15472 - Star Cluster Formation and Evolution in Luminous Galaxy Mergers: A Joint JWST-HST Investigation

Cycle: 25, Proposal Category: GO

(JWST Initative)

(Availability Mode: SUPPORTED)

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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	(8) IRASF12112+0305	WFC3/UVIS	1	01-Jun-2018 15:09:36.0	yes
02	(9) IRASF14378-3651	WFC3/UVIS	1	01-Jun-2018 15:09:37.0	yes
03	(10) IRASF17207-0014	WFC3/UVIS	1	01-Jun-2018 15:09:38.0	yes
04	(3) NGC-3256	WFC3/UVIS	1	01-Jun-2018 15:09:39.0	yes
05	(7) NGC-6240	WFC3/UVIS	1	01-Jun-2018 15:09:40.0	yes
06	(6) MRK-231	WFC3/UVIS	1	01-Jun-2018 15:09:41.0	yes
07	(4) IRASF08572+3915	WFC3/UVIS	1	01-Jun-2018 15:09:42.0	yes
08	(1) IC-1623	WFC3/UVIS	1	01-Jun-2018 15:09:42.0	yes
09	(2) NGC-7469	WFC3/UVIS	1	01-Jun-2018 15:09:43.0	yes
10	(5) ARP-220	WFC3/UVIS	1	01-Jun-2018 15:09:44.0	yes

10 Total Orbits Used

ABSTRACT

We propose new F336W observations of all 10 luminous infrared galaxies (LIRGs) in GOALS being observed by JWST as part of our approved ERS program "A JWST Study of the Starburst-AGN Connection in Merging LIRGs" (Armus PI) and as part of GTO campaigns. High-resolution studies of local LIRGs allows us to understand the manner in which star formation in extreme environments differs from that of normal star-forming galaxies, and is also critical for our understanding starbursts in cosmologically distant LIRGs which comprise the bulk of the IR energy density at z > 0.5. These observations allow us to map the distribution of star clusters and NUV emission over the entire extent of each LIRG and, combined with our pre-existing HST and upcoming JWST ERS and GTO datasets, enable the following questions to be answered: 1) Is star formation and cluster disruption in such violent environments fundamentally different than in normal star-forming galaxies? 2) Do star clusters in LIRGs have a characteristic mass consistent with them being the precursors to globular clusters? 3) Are the proximity of young NUV-bright clusters relative to embedded IR-bright star clusters as traced by JWST consistent with the NUV clusters being birthed from these energetic IR starburst regions? I.e., are NUV-bright clusters representative of the imbedded star formation which drives the high IR luminosities of LIRGs? The combined dataset has strong legacy value, and the present study will greatly expand our understanding of star cluster formation and evolution in the most extreme environments, providing one of the clearest pictures to date of the complex galactic ecosystems of local starburst galaxies.

OBSERVING DESCRIPTION

HST images will be obtained using the WFC3/UVIS in imaging mode with the broad-band F336W filter. The new observations will be paired with our pre-existing ACS/WFC F435W and F814W observations. The ACS/WFC and WFC3/UVIS cameras have comparable fields of view (202"x202" and 162"x162", respectively), and cover sufficient area to enable observations of these LIRGs in a single pointing.

The clusters observed in this sample of LIRGs have M_V= -8 to -16 mag and apparent F435W (B) magnitudes typically in the range B ~ 21-25.5 mag. We have made use of instantaneous starburst models from Bruzual & Charlot (2003) to estimate the observed magnitudes in the F336W filter. For a 100 Myr starburst (F336W - F435W = -0.53 mag) and a conservative apparent magnitude of B=25.5 mag, we find that we can reach a signal-to-noise ratio, SNR, of approximately 13 with F336W in roughly 40 minutes. Note that if the clusters are younger, their spectral energy distributions peak even higher in bluer filters, and are therefore 1-2 magnitudes brighter than described above. Thus, in the absence of dust, the achieved SNR will be significantly higher.

We model our observing strategy based on GO 14066 and use a custom 4-pt dither pattern for each source designed to (1) remove the gap between the chips (1.2 arcsec) (2) sub-sample the PSF (half pixel or a third of a pixel shift have been included if the pattern is a multiple of 2 or 3, respectively), and (3) to remove droplets (shift of 4 arcsec required). The 4-pointing pattern has the following coordinates in arcsec: (0,0), (-3.69,1.31), (-2.5, -2.44), (1.19,-3.75). Further, the main body of the galaxy has been placed at the UVIS2-FIX location (which is more sensitive in the UV, and therefore, optimal to detect clusters), or at the UVIS-FIX location in order to fully map the galaxy if it has very extended tidal features (Arp 220, Mrk 231, IC 1623, NGC 3256). The pointing center for NGC 7469 has been shifted slightly away from the galaxy in order to include the companion IC4283 with all possible ORIENT angles to maximize schedule availability. Finally, we utilize the ACCUM mode, and include a FLASH of 9-10 seconds with the CR_SPLIT=NO parameter to mitigate CTE losses.

The data reduction and calibration of new and archival data will be done using the standard HST pipeline. IRAF, IDL and python will be used for additional data reduction and photometry within metric apertures. The cluster analysis will be done by using Source Extractor to identify clusters and IDL routines to extract aperture measurements of clusters and calculate luminosities. Similar analysis has been done on the F435W and F814W data (Linden et al. 2017). Folding in the analysis of GOALS data at other wavelengths will complete the interpretation of the HST dataset.

Visit

Proposal 15472, Visit 01, implementation Fri Jun 01 19:09:45 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

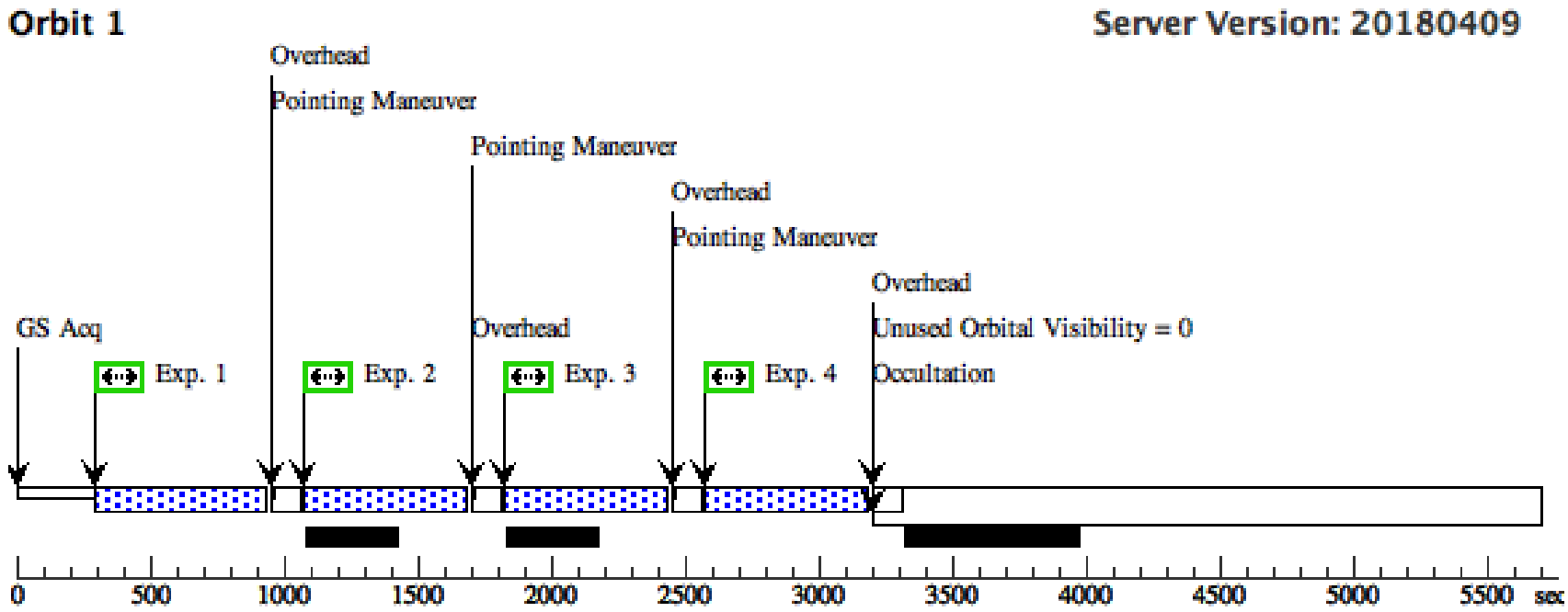
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(8)	IRASF12112+0305	RA: 12 13 46.0790 (183.4419958d) Dec: +02 48 41.15 (2.81143d) Equinox: J2000		V=16.26	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(8) IRASF12112+0305	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0; GS ACQ SCENARIO BASE1B3		614 Secs (614 Secs) *[==>]*	*[1]*
2		(8) IRASF12112+0305	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		617 Secs (617 Secs) *[==>]*	*[1]*
3		(8) IRASF12112+0305	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		614 Secs (614 Secs) *[==>]*	*[1]*
4		(8) IRASF12112+0305	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		614 Secs (614 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 02, implementation Fri Jun 01 19:09:45 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

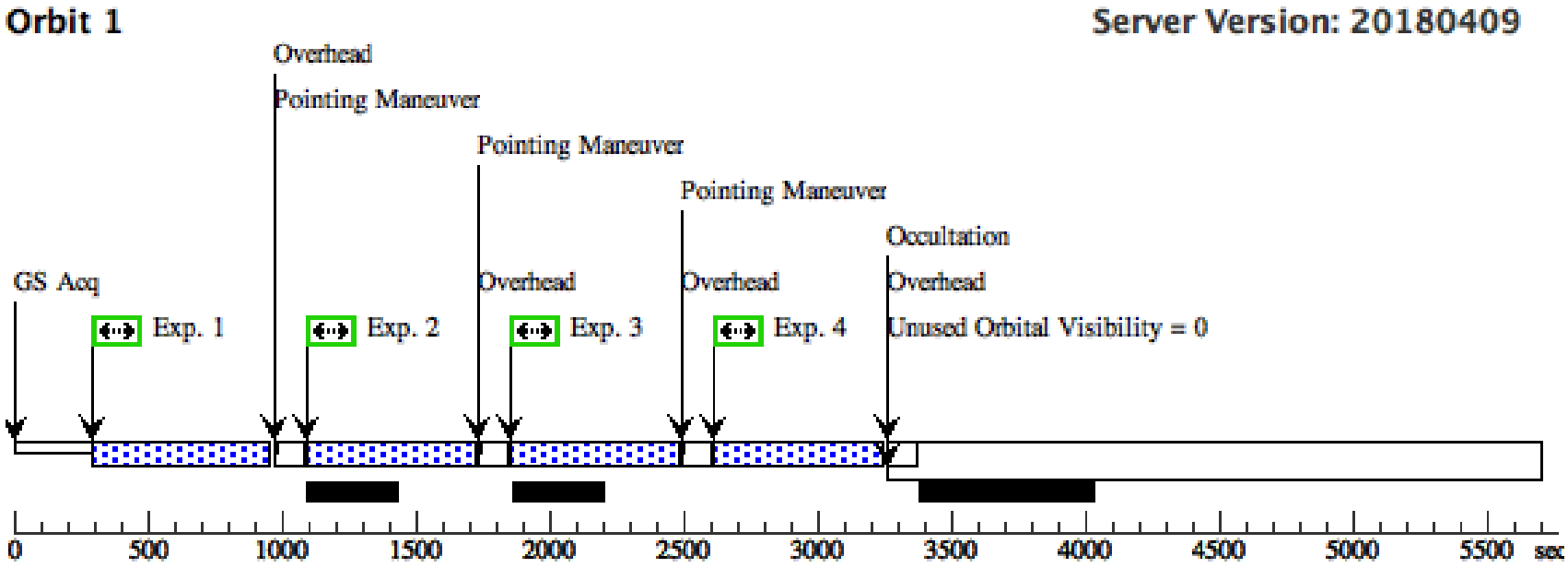
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(9)	IRASF14378-3651	RA: 14 40 59.0230 (220.2459292d) Dec: -37 04 31.23 (-37.07534d) Equinox: J2000		V=16.15	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(9) IRASF14378-3651	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		629 Secs (629 Secs) *[==>]*	*[1]*
2		(9) IRASF14378-3651	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		630 Secs (630 Secs) *[==>]*	*[1]*
3		(9) IRASF14378-3651	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		629 Secs (629 Secs) *[==>]*	*[1]*
4		(9) IRASF14378-3651	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		629 Secs (629 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 03, implementation Fri Jun 01 19:09:45 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

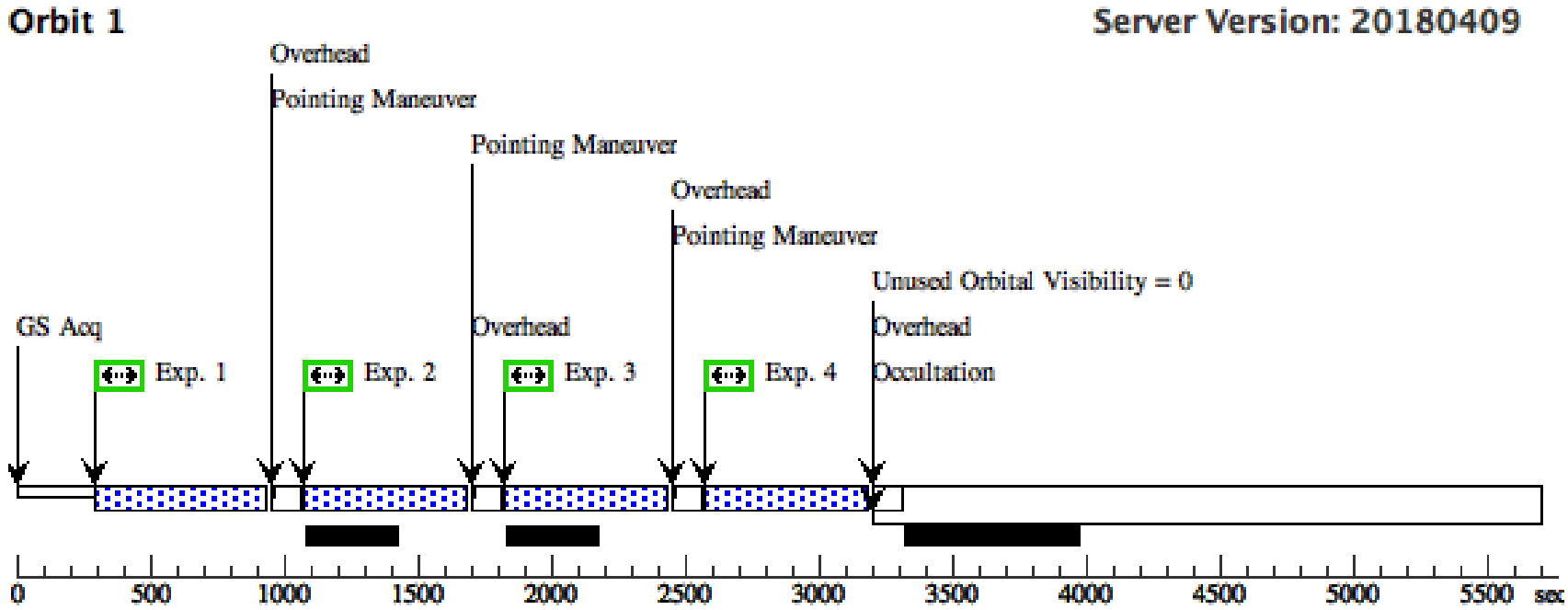
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(10)	IRASF17207-0014	RA: 17 23 22.0013 (260.8416721d) Dec: -00 17 1.00 (-.28361d) Equinox: J2000		V=14.89	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(10) IRASF17207-0014	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		614 Secs (614 Secs) *[==>]*	*[1]*
2		(10) IRASF17207-0014	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		617 Secs (617 Secs) *[==>]*	*[1]*
3		(10) IRASF17207-0014	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		614 Secs (614 Secs) *[==>]*	*[1]*
4		(10) IRASF17207-0014	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		614 Secs (614 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 04, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

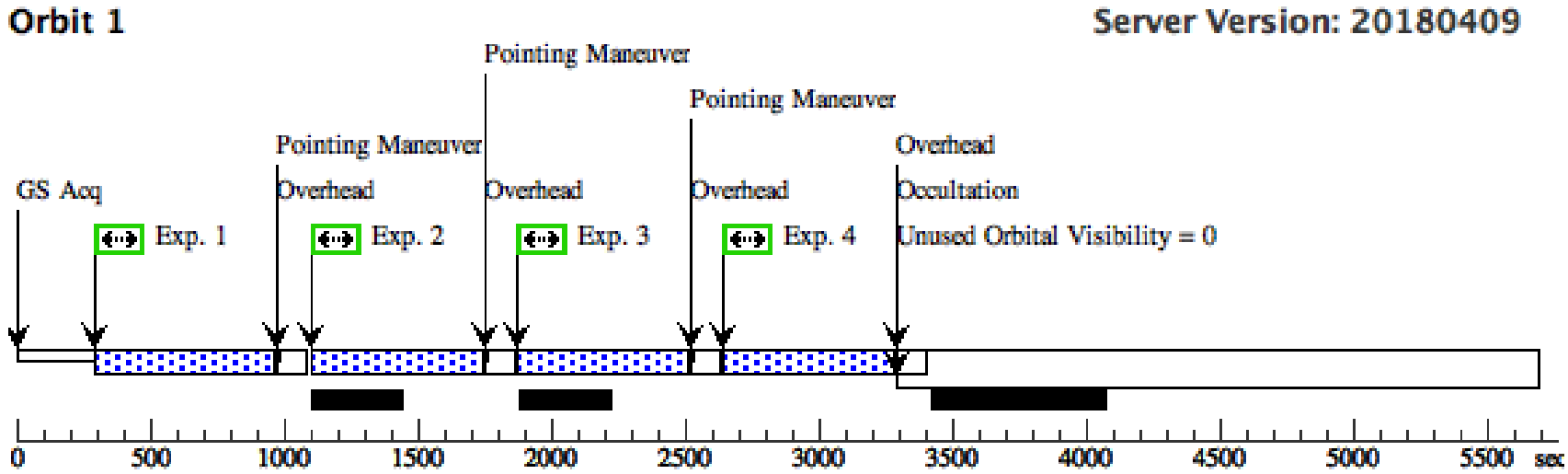
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	NGC-3256	RA: 10 27 51.3540 (156.9639750d) Dec: -43 54 11.35 (-43.90315d) Equinox: J2000		V=11.33	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) NGC-3256	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		638 Secs (638 Secs) *[==>]*	*[1]*
2		(3) NGC-3256	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		641 Secs (641 Secs) *[==>]*	*[1]*
3		(3) NGC-3256	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.4		638 Secs (638 Secs) *[==>]*	*[1]*
4		(3) NGC-3256	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		638 Secs (638 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 05, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

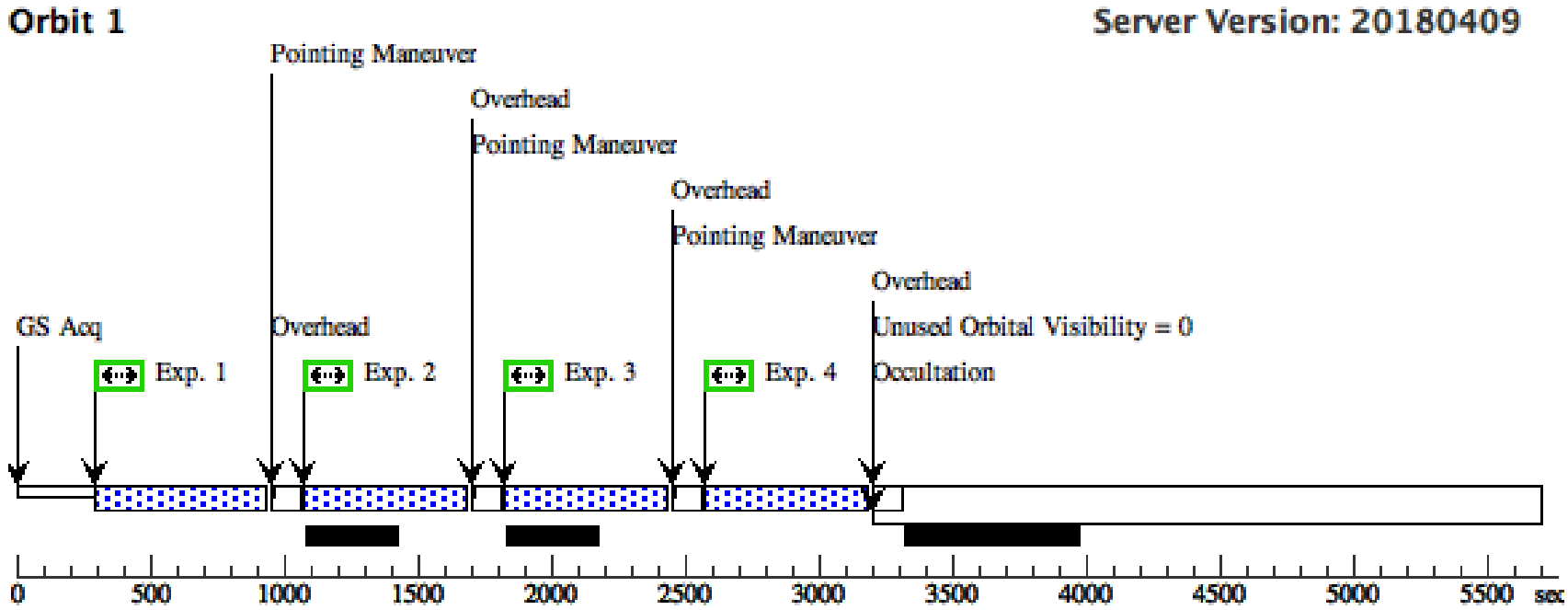
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	NGC-6240	RA: 16 52 58.9704 (253.2457100d) Dec: +02 24 2.28 (2.40063d) Equinox: J2000		V=13.37	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(7) NGC-6240	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		614 Secs (614 Secs) *[==>]*	*[1]*
2		(7) NGC-6240	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		617 Secs (617 Secs) *[==>]*	*[1]*
3		(7) NGC-6240	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		614 Secs (614 Secs) *[==>]*	*[1]*
4		(7) NGC-6240	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		614 Secs (614 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 06, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

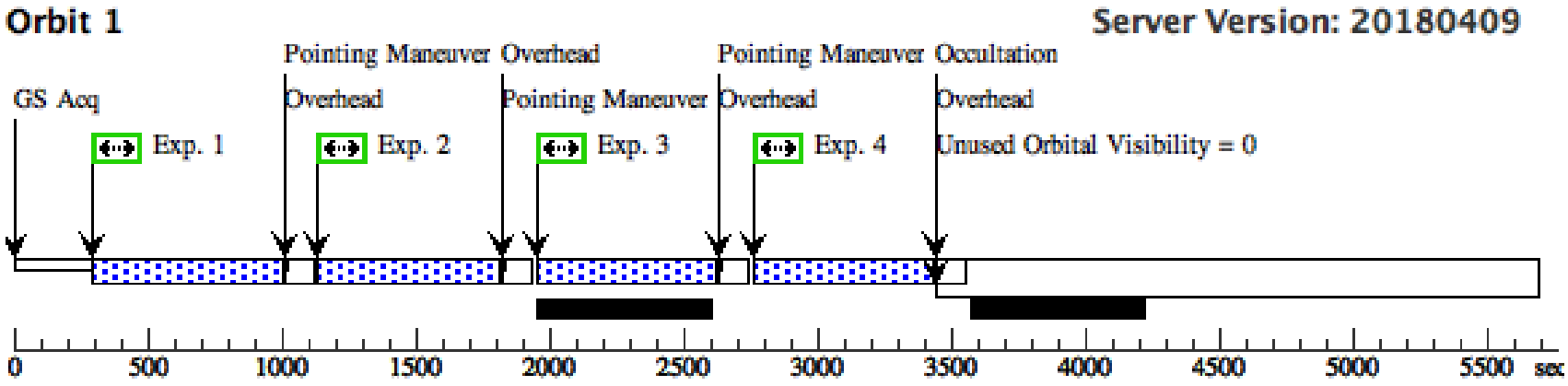
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(6)	MRK-231	RA: 12 56 14.1809 (194.0590871d) Dec: +56 52 25.16 (56.87366d) Equinox: J2000		V=13.84	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, QSO, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(6) MRK-231	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=9; CR-SPLIT=NO	POS TARG 0,0		676 Secs (676 Secs) *[==>]*	 ***[1]***
2		(6) MRK-231	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=9; CR-SPLIT=NO	POS TARG -3.69,1.31		678 Secs (678 Secs) *[==>]*	 ***[1]***
3		(6) MRK-231	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=9; CR-SPLIT=NO	POS TARG -2.5,-2.44		676 Secs (676 Secs) *[==>]*	 ***[1]***
4		(6) MRK-231	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=9; CR-SPLIT=NO	POS TARG 1.19,-3.75		676 Secs (676 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 15472, Visit 07, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

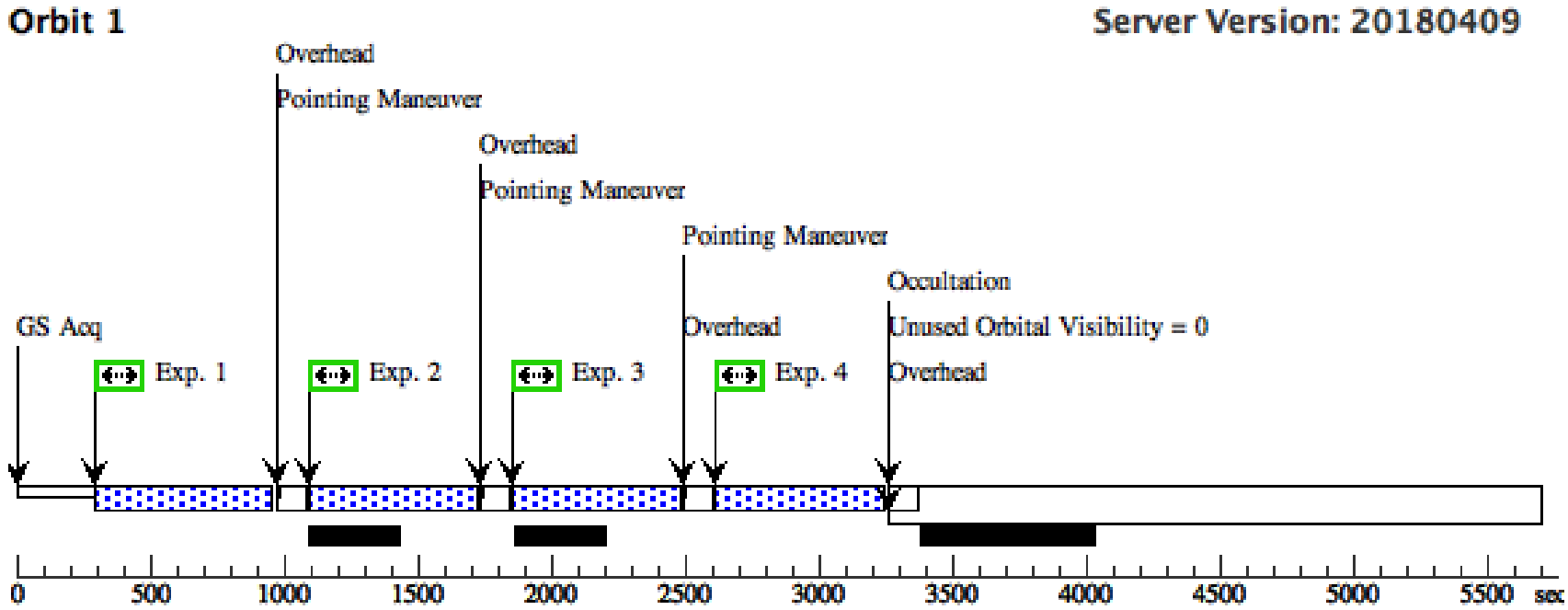
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	IRASF08572+3915	RA: 09 00 25.4815 (135.1061729d) Dec: +39 03 51.31 (39.06425d) Equinox: J2000		V=16.66	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) IRASF08572+3915	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		629 Secs (629 Secs) *[==>]*	*[1]*
2		(4) IRASF08572+3915	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		630 Secs (630 Secs) *[==>]*	*[1]*
3		(4) IRASF08572+3915	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		629 Secs (629 Secs) *[==>]*	*[1]*
4		(4) IRASF08572+3915	WFC3/UVIS, ACCUM, UVIS2-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		629 Secs (629 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 08, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

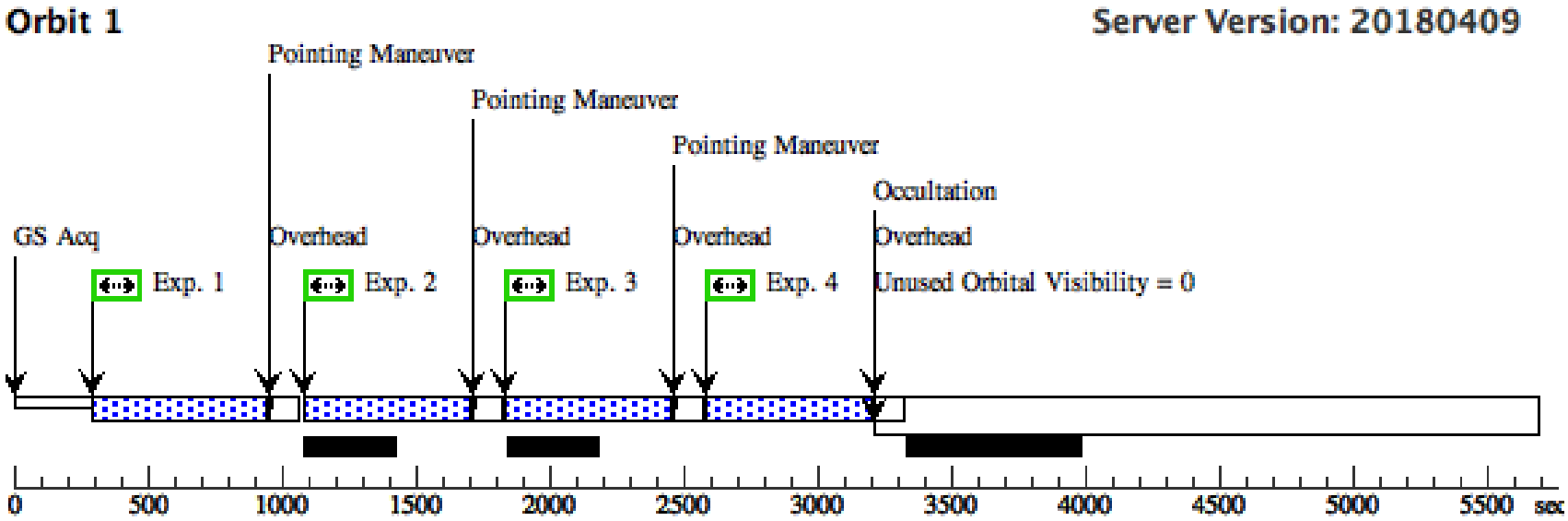
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	IC-1623	RA: 01 07 47.3219 (16.9471746d) Dec: -17 30 26.18 (-17.50727d) Equinox: J2000		V=12.91	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) IC-1623	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		618 Secs (618 Secs) *[==>]*	*[1]*
2		(1) IC-1623	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		619 Secs (619 Secs) *[==>]*	*[1]*
3		(1) IC-1623	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.4 4		618 Secs (618 Secs) *[==>]*	*[1]*
4		(1) IC-1623	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		618 Secs (618 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 09, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

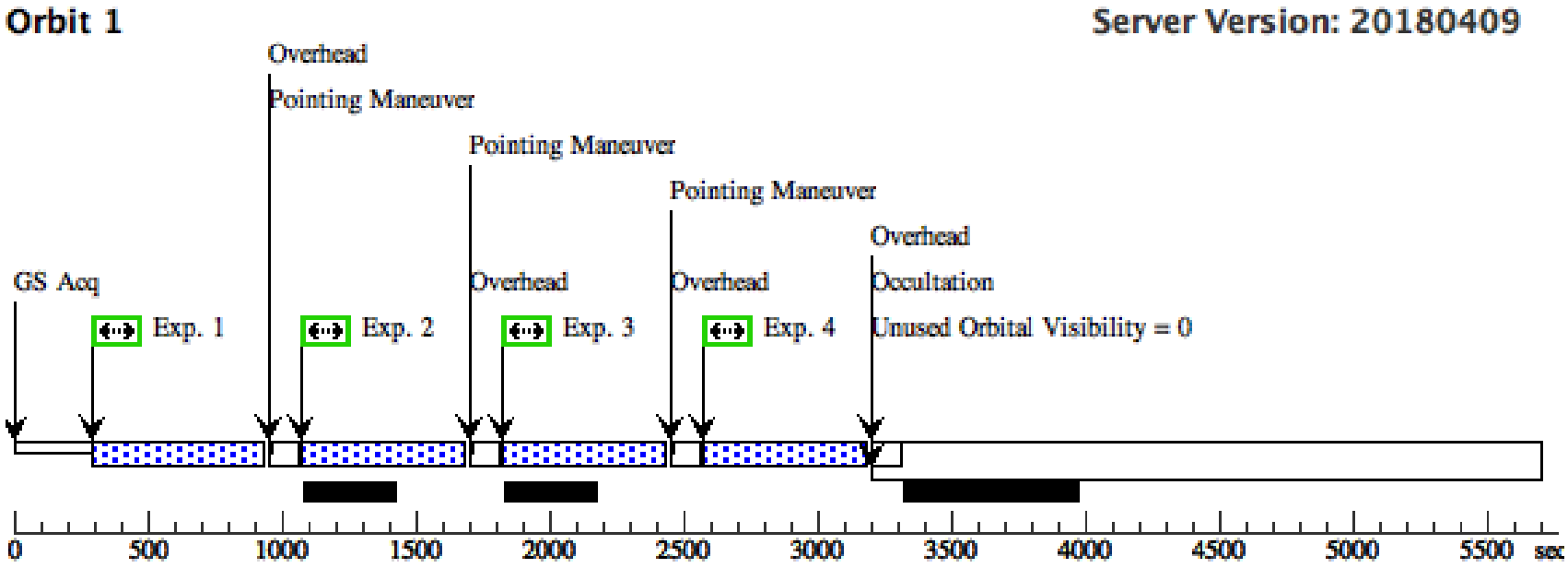
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-7469	RA: 23 03 16.3827 (345.8182613d) Dec: +08 52 53.83 (8.88162d) Equinox: J2000		V=12.34	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) NGC-7469	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		615 Secs (615 Secs) *[==>]*	*[1]*
2		(2) NGC-7469	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		617 Secs (617 Secs) *[==>]*	*[1]*
3		(2) NGC-7469	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		615 Secs (615 Secs) *[==>]*	*[1]*
4		(2) NGC-7469	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		615 Secs (615 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15472, Visit 10, implementation Fri Jun 01 19:09:46 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	ARP-220	RA: 15 34 57.2869 (233.7386954d) Dec: +23 30 11.30 (23.50314d) Equinox: J2000		V=13.88	Reference Frame: SIMBAD

Comments:
Category=GALAXY
Description=[INTERACTING GALAXY, MULTIPLE NUCLEI, STARBURST, ULTRALUMINOUS IR GAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) ARP-220	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 0,0		618 Secs (618 Secs) *[==>]*	*[1]*
2		(5) ARP-220	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -3.69,1.31		620 Secs (620 Secs) *[==>]*	*[1]*
3		(5) ARP-220	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG -2.5,-2.44		618 Secs (618 Secs) *[==>]*	*[1]*
4		(5) ARP-220	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10; CR-SPLIT=NO	POS TARG 1.19,-3.75		618 Secs (618 Secs) *[==>]*	*[1]*

Orbit Structure