17301 - Ultraviolet imaging of a candidate runaway supermassive black hole

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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Dr. Grant R. Tremblay (CoI)	Smithsonian Institution Astrophysical Observatory

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) WAKE	WFC3/UVIS	2	13-Apr-2023 12:00:16.0	yes
02	(1) WAKE	WFC3/UVIS	2	13-Apr-2023 12:00:17.0	yes
03	(1) WAKE	WFC3/UVIS	2	13-Apr-2023 12:00:17.0	yes
04	(1) WAKE	WFC3/UVIS	2	13-Apr-2023 12:00:18.0	yes
05	(1) WAKE	WFC3/UVIS	2	13-Apr-2023 12:00:19.0	yes
06	(1) WAKE	WFC3/UVIS	2	13-Apr-2023 12:00:20.0	yes

12 Total Orbits Used

ABSTRACT

A recent study announced the discovery in HST/ACS data of a remarkably thin, 62 kpc long feature associated with a compact galaxy at z=0.964. It was proposed that we are witnessing shocks and star formation in the wake of a runaway supermassive black hole (SMBH). The existing HST data sample the rest-frame near-UV, and show where stars have formed in the feature. A ground-based u band image shows that the rest-frame far-UV emission is qualitatively different from the rest-frame near-UV: the linear feature is longer, extending all the way to the compact galaxy, and there is flux on the other side of the galaxy, opposite the linear feature that is in the ACS data. The rest-frame far-UV emission likely traces shocked gas rather than (only) hot stars, and the u band detection on the other side may be another wake, behind a simultaneously ejected binary SMBH. The interpretation is hampered by the low resolution of the ground-based u band data. Here we propose to obtain high resolution, deep UV imaging of this remarkable system with UVIS. These observations will show whether there is indeed a counter linear feature, whether it is connected to a compact object that would be the location of the binary SMBH, and whether it shows the characteristic fanning out from the tip that is expected for the wake of a SMBH. The data will also map the rest-frame far-UV emission around the tip of the main feature, which could resolve into a spectacular kpc-scale bow shock. The observations will be done in the difference bandpass F200LP - F350LP. As a bonus, the summed image (F200LP + F350LP) will provide a monochromatic image of the entire system that is 30x deeper than the existing ACS data.

OBSERVING DESCRIPTION

The observations are split into 6 visits of 2 orbits each.

Within each visit, the first orbit is in F200LP and the second in F350LP. As the science comes from the difference frames F200LP - F350LP, we want to make sure that the F200LP data are taken in the exact same way (with the same ORIENT etc) as the F350LP data. We therefore observe in both filters in each visit.
(Rather than, say, having 6 visits of F200LP observations and 6 visits in F350LP).

The target is placed at the UVIS2 aperture. The UVIS2 chip has a higher QE in the UV than UVIS1, and as the target is small we do not need to place it near the center of the full array. We contemplated placing the target nearer amplifier C to improve CTE, but given the high background in the long pass filters we figured that UVIS2 is going to be OK.

Within each orbit, three exposures are obtained with the WFC3-UVIS-DITHER-LINE-3PT pattern. We are not concerned with dithering over the chip gap, and this pattern improves subpixel sampling. Doing 3 pointings (rather than 2 or a box of 2x2) is a compromise between limiting overheads, having a high enough background to limit CTE losses, and having enough exposures for redundancy and subpixel sampling. In the end we will have 18 exposures in each band and that will certainly be sufficient. The sky background of each exposure is about 85 counts, which is hopefully sufficient.

There are no ORIENT or timing constraints. It is also fine if different visits are taken at different ORIENTs.

Visit

Proposal 17301, Visit 01, implementation Thu Apr 13 16:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

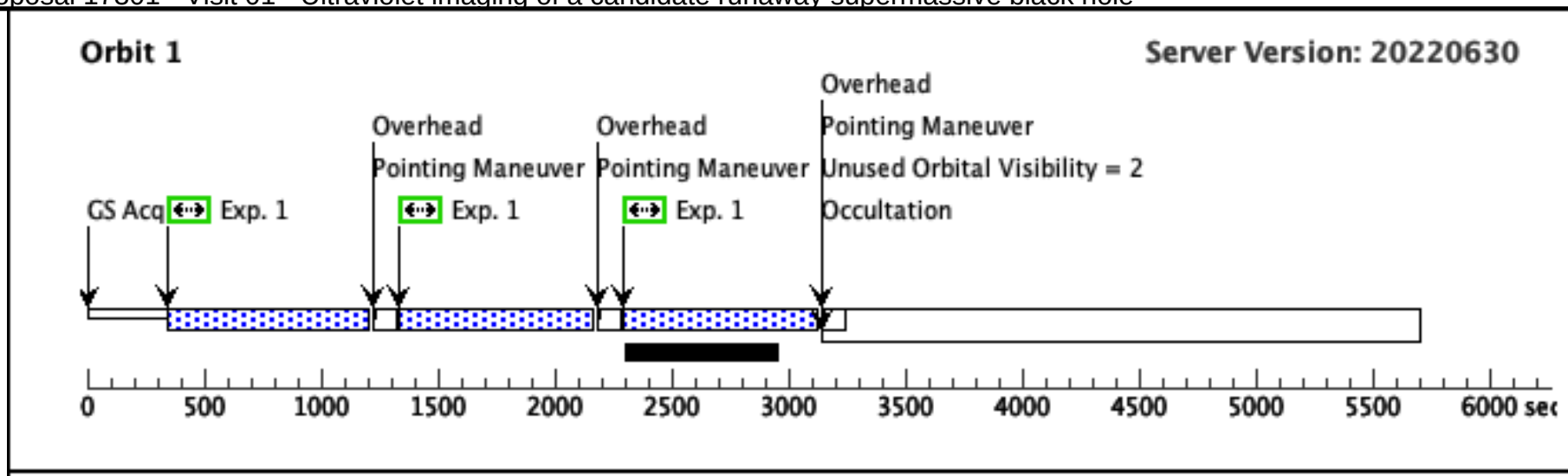
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WAKE	RA: 02 41 45.5760 (40.4399000d) Dec: -08 20 58.92 (-8.34970d) Equinox: J2000		V=25	Reference Frame: ICRS

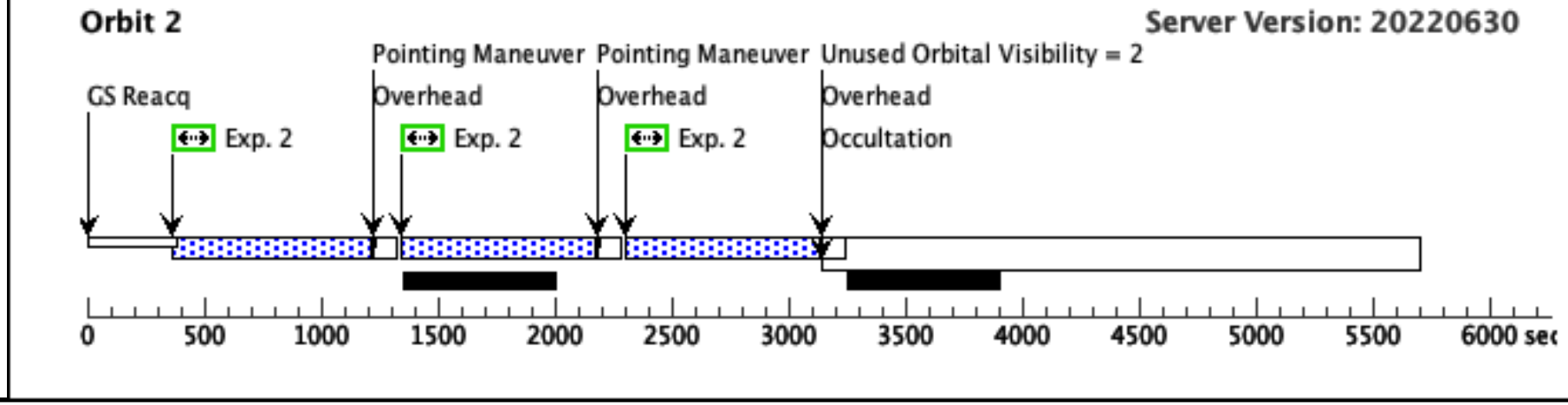
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, SHOCK FRONT]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F200LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 01 (1)	700 Secs (2496 Secs) *[==>832.0 Secs (Pattern 1)]* *[==>832.0 Secs (Pattern 2)]* *[==>832.0 Secs (Pattern 3)]*	***[1]***
2		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 01 (1)	700 Secs (2487 Secs) *[==>829.0 Secs (Pattern 1)]* *[==>829.0 Secs (Pattern 2)]* *[==>829.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure





Visit

Proposal 17301, Visit 02, implementation Thu Apr 13 16:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

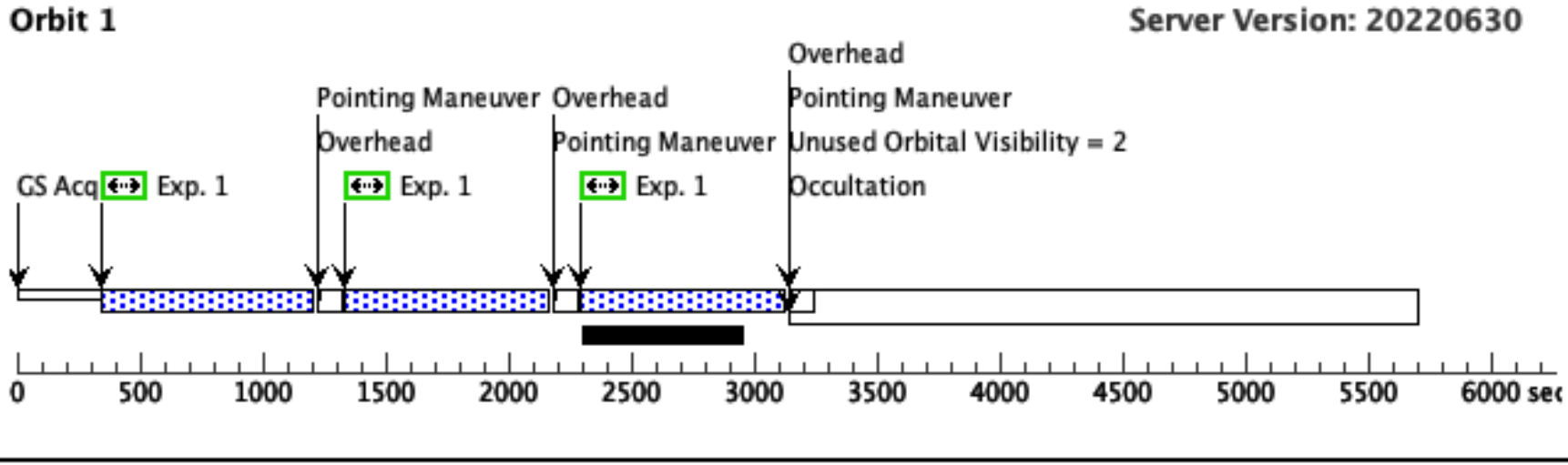
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WAKE	RA: 02 41 45.5760 (40.4399000d) Dec: -08 20 58.92 (-8.34970d) Equinox: J2000		V=25	Reference Frame: ICRS

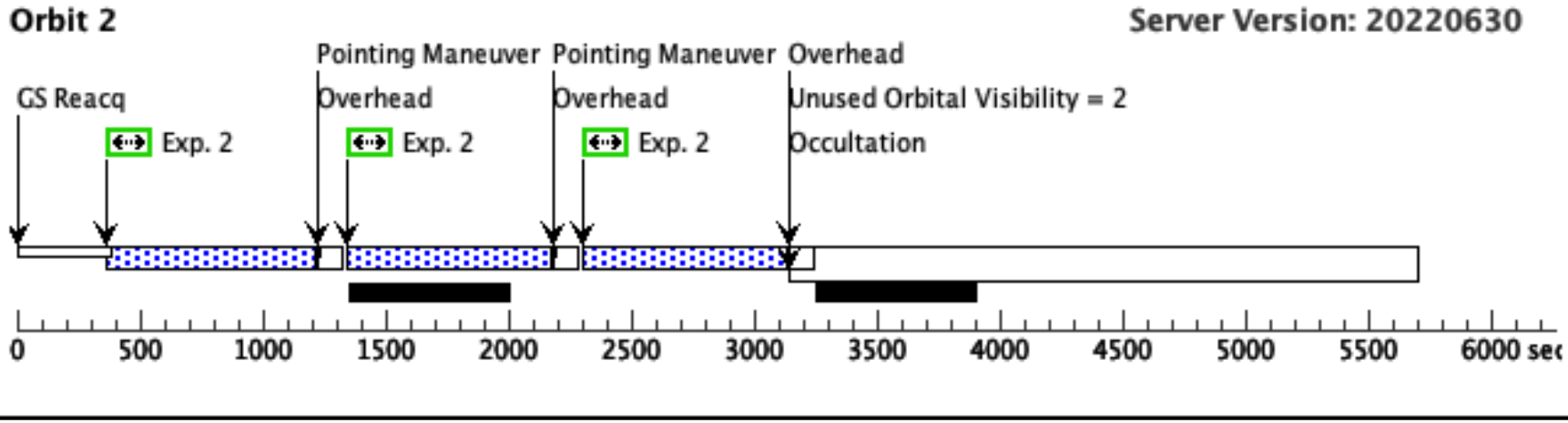
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, SHOCK FRONT]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F200LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 02 (1)	700 Secs (2496 Secs) *[==>832.0 Secs (Pattern 1)]* *[==>832.0 Secs (Pattern 2)]* *[==>832.0 Secs (Pattern 3)]*	***[1]***
2		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 02 (1)	700 Secs (2487 Secs) *[==>829.0 Secs (Pattern 1)]* *[==>829.0 Secs (Pattern 2)]* *[==>829.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure





Visit

Proposal 17301, Visit 03, implementation Thu Apr 13 16:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

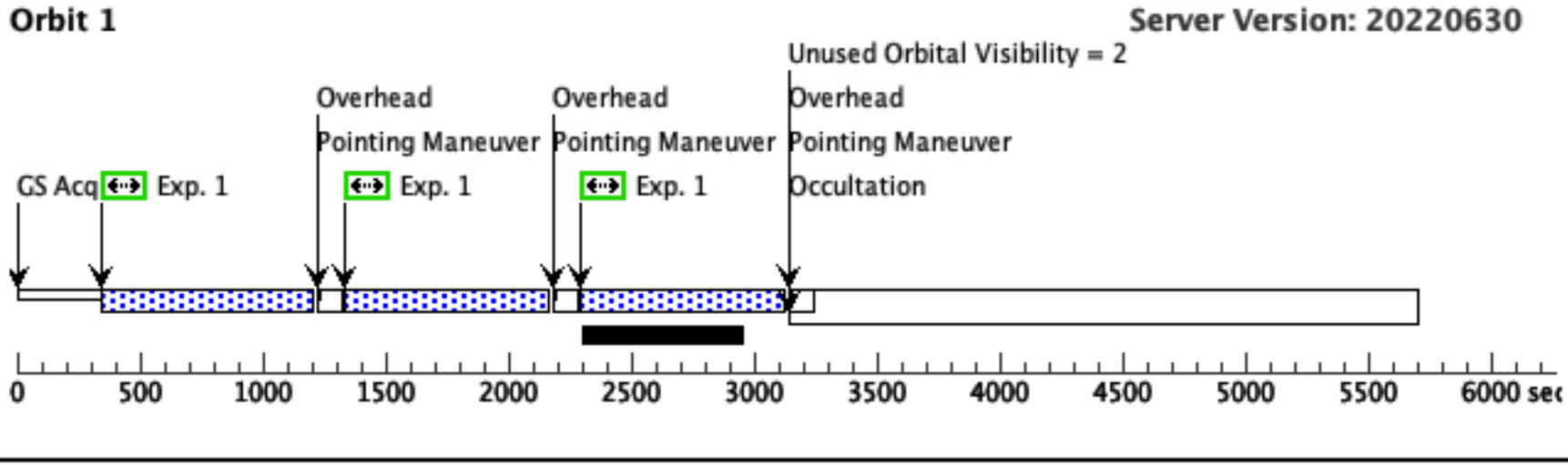
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WAKE	RA: 02 41 45.5760 (40.4399000d) Dec: -08 20 58.92 (-8.34970d) Equinox: J2000		V=25	Reference Frame: ICRS

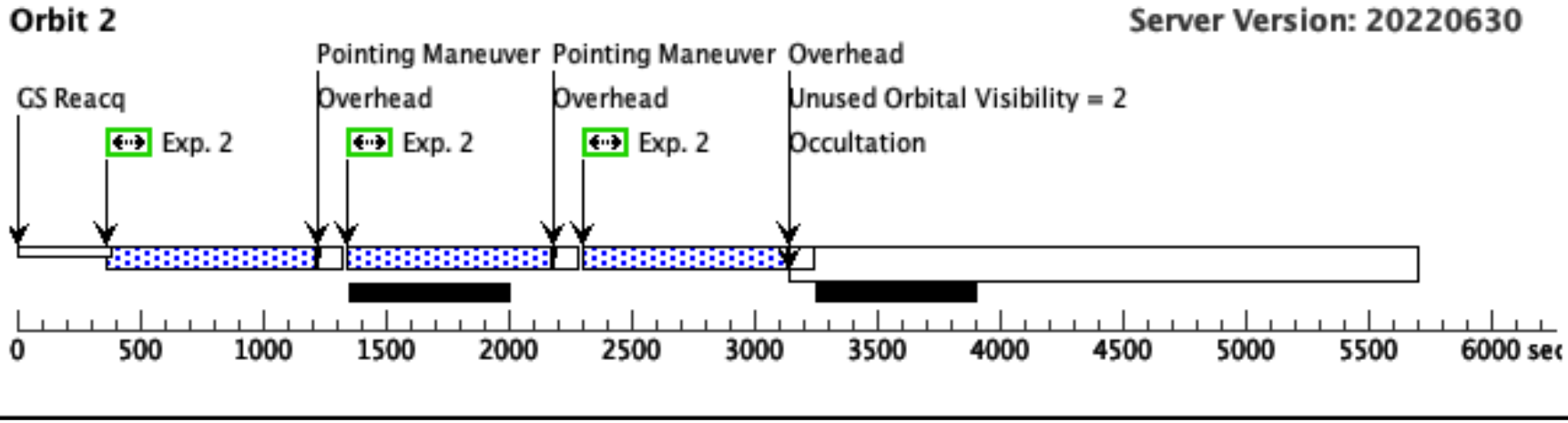
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, SHOCK FRONT]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F200LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 03 (1)	700 Secs (2496 Secs) *[==>832.0 Secs (Pattern 1)]* *[==>832.0 Secs (Pattern 2)]* *[==>832.0 Secs (Pattern 3)]*	***[1]***
2		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 03 (1)	700 Secs (2487 Secs) *[==>829.0 Secs (Pattern 1)]* *[==>829.0 Secs (Pattern 2)]* *[==>829.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure





Visit

Proposal 17301, Visit 04, implementation Thu Apr 13 16:00:21 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

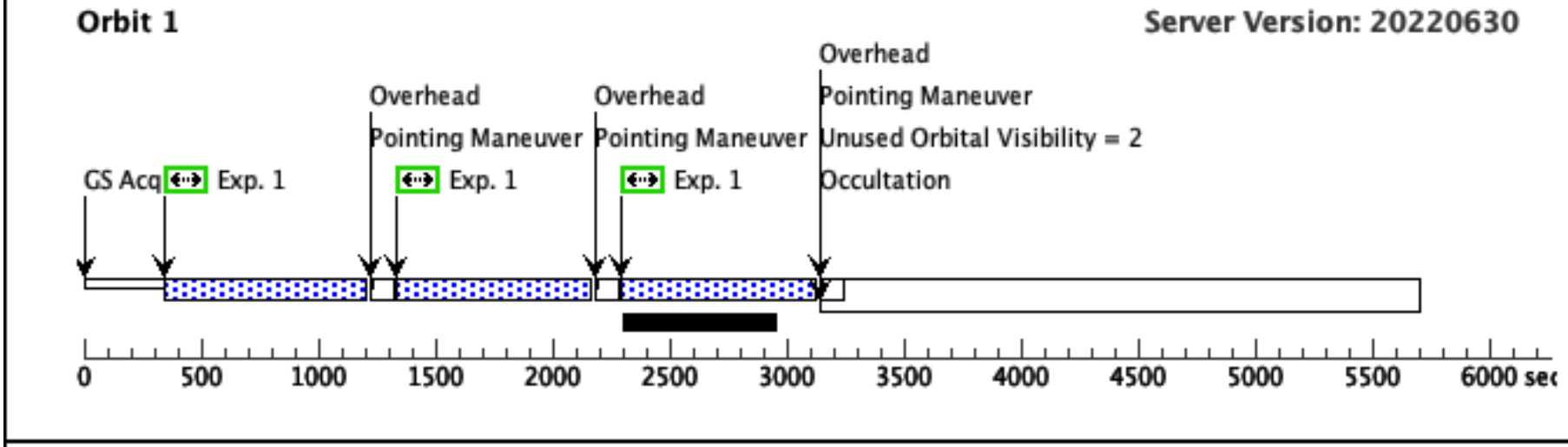
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WAKE	RA: 02 41 45.5760 (40.4399000d) Dec: -08 20 58.92 (-8.34970d) Equinox: J2000		V=25	Reference Frame: ICRS

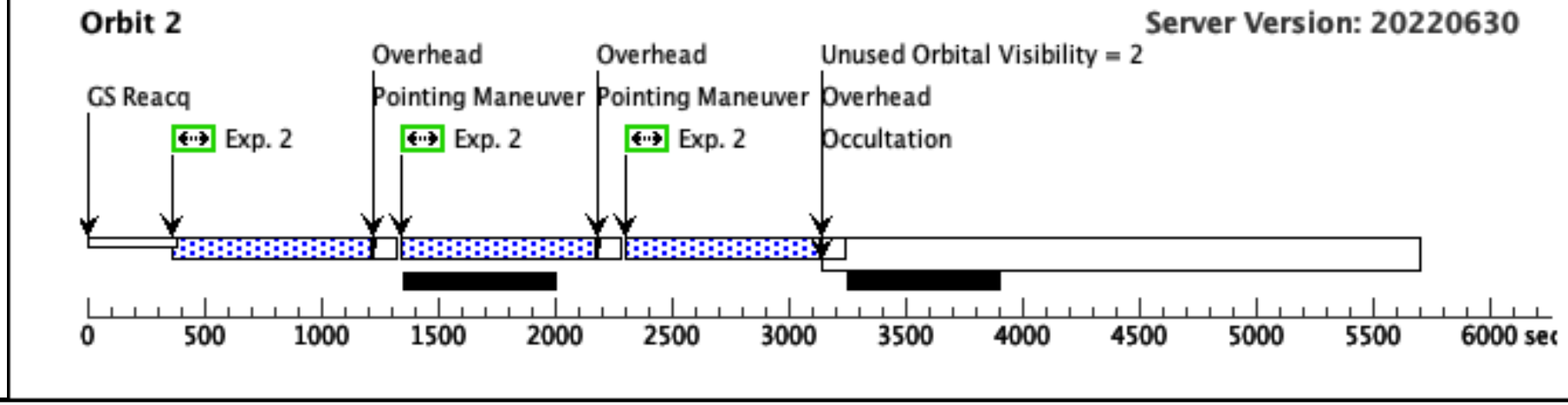
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, SHOCK FRONT]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F200LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 04 (1)	700 Secs (2496 Secs) *[==>832.0 Secs (Pattern 1)]* *[==>832.0 Secs (Pattern 2)]* *[==>832.0 Secs (Pattern 3)]*	***[1]***
2		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 04 (1)	700 Secs (2487 Secs) *[==>829.0 Secs (Pattern 1)]* *[==>829.0 Secs (Pattern 2)]* *[==>829.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure





Visit

Proposal 17301, Visit 05, implementation Thu Apr 13 16:00:21 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

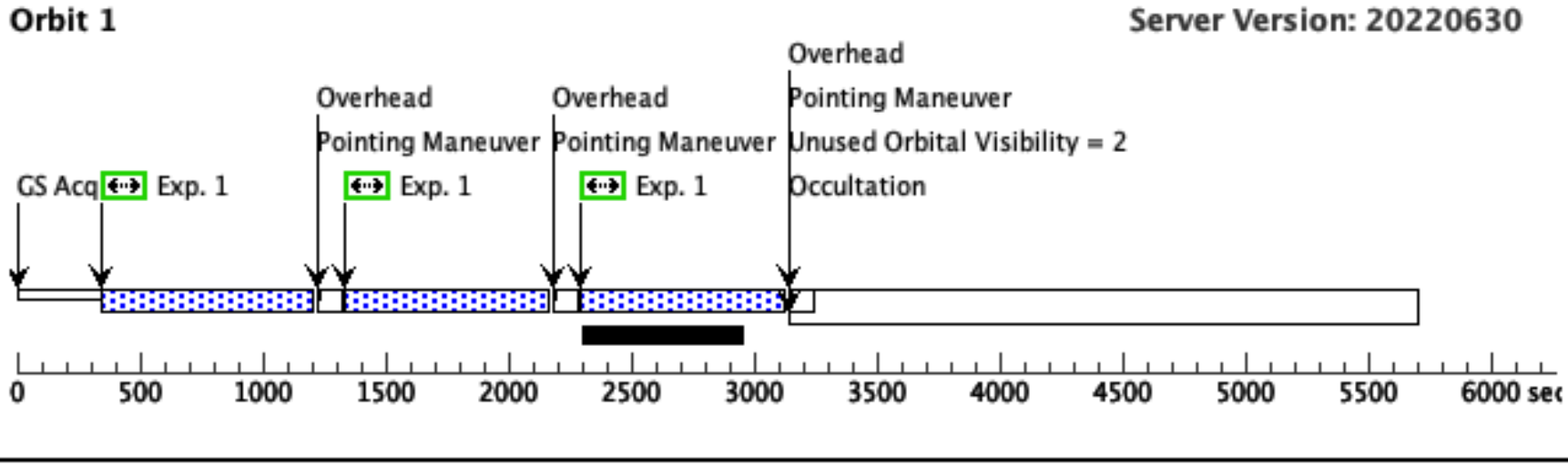
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WAKE	RA: 02 41 45.5760 (40.4399000d) Dec: -08 20 58.92 (-8.34970d) Equinox: J2000		V=25	Reference Frame: ICRS

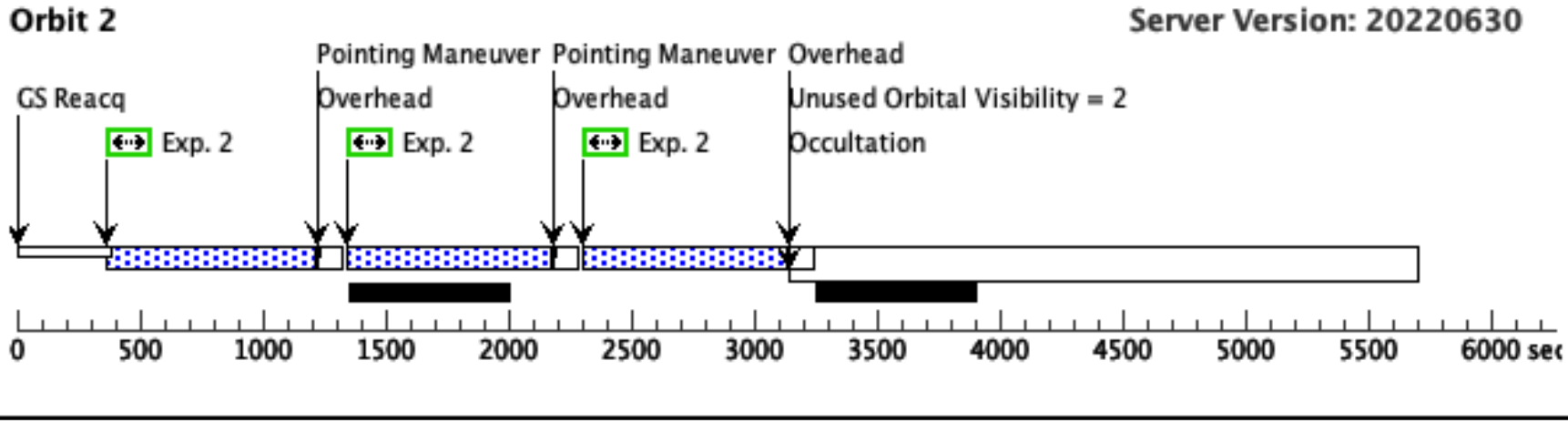
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, SHOCK FRONT]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F200LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 05 (1)	700 Secs (2496 Secs) *[==>832.0 Secs (Pattern 1)]* *[==>832.0 Secs (Pattern 2)]* *[==>832.0 Secs (Pattern 3)]*	***[1]***
2		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 05 (1)	700 Secs (2487 Secs) *[==>829.0 Secs (Pattern 1)]* *[==>829.0 Secs (Pattern 2)]* *[==>829.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure





Visit

Proposal 17301, Visit 06, implementation Thu Apr 13 16:00:21 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WAKE	RA: 02 41 45.5760 (40.4399000d) Dec: -08 20 58.92 (-8.34970d) Equinox: J2000		V=25	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, SHOCK FRONT]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F200LP		GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in Visit 06 (1)	700 Secs (2496 Secs) *[==>832.0 Secs (Pattern 1)]* *[==>832.0 Secs (Pattern 2)]* *[==>832.0 Secs (Pattern 3)]*	***[1]***
2		(1) WAKE	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 06 (1)	700 Secs (2487 Secs) *[==>829.0 Secs (Pattern 1)]* *[==>829.0 Secs (Pattern 2)]* *[==>829.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure