14203 - Confirmation of the First Ultracompact Black Hole X-ray Binary

Cycle: 23, Proposal Category: GO

(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?*
02	(1) 47-TUC-X9 (2) 47-TUC-X9-OFFSET CCDFLAT WAVE	STIS/CCD	4	24-Jul-2015 22:25:36.0	yes

4 Total Orbits Used

ABSTRACT

We have recently detected strong, steady radio emission from the well-known X-ray source X9 in the globular cluster 47 Tuc. The level of radio emission rules out the previous interpretation of the source as a cataclysmic variable, and instead suggests that it hosts a quiescently accreting stellar-mass black hole. An existing far-UV spectrum shows shows a strong C IV 1550 emission line, but no sign of He II 1640 emission. Narrow-band HST photometry exhibits no Halpha excess (down to an equivalent width limit of >~ -10A) and Chandra X-ray observations show an unusual feature that is likely attributable to O VIII emission. All of this evidence, as well as the unusually high X-ray luminosity of the system, points to X9 being an ultracompact binary in which a stellar-mass black hole accretes material from a white dwarf -- which if confirmed would be the first such system ever discovered. Here, we request HST observations to obtain a broad-band optical spectrum of X9 to confirm or reject the ultracompact nature of the system. The resulting data will also be used to evaluate the optimal strategy for determining the system parameters, in particular the orbital period.

OBSERVING DESCRIPTION

The main goal of the observations is to search for emission lines (H, He, C, and O) that will help classify the donor star in this candidate ultra-compact black hole binary. A secondary goal is to measure and model the overall SED of the binary.

We will first acquire a bright (V~12.4) red giant that is 17" away and then do an offset to the main target, peaking up sing the 52x0.1E1 aperture. The target object has a nominal V~19.8 but is variable, with the faintest recorded mag at V~21.4; we have chosen a peakup exposure time as a compromise in case the object is fainter than expected, but will not saturate the detector even if brighter than expected.

All data are taken in a single 4-orbit visit. Two orbits are used on the G430L grating and two with the G750L grating, with 3 CR-SPLITs in all but the first orbit. We have added fringe flats in occultation to the G750L exposures. To improve wavelength calibration, we have added several GO-WAVECALs around the G430L observations.

Visit

Proposal 14203, two-grating visit (02) Sat Jul 25 02:25:38 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: (none)

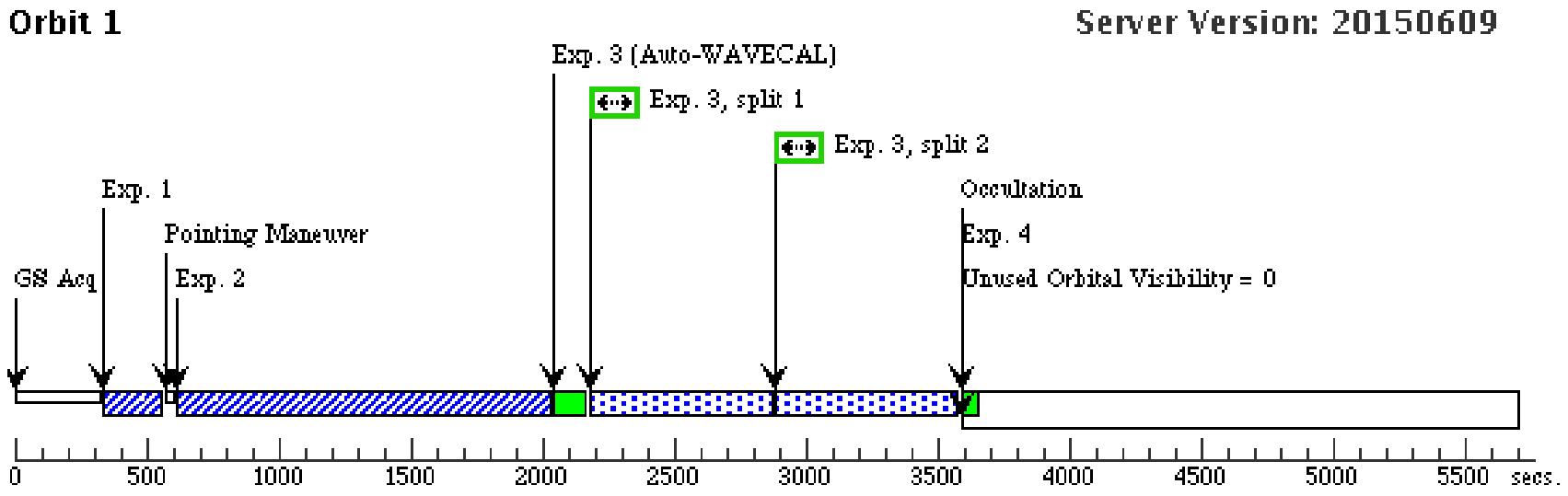
Fixed Targets

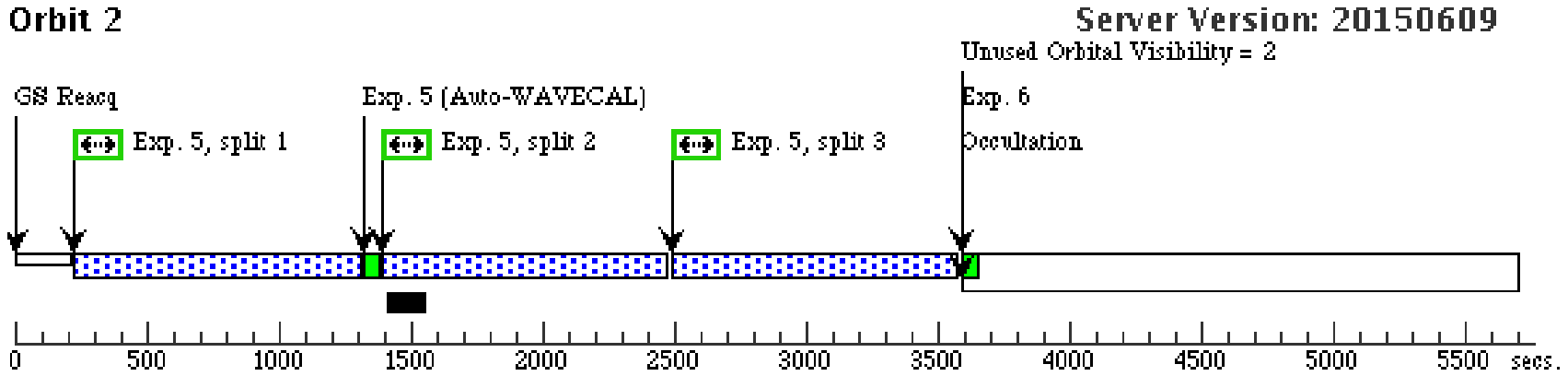
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	47-TUC-X9	RA: 00 24 4.2420 (6.0176750d)		V=19.8+/-1.5	Reference Frame: ICRS
	Alt Name1: X9	Dec: -72 04 58.07 (-72.08280d)			
	Alt Name2: V1	Equinox: J2000			
Comments: Position is from an HST/ACS F606W image calibrated to ICRS using a large sample of 2MASS stars. Extended=NO					
(2)	47-TUC-X9-OFFSET	RA: 00 24 1.2010 (6.0050042d)		V=12.4	Reference Frame: ICRS
	Alt Name1: X9	Dec: -72 05 8.28 (-72.08563d)			
	Alt Name2: V1	Equinox: J2000			
Comments: Position is from an HST/ACS F606W image calibrated to ICRS using a large sample of 2MASS stars. Extended=NO					

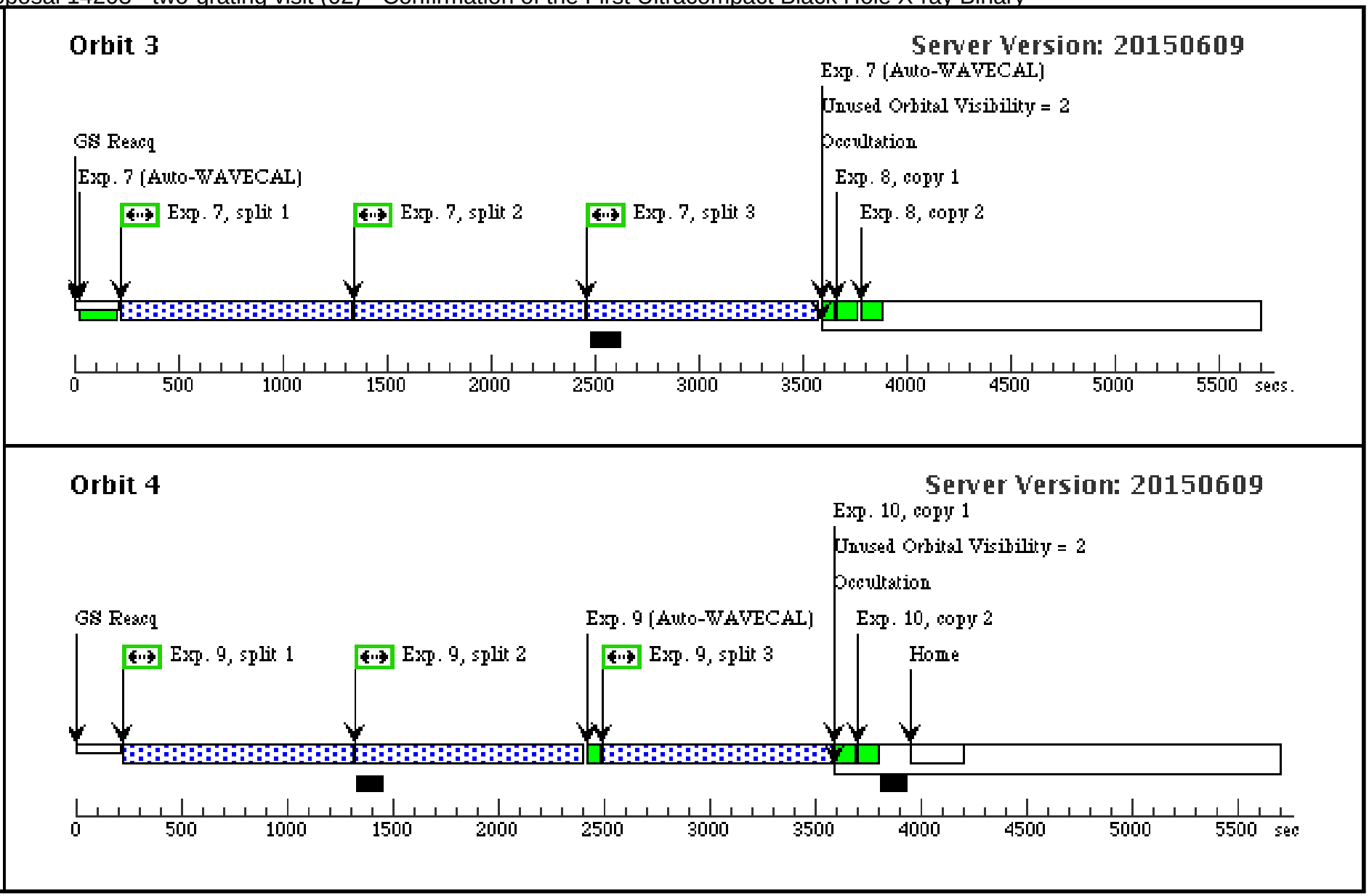
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ	(2) 47-TUC-X9-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			0.3 Secs (0.3 Secs) *[==>]*	 ***[1]***
2	PEAKUP	(1) 47-TUC-X9	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				100 Secs (100 Secs) *[==>]*	 ***[1]***
3	M62-VLA1 SCI G430L (orbit 1)	(1) 47-TUC-X9	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=2			1322 Secs (1322 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	 ***[1]***
4	GO-WAVE CAL	WAVE	STIS/CCD, ACCUM, 52X0.1	G430L 4300 A				*[==>]*	***[1]***
5	M62-VLA1 SCI G430L (orbit 2)	(1) 47-TUC-X9	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=3			3156 Secs (3156 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]*	 ***[2]***
6	GO-WAVE CAL	WAVE	STIS/CCD, ACCUM, 52X0.1	G430L 4300 A				*[==>]*	***[2]***
7	M62-VLA1 SCI G750L (orbit 3)	(1) 47-TUC-X9	STIS/CCD, ACCUM, 52X0.1E1	G750L 7751 A	CR-SPLIT=3			3234 Secs (3234 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]*	 ***[3]***
8	fringe flat (orbit 3)	CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[3]***
9	M62-VLA1 SCI G750L (orbit 4)	(1) 47-TUC-X9	STIS/CCD, ACCUM, 52X0.1E1	G750L 7751 A	CR-SPLIT=3			3153 Secs (3153 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]*	 ***[4]***
10	fringe flat (orbit 4)	CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[4]***

Orbit Structure






Orbit 3
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Unused Orbital Visibility = 2
Occultation
GS Reacq
Exp. 7 (Auto-WAVECAL)
Exp. 7, split 1
Exp. 7, split 2
Exp. 7, split 3
Exp. 8, copy 1
Exp. 8, copy 2
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.
Orbit 4
Server Version: 20150609
Exp. 10, copy 1
Unused Orbital Visibility = 2
Occultation
GS Reacq
Exp. 9 (Auto-WAVECAL)
Exp. 10, copy 2
Exp. 9, split 1
Exp. 9, split 2
Exp. 9, split 3
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec