



13754 - The first mass and angular momentum loss measurements for a CV-like binary

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Jeremy J. Drake (PI) (Contact)	Smithsonian Institution Astrophysical Observatory	jdrake@cfa.harvard.edu
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Dr. Dai Takei (CoI)	RIKEN SPring-8 Center	takei@spring8.or.jp

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) QS-VIR	COS/FUV	1	09-Sep-2014 21:25:15.0	yes
02	(1) QS-VIR	COS/FUV	1	09-Sep-2014 21:25:16.0	yes
03	(1) QS-VIR	COS/FUV	1	09-Sep-2014 21:25:18.0	yes
04	(1) QS-VIR	COS/FUV	1	09-Sep-2014 21:25:19.0	yes

4 Total Orbits Used

ABSTRACT

The period distribution of close binaries, cataclysmic variables, novae and single-degenerate SN1a progenitor candidates is largely controlled by magnetically-driven mass and angular momentum loss (AML) from the M dwarf secondary. The mass loss rates for these spun-up stars remain

essentially unknown and impossible to observe directly, with likely values in the range $1e-12$ to $1e-15$ M_{sun}/yr . AML prescriptions for CVs differ by orders of magnitude. One way to measure the mass loss rate is to observe the dM wind accrete onto its WD companion in a pre-CV very close to Roche Lobe overflow but lacking the obscuring complications and emission from an accretion disk. The measurement can be combined with realistic MHD models to understand the accretion fraction, the mass that escapes, and the AML. The best-studied nearby pre-CV is QS Vir (48pc, $P=3.6\text{hr}$). However, its wind accretion rates measured from 1999 HST UV spectra of the WD metal absorption lines and 2006 XMM-Newton CCD spectroscopy differ by a factor of a thousand, pointing to either a dominant CME stochastic component, or a "magnetic switch" found in MHD simulations and driven by cyclic activity on the M dwarf. HST COS spectra combined with XMM-Newton monitoring on timescales from weeks to years will tease out CME vs cyclic accretion variations. UV and X-ray measurements will provide the first consistency check of both accretion rate measurement methods. MHD models tailored to the system will enable the first quasi-direct measurements of the mass loss and AML from a CV-like binary. Our project requires 6 HST/COS orbits in Cycles 22-24, and 60ksec on XMM in Cycle 22

OBSERVING DESCRIPTION

The target of this proposal is QS Vir, a well-studied detached white dwarf plus M-dwarf binary with an orbital period of 3.61h. The aim of this program is to provide measurements of the wind loss rate of an M-dwarf by measuring (quasi)simultaneously the X-ray luminosity generated by the accretion of the wind onto the white dwarf, and the photospheric abundances of the metals ingested into the atmosphere of the white dwarf.

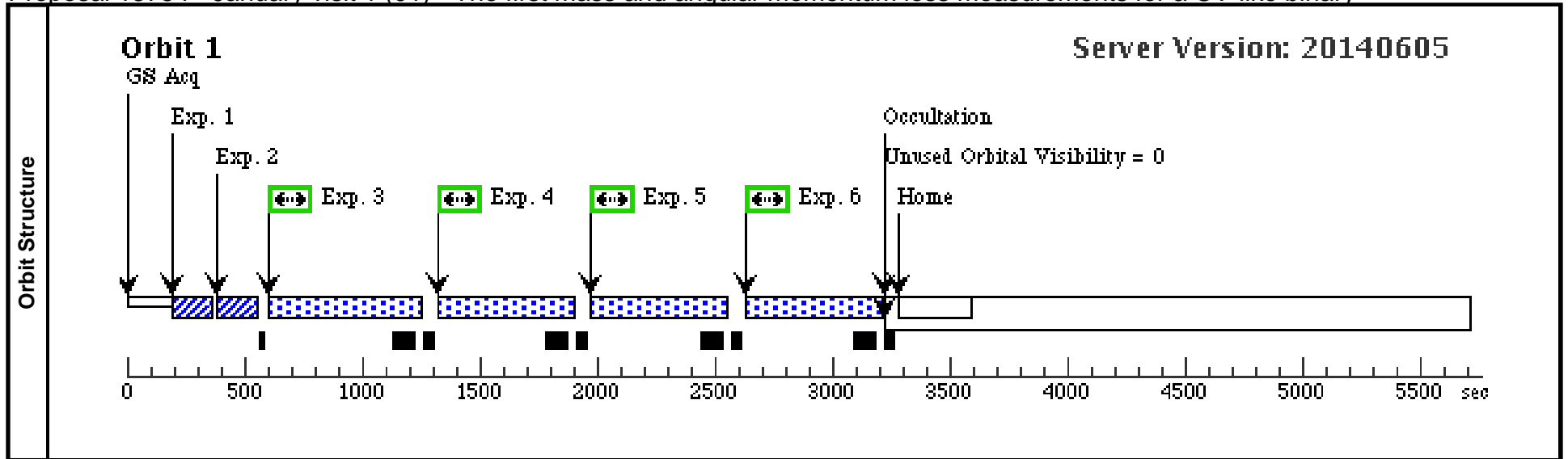
XMM has two observing opportunities during HST Cycle 22: Jan 1 - Feb 7 2015, and Jul 3 - Aug 11 2015. We will carry out three XMM + HST observations, separated by ~ 1 week, during the Jan/Feb window, and one additional HST + XMM observation during the Jul/Aug window. In this Phase II submission, we have set up the HST visits to fall within the two XMM windows. We will ask the XMM operations team to provide us with the exact start/end dates of the XMM observations as soon as possible, so that we can refine the dates of the HST observations. In an ideal world, the HST observations should start shortly after the longer (15ksec=4.17h) XMM observations, or at least be scheduled as soon as possible after the end of each XMM observation.

One additional complication is that QS Vir is eclipsing, and the COS target acquisition has to avoid the eclipse of the white dwarf, as there is no UV flux left to acquire on.

Proposal 13754 - January visit 1 (01) - The first mass and angular momentum loss measurements for a CV-like binary

Wed Sep 10 01:25:21 GMT 2014

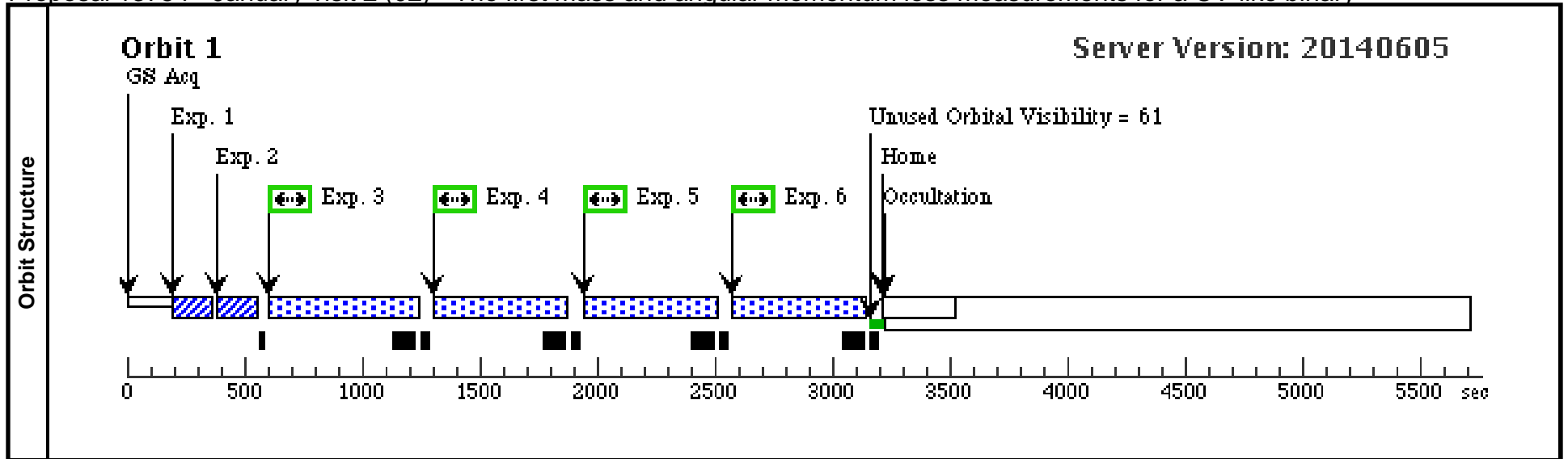
Visit	Proposal 13754, January visit 1 (01), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV Special Requirements: BETWEEN 04-JAN-2015:15:50:00 AND 04-JAN-2015:17:00:00; Period 0.15075756940 D AND ZERO-PHASE HJD2448689.6372851 Comments: This visit should be scheduled as close as possible to the XMM observations of QS Vir. We will provide the exact data of the XMM observations as soon as we get to know from the XMM operations team. The target acquisition has to avoid the eclipse of the WD, as there is not sufficient UV flux left during the eclipse.												
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	1	(COS.sa.622 228)	(1) QS-VIR	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A		PHASE 0.2 TO 0.8		5 Secs (5 Secs) [==>]	[1]			
	2	(COS.sa.622 228)	(1) QS-VIR	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	CENTER=DEF; STEP-SIZE=0.09; NUM-POS=5			5 Secs (5 Secs) [==>]	[1]			
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Proposal 13754 - January visit 2 (02) - The first mass and angular momentum loss measurements for a CV-like binary

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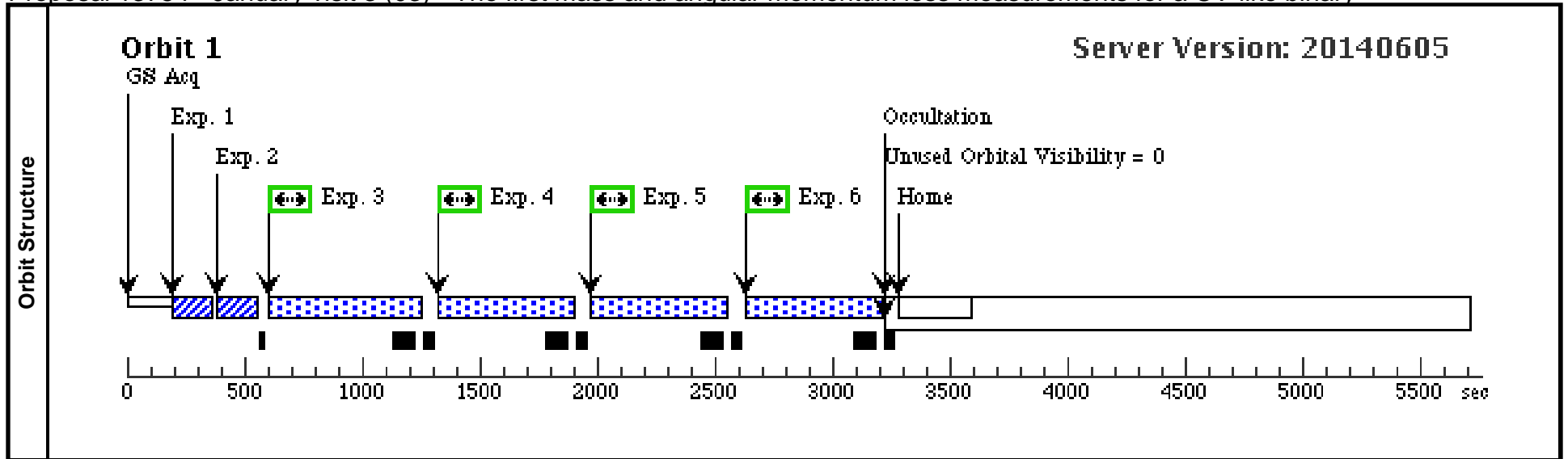
Visit	Proposal 13754, January visit 2 (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV Special Requirements: BETWEEN 18-JAN-2015:09:30:00 AND 18-JAN-2015:11:00:00; Period 0.15075756940 D AND ZERO-PHASE HJD2448689.6372851 Comments: This visit should be scheduled as close as possible to the XMM observations of QS Vir. We will provide the exact data of the XMM observations as soon as we get to know from the XMM operations team. The target acquisition has to avoid the eclipse of the WD, as there is not sufficient UV flux left during the eclipse.												
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Proposal 13754 - January visit 3 (03) - The first mass and angular momentum loss measurements for a CV-like binary

Wed Sep 10 01:25:21 GMT 2014

Visit	Proposal 13754, January visit 3 (03), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV Special Requirements: BETWEEN 11-JAN-2015:11:50:00 AND 11-JAN-2015:13:20:00; Period 0.15075756940 D AND ZERO-PHASE HJD2448689.6372851 Comments: This visit should be scheduled as close as possible to the XMM observations of QS Vir. We will provide the exact data of the XMM observations as soon as we get to know from the XMM operations team. The target acquisition has to avoid the eclipse of the WD, as there is not sufficient UV flux left during the eclipse.												
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Proposal 13754 - July/August visit (04) - The first mass and angular momentum loss measurements for a CV-like binary

Wed Sep 10 01:25:21 GMT 2014

Visit	Proposal 13754, July/August visit (04), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/FUV Special Requirements: BETWEEN 03-JUL-2015:00:00:00 AND 11-AUG-2015:00:00:00; Period 0.15075756940 D AND ZERO-PHASE HJD2448689.6372851 Comments: This visit should be scheduled as close as possible to the XMM observations of QS Vir. We will provide the exact data of the XMM observations as soon as we get to know from the XMM operations team. The target acquisition has to avoid the eclipse of the WD, as there is not sufficient UV flux left during the eclipse.												
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