13043 - Multiwavelength spectra of the fine structure of the Crab

Cycle: 20, 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) CRAB	ACS/SBC WFC3/IR WFC3/UVIS	2	02-Nov-2012 21:01:04.0	yes

2 Total Orbits Used

ABSTRACT

The Crab is one of the most famous objects in high-energy astrophysics and an archetypal example of a young pulsar with a pulsar wind nebula (PWN). Observations with HST and Chandra have resolved the remarkable dynamic PWN structure and served as a prolific driver in advancing the theory of relativistic magnetized outflows in general and pulsar winds in particular. Despite the large amount of data collected, there are still

important gaps in our knowledge, such as the lack of contemporaneous, multiwavelength spectra of the prominent PWN features. Furthermore, high-resolution, wide-field, high-quality NIR and FUV images have never been obtained.
We propose a joint HST-Chandra-EVLA campaign to understand multiwavelength spectral changes across the PWN. Thanks to the brightness of the Crab PWN and superb resolution of all the three observatories, spectral changes can be mapped on ~1 arcsecond scales in a very short time. Therefore, this program is very efficient, highly synergistic, and will also provide a legacy set of contemporaneous, high-resolution images of the Crab PWN (taken across 9 decades in frequency!) that will serve as a reference for years to come.

OBSERVING DESCRIPTION

Our goal is to obtain high-resolution NIR, optical, and UV images covering the area surrounding the Crab pulsar. The HST visit will consist of just 2 orbits.

During the 1st orbit we will take 4 images with ACS/SBC F140LP covering ~55"x55" region centered on the pulsar to produce a 4-tile mosaic covering the central part of the PWN which includes the interesting features such as the bright wisps, the base of the jet, and knots. For the brightest PWN region (with the pulsar included) the total count rate in the detector FoV will not exceed 2,500 cts/s which is significantly below the SBC global count rate limit. We estimate the average source count rate per square arcminute to be ~2.2 cts/s/arcs^2 (see ACS.im.413982) and up to a factor of 5 higher for the brightest PWN features (wisps and knots). For our estimates we used UIT observation results from Hennessy et al. (1992; http://adsabs.harvard.edu/abs/1992ApJ...395L..13H) as well as our own measurments based in WFPC2 F170W images from HST program GO-5354. The above count rates are much higher than the sky and detector dark/glow count rates which therefore will not be of a concern with F140LP. In 688 s exposure for each of the mosaic tiles we will obtain S/N=50-100 for the the brightest PWN features and accurately measure their FUV fluxes and surface brightness distribution. The pulsar count rate will be ~37 cts/s within r=1" aperture (see ACS.im.413443). This is well below the local SBC limit. There are no bright stars within the region we will observe (as we verified with the APT BOT). .

During the 2nd orbit of the same visit we will obtain four images (at 4 dither points using WFC3-IR-DITHER-LINE pattern; total scientific exposure 1,612 s) with the WFC3/IR F160W filter, which offers 123"x136" field of view. We will use the SAMPSEQ=SPARS50 with NSAMP=9 to obtain a better dynamic range for the images. We estimate S/N to be in the range 20-100 (depending on the brightness of the PWN features), sufficient for accurate flux measurments. The two images with WFC3/UVIS/F555W (total exposure 774 s) will be obtained at two different positions (using WFC3-UVIS-DITHER-LINE) pattern to remove the artifacts in the post processing. To reduce the CTE loss we will use post-flash LED (with FLASH=12 e/pixel). The PWN features in the F555W image will have even higher S/N and, aside from the multiwavelength spectra, it will be used

for comparison with the Crab images that were previously obtain with HST using the same or similar V-band filter.

Visit

Proposal 13043, Visit 01, scheduling Sat Nov 03 01:01:13 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, WFC3/UVIS, ACS/SBC

Special Requirements: BETWEEN 26-NOV-2012 AND 03-DEC-2012

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-MOSAIC-BOX Purpose=MOSAIC Number Of Points=4 Point Spacing=24 Line Spacing=28	Coordinate Frame=POS-TARG Pattern Orientation=90.0 Angle Between Sides=264.24 Center Pattern=true		(1)
(2)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(2)
(3)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=4 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(3)

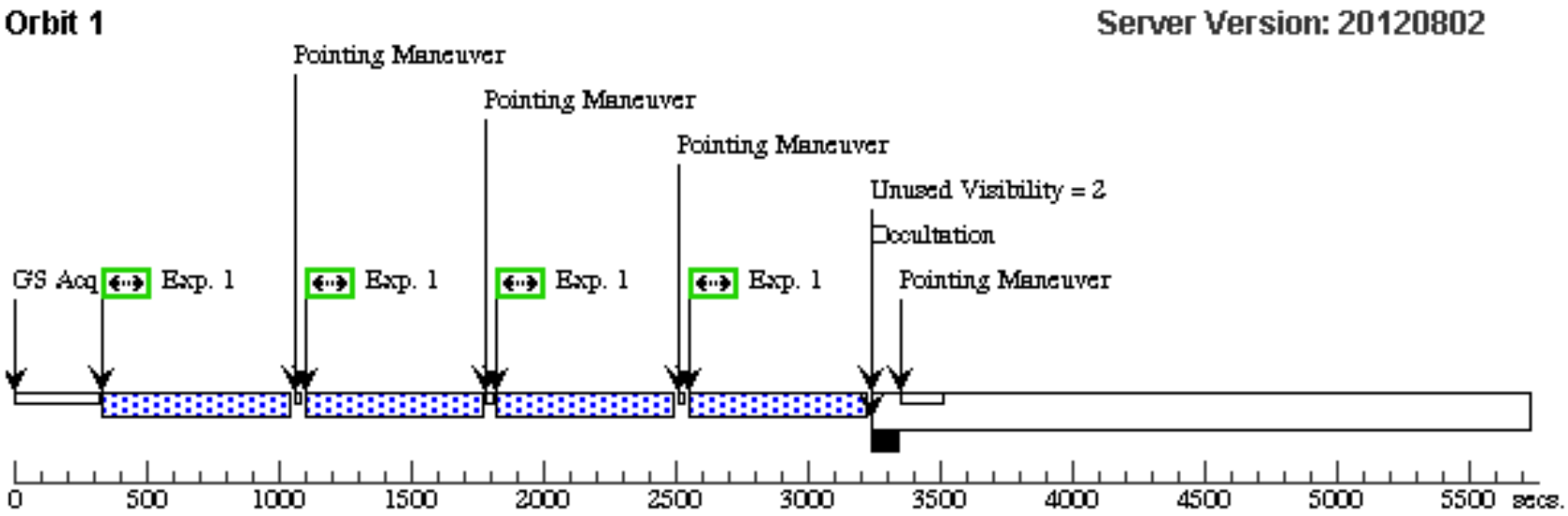
Fixed Targets

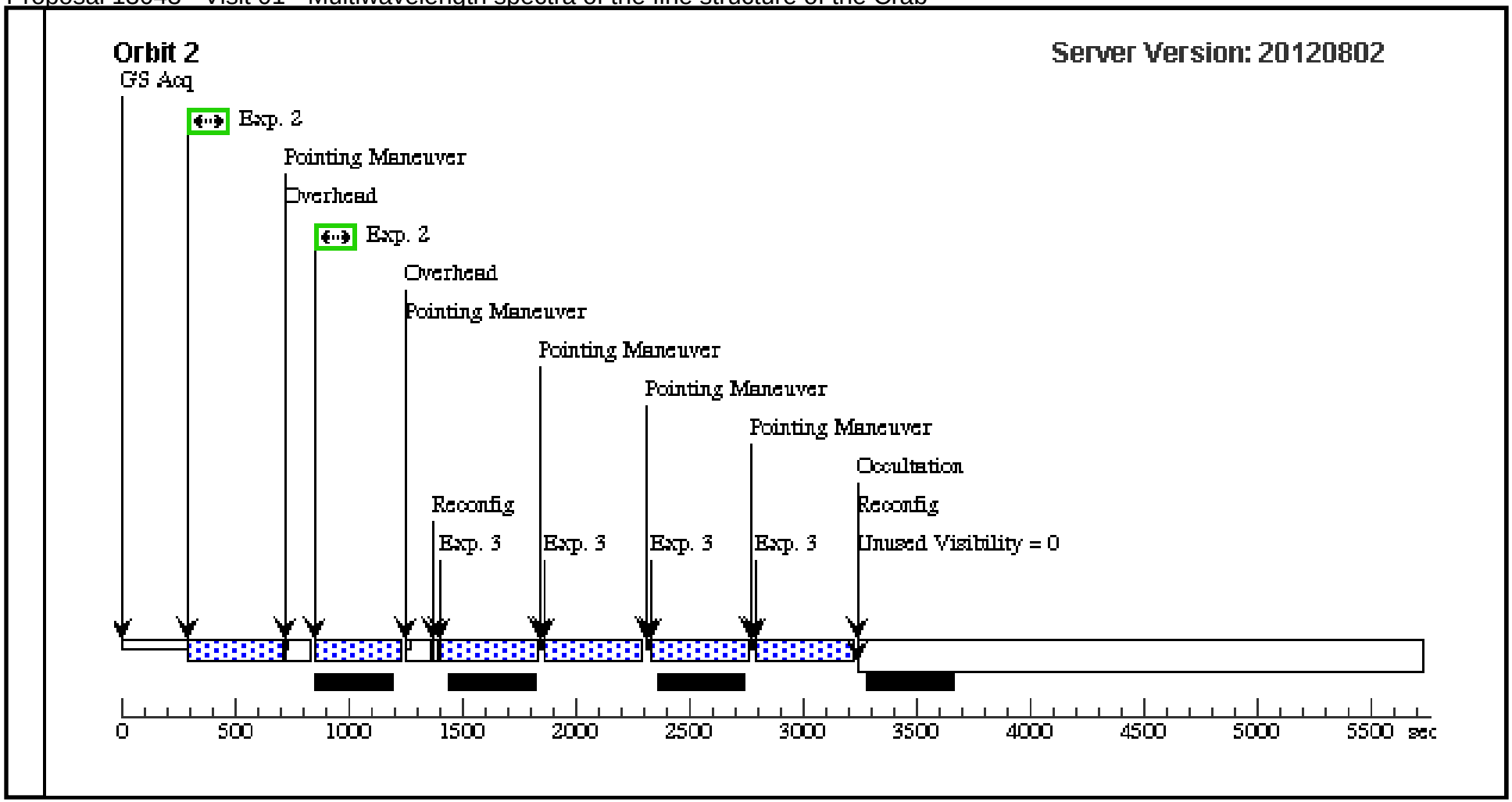
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	CRAB	RA: 05 34 31.9787 (83.6332446d) Dec: +22 00 53.96 (22.01499d) Equinox: J2000		V=16.5	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(ACS.im.413982)	(1) CRAB	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1, Exps 1-1 in Visit 01 (1)	95 Secs *[==>648.0 Secs (Pattern 1)]* *[==>648.0 Secs (Pattern 2)]* *[==>648.0 Secs (Pattern 3)]* *[==>648.0 Secs (Pattern 4)]*	***[1]***
2		(1) CRAB	WFC3/UVIS, ACCUM, UVIS-FIX	F555W	FLASH=12		Pattern 2, Exps 2-2 in Visit 01 (2)	937 Secs *[==>387.0 Secs (Pattern 1)]* *[==>387.0 Secs (Pattern 2)]*	***[2]***
3		(1) CRAB	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=9; SAMP-SEQ=SPARS50		Pattern 3, Exps 3-3 in Visit 01 (3)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20120802
GS Acq
Exp. 2
Pointing Maneuver
Overhead
Exp. 2
Overhead
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Occultation
Reconfig
Reconfig
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Unused Visibility = 0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec