15835 - Near-Ultraviolet Follow-up of the X-ray-detected Warm-Hot Intergalactic Medium Toward 1ES 1553+113

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Sowgat Muzahid (PI) (ESA Member) (Contact)	**Leibniz-Institut fur Astrophysik Potsdam (AIP)**	**sowgatm@gmail.com**
Dr. Sean Johnson (CoI) (AdminUSPI) (Contact)	University of Michigan	sdj@astro.princeton.edu
Prof. Joop Schaye (CoI) (ESA Member)	Universiteit Leiden	schaye@strw.leidenuniv.nl
Prof. Jane C. Charlton (CoI)	The Pennsylvania State University	charlton@astro.psu.edu
Prof. Hsiao-Wen Chen (CoI)	University of Chicago	hchen@oddjob.uchicago.edu
Dr. Anand Narayanan (CoI)	Indian Institute of Space Science and Technology	anand@iist.ac.in
Ms. Nastasha Wijers (CoI) (ESA Member)	Universiteit Leiden	wijers@strw.leidenuniv.nl
Dr. John S. Mulchaey (CoI)	Carnegie Institution of Washington	mulchaey@obs.carnegiescience.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) QSO-B1553+113	COS/FUV COS/NUV	2	30-Jul-2020 15:00:14.0	yes
02	(1) QSO-B1553+113	COS/FUV COS/NUV	2	30-Jul-2020 15:00:15.0	yes
52	(1) QSO-B1553+113	COS/FUV COS/NUV	1	30-Jul-2020 15:00:16.0	yes

5 Total Orbits Used

ABSTRACT

One of the strengths of modern cosmology is that the cosmic baryon density predicted by Big Bang nucleosynthesis precisely matches the measured value from the cosmic microwave background. At high redshift the vast majority of these baryons are found in the photoionized intergalactic medium. However, cosmological simulations of structure formation predict that a substantial portion of these baryons will be shock heated into the elusive warm-hot intergalactic medium (WHIM) as the universe evolves. Confirmation of these predictions through observations of the WHIM and measurements of its physical state provide a sensitive test of our understanding of the growth of structure in the universe. Recently, Nicastro et al. (2018) reported the first detections of two intervening OVII absorption systems in the X-ray spectrum of the blazar 1ES 1553+113. These systems are thought to be arising from the WHIM with a temperature of ~10^6 K. Nevertheless, the redshift of the blazar is not known with adequate precision, which makes the origin(s) of the OVII bearing gas and its contribution to the cosmic baryon density highly uncertain. Here we propose to obtain NUV spectra of the blazar using the COS G185M grating. The proposed spectra will enable us to detect intervening Lyman alpha absorbers with log N(HI)/cm-2 > 13.0 from z = 0.45 - 0.7. The stringent lower (upper) limit on the blazar's redshift to be obtained from the presence (absence) of any such absorber will be crucial to validate or rule out the claim of potentially solving the so called "missing baryons problem".

OBSERVING DESCRIPTION

In order to place stringent constraints on the blazar (1ES1553+113) redshift and determine whether the O VII absorber at z = 0.4339 is in the blazar's host environment, we will obtain NUV COS spectra to search for intervening IGM HI Lya lines at z > 0.41. Contiguous spectral coverage in the NUV from 1767 to 2068 Angstrom with a S/N per resolution element of 12 will enable us to detect intervening IGM Lya absorption systems with log N(HI) > 13 from z = 0.45 to 0.7. Based on the expected number of such HI systems per unit redshift from Danforth et al. (2016), we expect to detect 10 Lya lines per dz = 0.1 interval. Non-detection of Lya at z > 0.45 in combination with our deep and highly complete galaxy redshift survey in the field would indicate that the blazar is in the same environment as the WHIM candidate at z=0.4339.

Based on the COS ETC, obtaining the desired spectral coverage and S/N will require observations with COS G185M gratings with central wavelength settings of 1882, 1913, 1941, and 1953, each observed for one orbit for a total of four orbits of COS NUV spectroscopy. We will split each central wavelength setting into four FP-POS positions as recommended to minimize flat fielding errors. Moreover, as per the instructions after the gyro failure, we will complete the total allocated 4 orbits in two visits.

Since the co-ordinates of the target are obtain from GAIA with an accuracy better than 0.02", we will directly use PEAKXD followed by PEAKD for acquisition. For the flux observed in the existing COS spectrum (F(1300) = 1.5e-14), ACQ/IMAGE is a viable option. However, it exceeds the bright limit if the flux is increased by a factor of 2.5 (1 mag) owing to unexpected flare. Therefore, we adopt the spectroscopic acquisition for instruments' safety. We used the existing archival COS spectrum of the blazar for calculating the exposure time for spectroscopic acquisition (COS.sa.1366483).

Impact of reduced-gyro operations: There are no significant impact of the reduced-gyro mode (RGM) operations except for an increased target acquisition time of 2 minutes.

Visit

Proposal 15835, QSO-B1553+113-VISIT-01 (01), completed Thu Jul 30 19:00:17 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(QSO-B1553+113-VISIT-01 (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

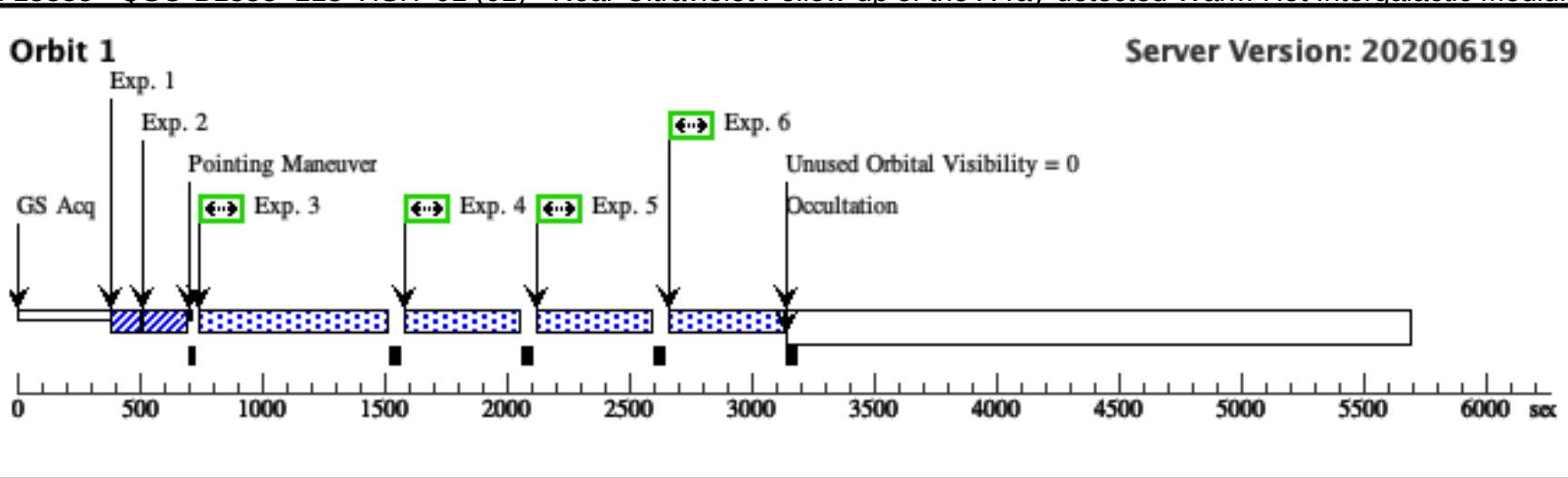
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	QSO-B1553+113	RA: 15 55 43.0440 (238.9293500d) Dec: +11 11 24.37 (11.19010d) Equinox: J2000		V=14.57 G=14, FUV=16.3, NUV=15.6, F(1300) = 1.5e-14 from HST/COS	Reference Frame: ICRS

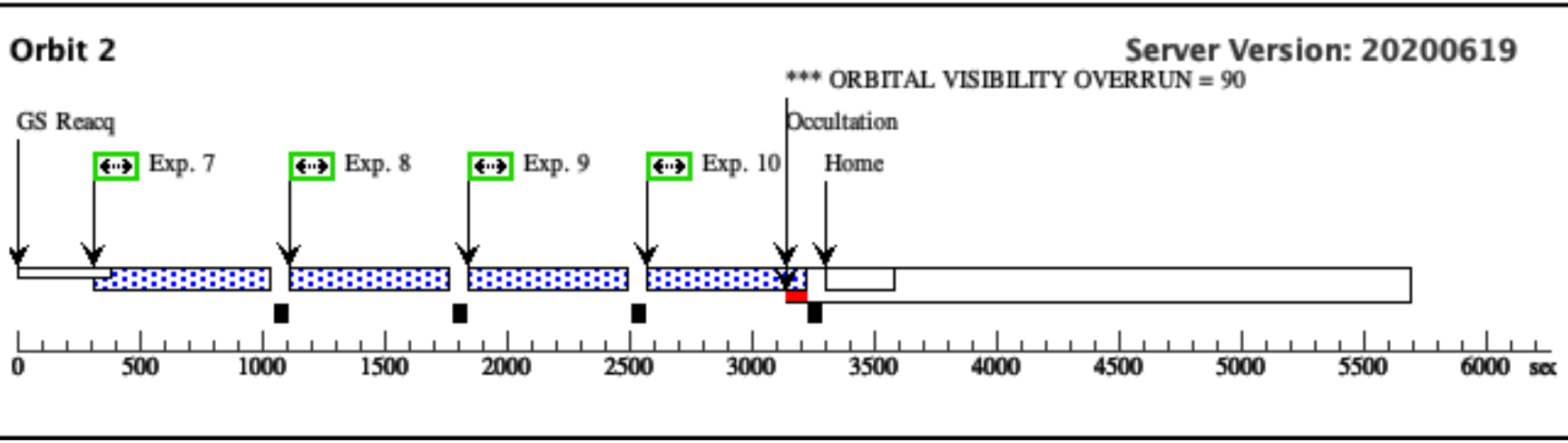
Comments: Co-ordinates are from GAIA
Category=GALAXY
Description=[BL LAC]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ-PEAKXD (COS.sa.1366483)	(1) QSO-B1553+113	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A	SEGMENT=BOTH; NUM-POS=3; STEP-SIZE=1.3; CENTER=FLUX-WT			5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ-PEAKD (COS.sa.1366483)	(1) QSO-B1553+113	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5; STEP-SIZE=0.9; SEGMENT=BOTH; CENTER=FLUX-WT-FLR			5 Secs (5 Secs) *[==>]*	*[1]*
3	TIME-TAG-G185M-1882-FP-1 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1882 A	FP-POS=1; BUFFER-TIME=1561			456 Secs (456 Secs) *[==>]*	*[1]*
4	TIME-TAG-G185M-1882-FP-2 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1882 A	FP-POS=2; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*
5	TIME-TAG-G185M-1882-FP-3 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1882 A	FP-POS=3; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*
6	TIME-TAG-G185M-1882-FP-4 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1882 A	FP-POS=4; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*
7	TIME-TAG-G185M-1913-FP-1 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1913 A	FP-POS=1; BUFFER-TIME=1561			633 Secs (633 Secs) *[==>]*	*[2]*
8	TIME-TAG-G185M-1913-FP-2 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1913 A	FP-POS=2; BUFFER-TIME=1561			632 Secs (632 Secs) *[==>]*	*[2]*
9	TIME-TAG-G185M-1913-FP-3 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1913 A	FP-POS=3; BUFFER-TIME=1561			632 Secs (632 Secs) *[==>]*	*[2]*
10	TIME-TAG-G185M-1913-FP-4 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1913 A	FP-POS=4; BUFFER-TIME=1561			632 Secs (632 Secs) *[==>]*	*[2]*

Orbit Structure





Visit

Proposal 15835, QSO-B1553+113-VISIT-02 (02), failed Thu Jul 30 19:00:17 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(QSO-B1553+113-VISIT-02 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

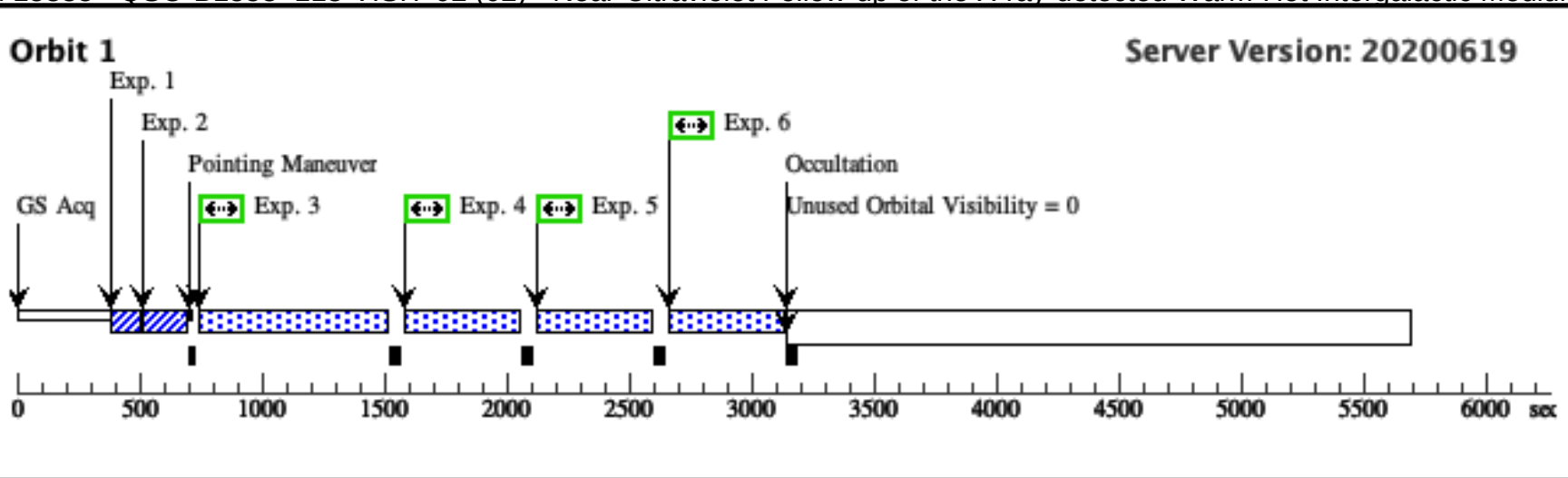
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	QSO-B1553+113	RA: 15 55 43.0440 (238.9293500d) Dec: +11 11 24.37 (11.19010d) Equinox: J2000		V=14.57 G=14, FUV=16.3, NUV=15.6, F(1300) = 1.5e-14 from HST/COS	Reference Frame: ICRS

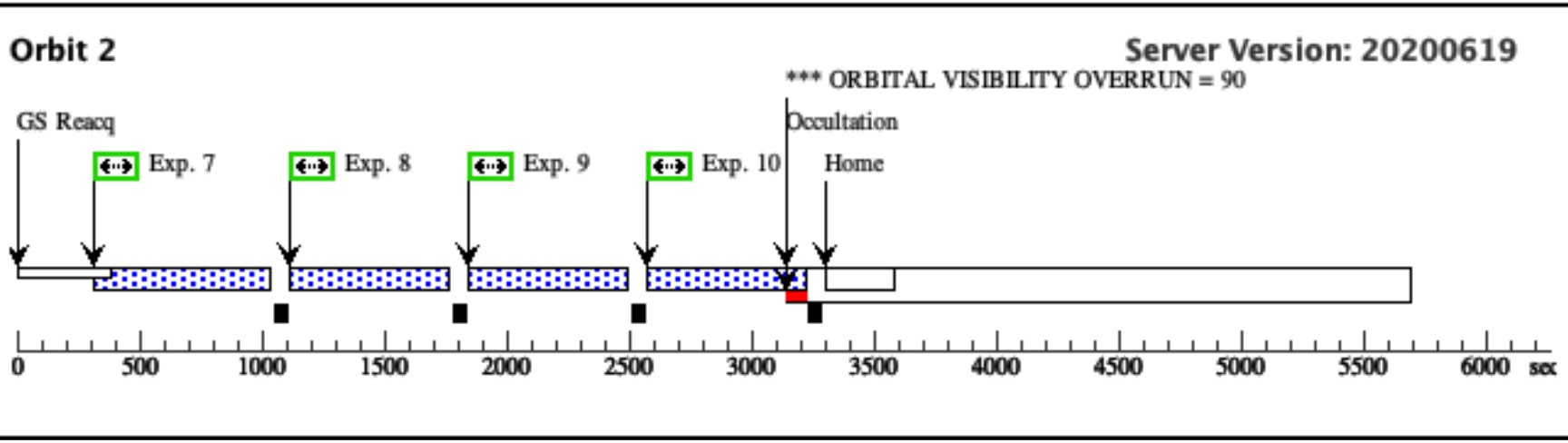
Comments: Co-ordinates are from GAIA
Category=GALAXY
Description=[BL LAC]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ-PEAKXD (COS.sa.1366483)	(1) QSO-B1553+113	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A	SEGMENT=BOTH; NUM-POS=3; STEP-SIZE=1.3; CENTER=FLUX-WT			5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ-PEAKD (COS.sa.1366483)	(1) QSO-B1553+113	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5; STEP-SIZE=0.9; SEGMENT=BOTH; CENTER=FLUX-WT-FLR			5 Secs (5 Secs) *[==>]*	*[1]*
3	TIME-TAG-G185M-1953-FP-1 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=1; BUFFER-TIME=1561			455 Secs (455 Secs) *[==>]*	*[1]*
4	TIME-TAG-G185M-1953-FP-2 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=2; BUFFER-TIME=1561			455 Secs (455 Secs) *[==>]*	*[1]*
5	TIME-TAG-G185M-1953-FP-3 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=3; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*
6	TIME-TAG-G185M-1953-FP-4 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=4; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*
7	TIME-TAG-G185M-1941-FP-1 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=1; BUFFER-TIME=1561			633 Secs (633 Secs) *[==>]*	*[2]*
8	TIME-TAG-G185M-1941-FP-2 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=2; BUFFER-TIME=1561			632 Secs (632 Secs) *[==>]*	*[2]*
9	TIME-TAG-G185M-1941-FP-3 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=3; BUFFER-TIME=1561			632 Secs (632 Secs) *[==>]*	*[2]*
10	TIME-TAG-G185M-1941-FP-4 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=4; BUFFER-TIME=1561			632 Secs (632 Secs) *[==>]*	*[2]*

Orbit Structure





Visit

Proposal 15835, QSO-B1553+113-VISIT-52 (52) Thu Jul 30 19:00:17 GMT 2020

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	QSO-B1553+113	RA: 15 55 43.0440 (238.9293500d) Dec: +11 11 24.37 (11.19010d) Equinox: J2000		V=14.57 G=14, FUV=16.3, NUV=15.6, F(1300) = 1.5e-14 from HST/COS	Reference Frame: ICRS

Comments: Co-ordinates are from GAIA
Category=GALAXY
Description=[BL LAC]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ-PEAKXD (COS.sa.1366483)	(1) QSO-B1553+113	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A	SEGMENT=BOTH; NUM-POS=3; STEP-SIZE=1.3; CENTER=FLUX-WT			5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ-PEAKD (COS.sa.1366483)	(1) QSO-B1553+113	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5; STEP-SIZE=0.9; SEGMENT=BOTH; CENTER=FLUX-WT-FLR			5 Secs (5 Secs) *[==>]*	*[1]*
3	TIME-TAG-G185M-1953-FP-1 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=1; BUFFER-TIME=1561			455 Secs (455 Secs) *[==>]*	*[1]*
4	TIME-TAG-G185M-1953-FP-2 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=2; BUFFER-TIME=1561			455 Secs (455 Secs) *[==>]*	*[1]*
5	TIME-TAG-G185M-1953-FP-3 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=3; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*
6	TIME-TAG-G185M-1953-FP-4 (COS.sp.1366492)	(1) QSO-B1553+113	COS/NUV, TIME-TAG, PSA	G185M 1953 A	FP-POS=4; BUFFER-TIME=1561			454 Secs (454 Secs) *[==>]*	*[1]*

Orbit Structure