



## 10844 - Following Eta Carinae's Change of State

Cycle: 15, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

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### VISITS

<i>Visit</i>	<i>Targets</i>	<i>Configurations</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) ETA-CAR-A	ACS/HRC	1	17-May-2006 21:26:07.0	yes
02	(1) ETA-CAR-A (2) ETA-CAR-X	ACS/HRC	1	17-May-2006 21:26:27.0	yes
03	(1) ETA-CAR-A (2) ETA-CAR-X	ACS/HRC	1	17-May-2006 21:26:43.0	yes

3 Total Orbits Used

## **ABSTRACT**

Eta Carinae is now known to be undergoing some unusually rapid changes on a timescale of several years. They are probably essential for modeling the star's long-term recovery from its Giant Eruption 160 years ago -- the prototype "supernova impostor" event. Since high spatial resolution is needed to isolate the central star, and the present state will probably not recur in the future, it is important to obtain HST data during the next two years. We propose a cost-effective set of ACS observations with three goals: (1) to obtain a continuing record of the star's rapid UV and visual brightening; (2) to lengthen the temporal baseline of ACS images enough to settle an important question concerning ejecta ages; and (3) to extend the record of morphological changes in the inner ejecta past the midpoint of eta Car's 5.5-year cycle.

## **OBSERVING DESCRIPTION**

We use two visits in Cy 15.

--First visit, one orbit: Mainly short ACS/HRC integrations which are 4-pt dithered to improve the sampling, plus some medium-length exposures where dithering is less essential.

--Second visit, two orbits, several months after visit 1: Larger series of ACS/HRC images with short, medium, and long exposure times. Again the short exposures have highest priority.

--In each case we use filters F550M, F330W, F250W, and F220W. If time allows, we may also include a short exposure with F658N in the second visit.

--We expect to repeat nearly the same plan in HST Cycle 16.

## **REAL TIME JUSTIFICATION**

One goal is to extend an existing temporal baseline (i.e., ACS data in 2002-05) with a roughly uniform sampling interval of six months or so. This implies two approximate goals for scheduling:

(1) Visit 1 should occur fairly near the beginning of Cycle 15, say in the first 3 months. First 2 months would be best.

(2) Visit 2 should not follow Visit 1 too closely. An interval of 4 to 8 months is OK, about 6 months would be best.

--It is OK to interchange Visits 1 and 2, i.e., Visit 2 can precede Visit 1 if some scheduling consideration makes this appropriate. In that case,

## Proposal 10844 - Overview

however, there should still be an interval of several months between the two visits.

### **CALIBRATION JUSTIFICATION**

-- none requested --

### **ADDITIONAL COMMENTS**

(Regarding early scheduling within Cycle 15): We are monitoring progressive changes in Eta Car. The Treasury Program obtained a number of ACS/HRS images from 10/2002 to 11/2005. The gap between 11/2005 and early-Cycle-15 will be more than half a year. To prevent this gap from becoming too long, we prefer to do the first visit as early as possible -- or, anyway, at the earliest convenient opportunity.

Proposal 10844 - Visit 01 - Following Eta Carinae's Change of State

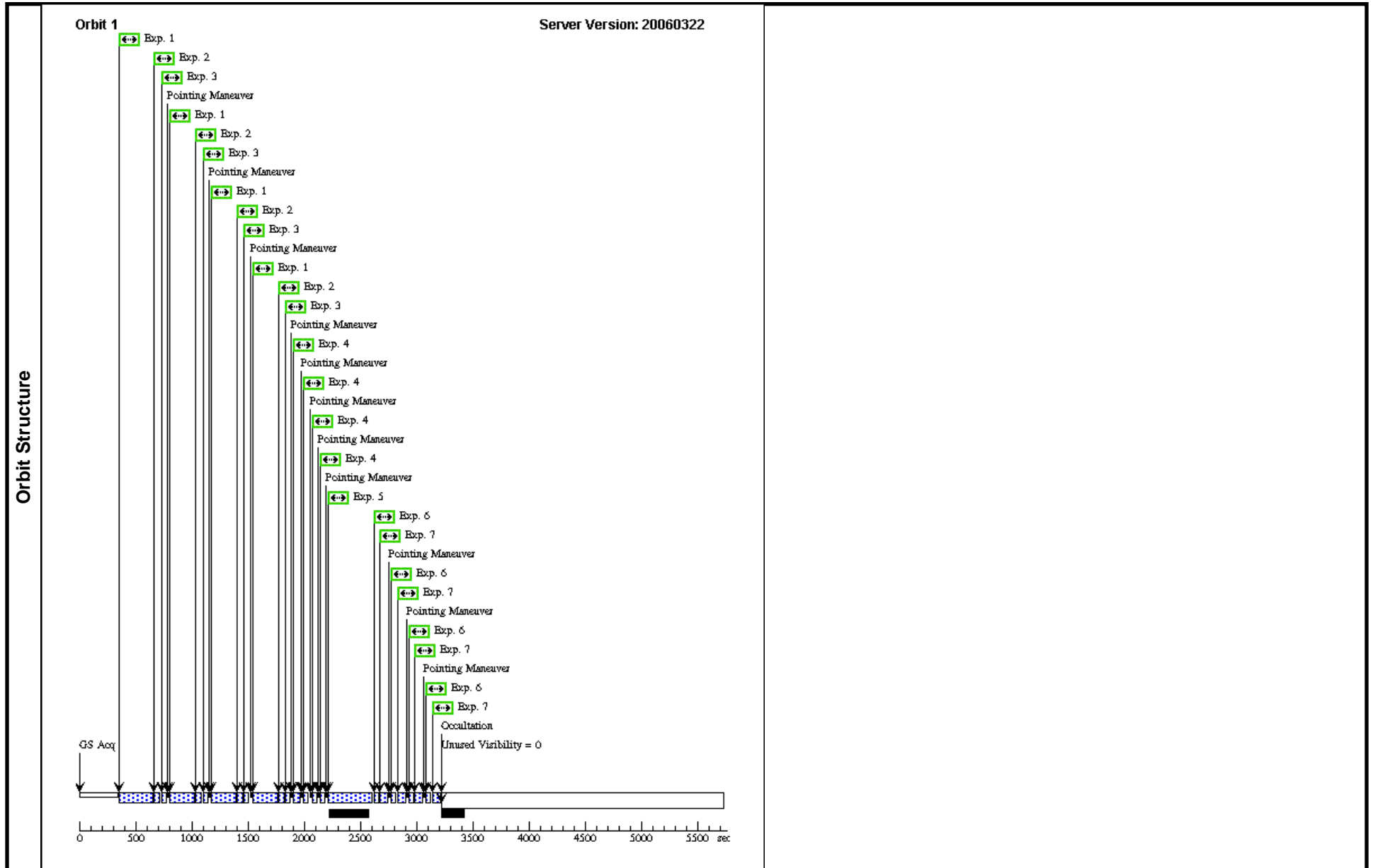
Thu May 18 01:26:47 GMT 2006

<b>Visit</b>	<p><b>Proposal 10844, Visit 01</b></p> <p><b>Diagnostic Status: No Diagnostics</b></p> <p>Scientific Instruments: ACS/HRC</p> <p>Special Requirements: BEFORE 01-OCT-2006:00:00:00</p> <p><i>Comments: Visits 01 and 02 (one orbit each) would normally be one visit; we have separated them merely to force an ACS buffer dump after the first orbit visibility period. See comments for Visit 02.</i></p> <p>---</p> <p><i>Our fundamental timing requirements are really as follows:</i></p> <p>-- (1) <i>The first observation set (either "Visits 01+02" or else Visit 03) should occur as early in Cycle 15 as possible. Reason: We are monitoring Eta Car's behavior and the last observation was in 2005.</i></p> <p>-- (2) <i>Then, it is highly desirable for the second set of observations to occur about 6 months after the first -- in other words, near the middle of the AFTER 01 timing requirement that we have specified for Visit 3. Reason: To provide a roughly uniform sampling interval for the monitoring.</i></p> <p>-- (3) <i>In this plan we prefer to obtain Visits 01+02 first because they obtain far more data than 03. However, it would be acceptable to do Visit 03 first if this makes scheduling significantly easier. In that case, Visit 01 would need a new timing requirement "after 03 by 100 to 250 days."</i></p>																																																																					
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#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
Exposures (continued)	2	250 MED	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F250W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5 Pattern 1-3 (1)	14.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	3	250 SHORT	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F250W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5 Pattern 1-3 (1)	1.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	4	330 SHORT	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5 Pattern 4-4 (1)	0.2 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	5	330 VLON G1	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	360.0 Secs [==>]	[1]	
	<i>Comments: This long exposure must coincide with buffer readout, so detector is not idle during that time. There is no CR-SPLIT or dither, but a similar exposure will be obtained in the following orbit.</i>									
	6	330 MED	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5 Pattern 6-7 (1)	3.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	7	330 LONG	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5 Pattern 6-7 (1)	30.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	

# Proposal 10844 - Visit 01 - Following Eta Carinae's Change of State



Proposal 10844 - Visit 02 - Following Eta Carinae's Change of State

Thu May 18 01:26:48 GMT 2006

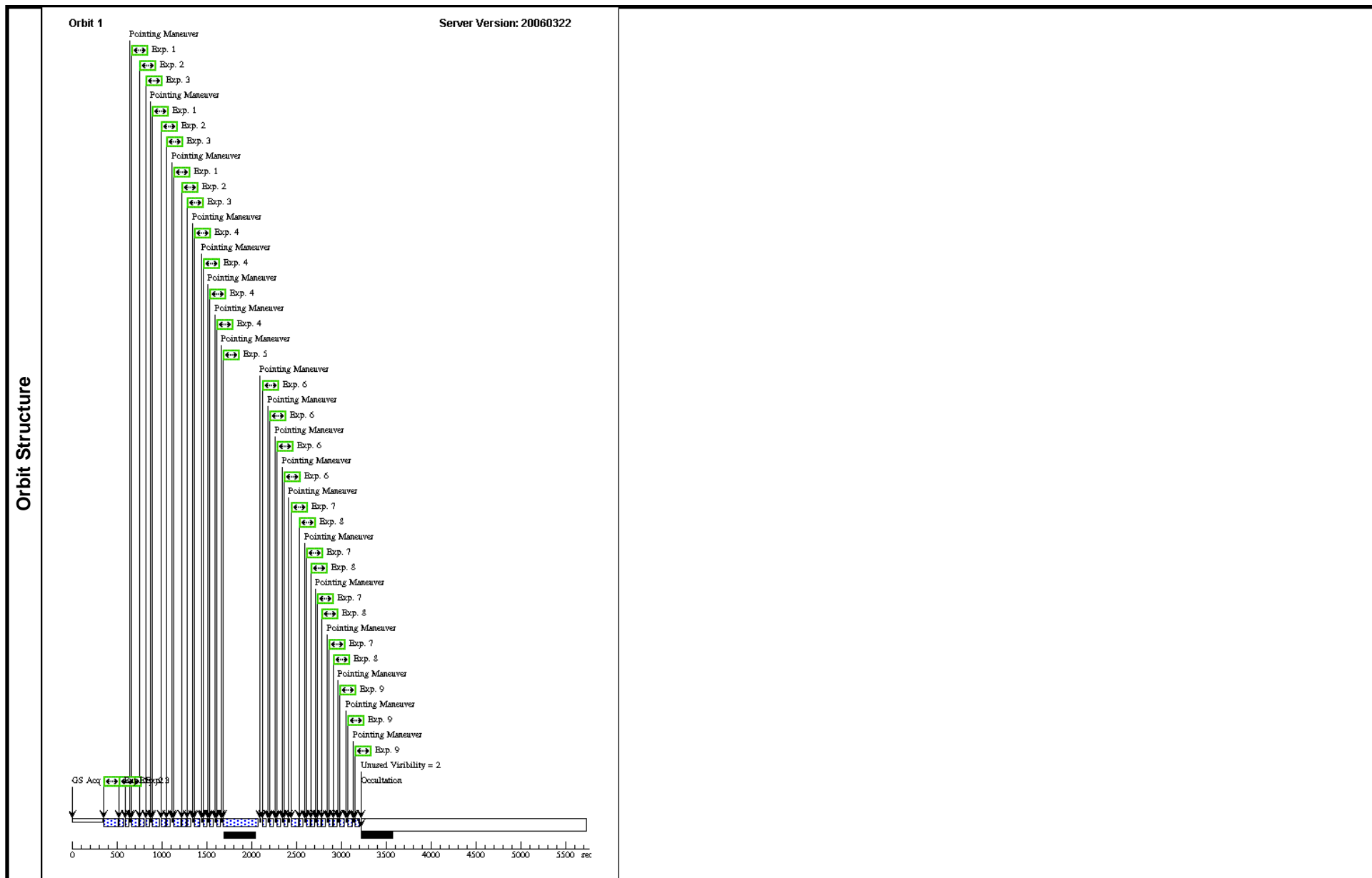
<b>Visit</b>	<p><b>Proposal 10844, Visit 02</b></p> <p><b>Diagnostic Status: No Diagnostics</b></p> <p>Scientific Instruments: ACS/HRC</p> <p>Special Requirements: AFTER 01 BY 0.8 Orbits TO 1.2 Orbits; BEFORE 01-OCT-2006:00:00:00</p> <p><i>Comments: Visits 01 and 02 (one orbit each) would normally be one visit, but we have separated them in order to force an ACS buffer dump after the first orbit visibility period. See comments for Visit 01.</i></p> <p>---</p> <p><i>In order to execute Visits 01 and 02 together, we have used timing requirement "02 after 01 by 0.8 to 1.2 orbits". However, this is not absolutely necessary for the science goals. It would be OK for Visits 01 and 02 to be separated by as much as several days, if this makes scheduling much easier.</i></p>					
<b>Patterns</b>	<b>#</b>	<b>Primary Pattern</b>	<b>Secondary Pattern</b>	<b>Exposures</b>		
	(1)	Pattern Type=ACS-HRC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.151 Line Spacing=0.098	Coordinate Frame=POS-TARG Pattern Orientation=20.1 Angle Between Sides=63.6 Center Pattern=false		(1-3), (4), (6), (7-8)	
(2)	Pattern Type=ACS-HRC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.198 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.3 Angle Between Sides= Center Pattern=false		(9)		
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>
	(1)	ETA-CAR-A Alt Name1: HD93308	RA: 10 45 3.6000 (161.2650000d) Dec: -59 41 4.10 (-59.68447d) Equinox: J2000 Plate Id: ZZZQ		V=6.7+/-1.0 F(2200)=3.0+/-1.5 E-12	Reference Frame: GSC1
<p><i>Comments: IMPORTANT: Acquiring Eta Car is potentially tricky because of the surrounding Carina Nebula. In this region, bright nebulosity tends to hide large areas in ordinary wide-field plates. (VTT, for instance, is murky around Eta Car.) Therefore we fear that the distribution of GSC2 guide stars contains "holes." Even worse, some official guide stars cannot be trusted because they're perturbed by nebular features seen with inadequate plate scale.</i></p> <p><i>-- These problems were foreseen long ago. Special catalog ZZZQ, prepared from different data in 1989, was used to acquire Eta Car dozens of times from 1990 to 2005, and so far as we know it has never failed. ZZZQ is practically in the GSC1 coordinate system, where Eta Car's position is 10h 45m 3.64s, -59d 41' 04.1". (GSC1 and IRCS differ by about 0.08s in RA at this location, corresponding to 0.6".)</i></p> <p><i>-- On the other hand, the GSC2 may be OK. Frankly we don't know how to decide this question without careful tests of GSC2, which we don't have enough information to attempt.</i></p> <p><i>-- PROBABLY THE SAFEST PROCEDURE IS TO DUPLICATE THE ACQUISITION PARAMETERS USED FOR PREVIOUS ACS OBSERVATIONS IN 2004-2005. They employed special catalog ZZZQ.</i></p>						
(2)	ETA-CAR-X Alt Name1: HD93308X	RA: 10 45 4.0000 (161.2666667d) Dec: -59 41 1.50 (-59.68375d) Equinox: J2000 Plate Id: ZZZQ		V=6.7+/-1.0 F(2200)=3.0+/-1.5 E-12	Reference Frame: GSC1	
<p><i>Comments: IMPORTANT: For acquisition, see comment for target ETA-CAR-A. We should probably use special catalog ZZZQ as explained there.</i></p> <p><i>-- Target position ETA-CAR-X is offset about 4 arcsec relative to ETA-CAR-A, in order to include two or three nearby stars for possible astrometric purposes.</i></p>						

Proposal 10844 - Visit 02 - Following Eta Carinae's Change of State

	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
<b>Exposures</b>	1	220 LONG	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F220W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	Pattern 1-3 (1)	40.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	<i>Comments: POS TARG dY=-1.5" to move target slightly farther from the ACS occulting finger. See comments for Visit 01.</i>										
	2	220 MED	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F220W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	Pattern 1-3 (1)	15.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	3	220 SHORT	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F220W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	Pattern 1-3 (1)	3.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	4	X 330 SHO RT	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 4-4 (1)	0.3 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	
	<i>Comments: This position is offset about 4" relative to the other one. Reason: To include two or three nearby stars for possible astrometric purposes. For observations of ETA-CAR-X we omit the POS TARG used for observations of ETA-CAR-A.</i>										
	5	330 VLON G	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG -0.283,- 1.777		360.0 Secs [==>]	[1]	
<i>Comments: This exposure must coincide with a buffer transfer, and it must not end before the transfer is finished. Here we are trying to make use of the buffer-transfer time, so the detector is not idle then. This exposure will be very heavily overexposed/saturated in the central regions. -- There is no CR-SPLIT, but a companion exposure is obtained in the middle of orbit 1. Note the POS TARG for this exposure (-10,-10 pixels in addition to POS TARG used for the other exposures).</i>											
6	X 330 MED	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 6-6 (1)	8.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]		
7	550 SHORT	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F550M	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	Pattern 7-8 (1)	0.1 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]		

Proposal 10844 - Visit 02 - Following Eta Carinae's Change of State

Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	8	550 MED	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F550M	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	Pattern 7-8 (1)	1.3 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]
9	550 LONG	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F550M	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5	Pattern 9-9 (2)	14.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]	



Proposal 10844 - Visit 03 - Following Eta Carinae's Change of State

Thu May 18 01:26:50 GMT 2006

<b>Visit</b>	<p><b>Proposal 10844, Visit 03</b></p> <p><b>Diagnostic Status: No Diagnostics</b></p> <p>Scientific Instruments: ACS/HRC</p> <p>Special Requirements: AFTER 01 BY 100 D TO 240 D</p> <p><i>Comments: Visit 03 uses only one orbit, emphasizing short ACS/HRC exposures which are suitable for the central star and bright inner ejecta.</i></p> <p>---</p> <p><i>IMPORTANT: Our timing requirements are really as follows.</i></p> <p><i>(1) The first observations should occur early in Cycle 15.</i></p> <p><i>(2) Then there must be an interval of 3--8 months before the other visit. It is highly desirable for the interval to be about 6 months.</i></p> <p><i>-- Merely for reasons of APT syntax, in this plan we assume that Visits 01 and 02 occur first. It would be OK to interchange Visits 01+02 with Visit 03 if this makes scheduling much easier. See comments for Visit 01.</i></p>					
<b>Patterns</b>	<b>#</b>	<b>Primary Pattern</b>	<b>Secondary Pattern</b>	<b>Exposures</b>		
	(1)	Pattern Type=ACS-HRC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.151 Line Spacing=0.098	Coordinate Frame=POS-TARG Pattern Orientation=20.1 Angle Between Sides=63.6 Center Pattern=false	(1), (3-4), (7-8)		
(2)	Pattern Type=ACS-HRC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.198 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.3 Angle Between Sides= Center Pattern=false	(2), (9-10)			
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>
	(1)	ETA-CAR-A Alt Name1: HD93308	RA: 10 45 3.6000 (161.2650000d) Dec: -59 41 4.10 (-59.68447d) Equinox: J2000 Plate Id: ZZZQ		V=6.7+/-1.0 F(2200)=3.0+/-1.5 E-12	Reference Frame: GSC1
<p><i>Comments: IMPORTANT: Acquiring Eta Car is potentially tricky because of the surrounding Carina Nebula. In this region, bright nebulosity tends to hide large areas in ordinary wide-field plates. (VTT, for instance, is murky around Eta Car.) Therefore we fear that the distribution of GSC2 guide stars contains "holes." Even worse, some official guide stars cannot be trusted because they're perturbed by nebular features seen with inadequate plate scale.</i></p> <p><i>-- These problems were foreseen long ago. Special catalog ZZZQ, prepared from different data in 1989, was used to acquire Eta Car dozens of times from 1990 to 2005, and so far as we know it has never failed. ZZZQ is practically in the GSC1 coordinate system, where Eta Car's position is 10h 45m 3.64s, -59d 41' 04.1". (GSC1 and IRCS differ by about 0.08s in RA at this location, corresponding to 0.6".)</i></p> <p><i>-- On the other hand, the GSC2 may be OK. Frankly we don't know how to decide this question without careful tests of GSC2, which we don't have enough information to attempt.</i></p> <p><i>-- PROBABLY THE SAFEST PROCEDURE IS TO DUPLICATE THE ACQUISITION PARAMETERS USED FOR PREVIOUS ACS OBSERVATIONS IN 2004-2005. They employed special catalog ZZZQ.</i></p>						
(2)	ETA-CAR-X Alt Name1: HD93308X	RA: 10 45 4.0000 (161.2666667d) Dec: -59 41 1.50 (-59.68375d) Equinox: J2000 Plate Id: ZZZQ		V=6.7+/-1.0 F(2200)=3.0+/-1.5 E-12	Reference Frame: GSC1	
<p><i>Comments: IMPORTANT: For acquisition, see comment for target ETA-CAR-A. We should probably use special catalog ZZZQ as explained there.</i></p> <p><i>-- Target position ETA-CAR-X is offset about 4 arcsec relative to ETA-CAR-A, in order to include two or three nearby stars for possible astrometric purposes.</i></p>						

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	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
<b>Exposures</b>	1	550 SHORT	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F550M	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 1-1 (1)	0.1 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]
	2	550 MED	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F550M	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 2-2 (2)	2.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3	330 SHORT	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 3-4 (1)	0.3 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]
	4	330 MED	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F330W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 3-4 (1)	7.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]
	5	250 LONG	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F250W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG 0,-1.5		190.0 Secs [==>]	[1]
	<i>Comments: Companion for next exposure, even though the exposure times are different. See comments for that exposure.</i>									
	6	250 VLON G	(1) ETA-CAR-A	ACS/HRC, ACCUM, HRC	F250W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE	POS TARG -0.283,- 1.777		360.0 Secs [==>]	[1]
<i>Comments: This exposure must coincide with the ACS buffer dump, and exposure time must be about 6 minutes in order to extend beyond the buffer dump. For removing bad pixels, we will use the preceding exposure even though their exposure times differ.</i>										
<i>--- Note: This exposure and the preceding one use slightly different target positions and they have POS TARGs in order to move slightly away from the ACS occulting finger.</i>										
	7	250 MED	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F250W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 7-8 (1)	16.0 Secs [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]

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Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	8	250 SHORT	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F250W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 7-8 (1)	1.2 Secs [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[1]
	9	220 SHORT	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F220W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 9-10 (2)	3.0 Secs [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	10	220 MED	(2) ETA-CAR-X	ACS/HRC, ACCUM, HRC	F220W	CR-SPLIT=NO; GAIN=4; PAREXP=NONE		Pattern 9-10 (2)	20.0 Secs [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]

