



13034 - A Homunculus Around the Star NaSt1 (WR122)?

Cycle: 20, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) NAME-NAST1	WFC3/UVIS	1	26-Mar-2013 21:02:22.0	yes
11	(1) NAME-NAST1	WFC3/UVIS	1	26-Mar-2013 21:02:33.0	yes

2 Total Orbits Used

ABSTRACT

Eruptive mass loss during the LBV phase is the most puzzling aspect of massive stellar evolution, posing a serious limitation to theoretical models. Yet we know this is the key channel by which massive stars lose their hydrogen envelopes and become Wolf-Rayet stars. LBV eruptions also explain the phenomenon of supernova "impostors", and are the origin of luminous Type IIn supernovae. Our ignorance has partly persisted because there are so few Galactic examples for detailed study. Eta Car is only object to have recently experienced a giant eruption that is still embedded in a dense, massive, and highly CNO-processed outflow. Because of the compact size, most of what we know about Eta Car has been the result of HST observations. There is no known Galactic analog of this extremeness, so we do not know whether Eta Car represents a unusual or universal occurrence. NaSt1 (aka WR 122) is an evolved, luminous, hot star that is also embedded in a dense CNO-processed outflow. The system shares more characteristics with Eta Car than any other object known. The main difference appears to be the fact that the central star is suspected to be a hot

WR, so the system could represent what Eta Car will look like after it experiences another giant eruption. Like Eta Car, NaSt1's nebula is very bright in the light of [NII]. Although it exhibits a hint of bipolarity, it is very compact (7" diameter). Thus, ground-based imaging is unable to elucidate the object's nature. We propose a simple, narrow-band imaging experiment with HST/WFC3 to determine the precise morphology of NaSt1's [NII] nebula. The data will reveal whether NaSt1 is truly an Eta Car analog, or something entirely different.

OBSERVING DESCRIPTION

The WFC3 observations proposed here are designed to determine the precise morphology of the NaSt1 nebula in the light of [N II] 6583 Angstroms. Thus, we require images in the F658N filter. Taking our knowledge of Eta Car's Homunculus as a guide, which is dusty like NaSt1, we anticipate substantial flux from scattered light in the nebula. In order to subtract this contribution, and to probe the distribution of diffuse reflective nebular dust, we will also require continuum images through the F645N filter.

Sensitivity and Exposure Times: The outer portions of NaSt1's bright [N II] nebula have a contrast ratio of ~ 60 with the bright central unresolved portion of the nebula. The central portion exhibits a [N II] 6583 Angstrom integrated line flux of $2.7E-13$ erg/cm/s. Therefore, we intend to be sensitive to a line flux of 60 times less than this, or $4.5E-15$ erg/cm/s. The WFC3 exposure time calculator (ETC) predicts that an ~ 800 sec exposure in the F658N and F645N filters will detect the edge of the bright edge nebula with a signal to noise of >50 . This sensitivity will yield a firm detection of the nebular edge in Figure 2 of our phase I proposal, and will also allow us to probe for any fainter emission further out, which motivated by the detection of faint high-velocity [N II] emission far from Eta Car (Smith 2008), which we suspect is an analog to NaSt1.

The central peak of NaSt1, has been measured with $R=12.6$ mag, which will saturate WFC3 in 177 sec. Thus, we will to break our integration time into 5 separate 176 sec exposures, which will also facilitate our desire to dither. To maximize our image resolution, we use a 5-point sub-pixel dither pattern, using C4 WFC3-UVIS-DITHER-LINE, so that we can improve the image quality using the Multidrizzle software, and remove cosmic rays hits and bad pixels. The nebula is small, so we can use a 1Kx1K subarray (UVIS2-C1K1C-SUB), which will cut down on readout overhead time and will hopefully mitigate the known charge-transfer-efficiency (CTE) problem; we do not want to go smaller than 1Kx1K because we do not want to miss the opportunity to serendipitously detect faint nebular features lying further out from the star than expected. Note that our target is the brightest object in our planned field of view, and will not saturate.

In all, we will obtain 10 sub-array images (5 UVIS2-C1K1C-SUB images for both the F658N and F645N filters), with exposure times of 176 sec each. Including the guide star acquisition and filter change and readout overhead, the Phase-II orbit planner in APT suggest that the observation will

fit well into 1 orbit, with 4min 58sec remaining.

Proposal 13034 - Visit 01 - A Homunculus Around the Star NaSt1 (WR122)?

Wed Mar 27 01:02:41 GMT 2013

Visit	Proposal 13034, Visit 01, completed Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=5 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)				
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	NAME-NAST1	RA: 18 52 17.5519 (283.0731329d) Dec: +00 59 44.30 (.99564d) Equinox: J2000		V=15.4 R=12.6	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) NAME-NAST1	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F658N	FLASH=12.0		Pattern 1, Exps 1-1 in Visit 01 (1)	176. Secs	
									[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] [==>(Pattern 5)]	[1]
	2		(1) NAME-NAST1	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F645N	FLASH=12.0		Pattern 1, Exps 2-2 in Visit 01 (1)	176. Secs	
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] [==>(Pattern 5)]	[1]	

Proposal 13034 - Visit 11 - A Homunculus Around the Star NaSt1 (WR122)?

Wed Mar 27 01:02:43 GMT 2013

Visit	Proposal 13034, Visit 11 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=5 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	NAME-NAST1	RA: 18 52 17.5519 (283.0731329d) Dec: +00 59 44.30 (.99564d) Equinox: J2000		V=15.4 R=12.6	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) NAME-NAST1	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F658N	FLASH=12.0		Pattern 1, Exps 1-1 in Visit 11 (1)	176. Secs	
									[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] [==>(Pattern 5)]	[1]
	2		(1) NAME-NAST1	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F645N	FLASH=12.0		Pattern 1, Exps 2-2 in Visit 11 (1)	176. Secs	
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] [==>(Pattern 5)]	[1]	

Orbit Structure

