-1 in Visit 03 (4) 637 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]

