13288 - PG 1424+240: Too Distant to be Seen?

Cycle: 21, Proposal Category: GO

(UV Initiative)

(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) PG1424+240	STIS/CCD STIS/NUV-MAMA	5	11-Jun-2013 02:11:35.0	yes

5 Total Orbits Used

ABSTRACT

The propagation of very-high-energy (VHE; E>100 GeV) gamma rays is an increasing puzzle currently being unveiled by the combined observational power of Fermi, VERITAS and HST. Recent HST/COS observations of PG 1424+240 show the VHE blazar to be at the groundbreaking distance of z>0.6035, stirring fundamental questions regarding the validity of standard blazar emission mechanisms and the expected

pair production interaction between VHE and extragalactic background light (EBL) photons. Unfortunately, the measurement which provided the redshift limit is constrained by the COS spectral coverage, and could be pushed even higher with spectral coverage above 1750 A. While unprecedented limits on the EBL will result if the blazar is found to reside at any distance beyond z=0.6, all currently available EBL and broadband blazar emission models will be negated if a redshift beyond z~0.7 is found. The propagation of VHE gamma rays from a source at z>0.7 will demand the use of exotic physics (e. g. axion/gamma-ray "oscillations") to explain the unexpectedly long gamma-ray path length. We propose STIS/E230M observations of PG 1424+240 to probe intervening Lyman-alpha absorbers which can provide evidence that this gamma-ray blazar resides at a redshift greater than z=0.6.

OBSERVING DESCRIPTION

In order to set a more distant lower limit on the source redshift of PG1424+240, we require sensitivity to weaker absorbers. The current redshift limit is set by Lybeta and gamma lines observed in COS/FUV data (see Figure 1). The COS FUV data has S/N~9 per pixel which translates into a minimum 5 sigma detection of equivalent width Wobs=60 mA via Keeney et al. (2012). Since a single Lybeta line is ambiguous, we require both Lybeta and Lygamma detections. A Wobs = 60 mA Lygamma line at lambda~1550 (Lygamma at z~0.6) corresponds to log N(HI)=14.3 and the corresponding Lyalpha line would be observed at W~460mA at 1945A.

Improving the detection limit in column density by an order of magnitude (log N(HI) >13.3) will require detecting Lyalpha lines at ~2000A with an observed equivalent width W~125mA. This requires data of only modest S/N~5 per STIS/E230M resolution element. Binning the data to optimal resolution of ~30-50 km/s (rest-frame~25 km/s for redshifted Lyalpha) results in S/N improvements by a factor of root two.

PG 1424+240 is a variable source and the flux is uncertain. However, over the course of 2012, it has shown a reasonably constant flux in the FUV of ~1.4x10^14 ergs cm-2s-1. We conservatively estimate a flux level of half this (f ~7x10-15 ergs cm-2s-1) and estimate that the required data quality can be obtained in 14 ksec or approximately five HST orbits with the STIS/E230M grating.

Combining new observations using the I2124 setting (1720-2528A) and archival COS/FUV data (1135-1800A) will provide a contiguous spectrum of PG 1424+240 sensitive to Lyalpha absorbers at $0 < z < 1.07$ and many strong metal lines along a similar redshift range. An order of magnitude improvement in HI sensitivity at $z > 0.47$ should result in ~40x more HI absorbers and improve the precision of the redshift limit accordingly for this astrophysically important object. Additionally, high resolution ground-based spectroscopy will be obtained at the Apache Point Observatory 3.5m to search for redshifted Mg II absorption associated with the Lyalpha absorbers found with COS and STIS.

Visit

Proposal 13288, Visit 01 Tue Jun 11 06:11:46 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: (none)

Fixed Targets

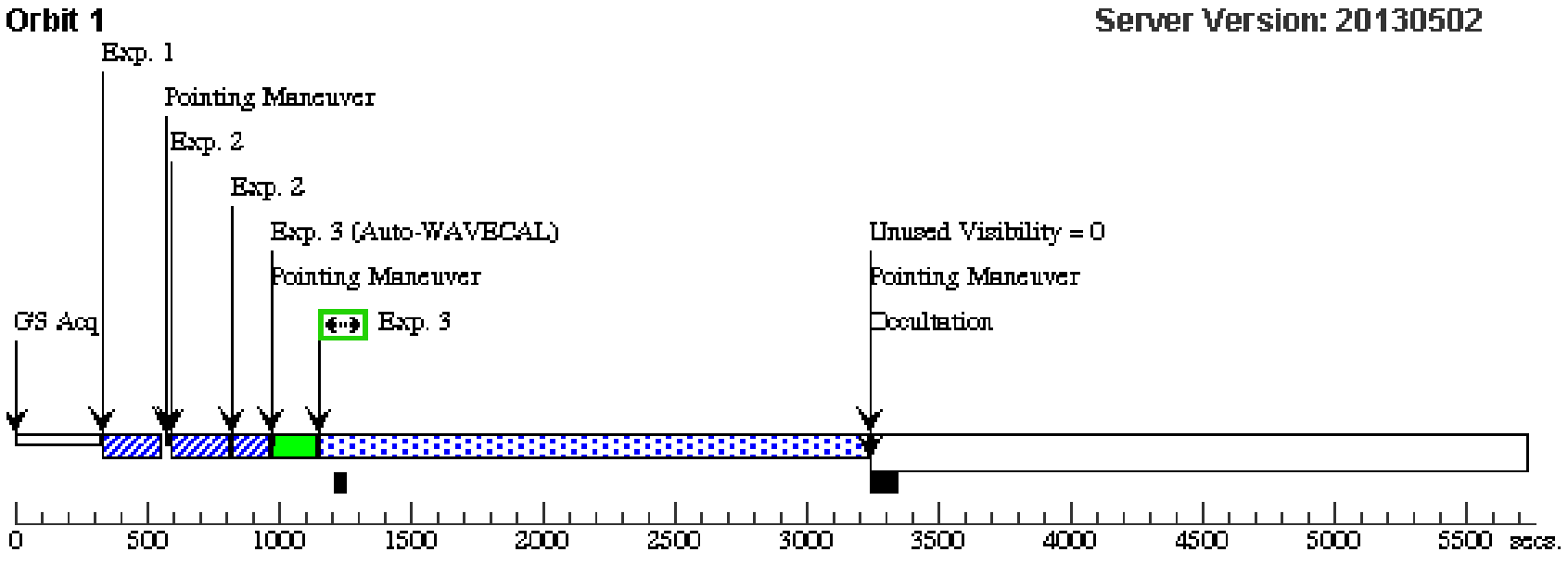
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PG1424+240 Alt Name1: PKS1424+240 Alt Name2: 7C1424+2401	RA: 14 27 0.3918 (216.7516325d) Dec: +23 48 0.05 (23.80001d) Equinox: J2000	Redshift: 0.6	V=14.95+/-1	Reference Frame: ICRS

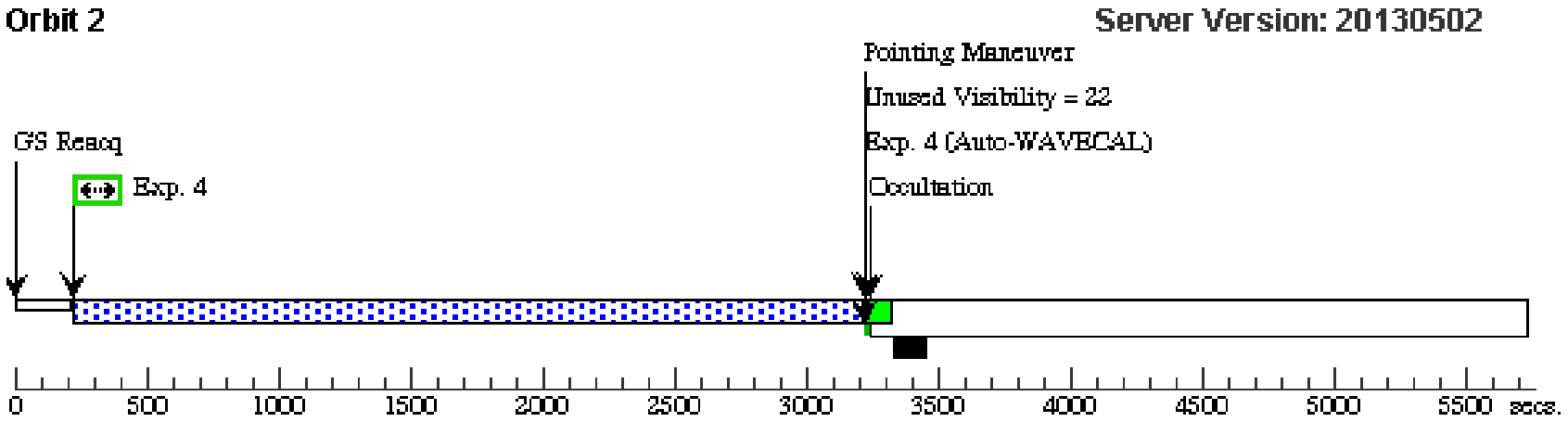
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Target coords precessed from GSC2.3, hstID=N5US000861

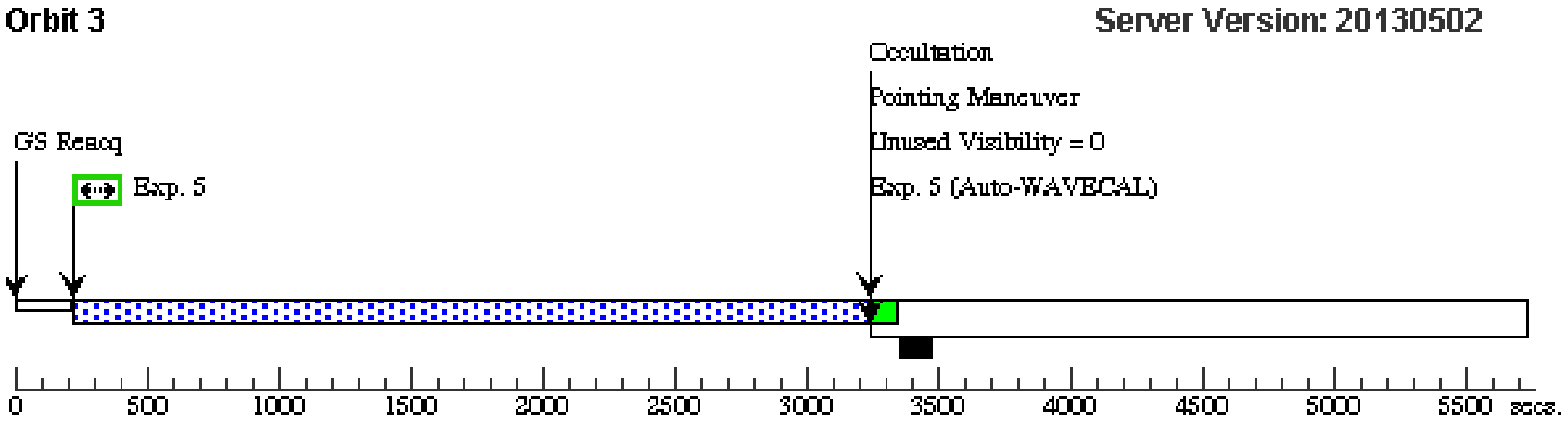
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acq (STIS.ta.510243)	(1) PG1424+240	STIS/CCD, ACQ, F28X50LP	MIRROR				.1 Secs (0.1 Secs) *[==>]*	***[1]***
2	acq/peak (STIS.ta.510244)	(1) PG1424+240	STIS/CCD, ACQ/PEAK, 0.2X0.06	MIRROR				.1 Secs (0.1 Secs) *[==>]*	***[1]***
3	obs1 (STIS.sp.510250)	(1) PG1424+240	STIS/NUV-MAMA, ACCUM, 0.2X0.2FPA	E230M 1978 A				2000 Secs (2026 Secs) *[==>2026.0 Secs]*	***[1]***
4	obs2 (STIS.sp.510250)	(1) PG1424+240	STIS/NUV-MAMA, ACCUM, 0.2X0.2FPB	E230M 1978 A				3000 Secs (2958 Secs) *[==>2958.0 Secs]*	***[2]***
5	obs3 (STIS.sp.510250)	(1) PG1424+240	STIS/NUV-MAMA, ACCUM, 0.2X0.2FPC	E230M 1978 A				3000 Secs (2958 Secs) *[==>2958.0 Secs]*	***[3]***
6	obs4 (STIS.sp.510250)	(1) PG1424+240	STIS/NUV-MAMA, ACCUM, 0.2X0.2FPD	E230M 1978 A				3000 Secs (2958 Secs) *[==>2958.0 Secs]*	***[4]***
7	obs5 (STIS.sp.510250)	(1) PG1424+240	STIS/NUV-MAMA, ACCUM, 0.2X0.2FPE	E230M 1978 A				3000 Secs (2958 Secs) *[==>2958.0 Secs]*	***[5]***

Orbit Structure



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GS Reacq
Exp. 5
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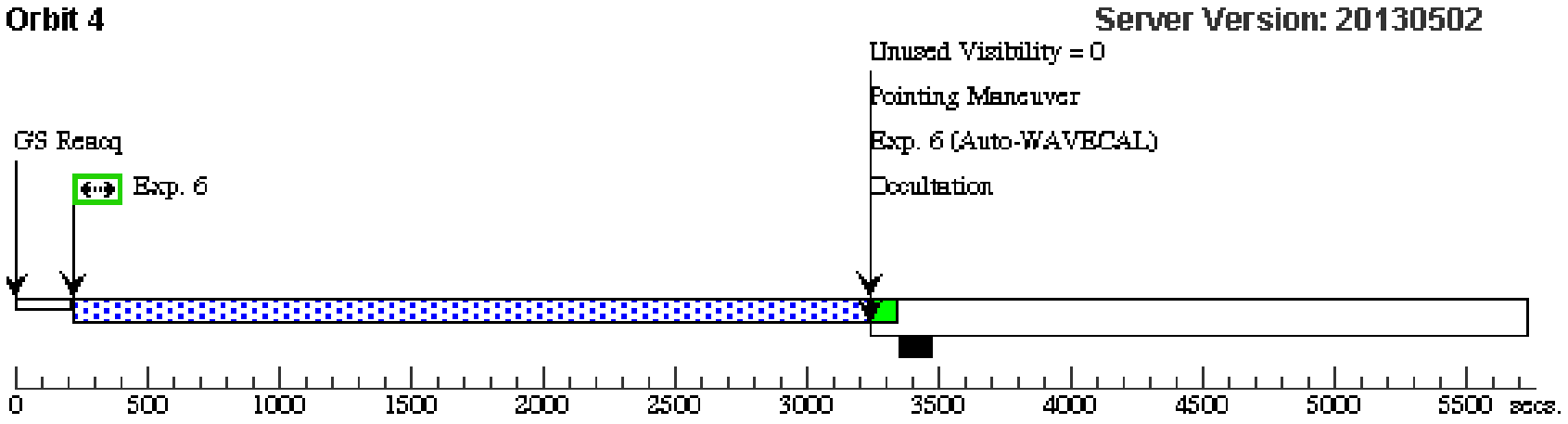
secs.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Occultation
GS Reacq
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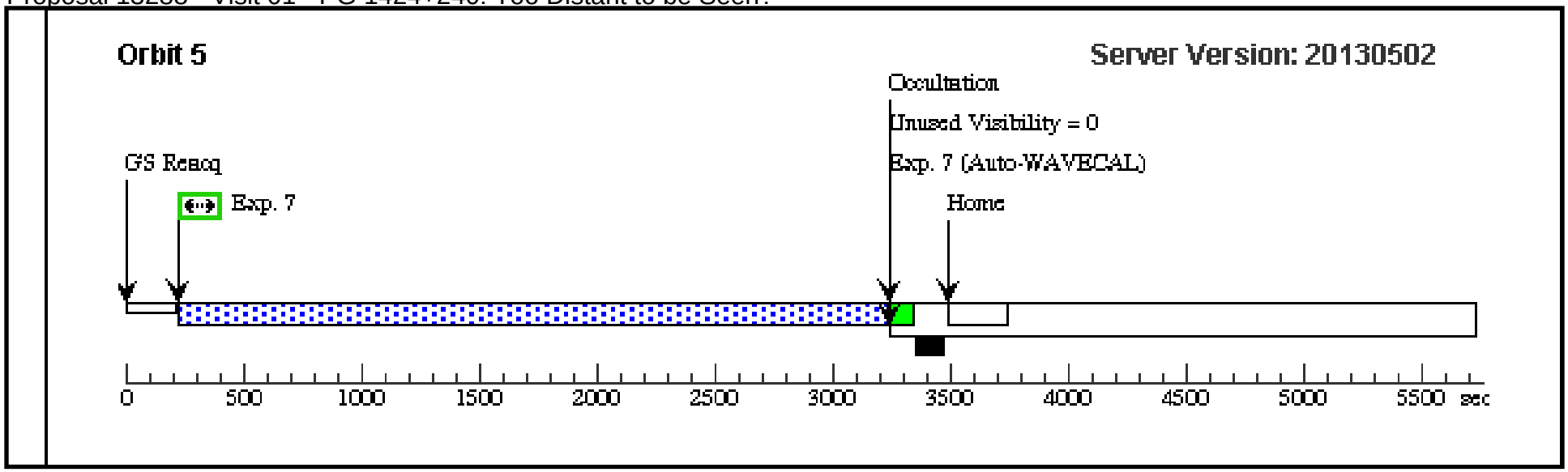
secs.


Orbit 5
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GS Reacq
Exp. 7
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