11342 - X-ray Jets Activity in the Symbiotic System CH Cyg

Cycle: 16, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) CHCYG	WFPC2	4	18-Jan-2008 07:57:19.0	yes

4 Total Orbits Used

ABSTRACT

We propose follow up Chandra/HST/VLA observations of the recently discovered X-ray jets in the nearby symbiotic system CH Cyg. CH Cyg is only the second symbiotic systems with jet activity detected at X-ray wavelengths. Symbiotic systems are fascinating accreting binaries with a key evolutionary importance since they are potential progenitors of bipolar PN and SN type Ia. The HST/WFPC2 observations, combined with Chandra and VLA imaging, will provide the closest view of the region where jets form and interact with the surrounding material. The observations will provide a key information on the spatial, spectral and temporal characteristics of the jets, crucial inputs and quantitative constraints to models of non-

relativistic jets.

OBSERVING DESCRIPTION

CH Cyg is a nearby (D~245pc) symbiotic system and one of very few interacting binary systems that are close enough for detailed high-angular resolution studies of the close binary environment including regions of jet formation and early propagation. Symbiotic systems are a very important subgroup of interacting binaries because they are likely progenitors of many bipolar planetary nebulae, and they may be progenitors of at least a fraction of Supernovae type Ia, key cosmological distance indicators.

We were awarded 4 orbits of HST observations of CH Cyg as part of a joint Chandra, HST and VLA proposal (No. 09300602). The main goals of this project are:
(1) to determine the spatial and spectral characteristics of the jets,
and
(2) to determine their origin and dynamical evolution as they
propagate and interact with the surrounding close circumbinary environment.

We plan to carry out WFPC2/PC high-angular resolution imaging of CH Cyg, using the dither mode in several spectral lines and the continuum. As part of the HST observations we expect to obtain 28 high-angular resolution images at wavelengths ranging from UV to optical. For this project we have selected a set of filters to separate line and continuum emission, to distinguish shocked from photoionized gas, and to determine the shock speed or the nature of the photoionizing continuum. We will be able to study the components of the system (and the changes that have occurred since the 1999 HST observation), including of the loop and of the newly ejected material, and the core. Difference and ratio maps will reveal changes in local physical conditions. The Hα , [OII]λ3729\AA, and [OIII] 5007\AA\ lines are bright, and they provide information
on the ionization state of the gas. The [SII]λ6731\AA/Hα ratio will allow us to identify shocked vs. ionized gas emission, e.g., the ratio will be $\sim$0.4 or shocked gas, and smaller for photoionized gas. The O[III] 4363\AA/5007\AA\ ratio gives the temperature which further constrains either the shock speed or the ionizing spectrum.

We will carry out analysis of the data using the latest HST calibration and analysis procedures. We plan to carry out the observations in a dither

mode to improve the sampling of the PSF, and to deal with cosmic rays. By using an appropriate dither pattern and processing using MultiDrizzle (developed and maintained by W. Hack at STScI) we will aim to reach $\sim$ 0.025 arcseconds/pixel, which will double the number of pixels covering the regions of interest, and better sample the PSF, allowing further enhancement in the resolution using deconvolution techniques (e.g. Richardson-Lucy and EMC2). The dithered observations will be taken using all filters at each position before moving to the next position in order to minimize the overheads.

We plan to combine the results from the multi-wavelength HST observations with the Chandra and VLA results, and derive a crucial information on the spatial, spectral and temporal characteristics of the jets. The results will provide key inputs and quantitative constraints to models of non relativistic jets, and to our understanding of jet formation and early stages of propagation in a wide range of interacting binaries in which early jet activity cannot be spatially resolved.

We note that the V magnitude of CH Cyg is V~10 now (~1 magnitude fainter than in 1999). Because CH Cyg is fainter now (and because the jet features have expanded and therefore are expected to be fainter) we have adjusted the exposures up from those in the 1999 observations. We plan to continue to follow the CH CYG brightness, and although we do not expect that it would change in a way that it will have any significant effect on the instrument (there may be a change of ~1 magnitude at most in the next year or so), we would like to confirm the exposures within a month of the final scheduling. The target is visible over several extended periods from 2008 February to 2008 July, which will allow scheduling flexibility. If possible, our preference is to get the HST observations within few months of the Chandra and VLA observations.

Visit

Proposal 11342, Visit 01 Fri Jan 18 12:57:27 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFPC2-BOX	Coordinate Frame=POS-TARG		(1-7)
	Purpose=DITHER	Pattern Orientation=26.56505		
	Number Of Points=4	Angle Between Sides=143.1301		
	Point Spacing=0.559017	Center Pattern=false		
	Line Spacing=0.559017			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	CHCYG	RA: 19 24 33.2000 (291.1383333d)		V=9+/-1	Reference Frame: ICRS
		Dec: +50 14 9.00 (50.23583d)			
		Equinox: J2000			

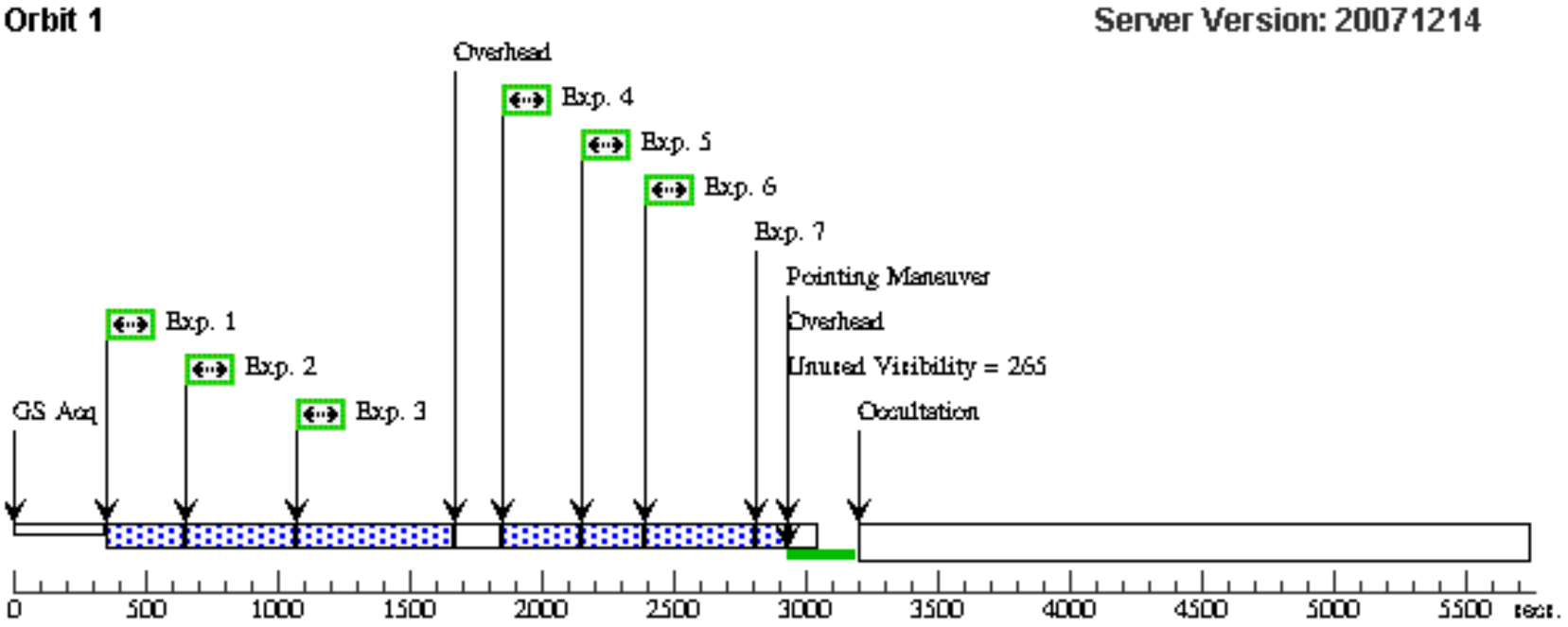
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	CHCYG336W	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F336W			Pattern 1-7 (1)	100.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
2	CHCYG375N	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F375N			Pattern 1-7 (1)	200.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
3	CHCYG437N	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F437N			Pattern 1-7 (1)	500.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
4	CHCYG502N	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F502N			Pattern 1-7 (1)	100.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

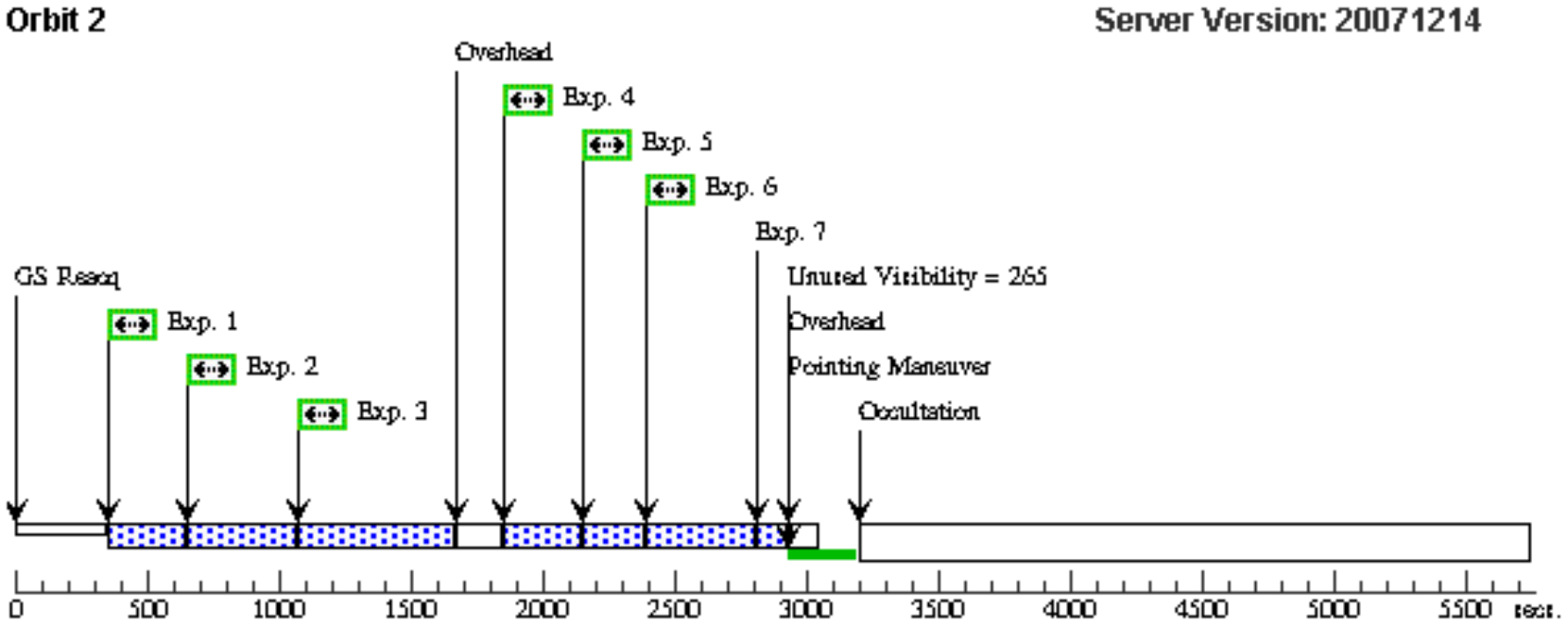
Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
5	CHCYG656N	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F656N			Pattern 1-7 (1)	100.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
6	CHCYG67N	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F673N			Pattern 1-7 (1)	200.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
7	CHCYG547M	(1) CHCYG	WFPC2, IMAGE, PC1-FIX	F547M			Pattern 1-7 (1)	14.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

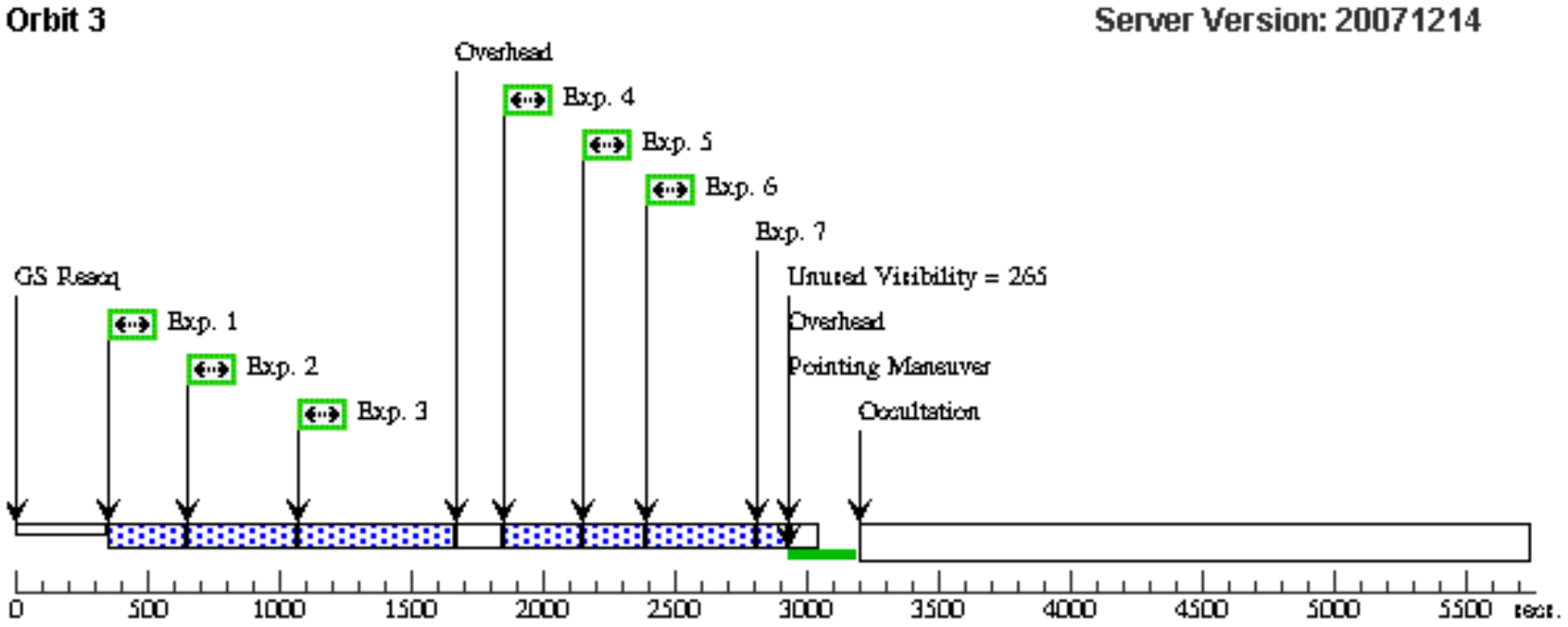
Orbit Structure



Orbit Structure (continued)



Orbit Structure (continued)



Orbit Structure (continued)