18126 - Efficient selection of Lyman Continuum emitters at z > 3

Cycle: 33, Proposal Category: GO

(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) PIE-FIELD-10	WFC3/UVIS	1	05-Aug-2025 13:01:37.0	yes
02	(2) PIE-FIELD-20	WFC3/UVIS	1	05-Aug-2025 13:01:38.0	yes
03	(3) PIE-FIELD-24	WFC3/UVIS	1	05-Aug-2025 13:01:38.0	yes
04	(4) PIE-FIELD-28	WFC3/UVIS	1	05-Aug-2025 13:01:38.0	yes
05	(5) PIE-FIELD-30	WFC3/UVIS	1	05-Aug-2025 13:01:39.0	yes
06	(6) PIE-FIELD-50	WFC3/UVIS	1	05-Aug-2025 13:01:39.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
07	(7) PIE-FIELD-52	WFC3/UVIS	1	05-Aug-2025 13:01:39.0	yes
08	(8) PIE-FIELD-54	WFC3/UVIS	1	05-Aug-2025 13:01:40.0	yes

8 Total Orbits Used

ABSTRACT

Understanding which galaxies dominated the ionizing flux (Lyman continuum, LyC) that reionized the early Universe requires measuring the escape fraction of galaxies during that epoch. This cannot be done directly, so instead we need to use indirect indicators calibrated on galaxies observed shortly after reionization.

The Parallel Ionizing Emissivity (PIE) survey is an ongoing effort to address this by detecting over 400 galaxies across ~50 independent fields that can be stacked to measure how LyC emission varies with galaxy properties. This survey uses F336W imaging to probe pure LyC at 3.1<z<3.5, alongside F625W and F814W to select U-dropout galaxies for spectroscopic follow-up, which will be used to confirm redshifts and measure emission-line properties.

Unfortunately, 8 fields with >3 orbits of F336W data are missing one of these bands, so cannot be used. Therefore, we propose a very small investment of WFC3 imaging to complement 40 orbits of existing data in these fields. These observations will allow us to efficiently detect dropout galaxies and thereby add over 100 galaxies at 3.1<z<3.5 to the PIE sample, of which ~30 will be confirmed as LyC emitters. Leveraging the existing data makes this program far more efficient than observing new fields. Confirmed LyC emitters will likely become prime targets for future studies with JWST.

Aided by the increased sample, we will calibrate LyC indicators out to z~3.5 by measuring escape fractions as a function of stellar mass, morphology, star-formation surface density, Ly-alpha properties, UV luminosity, and UV colors, helping to understand which galaxies emitted the flux that reionized the early Universe.

OBSERVING DESCRIPTION

AIMS:

The Parallel Ionizing Emissivity (PIE) survey is an ongoing effort to build a sample of over 400 galaxies across ~50 independent fields that can be stacked to measure how Lyman continuum (LyC) emission varies with galaxy properties. This survey uses F336W imaging to probe pure LyC at

3.1<z<3.5, alongside F625W and F814W to select U-dropout galaxies for spectroscopic follow-up, which will be used to confirm redshifts and measure emission-line properties. Unfortunately, 8 fields with >3 orbits of F336W data are missing one of the optical bands, so we cannot measure the colors required to select candidates for follow-up. This program aims to replace the missing F625W and F814W data and thereby substantially increase the number of candidate galaxies that we can target with spectroscopy.

EXPOSURES:

We use WFC3/UVIS observations so that we can utilize our existing pipeline to easily reduce the data and produce photometric catalogs including both the new and existing data. One orbit of F625W or F814W in each field is sufficient to match or exceed the depth of the existing observations. In order to ensure that CTE degradation does not affect our observations, we observe each field with three exposures (each of 750-800s depending on orbital visibility). These relatively long exposures allow for sufficient background to avoid the worst effects of poor CTE. We also add a small post-flash (2e-) to our F814W observations, ensuring that we exceed the recommended background levels.

DITHER:

We use the 'UVIS-GAP-LINE' dither pattern to cover the chip gap with two of our three exposures. This will allow reasonable cleaning of cosmic rays from the images and provide usable data at every location. This is particularly important for this program as the existing PIE data are not dithered, so do not cover the chip gap. The chip gap of the new data will be at a different orienation to that of the earlier data. Covering the chip gap in the new data ensures that we do not further restrict the available area in which there is coverage with all three filters.

SPECIAL REQUIREMENTS:

In order to maximize the overlap with the existing PIE data, we request ORIENT constraints. In the Phase I, we requested constraints such that at least 90% of the existing field is covered by the new observations (wherever this could be done with minimal impacts to schdeuling). This requires that the orientation of the new images matches that of the existing images to within ~15 degrees. For most of our observations these constraints can be applied and there are still large windows available during which they can be scheduled. However, for fields 52 and 54 (visits 07 and 08), this constraint leaves quite small windows for scheduling, so we remove the ORIENT constraints for these visits.

Visit

Proposal 18126, Visit 01 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 1D TO 31 D; ORIENT 91D TO 121 D; ORIENT 181D TO 211 D; ORIENT 271D TO 301 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

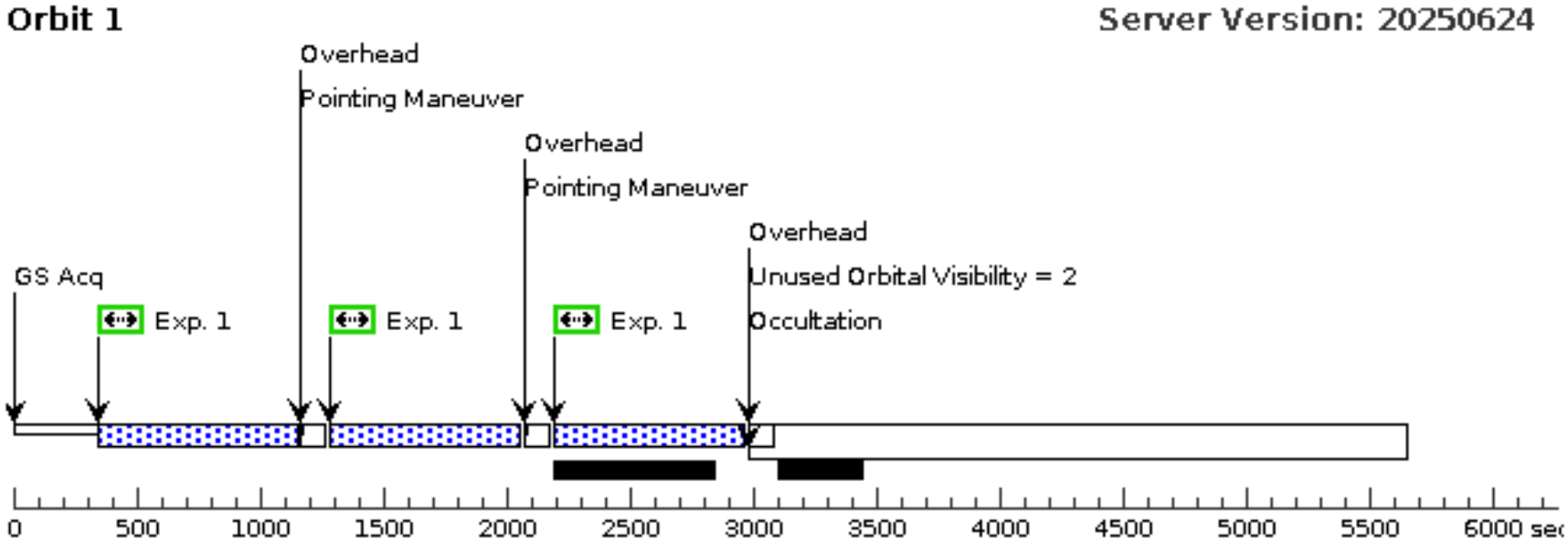
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PIE-FIELD-10	RA: 08 15 31.1100 (123.8796250d)		V=26.0	Reference Frame: ICRS
		Dec: +29 40 3.50 (29.66764d)			
		Equinox: J2000			

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) PIE-FIELD-10	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 01 (3)	550 Secs (2331 Secs)	
								[==>777.0 Secs (Pattern 1)]	
								[==>777.0 Secs (Pattern 2)]	***[1]***
								[==>777.0 Secs (Pattern 3)]	

Orbit Structure



Visit

Proposal 18126, Visit 02 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 68D TO 98 D; ORIENT 158D TO 188 D; ORIENT 248D TO 278 D; ORIENT 338D TO 8 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

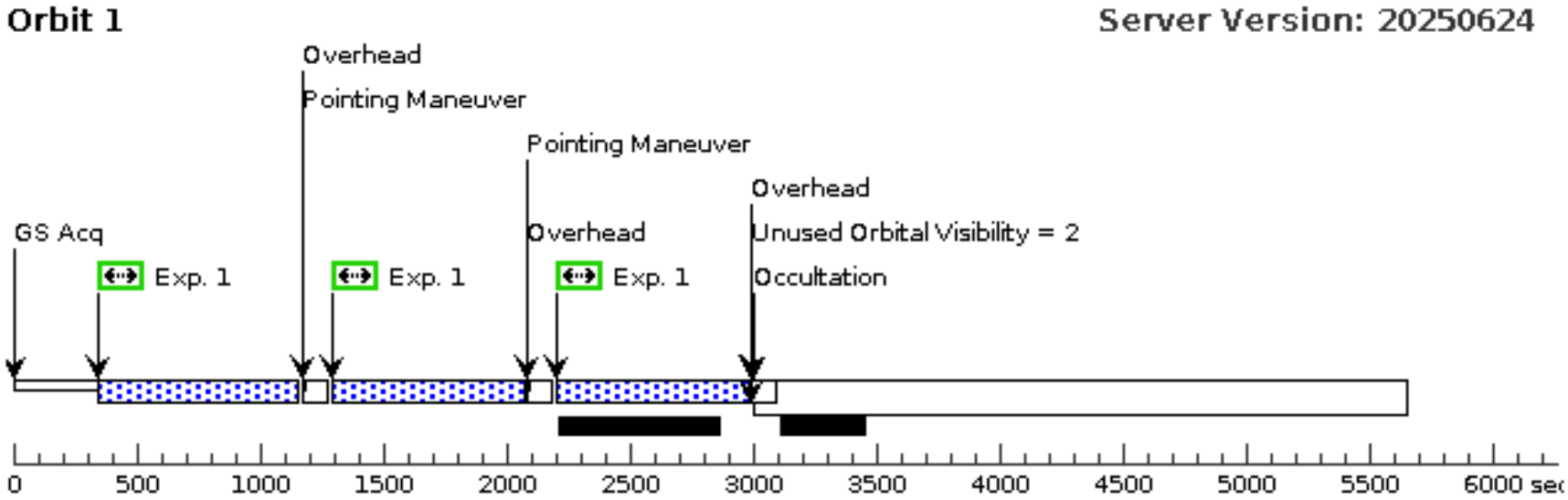
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PIE-FIELD-20	RA: 14 18 51.0371 (214.7126546d) Dec: +42 03 36.75 (42.06021d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) PIE-FIELD-20	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 02 (3)	550 Secs (2349 Secs) *[==>783.0 Secs (Pattern 1)]* *[==>783.0 Secs (Pattern 2)]* *[==>783.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 18126, Visit 03 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 73D TO 103 D; ORIENT 163D TO 193 D; ORIENT 253D TO 283 D; ORIENT 343D TO 13 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

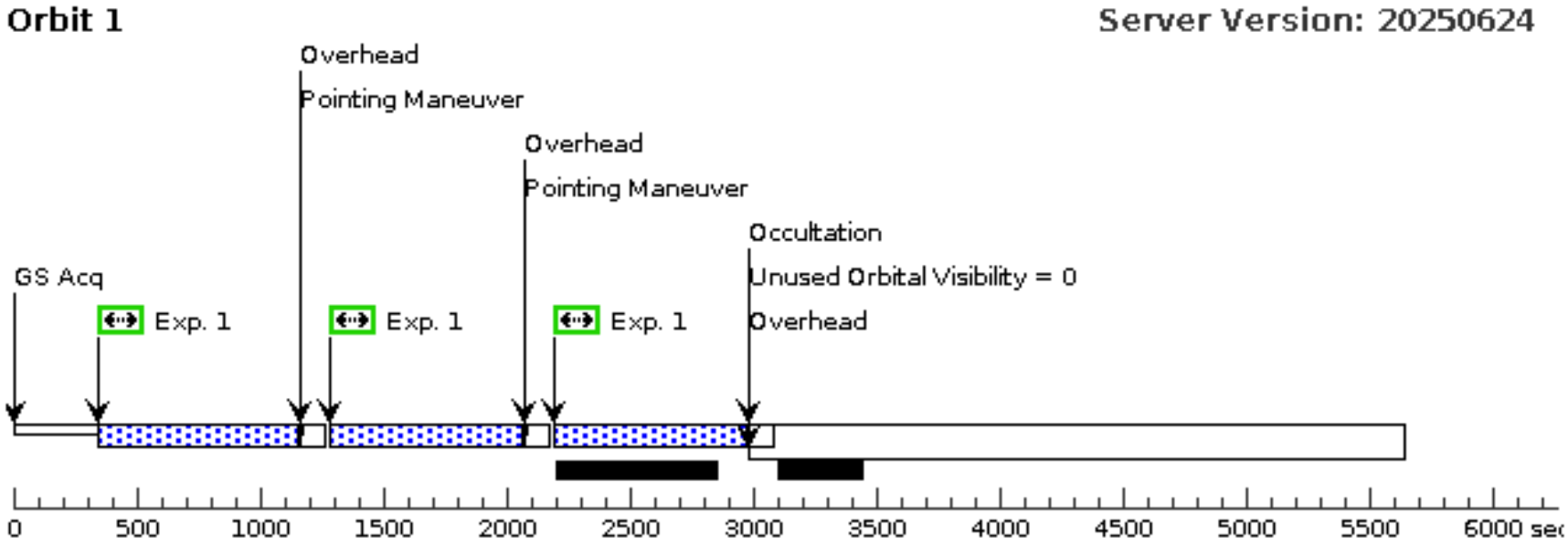
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	PIE-FIELD-24	RA: 16 07 27.1500 (241.8631250d) Dec: +32 14 1.81 (32.23384d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) PIE-FIELD-24	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 03 (3)	550 Secs (2337 Secs) *[==>779.0 Secs (Pattern 1)]* *[==>779.0 Secs (Pattern 2)]* *[==>779.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 18126, Visit 04 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 101D TO 131 D; ORIENT 191D TO 221 D; ORIENT 281D TO 311 D; ORIENT 11D TO 41 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

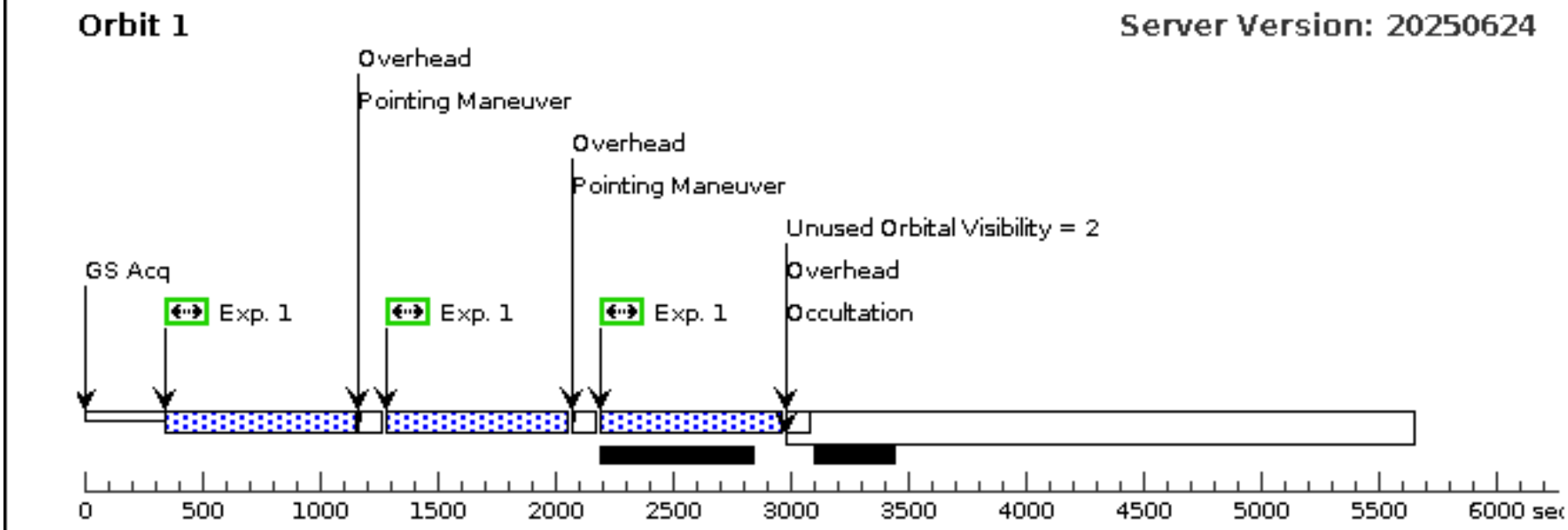
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	PIE-FIELD-28	RA: 09 09 41.4700 (137.4227917d) Dec: +27 39 43.39 (27.66205d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) PIE-FIELD-28	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 04 (3)	550 Secs (2331 Secs) *[==>777.0 Secs (Pattern 1)]* *[==>777.0 Secs (Pattern 2)]* *[==>777.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 18126, Visit 05 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 90D TO 120 D; ORIENT 180D TO 210 D; ORIENT 270D TO 300 D; ORIENT 0D TO 30 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

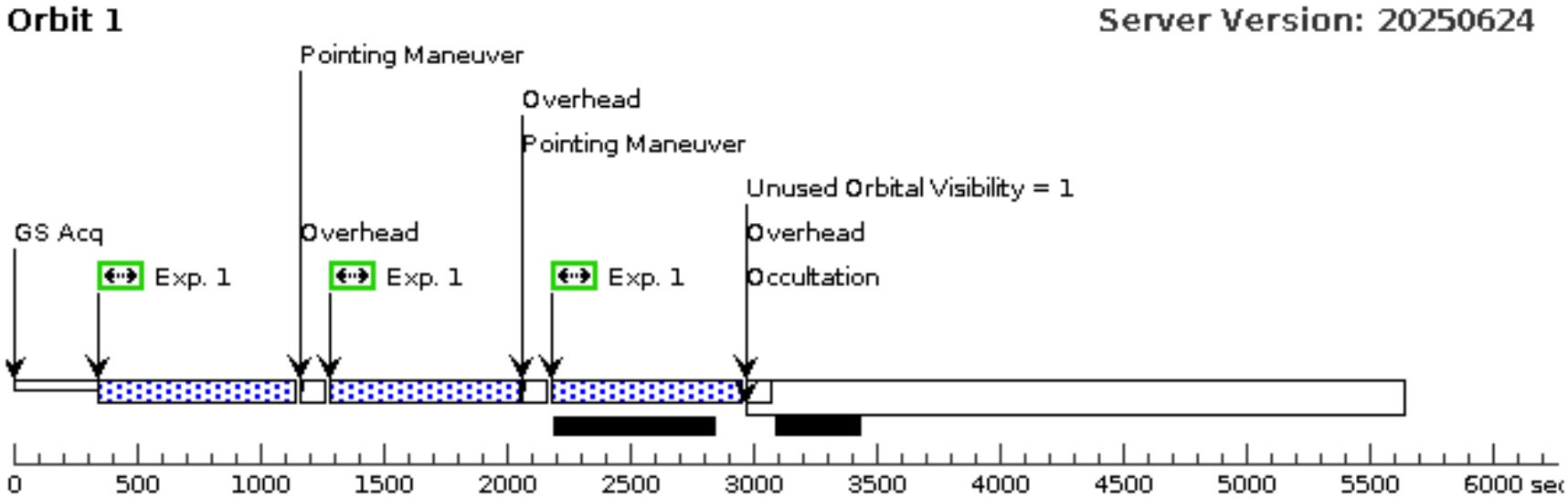
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	PIE-FIELD-30	RA: 07 45 47.4800 (116.4478333d) Dec: +19 22 54.40 (19.38178d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) PIE-FIELD-30	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 05 (3)	550 Secs (2325 Secs) *[==>775.0 Secs (Pattern 1)]* *[==>775.0 Secs (Pattern 2)]* *[==>775.0 Secs (Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 18126, Visit 06 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 8D TO 38 D; ORIENT 98D TO 128 D; ORIENT 188D TO 218 D; ORIENT 278D TO 308 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

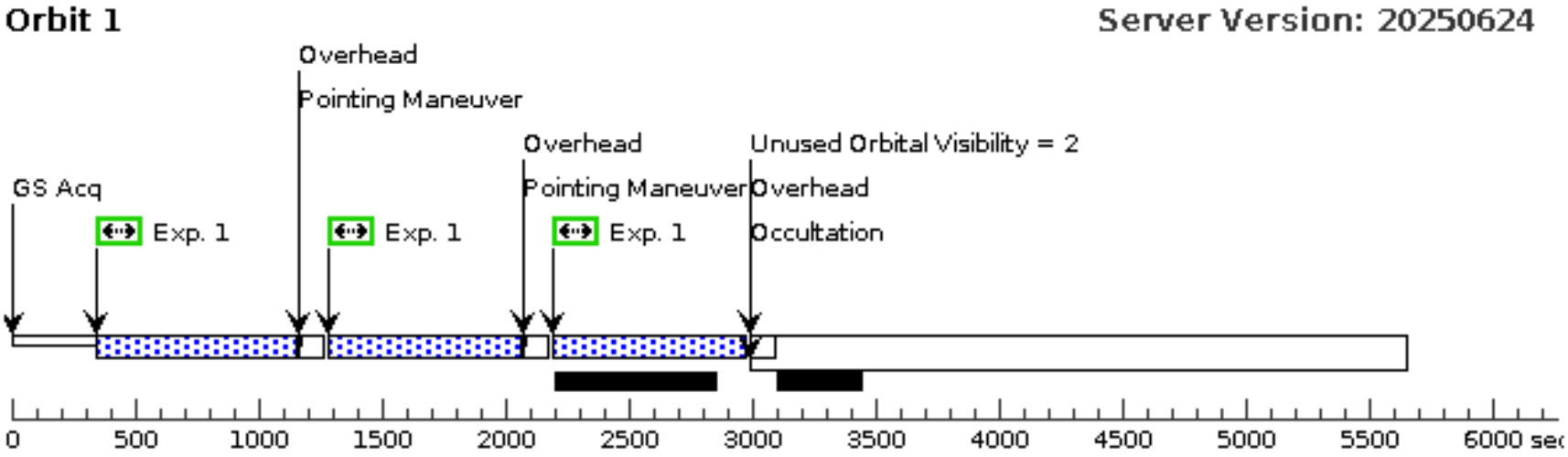
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(6)	PIE-FIELD-50	RA: 09 55 1.5040 (148.7562667d) Dec: +39 34 5.51 (39.56820d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(6) PIE-FIELD-50	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 06 (3)	550 Secs (2340 Secs) *[==>780.0 Secs (Pattern 1)]* *[==>780.0 Secs (Pattern 2)]* *[==>780.0 Secs (Pattern 3)]*	 ***[1]***

Orbit Structure



Visit

Proposal 18126, Visit 07 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

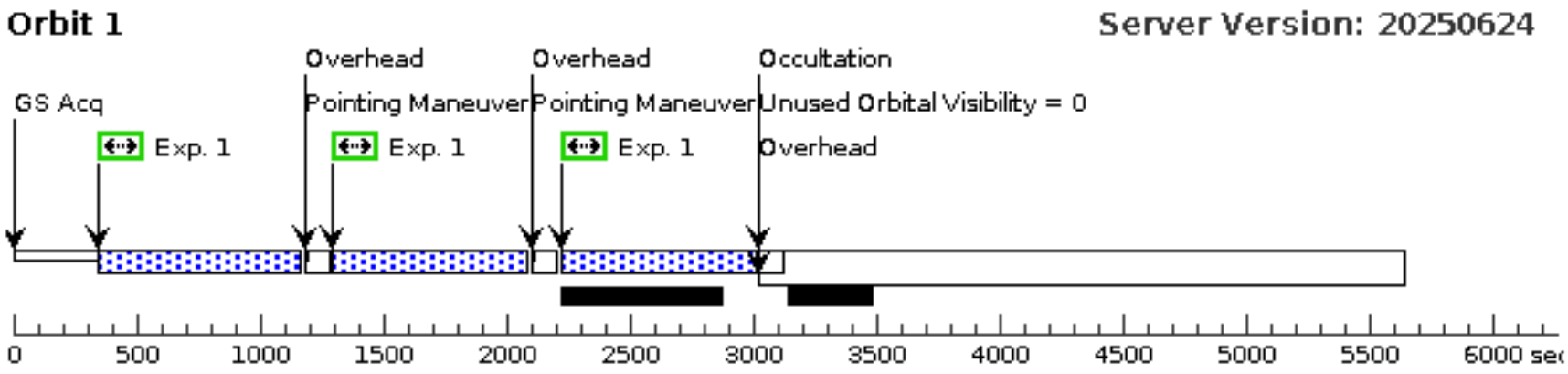
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	PIE-FIELD-52	RA: 06 27 55.9940 (96.9833083d)		V=26.0	Reference Frame: ICRS
		Dec: -50 57 10.94 (-50.95304d)			
		Equinox: J2000			

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(7) PIE-FIELD-52	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=2		Pattern 3, Exps 1-1 in Visit 07 (3)	550 Secs (2376 Secs)	
								[==>792.0 Secs (Pattern 1)]	
								[==>792.0 Secs (Pattern 2)]	***[1]***
								[==>792.0 Secs (Pattern 3)]	

Orbit Structure



Visit

Proposal 18126, Visit 08 Tue Aug 05 17:01:40 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(8)	PIE-FIELD-54	RA: 00 41 16.0520 (10.3168833d) Dec: -51 26 50.10 (-51.44725d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[PARALLEL FIELD]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(8) PIE-FIELD-54	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W			Pattern 3, Exps 1-1 in Visit 08 (3)	550 Secs (2382 Secs)	
								[==>794.0 Secs (Pattern 1)]	
								[==>794.0 Secs (Pattern 2)]	***[1]***
								[==>794.0 Secs (Pattern 3)]	

Orbit Structure