18039 - Confirming and Characterizing a Fast, Cool Inflow Toward a Luminous Quasar at z = 0.78

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Jennifer I. Li (CoI)	University of Illinois at Urbana - Champaign
Dr. Erin Boettcher (CoI)	University of Maryland
Prof. Hsiao-Wen Chen (CoI)	University of Chicago
Dr. Feige Wang (CoI)	University of Michigan

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) J0233-0455	STIS/CCD STIS/NUV-MAMA	3	14-Jan-2026 15:00:16.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
02	(1) J0233-0455	STIS/CCD STIS/NUV-MAMA	2	14-Jan-2026 15:00:17.0	yes
03	(1) J0233-0455	COS/FUV COS/NUV	4	14-Jan-2026 15:00:18.0	yes

9 Total Orbits Used

ABSTRACT

We propose HST COS+STIS observations of J0233-0455, a z=0.78 quasar exhibiting redshifted, inflowing Mg II absorption at +800 km/s, to study the elusive process of gas accretion onto supermassive black holes (SMBHs). While AGN outflows are well-documented, direct observations of gas inflows that fuel SMBHs remain extremely rare. Our target was identified through a systematic search for quasars with redshifted absorption, similar to a recent inflow discovered along with a filamentary nebula. As the brightest of the ten quasars found exhibiting the redshifted Mg II absorption, J0233-0455 is singularly suitable as a pilot target for the detailed UV spectroscopy we propose. The proposed UV spectroscopy will target key transitions including Ly-alpha, Ly-beta, the Lyman limit, C II, C IV, and O VI, allowing us to characterize the physical properties, ionization state, and chemical composition of the inflowing gas. The spectral diagnostics will enable measurements of the total mass and inflow rate of the accreting material. This study potentially offers a unique opportunity to quantitatively probe the mechanisms of black hole fueling, addressing a fundamental gap in our understanding of AGN physics and galaxy evolution.

OBSERVING DESCRIPTION

Summary of Program Goals:

This program aims to obtain UV spectra of J0233-0455, a z=0.78 quasar exhibiting redshifted, inflowing Mg II absorption at +800 km/s, to study the elusive process of gas accretion onto supermassive black holes (SMBHs). The UV spectroscopy will target key transitions including Ly-alpha, Ly-beta, the Lyman limit, C II, C IV, and O VI, allowing us to characterize the physical properties, ionization state, and chemical composition of the inflowing gas. The spectral diagnostics will enable measurements of the total mass and inflow rate of the accreting material.

STIS Configuration and visit schedules:

The program will use the E230M grating with a central wavelength of 2415 Ang and the 0.2"x0.2" aperture. The central wavelength provides

coverage from 2000-2800 Ang, necessary to capture the Ly-alpha and C IV at 2170 and 2770 Ang for the target at redshift z=0.78. The total STIS exposure time for J0233-0455 is 5 orbits, divided into two visits of 3 and 2 orbits, in accordance with the scheduling efficiency guidelines in the STIS instrument handbook.

STIS Target Acquisition:

The coordinate of J0233-0455 is known to better than 0.1". An ACQ sequence is sufficient to center the quasar in the 0.2"x0.2" aperture at the start of each visit. The GALEX NUV magnitude of the quasar is (NUV)=17.4. Using the STIS Target Acquisition ETC, we find that a S/N >~ 40 can be achieved with an acquisition exposure time of 7 seconds.

COS Configuration:

We aim to cover Ly-beta (1832 Ang), O VI (1843 Ang), C II (1851 Ang) between 1826 and 1859 Ang using the G185M grating with central wavelength c1941, and the Lyman limit (1629 Ang) using G160M with central wavelength c1600. We will employ FP-POS offsets 2, 3, and 4 for G185M, and 1, 2, 3, 4 for G160M to ensure that each wavelength window is observed at least three times with different grating positions. The total COS exposure time for J0233-0455 is 4 orbits within one single visit.

COS Target Acquisition:

We will obtain an NUV image in ACQ/IMAGE mode, as the 2.5" COS entrance aperture is sufficient to center the quasar. No ACQ/SEARCH is required since the quasar coordinates are known to better than 0.1". The GALEX FUV magnitude of the quasar is (NUV) = 17.4. Using the COS Target Acquisition ETC, we find that MIRROR B must be used to avoid exceeding the bright limit, and that a S/N greater than 40 can be achieved with a 20-second exposure.

Visit

Proposal 18039, J0233-STIS-SCI (01), implementation Wed Jan 14 20:00:18 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: (none)

Fixed Targets

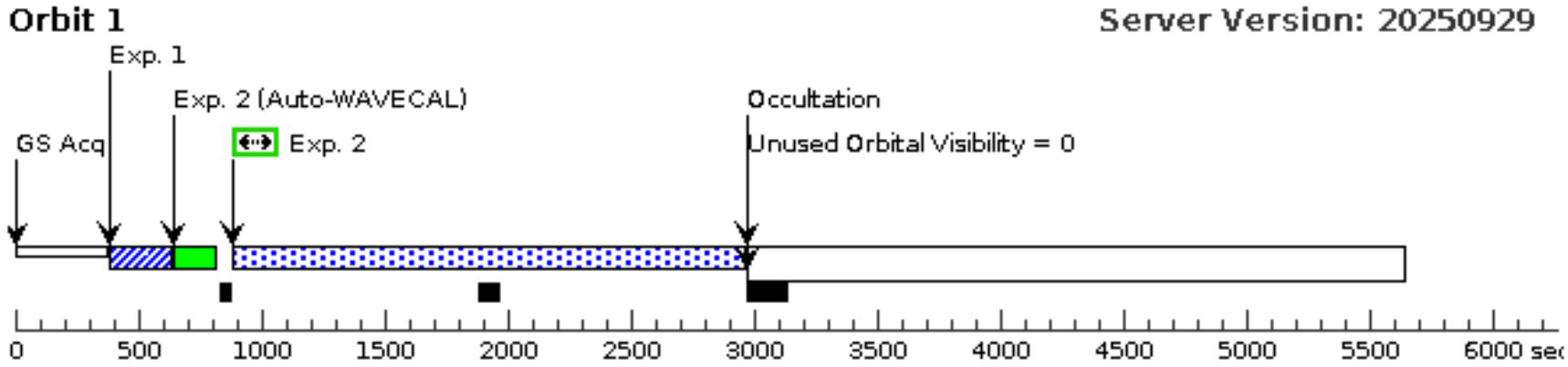
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J0233-0455	RA: 02 33 22.1601 (38.3423337d) Dec: -04 55 6.92 (-4.91859d) Equinox: J2000		V=17.12 AB=17.4 in NUV	Reference Frame: ICRS

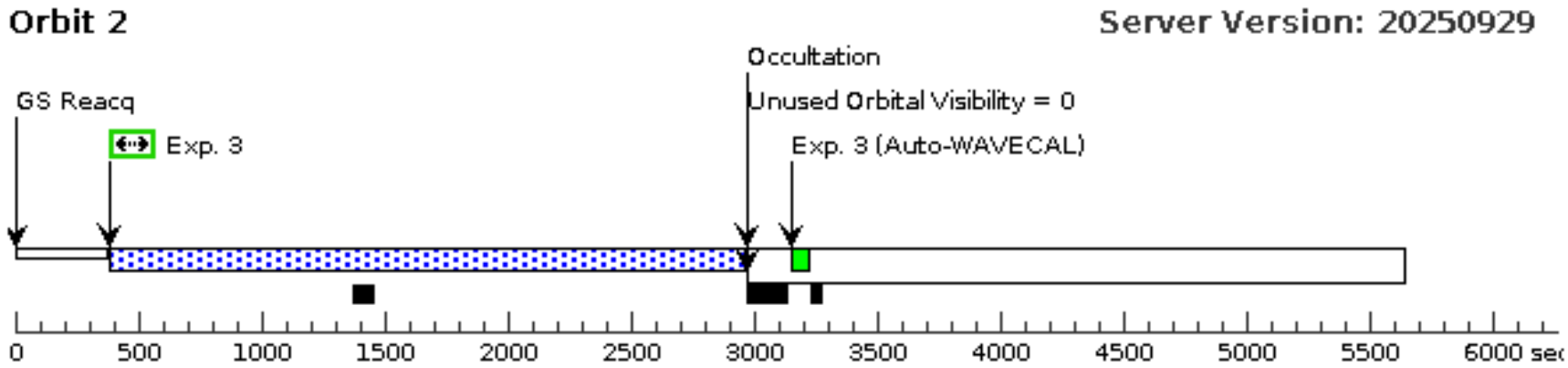
Comments:
Category=GALAXY
Description=[HALO, LYMAN ALPHA CLOUD, QSO, QUASAR]
Extended=NO

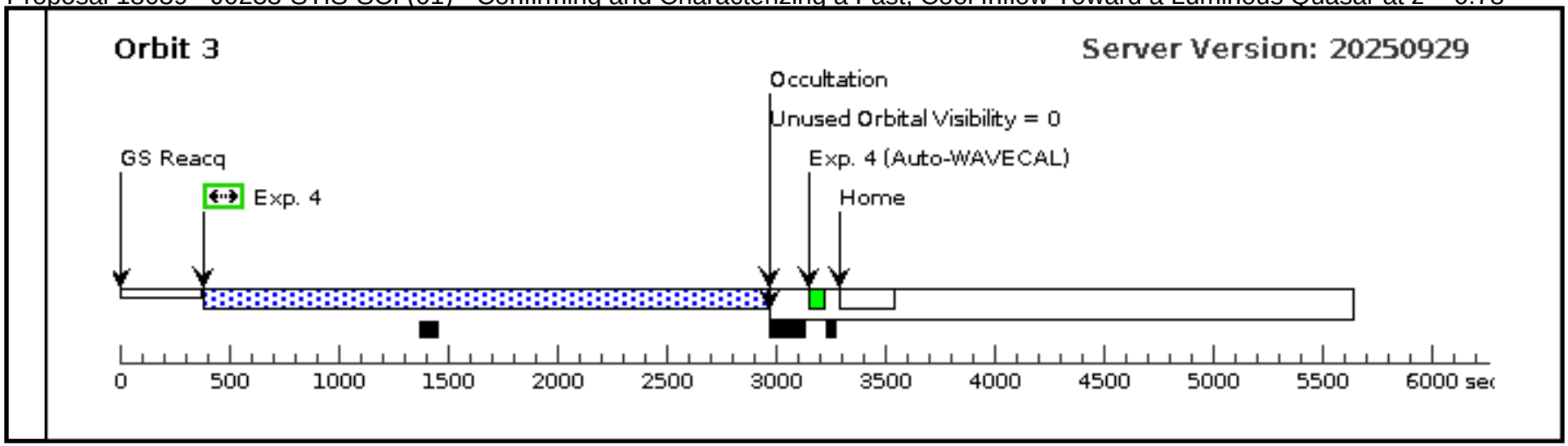
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.im.2023559)	(1) J0233-0455	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			7 Secs (7 Secs) *[==>]*	*[1]*
2	J0233-Science (STIS.sp.2023351)	(1) J0233-0455	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2415 A	BUFFER-TIME=1000			2000 Secs (2060 Secs) *[==>2060.0 Secs]*	*[1]*
3	J0233-Science (STIS.sp.2023351)	(1) J0233-0455	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2415 A	BUFFER-TIME=1000			2000 Secs (2569 Secs) *[==>2569.0 Secs]*	*[2]*
4	J0233-Science (STIS.sp.2023351)	(1) J0233-0455	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2415 A	BUFFER-TIME=1000			2000 Secs (2569 Secs) *[==>2569.0 Secs]*	*[3]*

Orbit Structure



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4000
4500
5000
5500
6000 sec

Visit

Proposal 18039, J0233-STIS-SCI (02), implementation Wed Jan 14 20:00:19 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: (none)

Fixed Targets

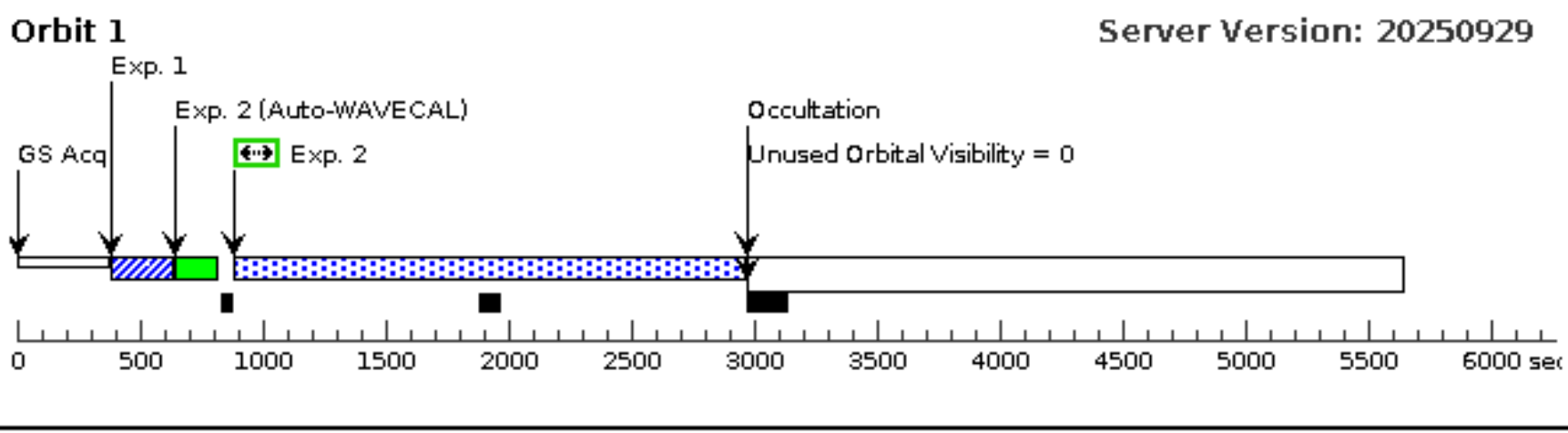
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J0233-0455	RA: 02 33 22.1601 (38.3423337d) Dec: -04 55 6.92 (-4.91859d) Equinox: J2000		V=17.12 AB=17.4 in NUV	Reference Frame: ICRS

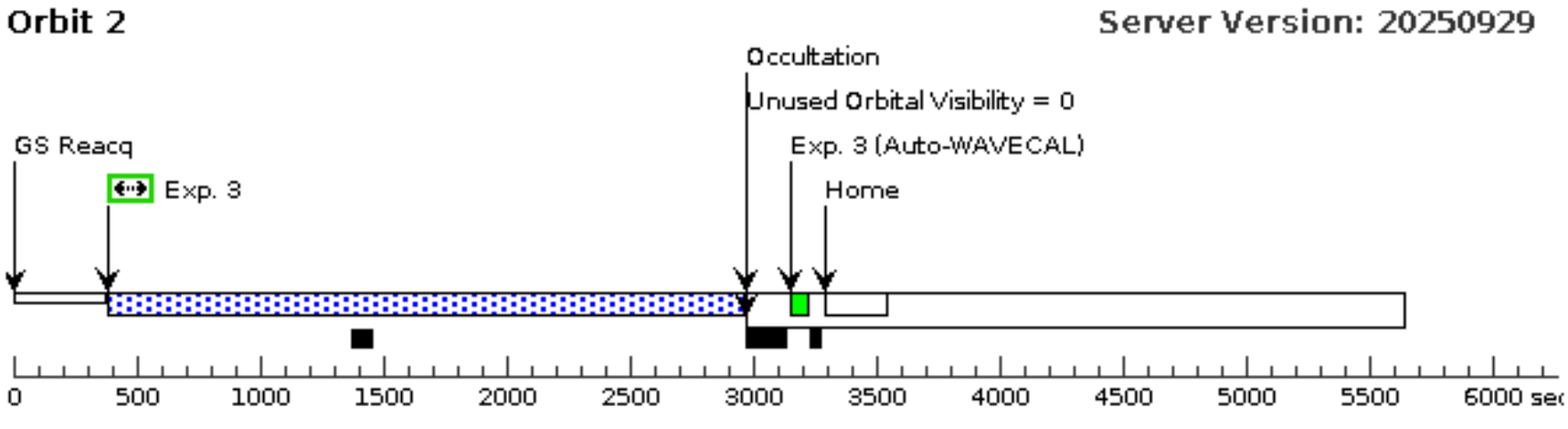
Comments:
Category=GALAXY
Description=[HALO, LYMAN ALPHA CLOUD, QSO, QUASAR]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (STIS.im.2023559)	(1) J0233-0455	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			7 Secs (7 Secs) *[==>]*	*[1]*
2	J0233-Science (STIS.sp.2023351)	(1) J0233-0455	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2415 A	BUFFER-TIME=1000			2000 Secs (2060 Secs) *[==>2060.0 Secs]*	*[1]*
3	J0233-Science (STIS.sp.2023351)	(1) J0233-0455	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230M 2415 A	BUFFER-TIME=1000			2000 Secs (2569 Secs) *[==>2569.0 Secs]*	*[2]*

Orbit Structure





Visit

Proposal 18039, J0233-COS-SCI (03), implementation Wed Jan 14 20:00:19 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

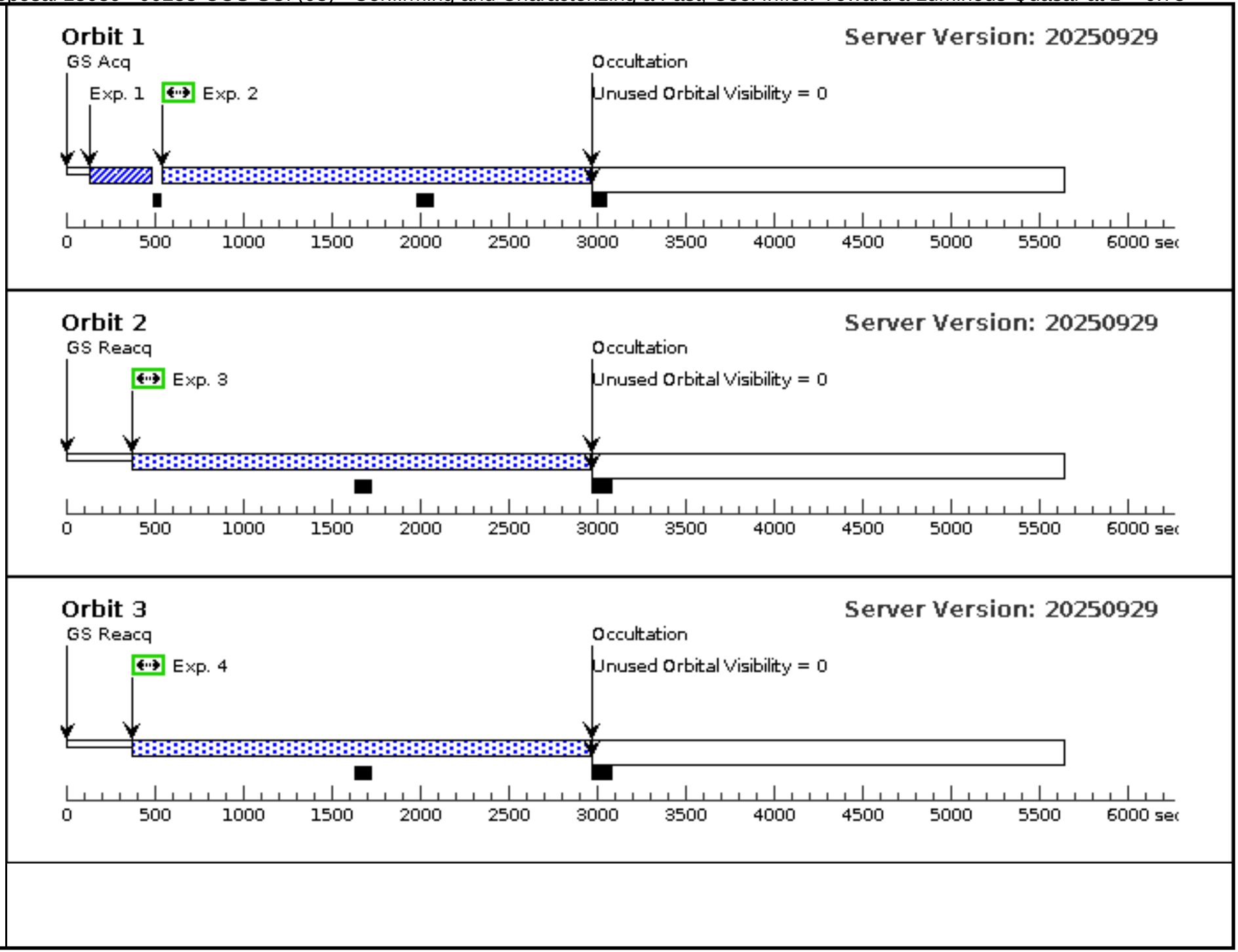
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J0233-0455	RA: 02 33 22.1601 (38.3423337d) Dec: -04 55 6.92 (-4.91859d) Equinox: J2000		V=17.12 AB=17.4 in NUV	Reference Frame: ICRS

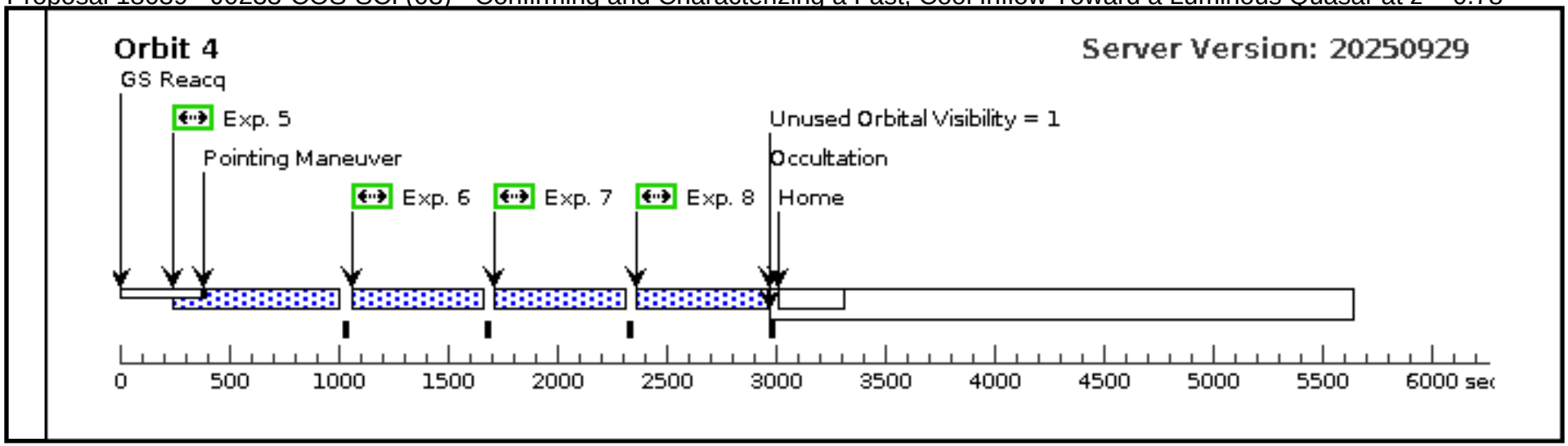
Comments:
Category=GALAXY
Description=[HALO, LYMAN ALPHA CLOUD, QSO, QUASAR]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (COS.ta.2023392)	(1) J0233-0455	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				20 Secs (20 Secs) *[==>]*	***[1]***
2	J0233-Science (COS.sp.2023396)	(1) J0233-0455	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=2; BUFFER-TIME=1257			2000 Secs (2221 Secs) *[==>2221.0 Secs]*	***[1]***
3	J0233-Science (COS.sp.2023396)	(1) J0233-0455	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=3; BUFFER-TIME=1257			2000 Secs (2572 Secs) *[==>2572.0 Secs]*	***[2]***
4	J0233-Science (COS.sp.2023396)	(1) J0233-0455	COS/NUV, TIME-TAG, PSA	G185M 1941 A	FP-POS=4; BUFFER-TIME=1257			2000 Secs (2572 Secs) *[==>2572.0 Secs]*	***[3]***
5	J0233-Science (COS.sp.2023398)	(1) J0233-0455	COS/FUV, TIME-TAG, PSA	G160M 1600 A	FP-POS=1; BUFFER-TIME=9075			500 Secs (547 Secs) *[==>547.0 Secs]*	***[4]***
6	J0233-Science (COS.sp.2023398)	(1) J0233-0455	COS/FUV, TIME-TAG, PSA	G160M 1600 A	FP-POS=2; BUFFER-TIME=9075			500 Secs (547 Secs) *[==>547.0 Secs]*	***[4]***
7	J0233-Science (COS.sp.2023398)	(1) J0233-0455	COS/FUV, TIME-TAG, PSA	G160M 1600 A	FP-POS=3; BUFFER-TIME=9075			500 Secs (547 Secs) *[==>547.0 Secs]*	***[4]***
8	J0233-Science (COS.sp.2023398)	(1) J0233-0455	COS/FUV, TIME-TAG, PSA	G160M 1600 A	FP-POS=4; BUFFER-TIME=9075			500 Secs (547 Secs) *[==>547.0 Secs]*	***[4]***

Orbit Structure

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