13807 - Unprecedented Tracking of the Unique Dwarf Nova GW Lib from Largest Amplitude Outburst to Quiescent Pulsations

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: AVAILABLE)

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) GW-LIB	COS/FUV	3	04-Feb-2015 21:12:24.0	yes
02	(1) GW-LIB	S/C	1	04-Feb-2015 21:12:25.0	yes
03	(2) GW-LIB-SAFE-OFFSET	COS/FUV	3	04-Feb-2015 21:12:27.0	yes

7 Total Orbits Used

ABSTRACT

The unique dwarf nova GW Lib, the prototype of cataclysmic variables containing white dwarfs that exhibit non-radial pulsations at quiescence, underwent the largest known amplitude outburst from an accretion disk instability (9 mag) in 2007. This huge outburst provided an unprecedented opportunity to probe how the
interior white dwarf structure reacts to the accretion of mass and angular momentum by using its pulsation
spectrum. As the outer envelope cools, the pulsation spectrum evolves, and we obtain the first opportunity to track how a white dwarf evolves through the instability strip on a timescale of just years.We have monitored GW Lib since its outburst with ground and COS observations. For the first 4 years after outburst, GW Lib followed a normal cooling pattern, with a different pulsation period than at quiescence becoming visible by year 3. However, rather than continuing to cool to its quiescent temperature, our latest 2013 COS observation showed a hotter temperature than in 2011, as well as a variable flux, temperature and pulsation amplitude during the HST orbits. As no previous dwarf nova has been followed for more than 3 years after outburst, and it is now obvious that the white dwarf in GW Lib does not cool monotonically, we propose to continue the cooling curve with a COS measurement in 2015. The cooling can only be constrained by an UV spectrum with HST (the optical spectrum is too contaminated by the accretion disk to determine a valid temperature) and the ratio of the UV to optical pulsation amplitude is needed to provide the mode index, essential for modeling the structure of the underlying white dwarf.

OBSERVING DESCRIPTION

We have 2 goals in mind for these observations.
One is to obtain a summed UV spectrum with sufficient
S/N (>10) to allow a temperature determination of the underlying white
dwarf by fitting the spectrum to white dwarf models. The second is
to obtain time-resolved light curves by summing the background-subtracted
TIME-TAG fluxes over several wavelength bands in 3sec intervals to detect and
constrain the UV pulsations. From our past observations, we know
that both goals can be accomplished by using the COS FUV with the G140 L
grating which provides good coverage from 1100-2000A. The orbital period of
GW Lib is very short (77 min) and the inclination is low (11 deg) so there
is a good view of the white dwarf throughout the GW Lib orbit. Three
HST orbits will provide a good spectrum
as well as a light curve that will reveal pulsations down to a few percent,

and allow further study of the relation between temperature and pulsation changes as observed in 2013.

We will continue our ground observing programs on GW Lib to: 1) monitor the pulsation spectrum changes prior to the HST observations, 2) provide confirmation that the objects are close to quiescence at the time of the HST observation (the outburst recurrence time for GW Lib is about 25 yrs and 3) determine the amplitude of the optical pulse for comparison with that from the UV (the UV/optical amplitude ratio allows the mode determination).

While the outburst timescale for GW Lib is on the order of 25 years, with the last outburst in 2007, HST still requires ground monitoring prior to the HST observations to ensure that it remains at quiescence. To accomplish this (using the AAVSO worldwide network as we have done for our past observations), as well as obtaining near-simultaneous data to compute our UV/opt pulsation amplitude ratio, we need the HST observation scheduled during months when GW Lib can be observed from the ground (Mar to June 2015). The best months would be April or May.

Visit

Proposal 13807, GW-Lib (01), scheduling Thu Feb 05 02:12:28 GMT 2015

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: SCHED 100%; ORIENT 200D TO 80 D; AFTER 02 BY 3 D TO 5 D; BETWEEN 22-APR-2015 AND 23-APR-2015; Period 1 D AND ZERO-PHASE HJD2457083.417

Comments: This should be scheduled in during the evening - Baltimore time. Flags need to be cleared during the work day. The PHASE requirement will enforce this.

Diagnostics

(GW-Lib (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

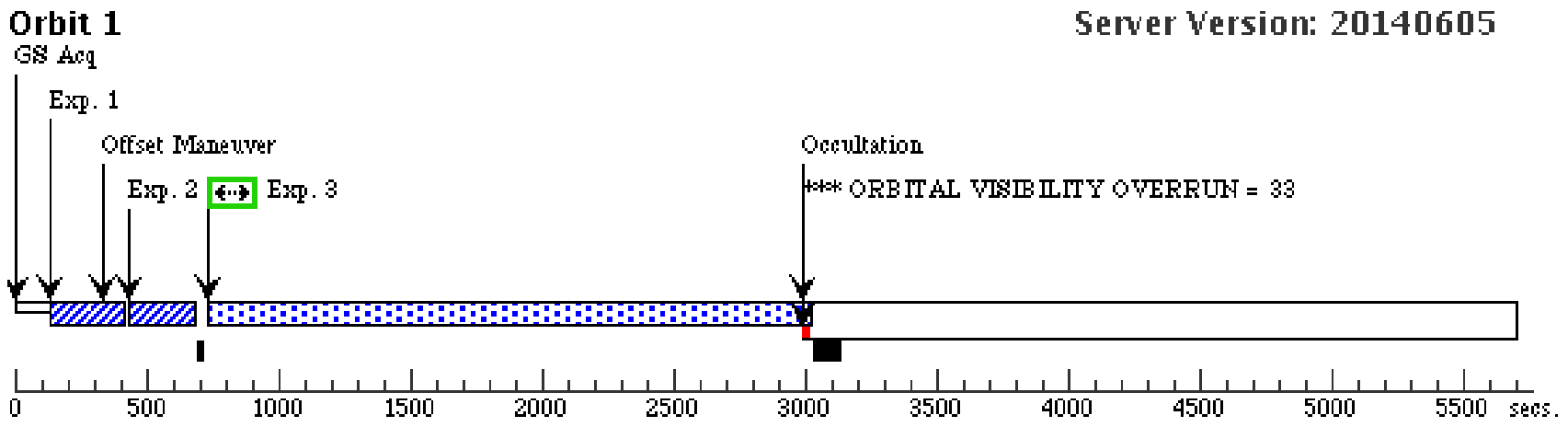
Fixed Targets

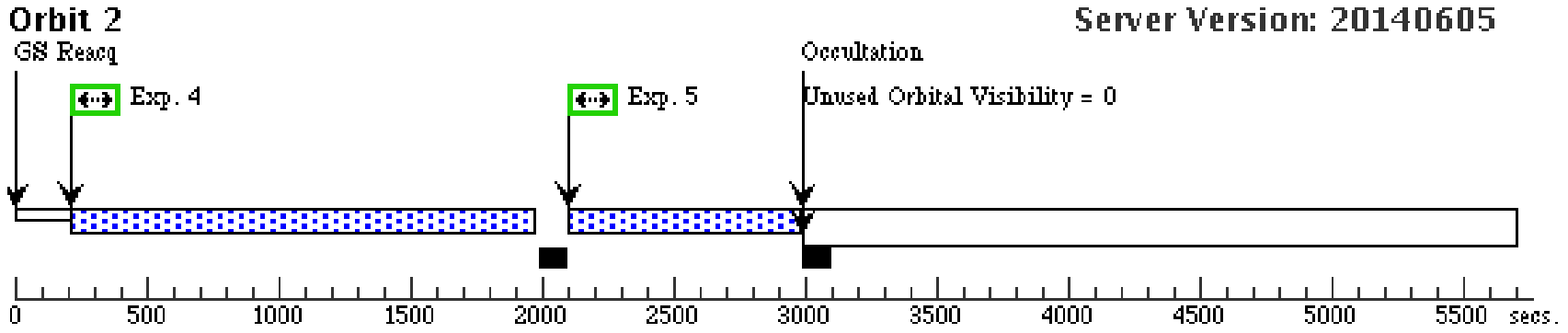
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GW-LIB	RA: 15 19 55.3400 (229.9805833d) Dec: -25 00 24.58 (-25.00683d) Equinox: J2000	Proper Motion RA: -63.7 mas/yr Proper Motion Dec: 16.5 mas/yr Epoch of Position: 2000.0	V=16.5+/-0.5	Reference Frame: ICRS

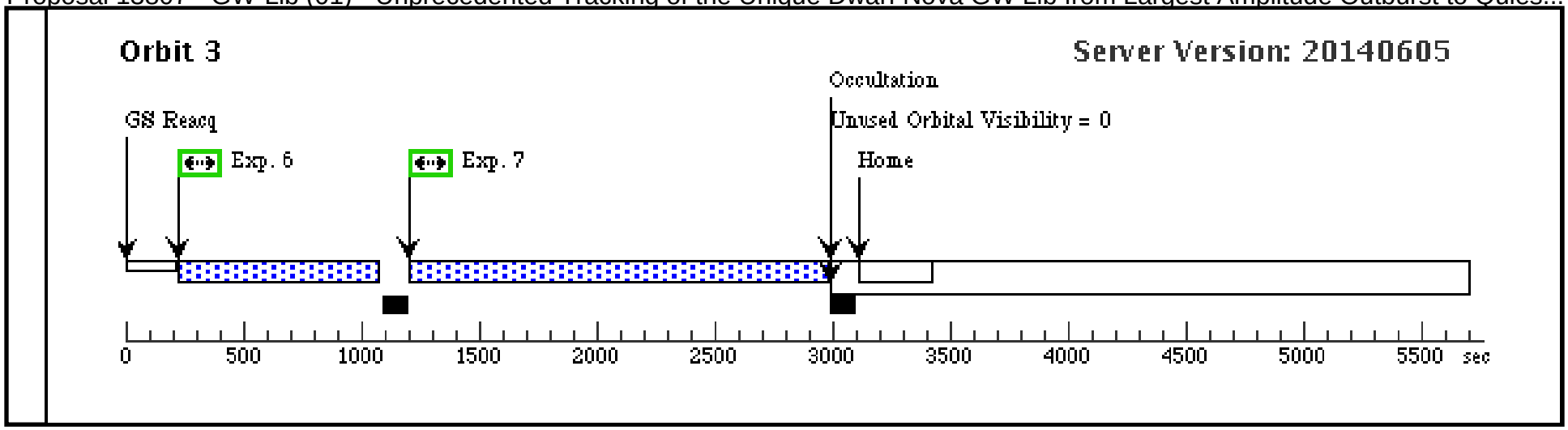
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GW-Lib ACQ/PEAKXD (COS.616884)	(1) GW-LIB	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A		PHASE 0 TO 0.5; USE OFFSET 01SAFE		20 Secs (20 Secs) *[==>]*	***[1]***
2	GW-Lib ACQ/PEAKD (COS.616884)	(1) GW-LIB	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	STEP-SIZE=0.9; NUM-POS=5; CENTER=DEF	USE OFFSET 01SAFE		20 Secs (20 Secs) *[==>]*	***[1]***
3	GW-LIB FP-1 (COS.616885)	(1) GW-LIB	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=2168; FLASH=YES; FP-POS=1	USE OFFSET 01SAFE		2168 Secs (2168 Secs) *[==>]*	***[1]***
4	GW-LIB FP-2 (COS.616885)	(1) GW-LIB	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=1708; FP-POS=2; FLASH=YES	USE OFFSET 01SAFE		1708 Secs (1708 Secs) *[==>]*	***[2]***
5	GW-LIB FP-3 (COS.616885)	(1) GW-LIB	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=824; FP-POS=3; FLASH=YES	USE OFFSET 01SAFE		824 Secs (824 Secs) *[==>]*	***[2]***
6	GW-LIB FP-3 (COS.616885)	(1) GW-LIB	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=804; FP-POS=3; FLASH=YES	USE OFFSET 01SAFE		804 Secs (804 Secs) *[==>]*	***[3]***
7	GW-LIB FP-4 (COS.616885)	(1) GW-LIB	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=1728; FP-POS=4; FLASH=YES	USE OFFSET 01SAFE		1728 Secs (1728 Secs) *[==>]*	***[3]***

Orbit Structure



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Occultation
GS Reacq
Unused Orbital Visibility = 0
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Exp. 7
Home
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1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13807, Safe Offset (02), implementation Thu Feb 05 02:12:28 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: S/C

Special Requirements: ORIENT 200D TO 80 D; Period 7 D AND ZERO-PHASE HJD2457082.5

Comments: This visit allocates and sets up the safe position offset slot for visit 01 which will use that slot. This S/C visit should go earlier in the week while visit 01 will be at least 3 days later. The PHASE requirement will ensure that the visit is sheduled on a Sunday.

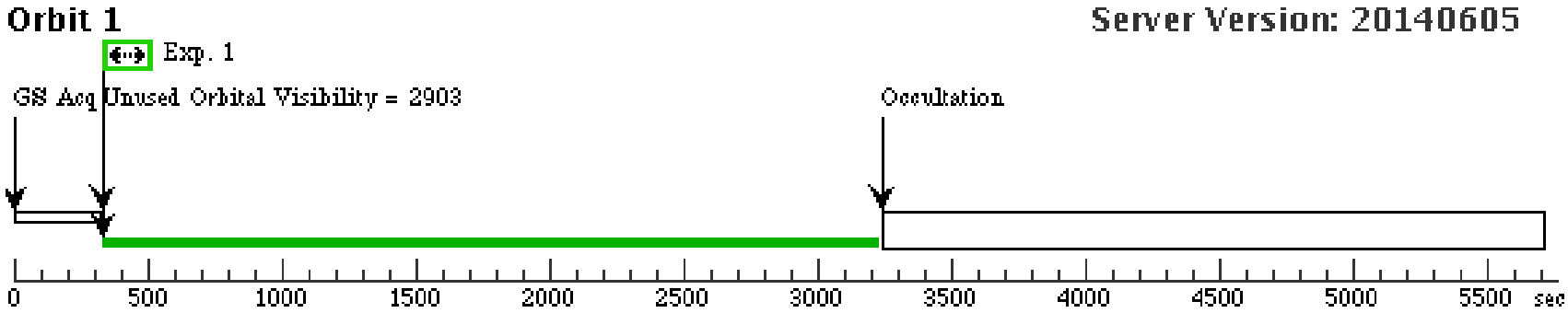
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GW-LIB	RA: 15 19 55.3400 (229.9805833d) Dec: -25 00 24.58 (-25.00683d) Equinox: J2000	Proper Motion RA: -63.7 mas/yr Proper Motion Dec: 16.5 mas/yr Epoch of Position: 2000.0	V=16.5+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) GW-LIB	S/C, POINTING, V1			POS TARG 235.158, -235.01; PHASE 0 TO 0.143; SAVE OFFSET 01SAFE; SPEC COM INSTR ECSLOTSET; QESIPARM ANGLE 0; QESIPARM DIST 9.75		5 Secs (5 Secs) *[==>]*	***[1]***

Orbit Structure



Visit

Proposal 13807, BOP Check Only (03), withdrawn Thu Feb 05 02:12:28 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: SCHED 100%; ORIENT 200D TO 80 D; BETWEEN 01-MAR-2015:00:00:00 AND 30-JUN-2015:00:00:00

Comments: This visit is for BOP checking the safe target only and should not execute onboard HST.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	GW-LIB	RA: 15 19 55.3400 (229.9805833d) Dec: -25 00 24.58 (-25.00683d) Equinox: J2000	Proper Motion RA: -63.7 mas/yr Proper Motion Dec: 16.5 mas/yr Epoch of Position: 2000.0	V=16.5+/-0.5	Reference Frame: ICRS
(2)	GW-LIB-SAFE-OFFSET	Offset from GW-LIB RA Offset: 0.0 Secs Dec Offset: 9.75 Arcsec		V=16.5+/-0.5	Offset Position (GW-LIB-SAFE-OFFSET)

Comments: This target is a blank piece of sky which is the bright object safe offset for GW-LIB.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	GW-Lib ACQ/PEAKXD (COS.616884)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A				20 Secs (20 Secs) *[==>]*	***[1]***
2	GW-Lib ACQ/PEAKD (COS.616884)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	STEP-SIZE=0.9; NUM-POS=5; CENTER=DEF			20 Secs (20 Secs) *[==>]*	***[1]***
3	GW-LIB FP-1 (COS.616885)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=2168; FLASH=YES; FP-POS=1			2168 Secs (2168 Secs) *[==>]*	***[1]***
4	GW-LIB FP-2 (COS.616885)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=1708; FP-POS=2; FLASH=YES			1708 Secs (1708 Secs) *[==>]*	***[2]***
5	GW-LIB FP-3 (COS.616885)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=824; FP-POS=3; FLASH=YES			824 Secs (824 Secs) *[==>]*	***[2]***
6	GW-LIB FP-3 (COS.616885)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=804; FP-POS=3; FLASH=YES			804 Secs (804 Secs) *[==>]*	***[3]***
7	GW-LIB FP-4 (COS.616885)	(2) GW-LIB-SAFE-OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=1728; FP-POS=4; FLASH=YES			1728 Secs (1728 Secs) *[==>]*	***[3]***

Orbit Structure