13832 - Absorption in the Cosmic Web: Characterizing the Intergalactic Medium in Cosmological Filaments

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) 2MASX-J16194054+2543233	COS/FUV COS/NUV	4	11-Jul-2014 21:04:22.0	yes

4 Total Orbits Used

ABSTRACT

We propose to observe and characterize the IGM associated with cosmological filaments in a statistical manner up to redshift ~0.4. For this purpose, we have used a published cluster catalog (Hao et al. 2010) to identify massive nodes in the cosmic web. We used cluster-pairs separated by < 20 Mpc (transverse) and < 2000 km/s (along the LOS) to identify zones where filaments should reside with high probabilities. We have selected a single QSO whose sightline passess through a total of 9 independent cluster-pairs (8 of which having spectroscopic redshifts) at impact parameters <10 Mpc (7 of which at < 5 Mpc). We propose to observe the QSO with HST/COS using the G130M and G160M gratings to cover the full FUV spectral range at medium resolution (R~20000). We require observations at S/N>10 to ensure a full characterization of HI and OVI lines at column densities N~10^13 cm^-2. This setup will allow us to detect broad and shallow HI and OVI lines (if any) at the redshifts of these filaments, believed to trace portions of the warm-hot intergalactic medium (WHIM). Combining these new observations with those from our pilot study carried out in cycle 20 (ID 12958, PI Tejos), we aim to provide a firm detection of the WHIM in cosmological filaments, at the 95% confidence level. Our findings will test our understanding of galaxy formation and the role of AGN/supernova feedback by comparing them with state-of-the-art hydrodynamical simulations. We will also test the the hypothesis which states that the majority of OVI absorbers at low-z are confined within <300 kpc from galaxies (i.e. circumgalactic medium) thus not related to the WHIM (Prochaska et al. 2011; Tumlinson et al. 2011).

OBSERVING DESCRIPTION

We use galaxy cluster-pairs to identify and target the densest filaments in the 'cosmic web'. We cross-match these cluster-pairs with QSO positions, with the aim to probe the filamentary structures in absorption along the QSO sightline.

We used clusters from the GMBCG catalog (Hao et al. 2010) which consists of >55 000 rich clusters at 0.1 < z < 0.55 based on SDSS DR7 data. This catalog has high purity and completeness across the full redshift range and is approximately volume limited up to redshift z ~ 0.4. Although the GMBCG detection algorithm is mainly based on photometry, an important component is the use of brightest cluster galaxies (BCGs) as cluster probes. Around 20000 out of 55000 of these BCGs have spectroscopic redshifts (\delta z ~ 0.0001-0.0002) which allow velocity precision of ~30 km/s at those cluster's rest-frames. We use the BCG spectroscopic redshift as the cluster redshift when available.

The QSOs were chosen from the combination of SDSS DR7 data (Schneider et al. 2010), BOSS data (Paris et al. 2012) and compilations from other catalogs intersecting the SDSS volume showing FUV <18 AB from the GALEX database. These comprise a large number of reliably identified QSOs with well known spectroscopic redshifts which are bright enough for feasible FUV spectroscopy in relatively short exposure times (< 10 orbits).

For each QSOs we selected the subsample of clusters within 20 Mpc from the QSO sightline. From that subsample we defined cluster-pairs according to the following criteria: (i) the transverse separation between the clusters has to be < 20 Mpc; (ii) at least one of the two members has to have a spectroscopic redshift determination and the other has to have a redshift uncertainty no larger than 0.1 (note that the majority of the cluster-pairs in our selected QSO sightline both have spectroscopic redshifts); and (iii) the rest-frame velocity difference has to be < 2000 km/s. For each cluster-pair we assign the redshift to be the average between the two cluster members. We further imposed that the impact parameter between the cluster-pair axis (straight line) and the QSO position is <10 Mpc. As expected from the clustering of galaxy clusters, many cluster-pairs arise at similar redshifts. In consequence, we have grouped cluster-pairs by joining those whose redshifts lie within 1000 km/s from one another, and treated them as single independent filament.

We then constructed a list of QSOs intersecting multiple independent filaments, giving priority based on brightness, number of intersected structures and redshift path (i.e. z_QSO).

We impose a minimum S/N ~ 10 per resolution element for the observations, as our experience with existing HST/COS spectra suggests that for S/N < 10 it becomes difficult to independently constrain the column density and Doppler parameter. Based on these constraints we finally chose the most promising QSO sightline (namely Q1619) that passes through 9 independent filaments. Our target was selected to provide the maximum number of filaments probed at the minimum observing cost, and is located in a safe region where no object is brighter than the target itself within the COS field-of-view (FUV=17.4 mag; note that we have successfully aquired objects of similar magnitude in previous HST/COS observations).

Visit

Proposal 13832, Visit 1 (01) Sat Jul 12 01:04:23 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Comments: 1/1 visit for J1619:
- 4 orbits in total.
- 2 orbits in G130M (1291 and 1309A)
- 2 orbits in G160M (1577A)

Fixed Targets

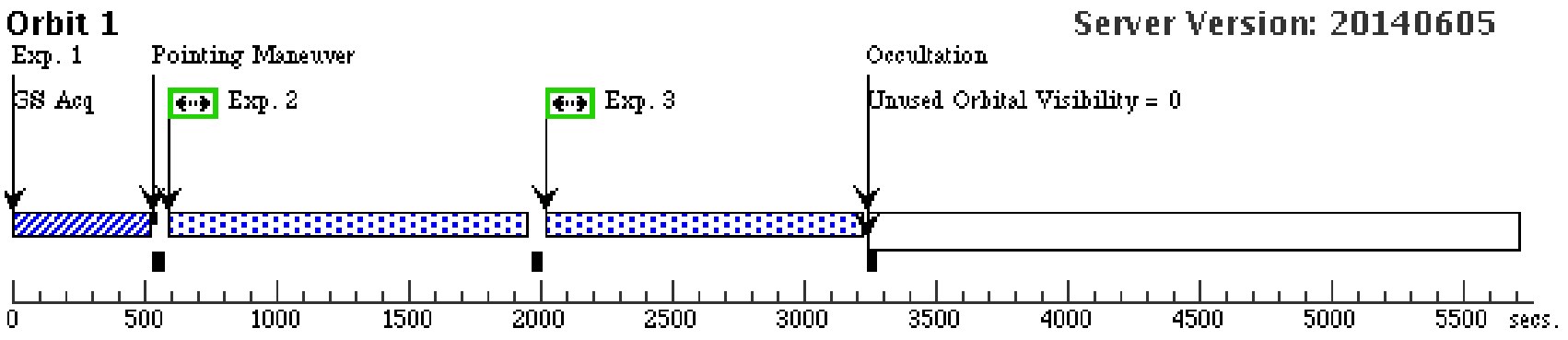
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	2MASX-J16194054+2543233	RA: 16 19 40.5619 (244.9190079d) Dec: +25 43 23.19 (25.72311d) Equinox: J2000		V=16.66 FUV = 17.44	Reference Frame: ICRS

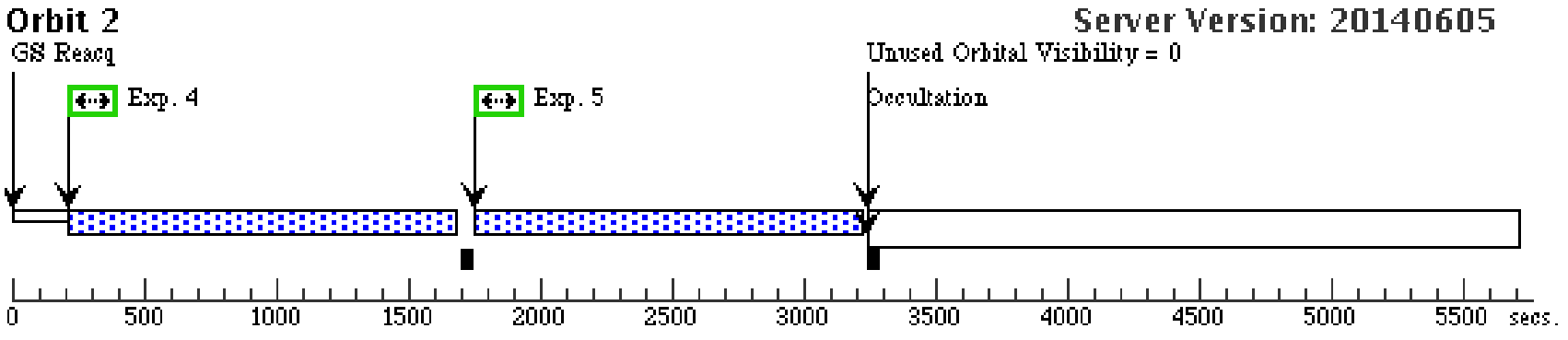
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

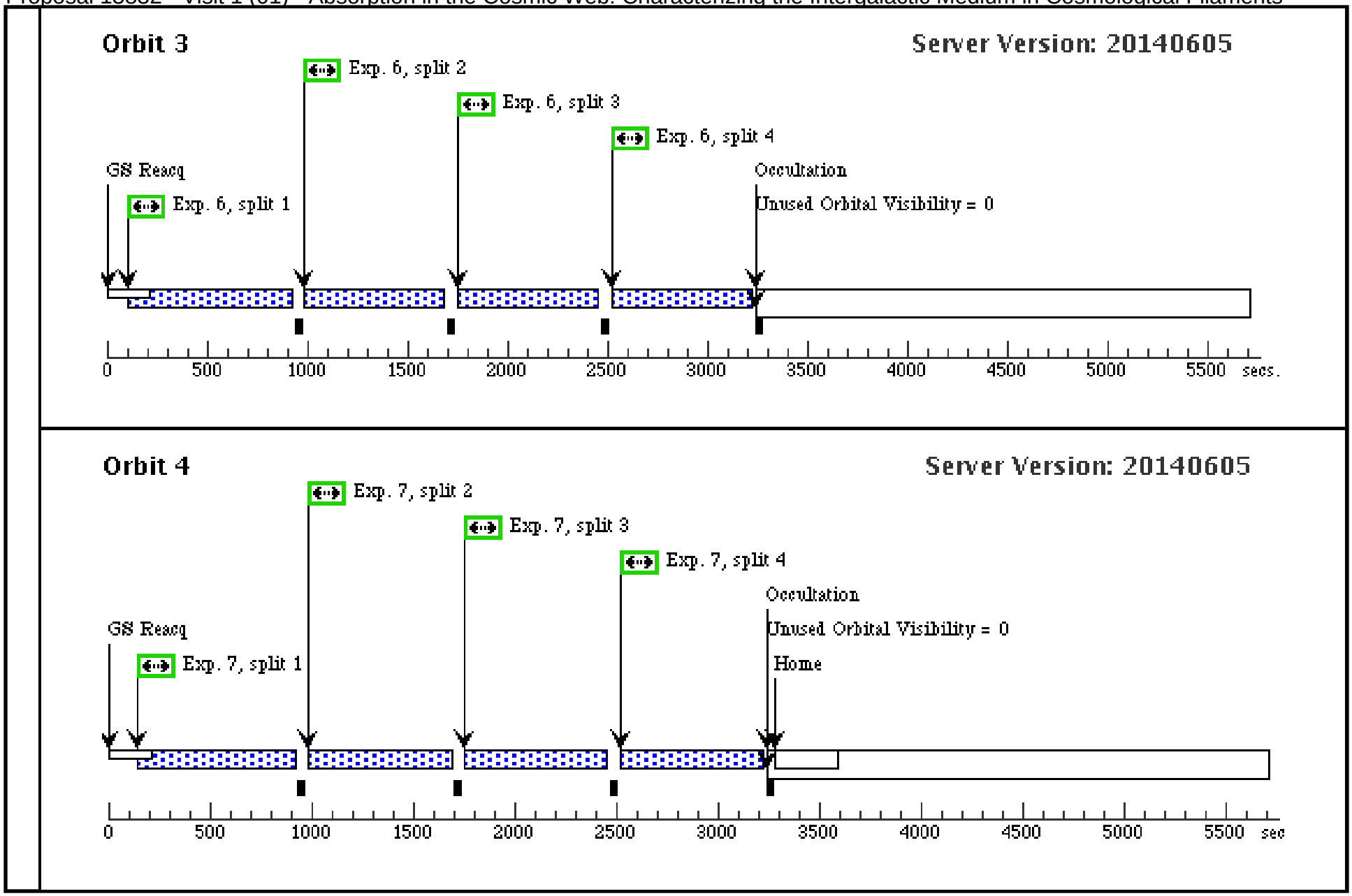
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (COS.ta.617481)	(1) 2MASX-J16194054+2543233	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				50 Secs (50 Secs) *[==>]*	*[1]*
2	G160M - 1577 - FP1 - o1 (COS.sp.618736)	(1) 2MASX-J16194054+2543233	COS/FUV, TIME-TAG, PSA	G160M 1577 A	FP-POS=1; BUFFER-TIME=6200			1152 Secs (1152 Secs) *[==>]*	*[1]*
3	G160M - 1577 - FP2 - o1 (COS.sp.618736)	(1) 2MASX-J16194054+2543233	COS/FUV, TIME-TAG, PSA	G160M 1577 A	FP-POS=2; BUFFER-TIME=6200			1152 Secs (1152 Secs) *[==>]*	*[1]*
4	G160M - 1577 - FP3 - o2 (COS.sp.618738)	(1) 2MASX-J16194054+2543233	COS/FUV, TIME-TAG, PSA	G160M 1577 A	FP-POS=3; BUFFER-TIME=6300			1416 Secs (1416 Secs) *[==>]*	*[2]*
5	G160M - 1577 - FP4 - o2 (COS.sp.618738)	(1) 2MASX-J16194054+2543233	COS/FUV, TIME-TAG, PSA	G160M 1577 A	FP-POS=4; BUFFER-TIME=6300			1415 Secs (1415 Secs) *[==>]*	*[2]*
6	G130M - 1291 - FPA - o3 (COS.sp.618739)	(1) 2MASX-J16194054+2543233	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=ALL; BUFFER-TIME=3000			652 Secs (2608 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[3]*
7	G130M - 1309 - FPA - o4 (COS.sp.618740)	(1) 2MASX-J16194054+2543233	COS/FUV, TIME-TAG, PSA	G130M 1309 A	FP-POS=ALL; BUFFER-TIME=3000			652 Secs (2610 Secs) *[==>653.0 Secs (Split 1)]* *[==>653.0 Secs (Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[4]*

Orbit Structure






Orbit 3
Server Version: 20140605
Exp. 6, split 2
Exp. 6, split 3
Exp. 6, split 4
GS Reacq
Exp. 6, split 1
Occultation
Unused Orbital Visibility = 0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.
Orbit 4
Server Version: 20140605
Exp. 7, split 2
Exp. 7, split 3
Exp. 7, split 4
Occultation
GS Reacq
Unused Orbital Visibility = 0
Exp. 7, split 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec