



15273 - A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

Cycle: 25, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) V838HER CCDFLAT	STIS/CCD	5	11-Jul-2019 10:00:14.0	yes
02	(1) V838HER (2) STAR-A-OFFSET CCDFLAT	STIS/CCD	4	11-Jul-2019 10:00:18.0	yes

9 Total Orbits Used

ABSTRACT

V838 Her was one of the fastest fading novae ever observed. Its nebular spectrum revealed unusual abundance ratios including a high sulfur content. These observations strongly imply that the white dwarf in the system is very close to the Chandrasekhar limit and may be the most massive known. However, no direct radial velocity measurements have confirmed this assertion. Our attempt to directly measure the mass was foiled by the light of very nearby stars contaminating the nova spectra and suppressing the estimated orbital velocity of the donor star. We propose STIS high-angular

Proposal 15273 (STScI Edit Number: 0, Created: Thursday, July 11, 2019 at 9:00:19 AM Eastern Standard Time) - Overview
resolution spectroscopy to eliminate any contamination and make a definitive, trustworthy mass measurement for the V838~Her white dwarf.

OBSERVING DESCRIPTION

We propose time-resolved spectroscopy of V838 Her with the STIS covering one binary orbit. Because the orbit is 7.1 hours long and the target visibility is 54 minutes, we will break the observations up into two visits. The first visit will be 5 HST orbits and cover an entire binary orbit. The second visit will be timed to fill in holes in phase created by the Earth occultations in the first visit. By coincidence, actually observing 9 consecutive orbits would naturally fill in the gaps, but such long periods of continuous observing are not commonly available. We have calculated that starting the second visit 63 HST orbits (4.2 days) after the beginning of the first visit will also fill all the missing phases. Longer delays (121, 130, 188 ... HST orbits) before starting the second visit will also work.

V838 Her has a brightness of $R=19.0$ mag. This is too faint for the medium resolution gratings, but good signal-to-noise ratio (SNR) can be achieved with the low resolution grating. Because the velocity amplitude is expected to be large, we will still achieve sufficient velocity resolution to measure the WD mass. We plan to use the 0.1 arcsec wide slit to improve the resolution while not significantly impacting the throughput. The narrow slit is critical for absorption line measurements because it maximizes spectral purity.

To avoid the emission lines from the disk that dominate the blue wavelengths, we will use the G750L grating and cover 530-1000 nm. This will include the strong NaI line as well as hundreds of weaker absorption lines found in K-type stars. These weak lines are important for the cross-correlation velocity measurement method. To reduce fringing beyond 700 nm we will take contemporaneous fringe flats that add 2 minutes of overhead.

With the G750L grating and 0.1-arcsec slit we will achieve a velocity resolution of 400 km/s. Using the cross-correlation technique, the velocity uncertainty per spectrum will be 35 km/s or an unbiased velocity amplitude good to 5% .

The STIS ETC shows that we will reach a $S/N=13$ per resolution element in a 900 sec exposure on the 19.0 mag star. Because of the multiplexing from cross-correlation this will be sufficient S/N to make an accurate velocity measurement.

Proposal 15273 - Visit 01 - A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

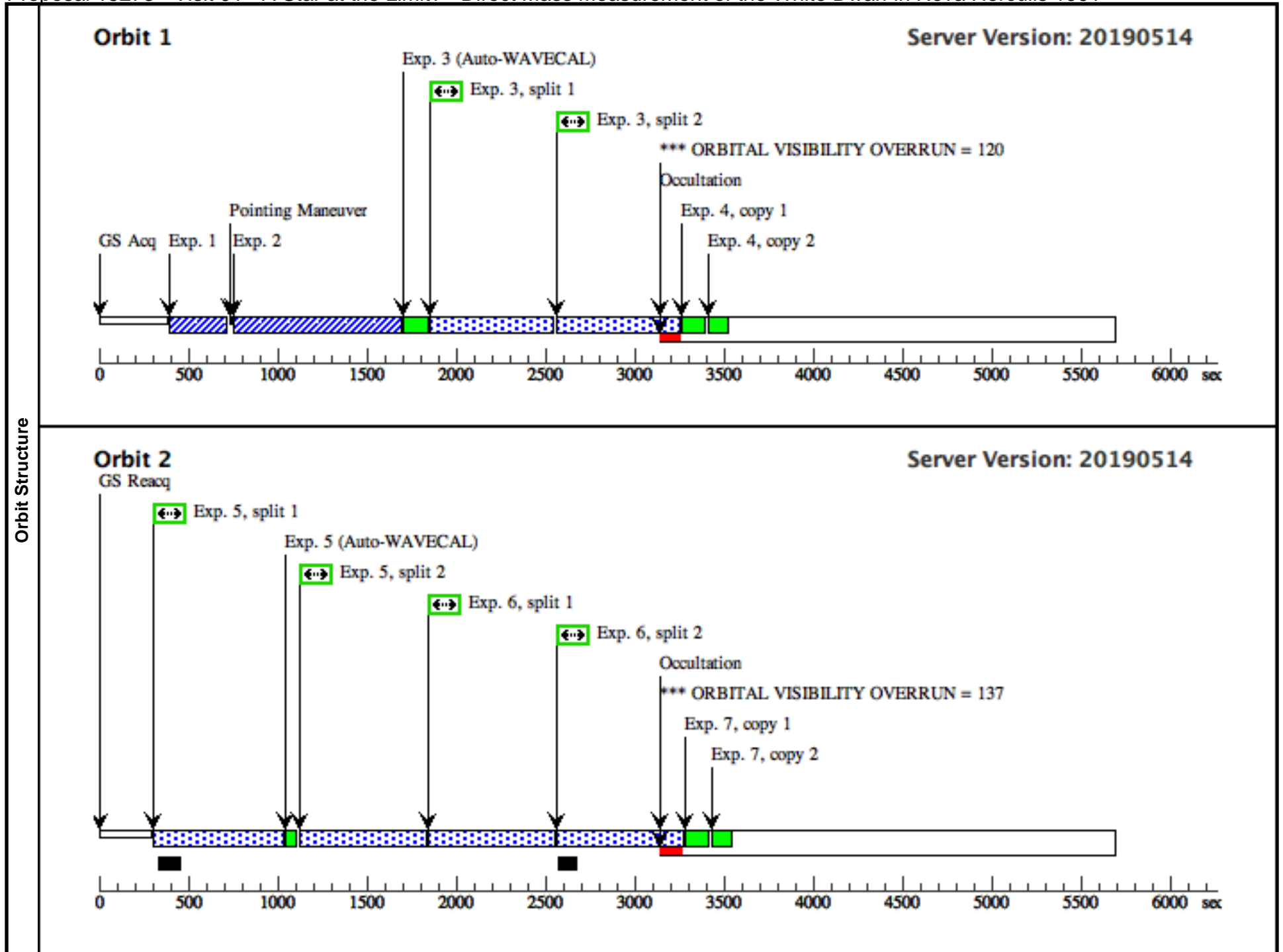
Visit	Proposal 15273, Visit 01, completed Thu Jul 11 14:00:19 GMT 2019 Diagnostic Status: Warning Scientific Instruments: STIS/CCD Special Requirements: (none)																
	Diagnosics (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN																
Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>V838HER</td> <td>RA: 18 46 31.4700 (281.6311250d) Dec: +12 14 2.26 (12.23396d) Equinox: J2000</td> <td>Epoch of Position: 2000</td> <td>V=19.5+/-0.3</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	V838HER	RA: 18 46 31.4700 (281.6311250d) Dec: +12 14 2.26 (12.23396d) Equinox: J2000	Epoch of Position: 2000	V=19.5+/-0.3	Reference Frame: ICRS				
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Comments: The position was determined from the GSC2 catalog. A plate solution was determined on a VATT image taken in 2016 and applied to the nova. Category=STAR Description=[CLASSICAL NOVA, INTERACTING BINARY, K V-IV] Extended=NO																	

Proposal 15273 - Visit 01 - A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition (STIS.ta.101 2237)	(1) V838HER	STIS/CCD, ACQ, F28X50LP	MIRROR				25 Secs (25 Secs) [==>]	[1]
<i>Comments: Initial exposure for V=20 mag target, spectrum = K4V</i>									
2	peakup (STIS.ta.101 2246)	(1) V838HER	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR				60 Secs (60 Secs) [==>]	[1]
<i>Comments: Exposure through 0.1 arcsec slit for V=20 mag target, spectrum = K4V</i>									
3		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1280 Secs (1318 Secs) [==>659.0 Secs (Split 1)] [==>659.0 Secs (Split 2)]	[1]
4	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A				[==>(Copy 1)] [==>(Copy 2)]	[1]
5		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1352 Secs) [==>676.0 Secs (Split 1)] [==>676.0 Secs (Split 2)]	[2]
6		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1352 Secs) [==>676.0 Secs (Split 1)] [==>676.0 Secs (Split 2)]	[2]
7	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A				[==>(Copy 1)] [==>(Copy 2)]	[2]
8		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1402 Secs) [==>701.0 Secs (Split 1)] [==>701.0 Secs (Split 2)]	[3]
9		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1402 Secs) [==>701.0 Secs (Split 1)] [==>701.0 Secs (Split 2)]	[3]
10	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A				[==>(Copy 1)] [==>(Copy 2)]	[3]
11		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1352 Secs) [==>676.0 Secs (Split 1)] [==>676.0 Secs (Split 2)]	[4]
12		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1352 Secs) [==>676.0 Secs (Split 1)] [==>676.0 Secs (Split 2)]	[4]
13	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A				[==>(Copy 1)] [==>(Copy 2)]	[4]
14		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1352 Secs) [==>676.0 Secs (Split 1)] [==>676.0 Secs (Split 2)]	[5]
15		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2		1200 Secs (1352 Secs) [==>676.0 Secs (Split 1)] [==>676.0 Secs (Split 2)]	[5]

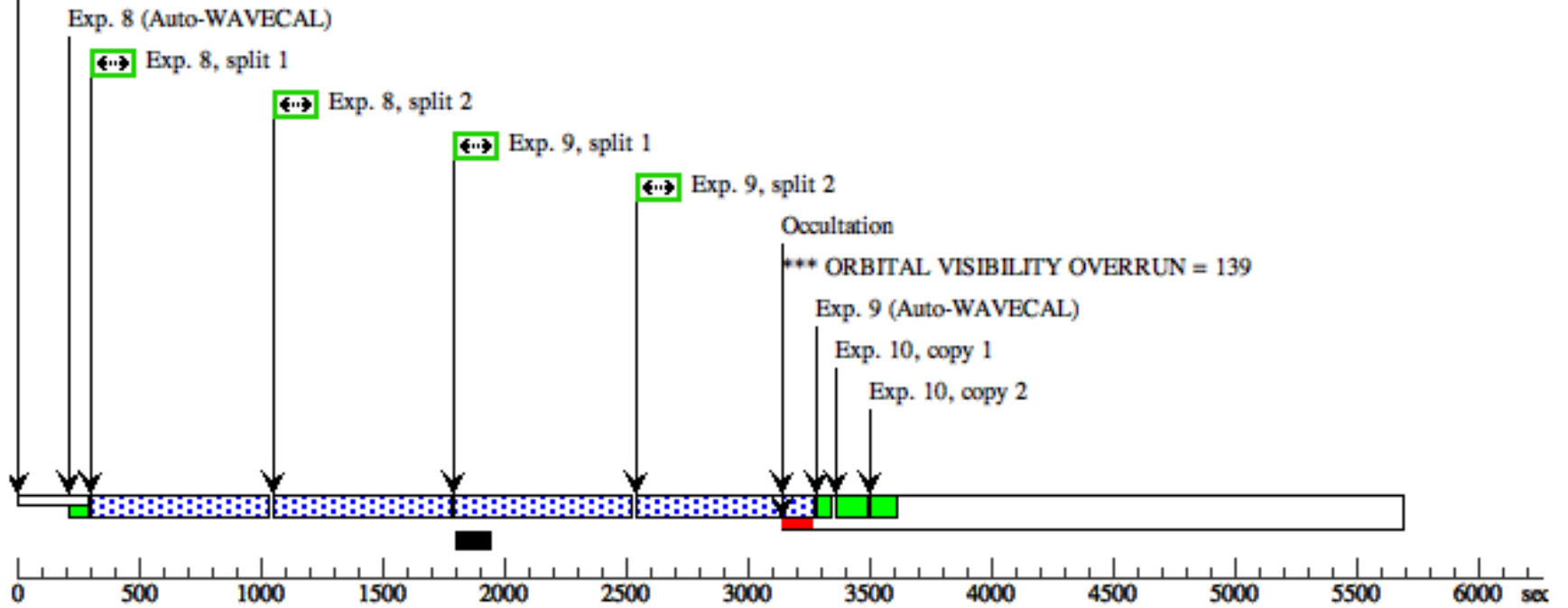
Proposal 15273 - Visit 01 - A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

16	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A	[==>(Copy 1)] [==>(Copy 2)]	[5]
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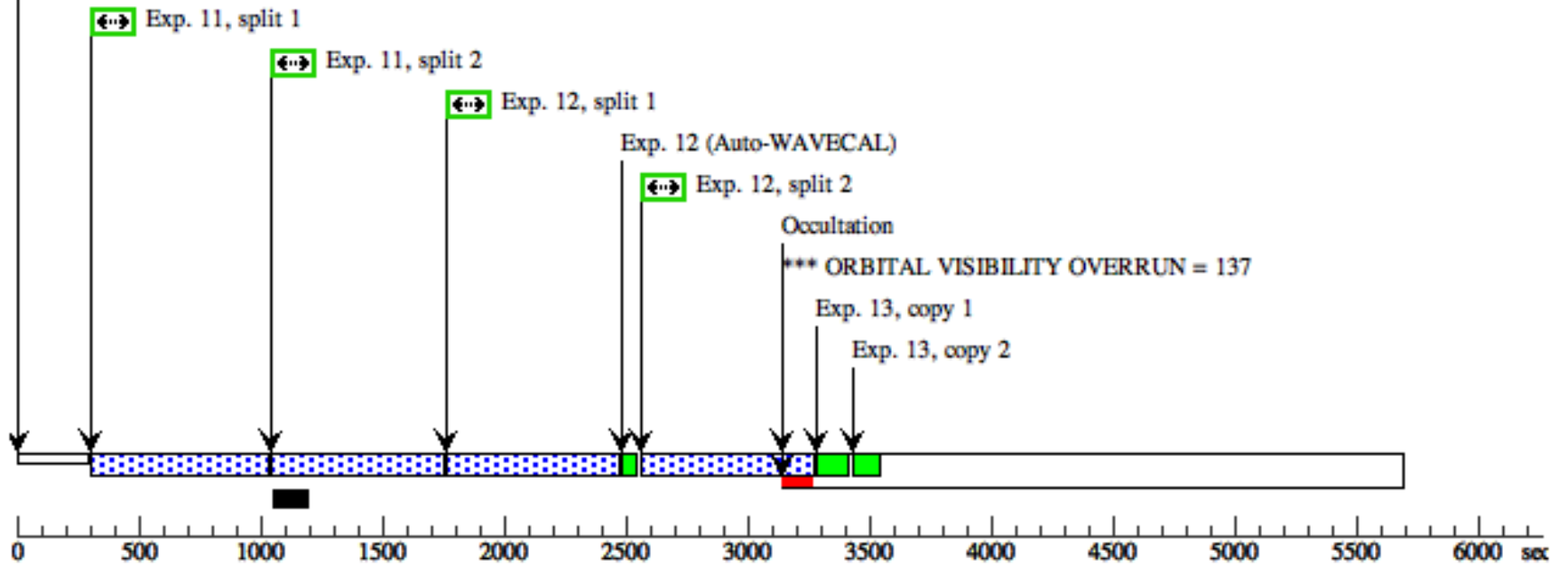
Orbit 3

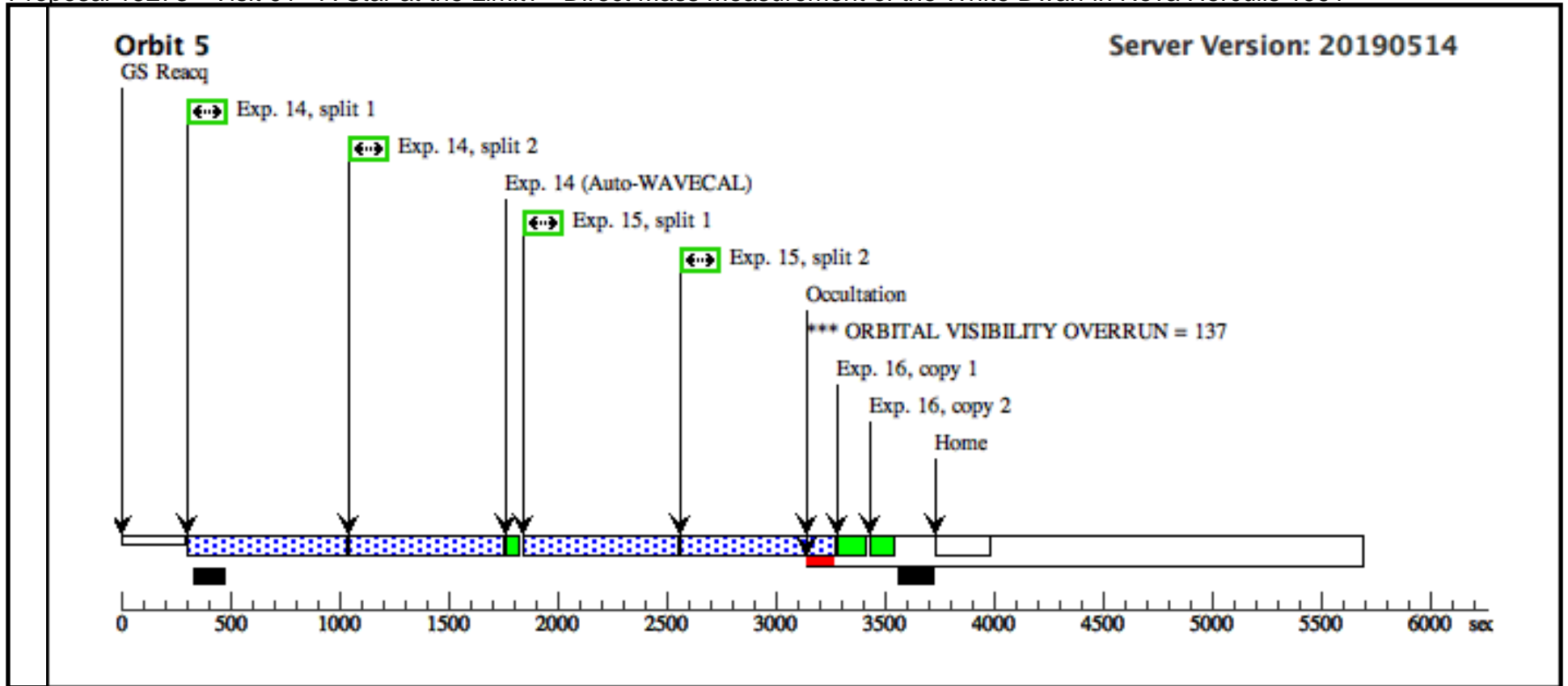
GS Reacq



Orbit 4

GS Reacq





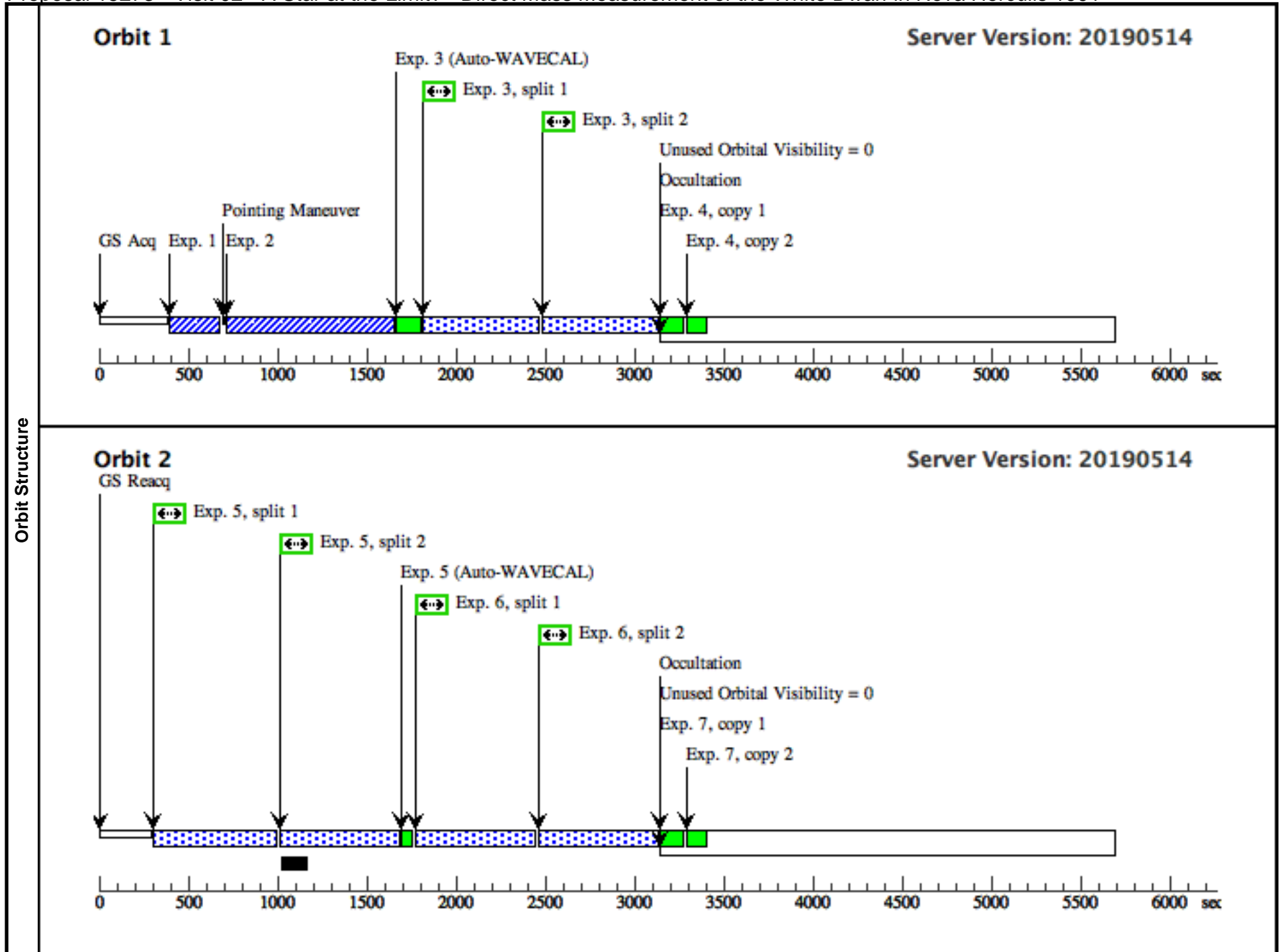
Proposal 15273 - Visit 02 - A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

Thu Jul 11 14:00:19 GMT 2019

Visit	<p>Proposal 15273, Visit 02, pi Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD Special Requirements: (none) <i>Comments: Have removed "after" restriction since Visit 01 completed</i></p>					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	V838HER	RA: 18 46 31.4700 (281.6311250d) Dec: +12 14 2.26 (12.23396d) Equinox: J2000	Epoch of Position: 2000	V=19.5+/-0.3	Reference Frame: ICRS
	<p><i>Comments: The position was determined from the GSC2 catalog. A plate solution was determined on a VATT image taken in 2016 and applied to the nova.</i> Category=STAR Description=[CLASSICAL NOVA, INTERACTING BINARY, K V-IV] Extended=NO</p>					
	(2)	STAR-A-OFFSET Alt Name1: STAR-A	RA: 18 46 31.5725 (281.6315521d) Dec: +12 14 0.99 (12.23361d) Equinox: J2000	Epoch of Position: 2000	V=18.8+/-0.1	Reference Frame: ICRS
	<p><i>Comments:</i> Category=EXT-STAR Description=[K V-IV] Extended=NO</p>					

Proposal 15273 - Visit 02 - A Star at the Limit? - Direct Mass Measurement of the White Dwarf in Nova Herculis 1991

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	acquisition (STIS.ta.101 T 2237)	(2) STAR-A-OFFSE	STIS/CCD, ACQ, F28X50LP	MIRROR			15 Secs (15 Secs) [==>]	[1]	
	<i>Comments: Initial exposure for V=20 mag target, spectrum = K4V</i>									
	2	peakup (STIS.ta.101 2246)	(1) V838HER	STIS/CCD, ACQ/PEAK, 52X0.1	MIRROR			60 Secs (60 Secs) [==>]	[1]	
	<i>Comments: Exposure through 0.1 arcsec slit for V=20 mag target, spectrum = K4V</i>									
	3		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1280 Secs (1236 Secs) [==>618.0 Secs (Split 1)] [==>618.0 Secs (Split 2)]	[1]	
	4	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A			[==>(Copy 1)] [==>(Copy 2)]	[1]	
	5		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1200 Secs (1283 Secs) [==>641.0 Secs (Split 1)] [==>642.0 Secs (Split 2)]	[2]	
	6		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1200 Secs (1284 Secs) [==>642.0 Secs (Split 1)] [==>642.0 Secs (Split 2)]	[2]	
	7	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A			[==>(Copy 1)] [==>(Copy 2)]	[2]	
	8		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1200 Secs (1283 Secs) [==>641.0 Secs (Split 1)] [==>642.0 Secs (Split 2)]	[3]	
	9		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1200 Secs (1284 Secs) [==>642.0 Secs (Split 1)] [==>642.0 Secs (Split 2)]	[3]	
	10	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A			[==>(Copy 1)] [==>(Copy 2)]	[3]	
	11		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1200 Secs (1332 Secs) [==>666.0 Secs (Split 1)] [==>666.0 Secs (Split 2)]	[4]	
12		(1) V838HER	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A		SAME POS AS 2	1200 Secs (1333 Secs) [==>667.0 Secs (Split 1)] [==>666.0 Secs (Split 2)]	[4]		
13	CCDFLAT	CCDFLAT	STIS/CCD, ACCUM, 0.2X0.06	G750L 7751 A			[==>(Copy 1)] [==>(Copy 2)]	[4]		



Orbit 3

Server Version: 20190514

