13843 - A Candidate Recoiling Black Hole in a Nearby Dwarf Galaxy

Cycle: 22, 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) SDSS1133	COS/FUV COS/NUV	4	14-Jul-2014 21:13:48.0	yes

4 Total Orbits Used

ABSTRACT

We have discovered a BH recoil candidate offset by 800 pc from a nearby dwarf galaxy. The object, SDSS1133, shows offset broad lines and strong variability. While originally classified as a supernova because of its non-detection in 2005, we detect it in recent and past observations over 63 years. Using high-resolution adaptive optics observations, we constrain the source emission region to be <12 pc. Overall these properties are consistent

with theoretical predictions for a runaway BH ejected from its host by gravitational-wave recoil following a merger. We propose a small, 4 orbit HST observation using the COS spectrograph in the FUV, to test for broad C IV emission and other high ionization emission lines which would decisively favor the recoiling BH interpretation. The unique UV spectroscopic capability of HST is critical to decide whether this is a recoiling black hole or an unprecedented 50 year outbursting LBV star (e.g. Eta Carina) followed by a unique long duration SN IIn with rebrightening. Either discovery would be extremely exciting. Finally, SDSS1133 has recently undergone a 1.3 mag rebrightening in PanSTARRS imaging suggesting that the coming year is a critical time to observe the source at maximum.

OBSERVING DESCRIPTION

Our main focus is to study the broad line C IV 1550 emission along with other nearby UV spectral lines (Lyman alpha, N V 1240, and SiIV+OIV complex near 1400) by measuring their width and flux. The medium-resolution COS FUV modes results in a discovery space (throughput times wavelength coverage) best suited for observations of faint FUV point sources, it is therefore the preferred instrument for this study.

The astrometry is based on the centroid of the point source from SDSS and PS1 observations in the optical. We expect at most a 0.3" uncertainty given fits to many images. Lower spatial resolution images in the FUV and NUV with SWIFT show a point source consistent with the optical image. High resolution images in the NIR AO and NIR narrow band (tracing Paschen Beta which also traces NUV emission from SF) suggest a point source at 0.1" offset by 6" from the galaxy nucleus.

We will use a NUV ACQ/Image exposure first, which we also use for science purposes to confirm it is a point source in the NUV as well as NIR. For exposure time planning we use NUV+FUV observations from SWIFT and FUV from galex as well as the broad hbeta emission for line emission. While the NUV show significant contamination from the galaxy, at HST resolutions similar to the NIR AO, the point source is much brighter than the surrounding background and even the nucleus of the galaxy 6" away so centroiding is not an issue. For the ACQ/Image, we use a S/N of 40 and a conservative estimate that our NUV emission is overestimated by a mag because of contamination from the galaxy.

Obtaining a full spectrum of an object requires several set-ups and exposures (5 setups for G130M in one orbit and 4 setups for G160M in another orbit), but covers a large spectra range 1140-1800 to observe the interested lines. The separate exposures will be coadded using the routines provided on the COS Tools Web site.

Visit

Proposal 13843, First Visit (01), implementation Tue Jul 15 01:13:50 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

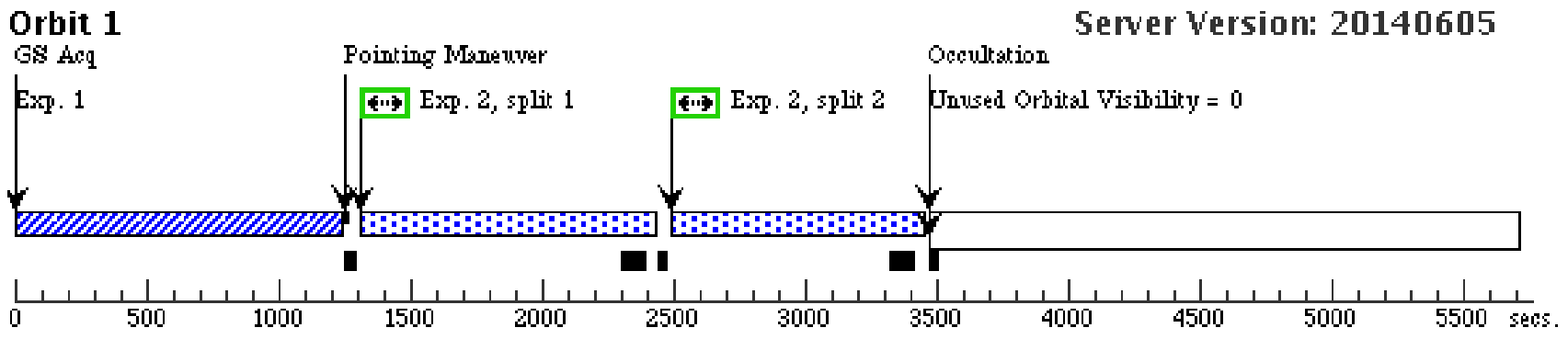
Fixed Targets

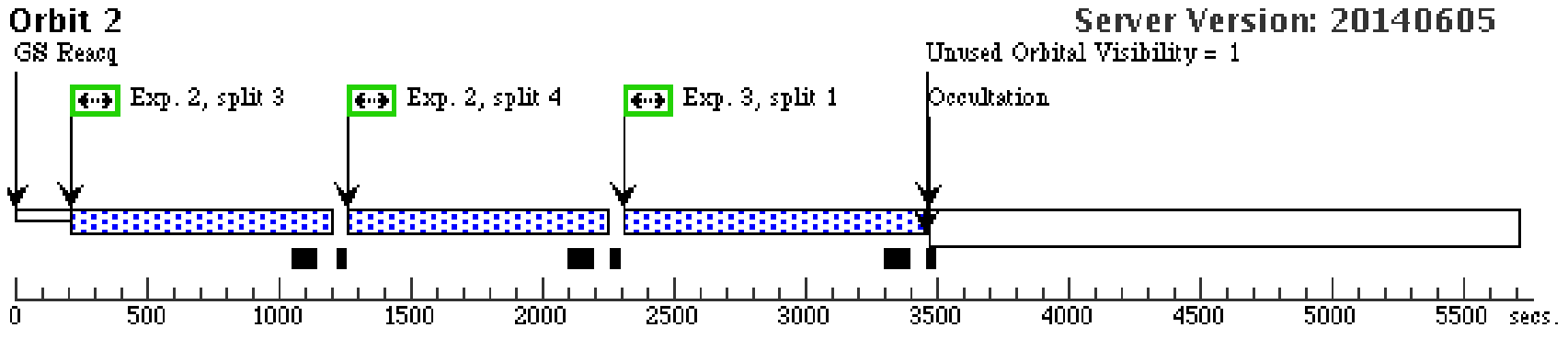
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS1133 Alt Name1: SDSSJ113323.97+550415.8 Alt Name2: VV2006CJ113324.0+550416	RA: 11 33 23.9738 (173.3498908d) Dec: +55 04 15.89 (55.07108d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0 Parallax: 0" Epoch of Position: 2000 Redshift: 0.007845	V=19.0+/-1	Reference Frame: ICRS

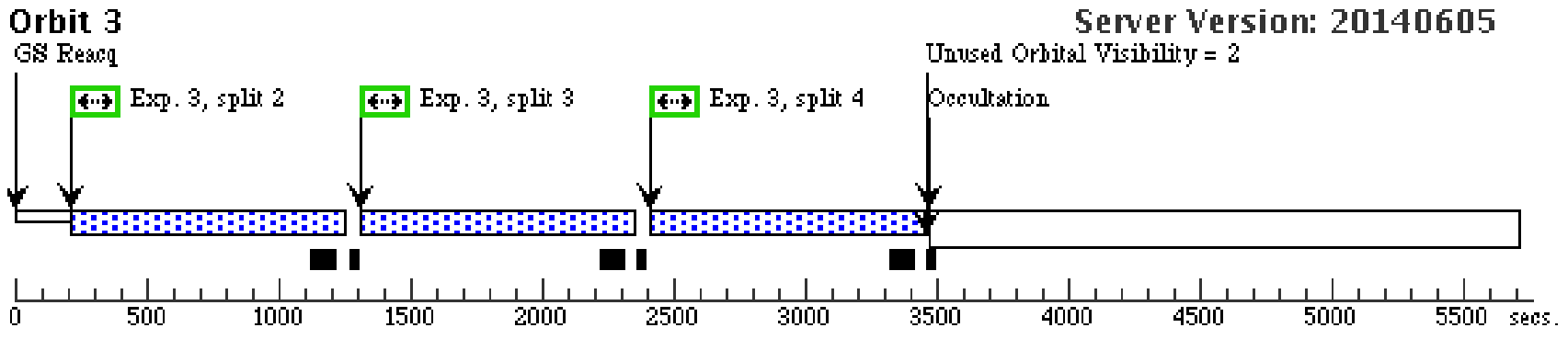
Exposures

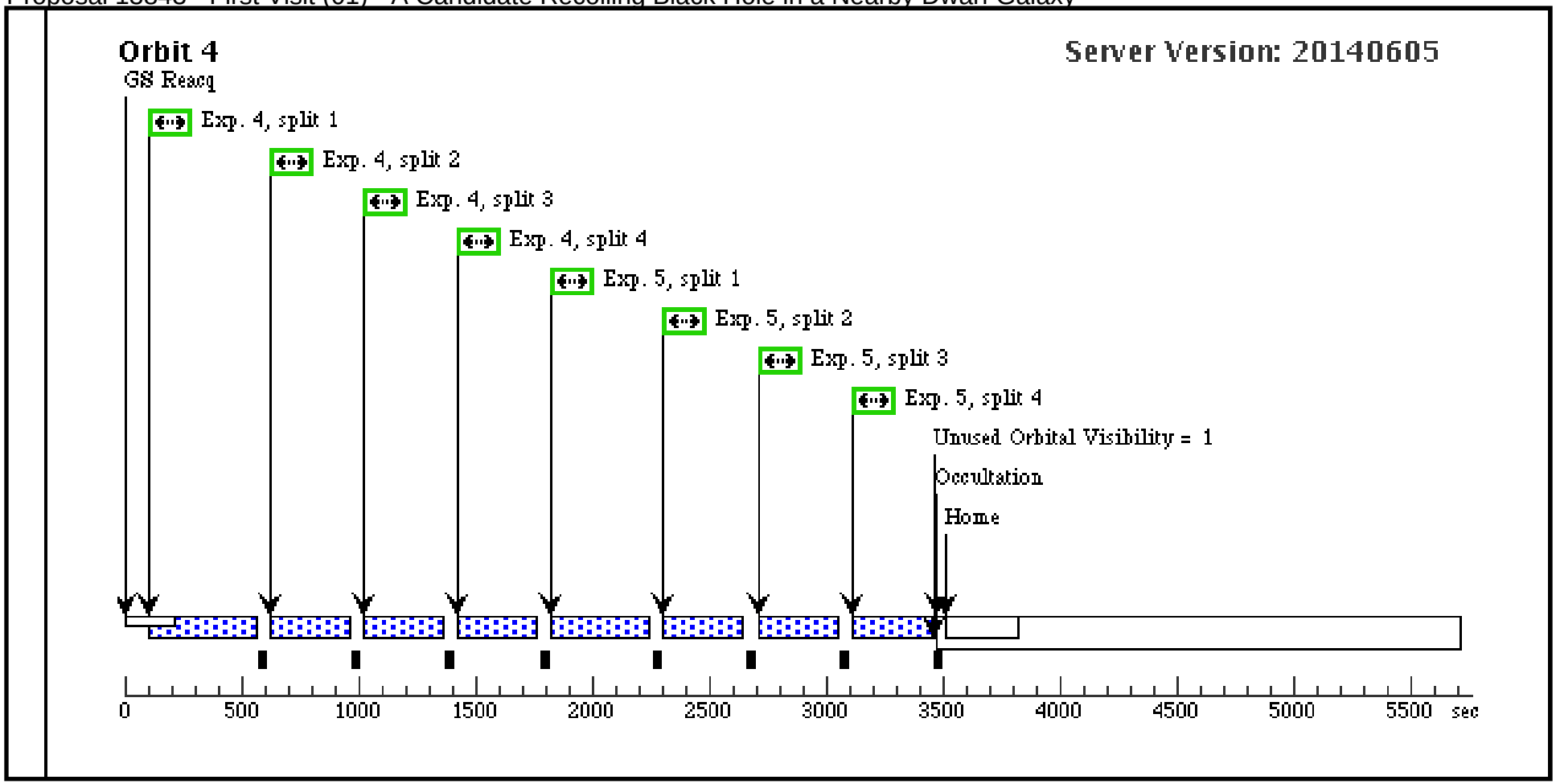
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Exposure 1 (COS.ta.618835)	(1) SDSS1133	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				422 Secs (422 Secs)	
								[==>]	***[1]***
2	(COS.sp.618905)	(1) SDSS1133	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=799; FP-POS=ALL			909 Secs (3686 Secs)	
								[==>(Split 1)] *[==>(Split 2)]*	***[1]***
								[==>934.0 Secs (Split 3)] *[==>934.0 Secs (Split 4)]*	***[2]***
3	(COS.sp.618905)	(1) SDSS1133	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=874; FP-POS=ALL	SAME POS AS 2		984 Secs (3961 Secs)	
								[==>1009.0 Secs (Split 1)]	***[2]***
								[==>(Split 2)] *[==>(Split 3)]* *[==>(Split 4)]*	***[3]***
4	(COS.sp.618903)	(1) SDSS1133	COS/FUV, TIME-TAG, PSA	G130M 1300 A	BUFFER-TIME=1500; FP-POS=ALL	SAME POS AS 2		287 Secs (1148 Secs)	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[4]***
5	(COS.sp.618905)	(1) SDSS1133	COS/FUV, TIME-TAG, PSA	G130M 1318 A	BUFFER-TIME=1500; FP-POS=ALL	SAME POS AS 2		288 Secs (1152 Secs)	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[4]***

Orbit Structure








Orbit 4
Server Version: 20140605
GS Reacq
Exp. 4, split 1
Exp. 4, split 2
Exp. 4, split 3
Exp. 4, split 4
Exp. 5, split 1
Exp. 5, split 2
Exp. 5, split 3
Exp. 5, split 4
Unused Orbital Visibility = 1
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec