14331 - The first mass and angular momentum loss measurements for a CV-like binary

Cycle: 23, 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) QS-VIR	COS/FUV	1	31-Mar-2016 21:05:17.0	yes

1 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 Msun/yr. AML presciptions 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=3.6hr). 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.

Visit

Proposal 14331, December 2015 visit (01), implementation Fri Apr 01 01:05:18 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: BETWEEN 19-JUL-2016:14:00:00 AND 19-JUL-2016:16:00:00; Period 0.15075756940 D AND ZERO-PHASE HJD2448689.6372851; ON HOLD

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.

On Hold Comments: We have do not have yet the XMM schedule.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	QS-VIR	RA: 13 49 51.9960 (207.4666500d)	Proper Motion RA: 41.7 mas/yr	V=14.8+/-0.3	Reference Frame: ICRS
		Dec: -13 13 37.00 (-13.22694d)	Proper Motion Dec: 19.4 mas/yr	F(1300A)=4.5e-14erg/cm2/s/A	
		Equinox: J2000	Epoch of Position: 2000		

Comments: QS Vir is a detached WD + M-dwarf binary, which has been previously observed with HST/STIS in the FUV and NUV (O57E51010, O57E51020, O57EB1010, O57EB1020), and has a well-defined ultraviolet, flux, F(1300A)=4.5e-14erg/cm2/s/A.

We observed QS Vir four times in Cycle 22 as part of program 13754, this program is a Cycle 23 extension of this monitoring. The same observational strategy will be followed as in 13754.
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.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]***
3	(COS.sp.622 229)	(1) QS-VIR	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=430; FP-POS=1			530 Secs (528 Secs)	
								[==>528.0 Secs]	***[1]***
4	(COS.sp.622 229)	(1) QS-VIR	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=430; FP-POS=2			530 Secs (528 Secs)	
								[==>528.0 Secs]	***[1]***
5	(COS.sp.622 229)	(1) QS-VIR	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=430; FP-POS=3			530 Secs (528 Secs)	
								[==>528.0 Secs]	***[1]***
6	(COS.sp.622 229)	(1) QS-VIR	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=430; FP-POS=4			529 Secs (527 Secs)	
								[==>527.0 Secs]	***[1]***

Orbit Structure