15198 - UV Observation of a QSO Sightline Intersecting an X-ray Identified Filament of the Cosmic Web

Cycle: 25, 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) VV98-J010250.2-220929	COS/FUV COS/NUV	3	18-Jul-2017 13:04:43.0	yes
02	(1) VV98-J010250.2-220929	COS/FUV COS/NUV	2	18-Jul-2017 13:04:45.0	yes

5 Total Orbits Used

ABSTRACT

We propose to observe Quasar VV98-J010250.2-220929 with COS for 5 orbits to study the multi-phase nature of a filament detected in X-rays connecting to Abell 133. The diffuse nature of cosmic filaments makes detecting them in X-rays an almost impossible task with current X-ray

observatories without dedicating extreme amounts of time; this filament was detected with almost a month of total observations with Chandra. As the only known quasar intersecting a reported X-ray filament, VV98-J010250.2-220929 offers us the unique opportunity to study the multi-phase conditions of a filament with both UV and X-ray observations. With the observations we propose, we will use Lyman-alpha absorption to detect neutral hydrogen down to a column density of N(HI) ~ 10^13.3 cm^-2. Additionally, we will use low- and intermediate-ionization metal transition lines to constrain the metallicity and ionization state of the filamentary gas.

OBSERVING DESCRIPTION

Our observations are designed to obtain UV observations of a QSO sightline intersecting an X-ray detected filament. The primary objective is to obtain S/N of 10 at the predicted location of Lyman-alpha absorption for the z=0.0556 filament, using the G140L grating at the 1105 central wavelength. This requires approximately 12.5 ksec of observations in this configuration, while our chosen observing plan will give us 13 ksec, modulo any variations in orbit length from scheduling.

Visits:

As we have 5 orbits, we will be observing our target in 2 visits: first in 3 orbits, and then in 2 orbits.

Acquisition:

We will be acquiring our target with ACQ/IMAGE, as our target is in the GSC2.3. The only nearby source detected by GALEX in NUV is 2 magnitudes fainter (NUV) and 14" East of our target, so we do not expect to mis-center. The 60 second exposure time will give us S/N of 40, per the calculation of the ETC.

Exposures:

We will be taking two exposures per orbit, using the entirety of the orbital visibility. For orbits without acquisition images, this is 2x1408s; for first orbits, this is 2x1161s. We will cycle through FP-POS in both visits (1-2-2-3-3-4 for the first, 1-2-3-4 for the second) to miminize the effects of pattern noise. Exposures will be taken in TIME-TAG mode with FLASH=YES. The calculated buffer time from the ETC greatly exceeds our exposure time, so we use BUFFER TIME = 8900, 2/3 of that calculated by the ETC.

Grating Choice:

We choose COS with the G140L grating over the similar G140L grating on STIS/FUV-MAMA due to the twice-higher spectral resolution (R ~ 2000) the COS/G140L configuration will deliver over its STIS counterpart (R ~ 1000). In addition to detecting Ly alpha absorption around the redshift of Abell 133 (z = 0.056), we will be able to detect other commonly detected low- and intermediate-ionization metal transitions such as C II, C IV, Si II, Si III, Si IV, and N V, thanks to the broad wavelength coverage of the G140L grating in its 1105 Angstrom central wavelength setting.

Depth:

We estimate that a signal-to-noise ratio (SNR) of >~ 10 per resolution element is necessary to place strong constraints on the presence of warm gas along the filamentary structure in Abell 133 probed by this QSO, as probed by the Ly alpha absorption line. At this moderate SNR, the observations will allow a 2-sigma detection limit of W_r = 0.12 Angstroms for Ly alpha absorption features near the redshift of Abell 133, which corresponds to a sensitive neutral hydrogen (HI) column density detection limit of N(HI) ~ 10^13.3 cm^-2. From observations of the Virgo Cluster (Yoon et al., 2012), the covering fraction of W_r > 0.1 Angstrom Ly alpha absorbers is high (>~ 60%) at d < Rvir. Furthermore, the covering fraction is even higher (close to unity) for Lyalpha absorbers along sightlines probing substructures in the Virgo Cluster. Because the filamentary structure probed by VV98-J010250.2-220929 appears to be associated with a substructure of Abell 133, we expect that a Lyalpha absorber will be detected near the cluster redshift in the proposed observations. We note that at this 2-sigma detection limit we will also be able to obtain sensitive constraints for the column densities of ionized metals in the gas: 10^13.8, 10^13.7, 10^12.9, 10^12.7, 10^13.2, and 10^13.8 cm^-2 for C II, C IV, Si II, Si III, Si IV, and N V, respectively.

Visit

Proposal 15198, Visit 01 Tue Jul 18 17:04:46 GMT 2017

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: PCS MODE FINE

Diagnostics

(Visit 01) Warning (Form): If the target coordinates are not known to 0.4" (or better), an ACQ/SEARCH should precede the ACQ/IMAGE.

Fixed Targets

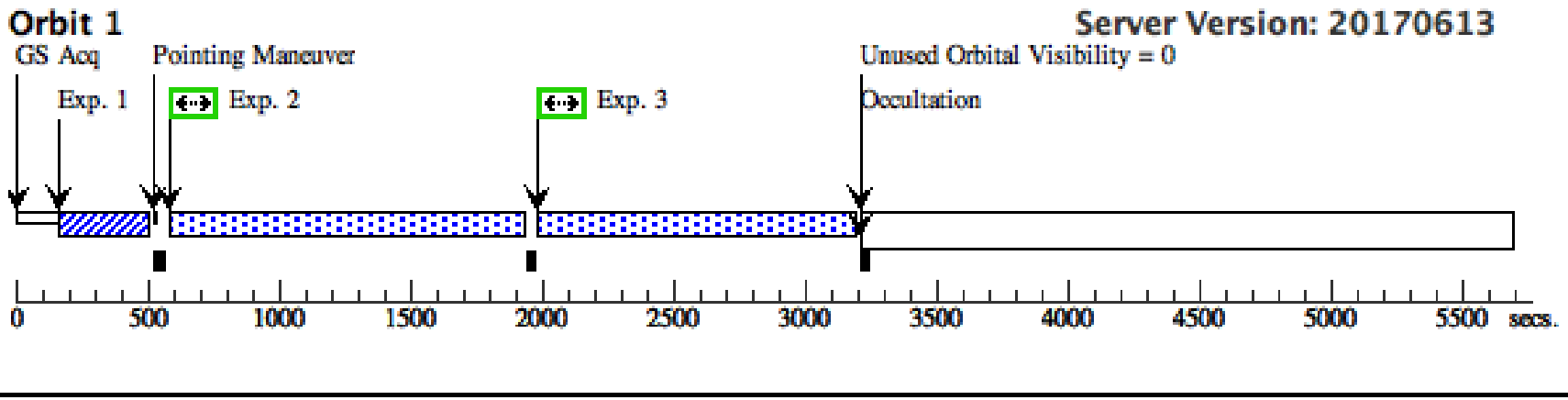
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	VV98-J010250.2-220929 Alt Name1: RXJ01028-2209 Alt Name2: LQAC015-022003	RA: 01 02 50.3290 (15.7097042d) Dec: -22 09 28.52 (-22.15792d) Equinox: J2000	Epoch of Position: 2000 Redshift: 0.766	V=18.60+/-0.2 FUV: 20.77 +/- 0.26 AB Mag (GALEX); NUV: 20.42 +/- 0.16 (GALEX)	Reference Frame: ICRS

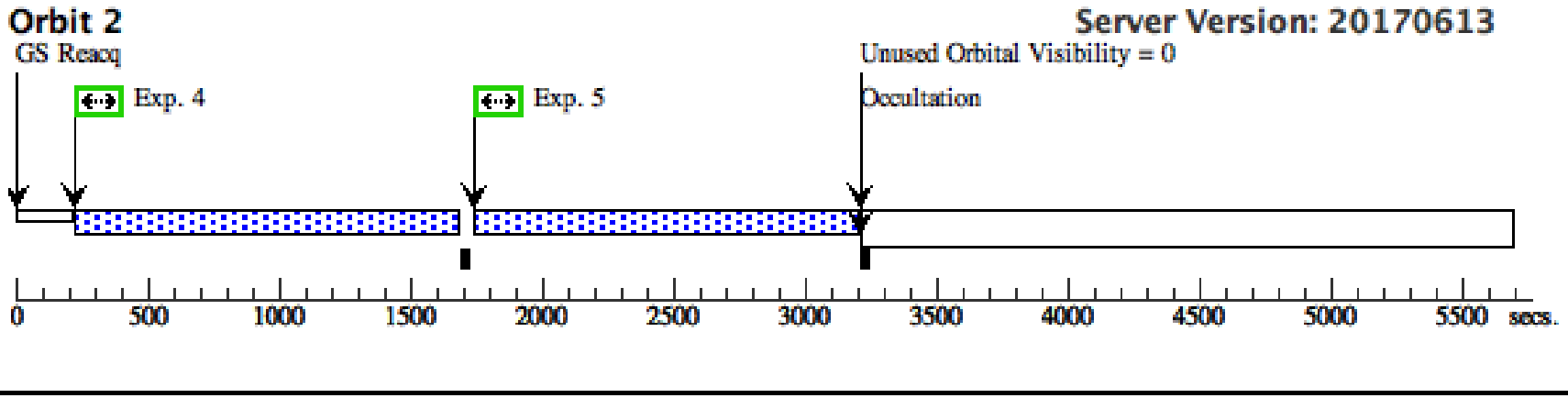
Comments: Target happens to be in the guide star catalog, GSC 2.3, GSC2ID S00302023786. The reported errors in the GSC are 0.35" (RA) and 0.34" (DEC).
Extended=NO

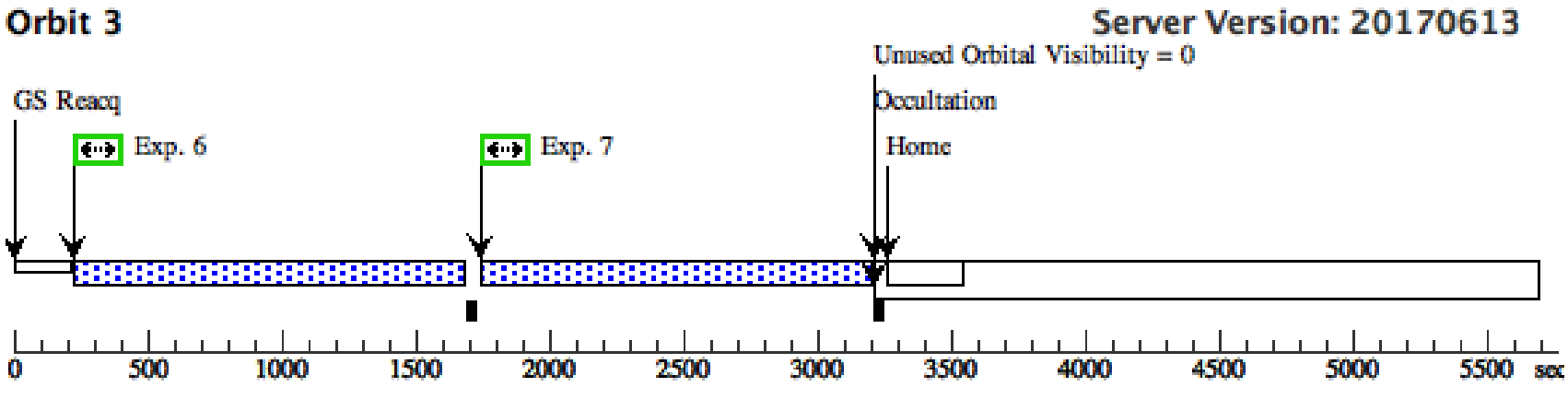
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition1 (COS.ta.1008388)	(1) VV98-J010250.2-220929	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				60 Secs (60 Secs) *[==>]*	***[1]***
2	Science1a (COS.sp.1008398)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	FP-POS=1; BUFFER-TIME=8900; FLASH=YES			1161 Secs (1161 Secs) *[==>]*	***[1]***
3	Science1b (COS.sp.1008398)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=2			1161 Secs (1161 Secs) *[==>]*	***[1]***
4	Science2a (COS.sp.1008399)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=2			1408 Secs (1408 Secs) *[==>]*	***[2]***
5	Science2b (COS.sp.1008399)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=3			1408 Secs (1408 Secs) *[==>]*	***[2]***
6	Science3a (COS.sp.1008399)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=3			1408 Secs (1408 Secs) *[==>]*	***[3]***
7	Science3b (COS.sp.1008399)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=4			1408 Secs (1408 Secs) *[==>]*	***[3]***

Orbit Structure







Visit

Proposal 15198, Visit 02 Tue Jul 18 17:04:46 GMT 2017

Diagnostic Status: Warning

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Special Requirements: PCS MODE FINE

Diagnostics

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Comments: Target happens to be in the guide star catalog, GSC 2.3, GSC2ID S00302023786. The reported errors in the GSC are 0.35" (RA) and 0.34" (DEC). Extended=NO

Exposures

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1	Acquisition4 (COS.ta.1008388)	(1) VV98-J010250.2-220929	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				60 Secs (60 Secs) *[==>]*	***[1]***
2	Science4a (COS.sp.1008398)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	FP-POS=1; BUFFER-TIME=8900; FLASH=YES			1161 Secs (1161 Secs) *[==>]*	***[1]***
3	Science4b (COS.sp.1008398)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=2			1161 Secs (1161 Secs) *[==>]*	***[1]***
4	Science5a (COS.sp.1008399)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=3			1408 Secs (1408 Secs) *[==>]*	***[2]***
5	Science5b (COS.sp.1008399)	(1) VV98-J010250.2-220929	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=8900; FLASH=YES; FP-POS=4			1408 Secs (1408 Secs) *[==>]*	***[2]***

Orbit Structure