15954 - The first pulsating white dwarf in an eclipsing binary

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Steven Gary Parsons (PI) (ESA Member) (Contact)	**University of Sheffield**	**s.g.parsons@sheffield.ac.uk**
Dr. Stuart Littlefair (CoI) (ESA Member)	University of Sheffield	s.littlefair@shef.ac.uk
Prof. Vik Dhillon (CoI) (ESA Member)	University of Sheffield	vik.dhillon@sheffield.ac.uk
Prof. Tom R. Marsh (CoI) (ESA Member)	The University of Warwick	t.r.marsh@warwick.ac.uk
Prof. Boris T. Gaensicke (CoI) (ESA Member)	The University of Warwick	boris.gaensicke@warwick.ac.uk
Dr. JJ Hermes (CoI) (AdminUSPI)	Boston University	jjhermes@bu.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) SDSS-J115219.99+024814.4	COS/FUV COS/NUV	5	19-Jul-2019 11:00:13.0	yes

5 Total Orbits Used

ABSTRACT

White dwarfs are the end states of all stars less massive than 8-10 solar masses. Encrypted inside these stellar remnants is a record of the evolutionary history of the progenitor stars, providing a wealth of information about the evolution of stars, star formation, and the age of a variety of stellar populations. However, the internal structure and composition of white dwarfs are hidden by their high gravities, which causes all elements, apart from hydrogen and helium, to settle out of their atmospheres. An exciting system has recently been discovered, the first pulsating white dwarf in an

eclipsing binary. Both binary modeling and asteroseismology of the pulsation periods are available to reveal the core composition of this roughly 0.35 solar-mass stellar remnant. Current modeling can constrain the radius of this white dwarf to around 5%, but by constraining the limb darkening via the temperature of the primary we can obtain a factor of five improvement to roughly 1% uncertainty. Only by measuring the temperature of the hotter star in the binary with COS FUV spectroscopy can we unlock the full potential of this unique system to accurately constrain the core composition of a 0.35 solar-mass white dwarf, accurately testing whether it has a helium-, carbon-oxygen, or even hybrid core composition. It will serve as a powerful benchmark to empirically constrain the core composition of low-mass stellar remnants and investigate the effects of close binary evolution on the internal structure of white dwarfs.

OBSERVING DESCRIPTION

The goal of this proposal is to obtain phase-resolved far-ultraviolet spectroscopy of the eclipsing double-white dwarf binary SDSS1152+0248. This data will be used to (1) measure the effective temperature and surface gravity from the well-calibrated COS/G140L spectrum, and (2) obtain high-quality far-ultraviolet light curves of the primay eclipse, from which we will measure the stellar radii.

The target will be acquired using COS/NUV imaging, followed by time-tagged COS/G140L spectroscopy. During the primary eclipse, the ultraviolet flux will drop dramitcally, hence we need to ensure via a phase constraint that the target acqusition occurs outside the primary eclipse.

The ephemeris is HJD(UTC) = 2457461.1502539(10) + 0.09986526542(10)E

and we need to acquire somewhere in the phase interval 0.15 - 0.85.

In principle, the phase constraint only applies to the first exposure, the short NUV acquisition image - however, the scheduling software doesn't cope well with periods shorter than the visit duration. Therefore we provide APT with three times the orbital period, 0.3994610617, and the phase window 0.05 - 0.285. This will probably reduce the number of scheduling opportunities by a factor three as well - if that becomes a problem, we need to re-think the strategy again.

APT warns about the inefficien sequence of the FP-POS changes, but that's not a problem as we switch FP-POS during Earth occultation.

Visit

Proposal 15954, Visit 01 Fri Jul 19 15:00:14 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: Period 0.3994610617 D AND ZERO-PHASE HJD2457461.1510218

Diagnostics

(Visit 01) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

Fixed Targets

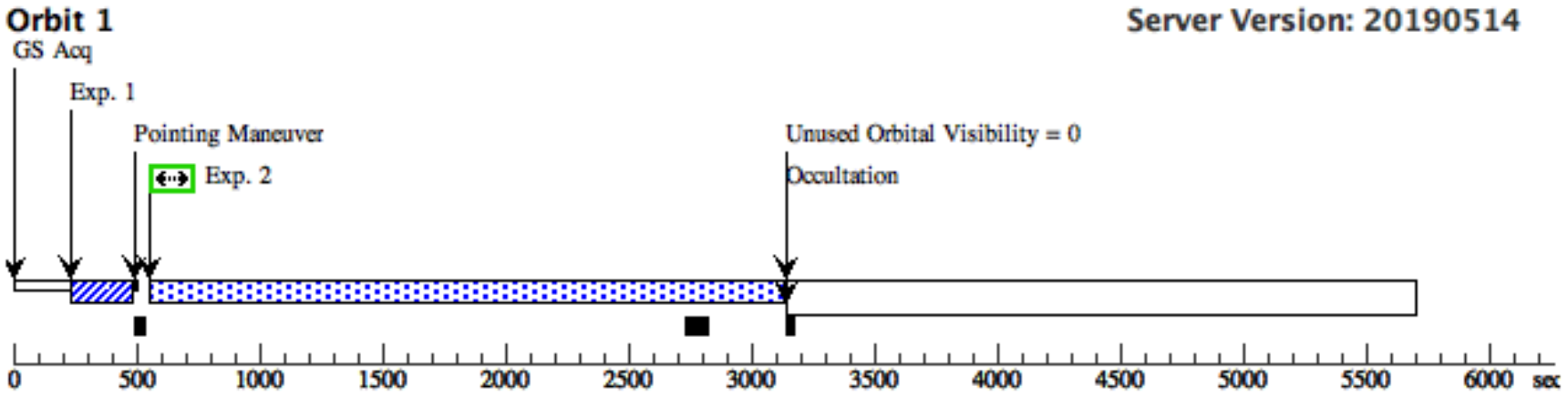
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J115219.99+024814.4	RA: 11 52 19.9989 (178.0833288d) Dec: +02 48 14.43 (2.80401d) Equinox: J2000	Proper Motion RA: 34.159 mas/yr Proper Motion Dec: -9.862 mas/yr Epoch of Position: 2015.5	V=17.880+/-0.001 FUV=17.962+/-0.069, NUV=18.270+/-0.048	Reference Frame: ICRS

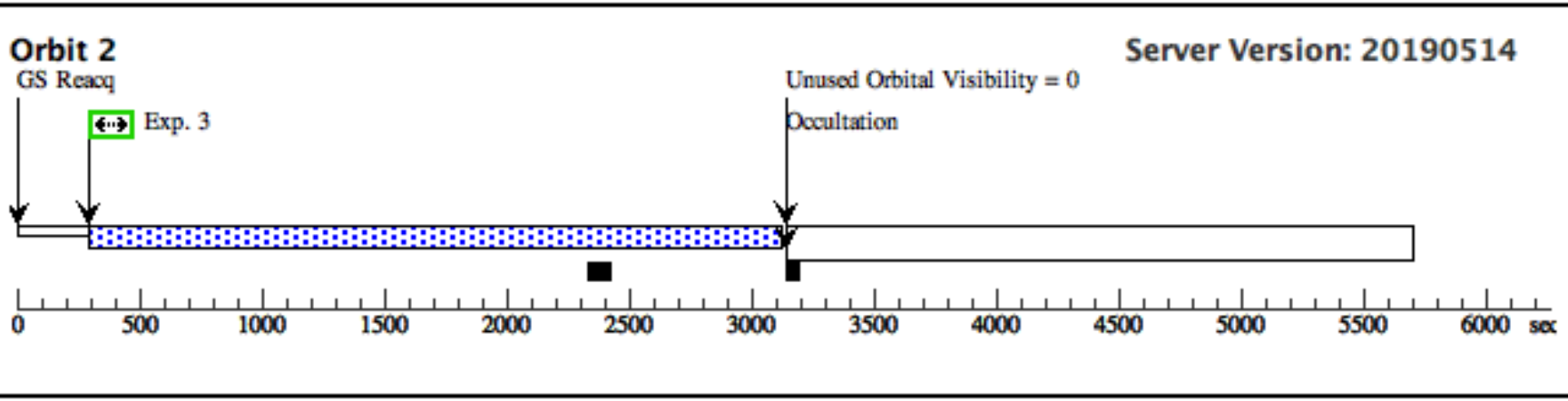
Comments:
Category=STAR
Description=[DA]
Extended=NO

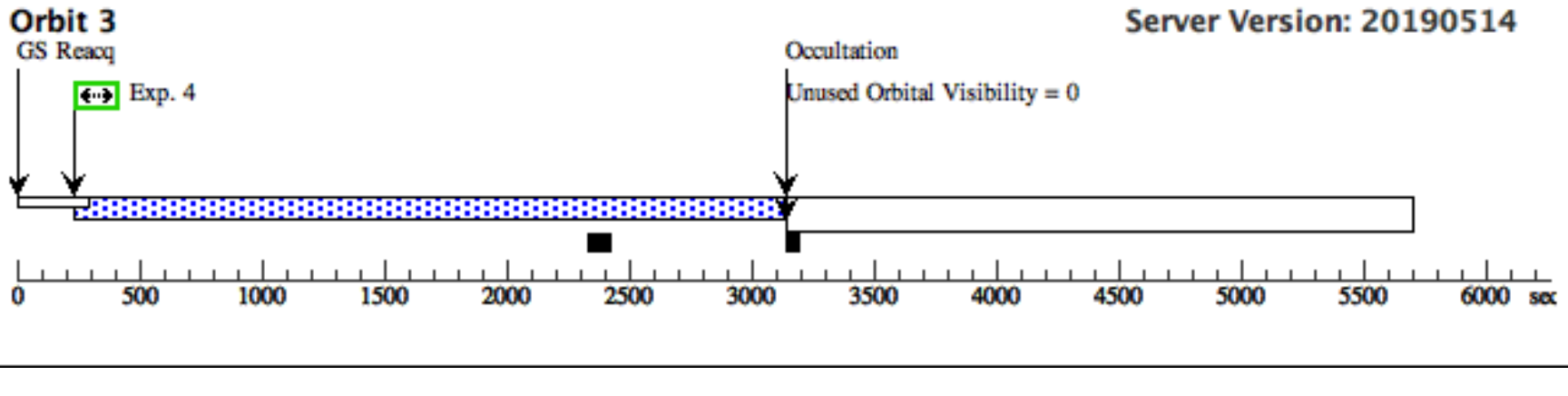
Exposures

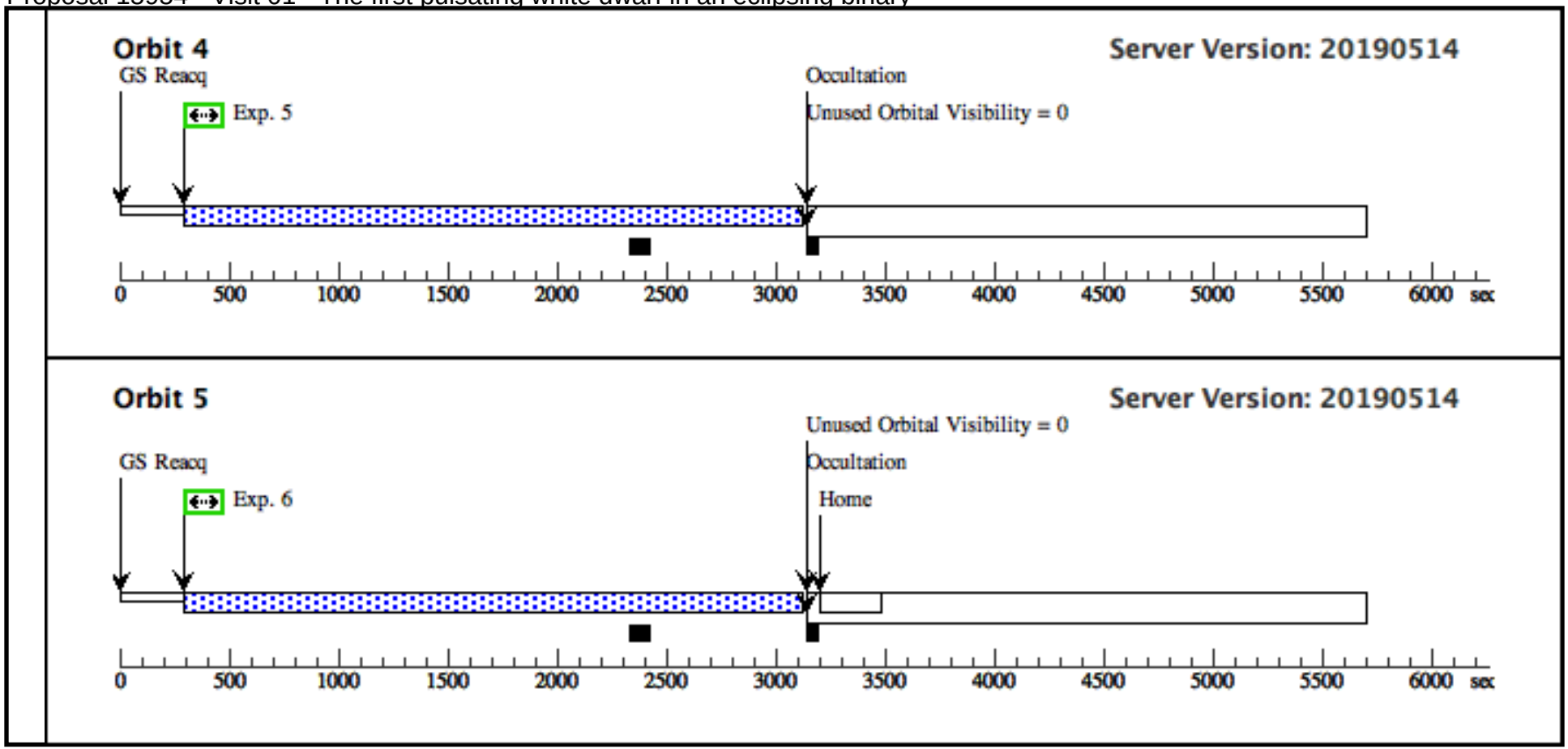
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1368683)	(1) SDSS-J115219.99+024814.4	COS/NUV, ACQ/IMAGE, PSA	MIRRORA		PHASE 0.05 TO 0.285		15 Secs (15 Secs) *[==>]*	***[1]***
2	(COS.sp.1368692)	(1) SDSS-J115219.99+024814.4	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=2000; FP-POS=3			2376 Secs (2376 Secs) *[==>]*	***[1]***
3	(COS.sp.1368692)	(1) SDSS-J115219.99+024814.4	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=2000; FP-POS=4			2776 Secs (2776 Secs) *[==>]*	***[2]***
4	(COS.sp.1368692)	(1) SDSS-J115219.99+024814.4	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=2000; FP-POS=1			2776 Secs (2776 Secs) *[==>]*	***[3]***
5	(COS.sp.1368692)	(1) SDSS-J115219.99+024814.4	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=2000; FP-POS=2			2776 Secs (2776 Secs) *[==>]*	***[4]***
6	(COS.sp.1368692)	(1) SDSS-J115219.99+024814.4	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=2000; FP-POS=3			2776 Secs (2776 Secs) *[==>]*	***[5]***

Orbit Structure








Orbit 4
Server Version: 20190514
GS Reacq
Exp. 5
Occultation
Unused Orbital Visibility = 0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec
Orbit 5
Server Version: 20190514
Unused Orbital Visibility = 0
GS Reacq
Exp. 6
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec