12000 - The Natural Coronagraph of R Coronae Borealis

Cycle: 16, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Geoffrey C. Clayton (PI)	**Louisiana State University and A & M College**	**gclayton@fenway.phys.lsu.edu**
Dr. Howard E. Bond (CoI)	Space Telescope Science Institute	bond@stsci.edu
Dr. Orsola De Marco (CoI)	Macquarie University	orsola@science.mq.edu.au
Dr. Thomas R. Geballe (CoI)	Gemini Observatory, Northern Operations	tgeballe@gemini.edu
Dr. Ben E. Sugerman (CoI)	Goucher College	ben.sugerman@goucher.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) R-CRB	WFPC2	1	14-Apr-2009 21:07:26.0	yes

1 Total Orbits Used

ABSTRACT

We propose HST/WFPC2 imaging to take advantage of a recent unique and dramatic fading of the unusual variable star R Coronae Borealis. R CrB has temporarily dropped 9 mag due to formation of a dust cloud above the photosphere in the line of sight. Since the dust does not block the star as seen from other directions, it acts as a "natural coronagraph," allowing us to explore the nearby circumstellar environment at HST resolution.

R Coronae Borealis (RCB) stars are rare hydrogen-deficient carbon-rich supergiants. Evolutionary scenarios proposed to account for their origin

include a merger of two white dwarfs (the double-degenerate or DD mode), or a final helium-shell flash in a single PN central star (FF mode). We have recently found a large overabundance of oxygen-18 in several RCB stars, favoring the DD merger scenario; however, the presence of Li in the atmospheres of four RCB stars, including R CrB itself, favors the FF scenario. The presence or absence of circumstellar material, and the morphology of this material if it exists, provide a fossil record of previous evolutionary stages. In particular, we expect to see evidence for an old PN shell in the FF stars, but not in DD merger descendants.

Our recent Gemini optical images of R CrB tantalizingly suggest circumstellar material very close to the star, but compromised by ground-based seeing and relatively low S/N. We propose HST/WFPC2 images to confirm this material at higher spatial resolution and signal than attainable from the ground.

OBSERVING DESCRIPTION

We will use WFPC2 to carry out direct imaging of the hydrogen-deficient star R CrB, which is currently (April 2009) in a deep minimum, more than 9 mag below its normal brightness. The aim is to study ejecta and possible companion stars in the immediate vicinity of R CrB, which are normally obscured by the wings of the stellar image when the star is at its usual magnitude of ~5.9.

We will place the target near the corner of the PC chip (for less degradation by CTE) and take dithered exposures in the broad-band V (F555W) and I (F814W) filters. Short exposures of 7 and 16 sec will reach about 50% of saturation. These will be followed by exposures of 120 sec (F555W) and 160-200 sec (F814W), which will be saturated by factors of ~5 to 8, obscuring a few pixels around the star but reaching more deeply into the immediate surroundings.

We are using CLOCKS=YES throughout, since this yields less time lost to overheads.

Visit

Proposal 12000, Visit 01, implementation Wed Apr 15 01:07:30 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: (none)

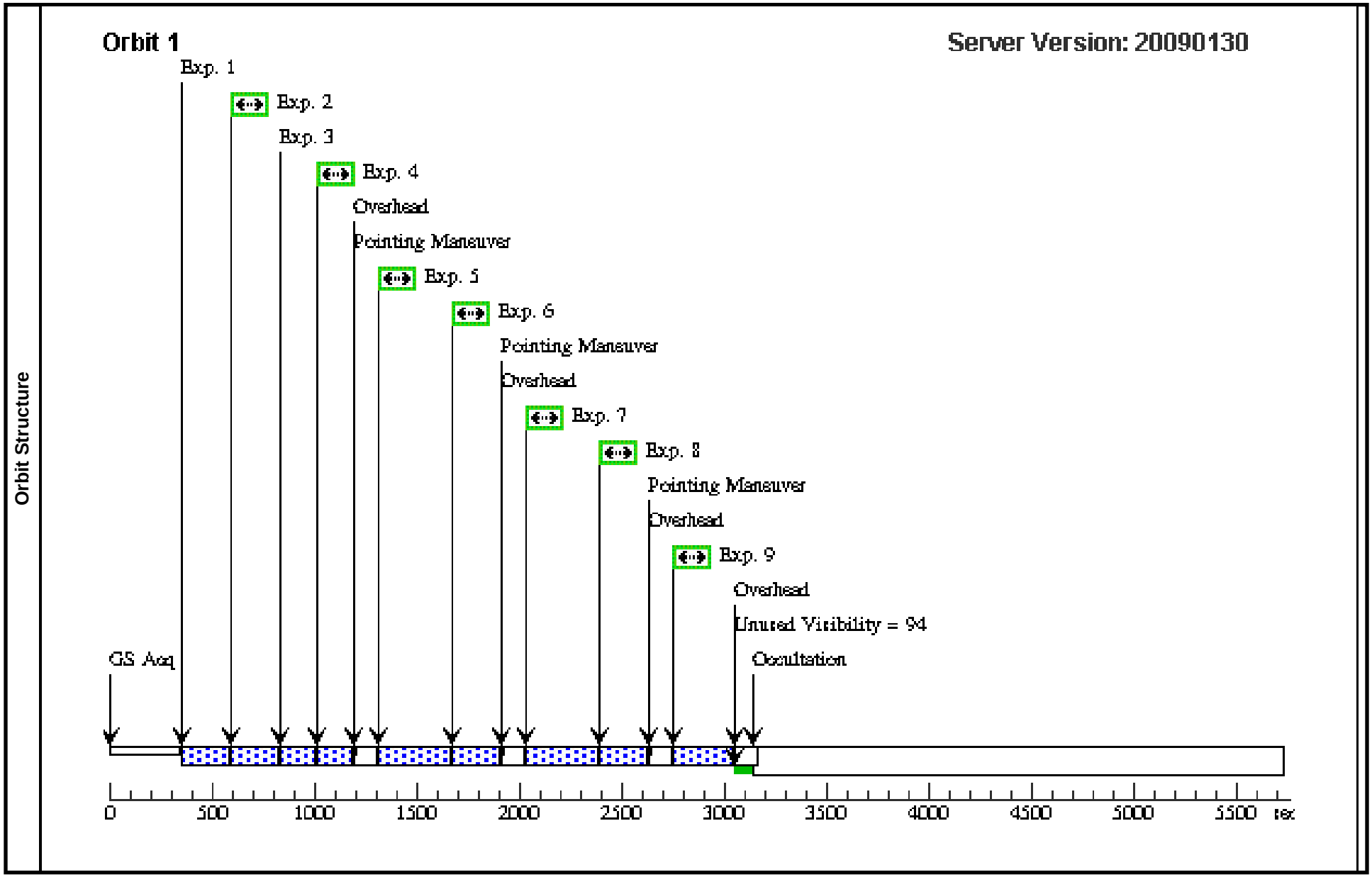
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	R-CRB	RA: 15 48 34.4149 (237.1433954d) Dec: +28 09 24.30 (28.15675d) Equinox: J2000		V=15	Reference Frame: ICRS

Comments: Star is normally at V=5.9, but is currently (April 2009) in a deep minimum at about V=15.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F555W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -7,-7		7 Secs *[==>]*	*[1]*
2		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F555W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -7,-7		120 Secs *[==>]*	*[1]*
3		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F814W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -7,-7		16 Secs *[==>]*	*[1]*
4		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F814W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -7,-7		160 Secs *[==>]*	*[1]*
5		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F814W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -6.7721 5,-6.886075		160 Secs *[==>]*	*[1]*
6		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F555W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -6.7721 5,-6.886075		120 Secs *[==>]*	*[1]*
7		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F814W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -6.6582 25,-6.658225		160 Secs *[==>]*	*[1]*
8		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F555W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -6.6582 25,-6.658225		120 Secs *[==>]*	*[1]*
9		(1) R-CRB	WFPC2, IMAGE, PC1-FIX	F555W	ATD-GAIN=7; CLOCKS=YES; CR-SPLIT=NO	POS TARG -6.8860 75,-6.77215		120 Secs *[==>]*	*[1]*


Orbit 1
Server Version: 20090130
Orbit Structure
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Overhead
Pointing Maneuver
Exp. 5
Exp. 6
Pointing Maneuver
Overhead
Exp. 7
Exp. 8
Pointing Maneuver
Overhead
Exp. 9
Overhead
Unused Visibility = 94
GS Acq
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec