



17117 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at $z=2.16$

Cycle: 30, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) SPIDERWEB-WFC3-1A	WFC3/IR	1	01-May-2023 10:00:14.0	yes
02	(2) SPIDERWEB-WFC3-1B	WFC3/IR	1	01-May-2023 10:00:15.0	yes
03	(3) SPIDERWEB-WFC3-1C	WFC3/IR	1	01-May-2023 10:00:16.0	yes
04	(4) SPIDERWEB-WFC3-2A	WFC3/IR	1	01-May-2023 10:00:16.0	yes
05	(5) SPIDERWEB-WFC3-2B	WFC3/IR	1	01-May-2023 10:00:17.0	yes
06	(6) SPIDERWEB-WFC3-3A	WFC3/IR	1	01-May-2023 10:00:18.0	yes
07	(7) SPIDERWEB-WFC3-3B	WFC3/IR	1	01-May-2023 10:00:18.0	yes

7 Total Orbits Used

ABSTRACT

We propose deep (7-orbit) WFC3/IR G141 spectroscopy of the central region of the best-studied galaxy cluster in formation - the "Spiderweb" protocluster at $z=2.16$ - to blindly search for and characterize quiescent members in the dense core of the protocluster. We will measure the strengths of the 4000Å break (D_n4000) and the equivalent widths of the H-delta absorption line for all cluster member galaxies in the single WFC3 FoV ($\sim 1.5\text{cMpc} \times 1.5\text{cMpc}$). This enables us to determine the formation redshifts (z_f) of individual cluster members and identify recently quenched galaxies (post-starbursts), allowing us to test if massive cluster galaxies are formed at much earlier epoch (at $z \gg 4$), or if a majority of them are recently quenched. Importantly, in addition to the rich multi-wavelength datasets collected over the last ~ 20 years, the scheduled JWST/NIRCam Cycle-1 GO program and ALMA Cycle-8 program for wide-field 1.1mm mapping will unveil the obscured star-formation in the Spiderweb protocluster through Paschen-beta and dust continuum. By mapping the internal distribution of star-forming and quenched/quenching pixels within the protocluster members - our ultimate goal is to reveal how the quenching event is triggered and propagated within massive cluster galaxies. Do the quenched region always propagate in an inside-out fashion? Or, does it happen simultaneously throughout the disk? The proposed WFC3 observations are critical to identify the quiescent members, and with the scheduled JWST observations, we will finally have a complete census of all cluster members of this structure at the peak epoch of star-formation, black hole and molecular gas activity.

OBSERVING DESCRIPTION

The aim of this proposal is to perform a slitless WFC3/IR G141 grism spectroscopy in the central region of the Spiderweb protocluster at $z = 2.16$. The primary spectrum order of the G141 grism covers $\lambda=1.07\text{-}1.72\mu\text{m}$ with a spectral resolution of $R \sim 130$. This wavelength range covers the major rest-optical spectral features of the protocluster member galaxies at $z=2.16$ such as [OII]3727, H β 4861, [OIII]5007, H δ 4102, and the 4000Å break. With a single pointing of WFC3 FoV ($2' \times 2'$; equivalently $1.5 \times 1.5 \text{ Mpc}^2$ in the comoving scale), we can efficiently observe a variety of galaxies situated in the protocluster core environment. To avoid overlapping of the spectra in dense environments, we request three different ORIENT.

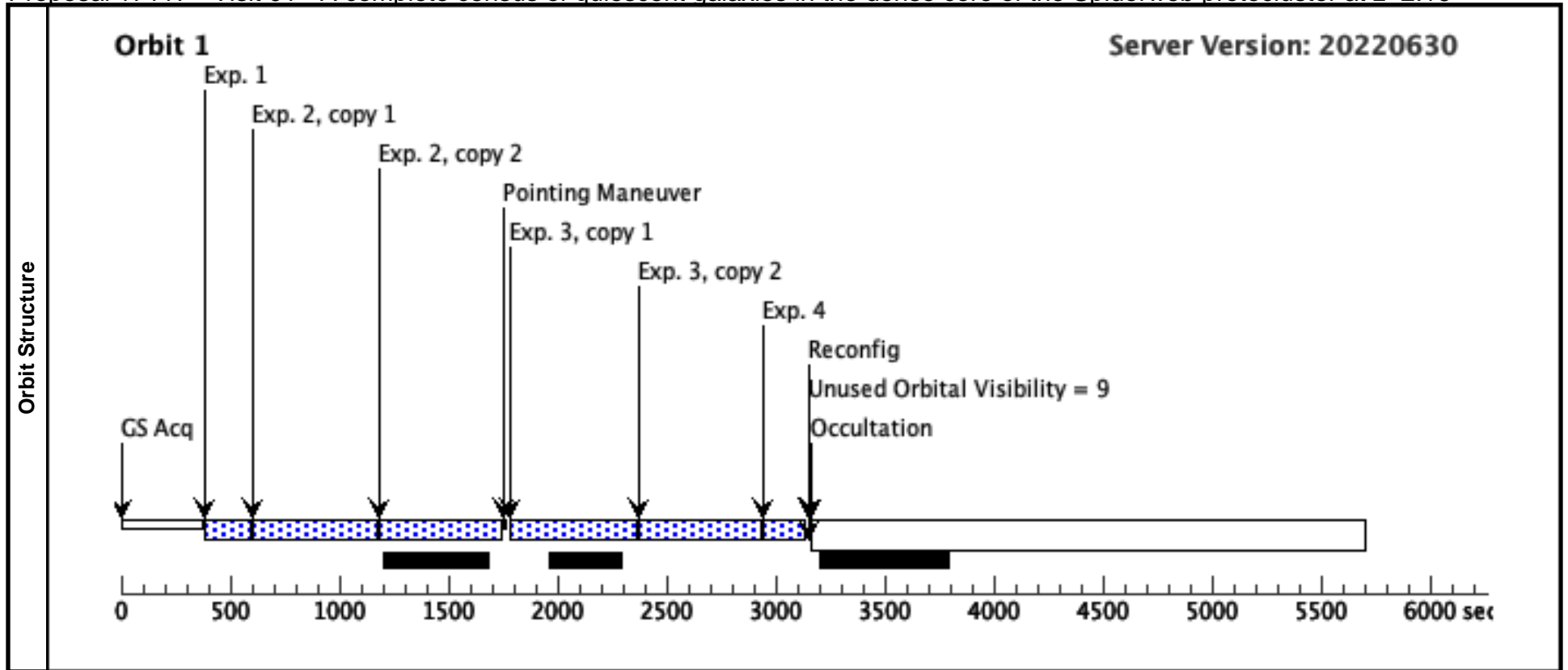
The proposed target is visible for 53min in one orbit. Following the standard overhead calculation described in the WFC3 Instrument Handbook, we will spend 9min for overheads per orbit, including guide star acquisition, filter change, camera setup, and readouts. Also we request a short direct imaging (undispersed) with F160W filter ($\sim 5\text{-min}$) to calibrate target positions and wavelengths. By subtracting these overhead times from the available orbit visibility of the target (53min), we can take 38min science exposure for grism spectroscopy. Our goal is to obtain a total 234min

Proposal 17117 (STScI Edit Number: 1, Created: Monday, May 1, 2023 at 9:00:19 AM Eastern Standard Time) - Overview
science exposure with G141 grism. To achieve this goal, we need 7 orbits in total.

Proposal 17117 - Visit 01 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

Mon May 01 14:00:19 GMT 2023

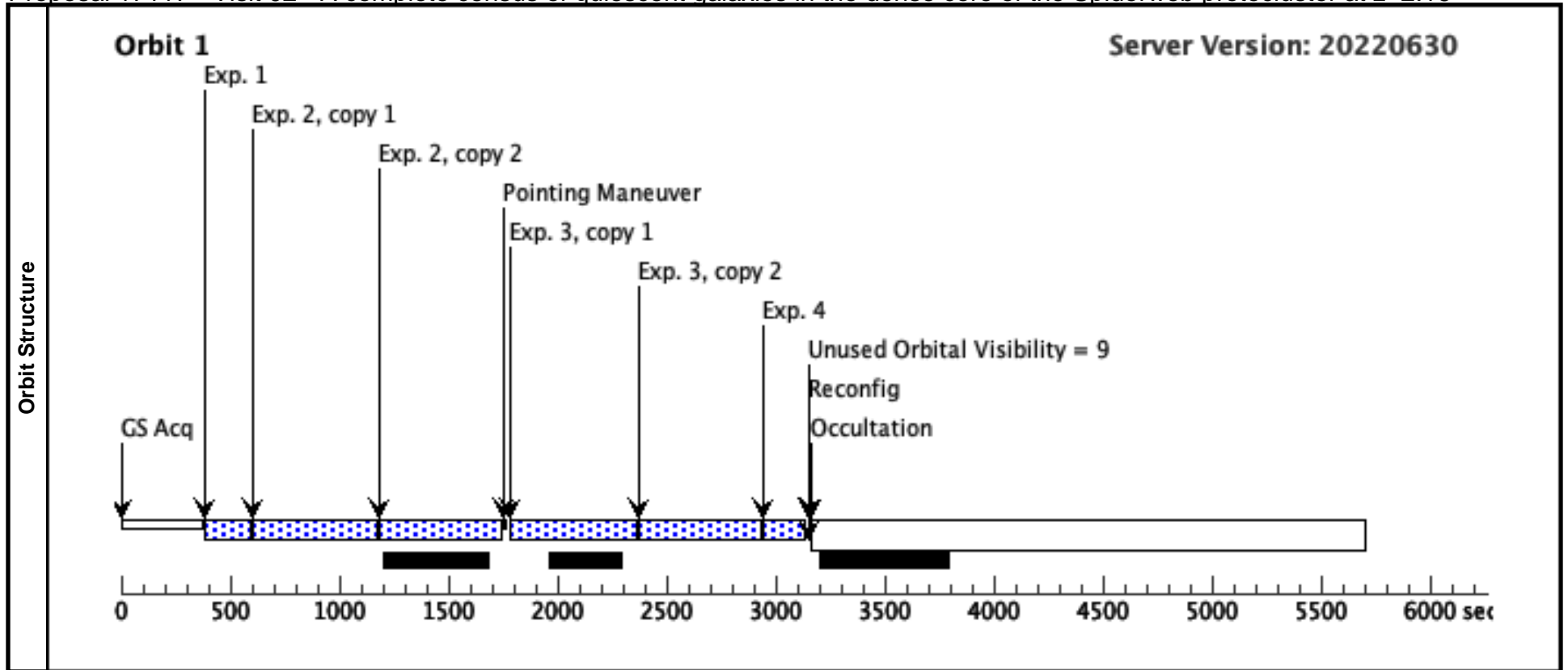
Visit	Proposal 17117, Visit 01, scheduled Diagnostic Status: Warning Scientific Instruments: WFC3/IR Special Requirements: ORIENT 80D TO 80 D									
	(Visit 01) Warning (Orbit Planner): SAME POS MAY NOT BE APPROPRIATE (Visit 01) Warning (Orbit Planner): SAME POS MAY NOT BE APPROPRIATE (Visit 01) Warning (Orbit Planner): SAME POS MAY NOT BE APPROPRIATE									
Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SPIDERWEB-WFC3-1A	RA: 11 40 49.2588 (175.2052450d) Dec: -26 29 30.64 (-26.49184d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS				
Comments: Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(1) SPIDERWEB-WFC3-1A	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 01	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 and 2	(1) SPIDERWEB-WFC3-1A	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 01	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 and 4	(1) SPIDERWEB-WFC3-1A	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 01	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(1) SPIDERWEB-WFC3-1A	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 01	177.935896 Secs (177.936 Secs) [==>]	[1]



Proposal 17117 - Visit 02 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

Mon May 01 14:00:19 GMT 2023

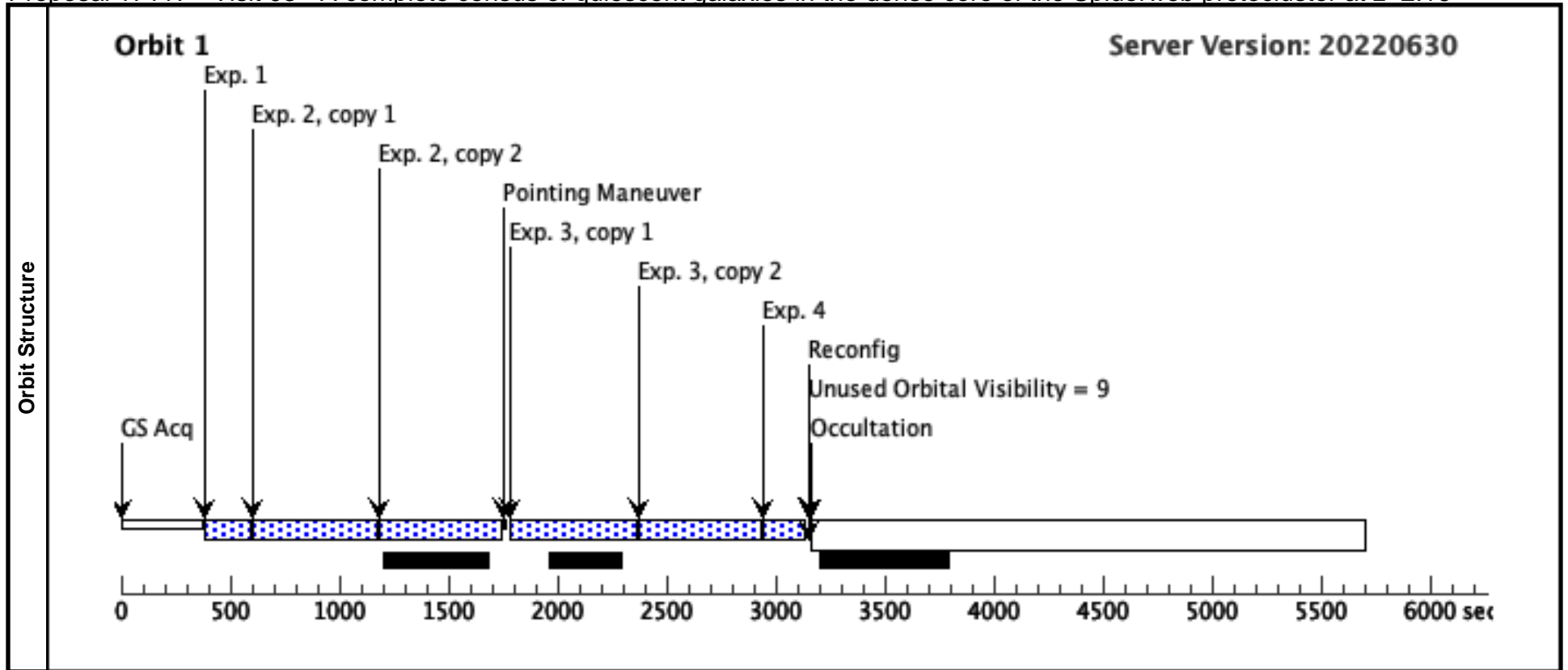
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	Diagnostics	(Visit 02) Warning (Orbit Planner): SAME POS MAY NOT BE APPROPRIATE (Visit 02) Warning (Orbit Planner): SAME POS MAY NOT BE APPROPRIATE (Visit 02) Warning (Orbit Planner): SAME POS MAY NOT BE APPROPRIATE								
Fixed Targets		#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(2)	SPIDERWEB-WFC3-1B	RA: 11 40 49.2588 (175.2052450d) Dec: -26 29 29.64 (-26.49157d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS			
	<i>Comments:</i> Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(2) SPIDERWEB-WFC3-1B	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 02	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 a nd 2	(2) SPIDERWEB-WFC3-1B	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 02	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 a nd 4	(2) SPIDERWEB-WFC3-1B	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 02	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(2) SPIDERWEB-WFC3-1B	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 02	177.935896 Secs (177.936 Secs) [==>]	[1]



Proposal 17117 - Visit 03 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

Mon May 01 14:00:19 GMT 2023

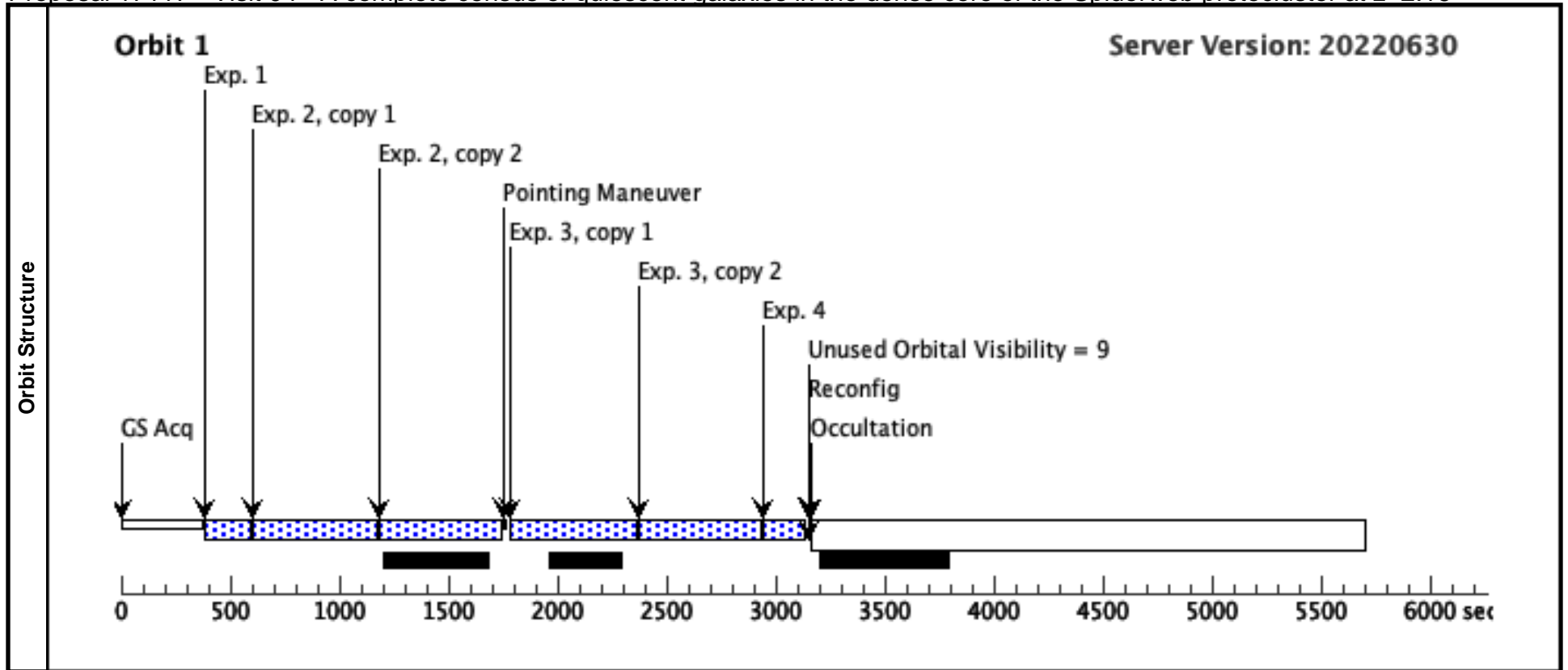
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Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(3)	SPIDERWEB-WFC3-1C	RA: 11 40 49.2588 (175.2052450d) Dec: -26 29 31.64 (-26.49212d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS				
Comments: Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(3) SPIDERWEB-WFC3-1C	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 03	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 and 2	(3) SPIDERWEB-WFC3-1C	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 03	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 and 4	(3) SPIDERWEB-WFC3-1C	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 03	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(3) SPIDERWEB-WFC3-1C	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 03	177.935896 Secs (177.936 Secs) [==>]	[1]



Proposal 17117 - Visit 04 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

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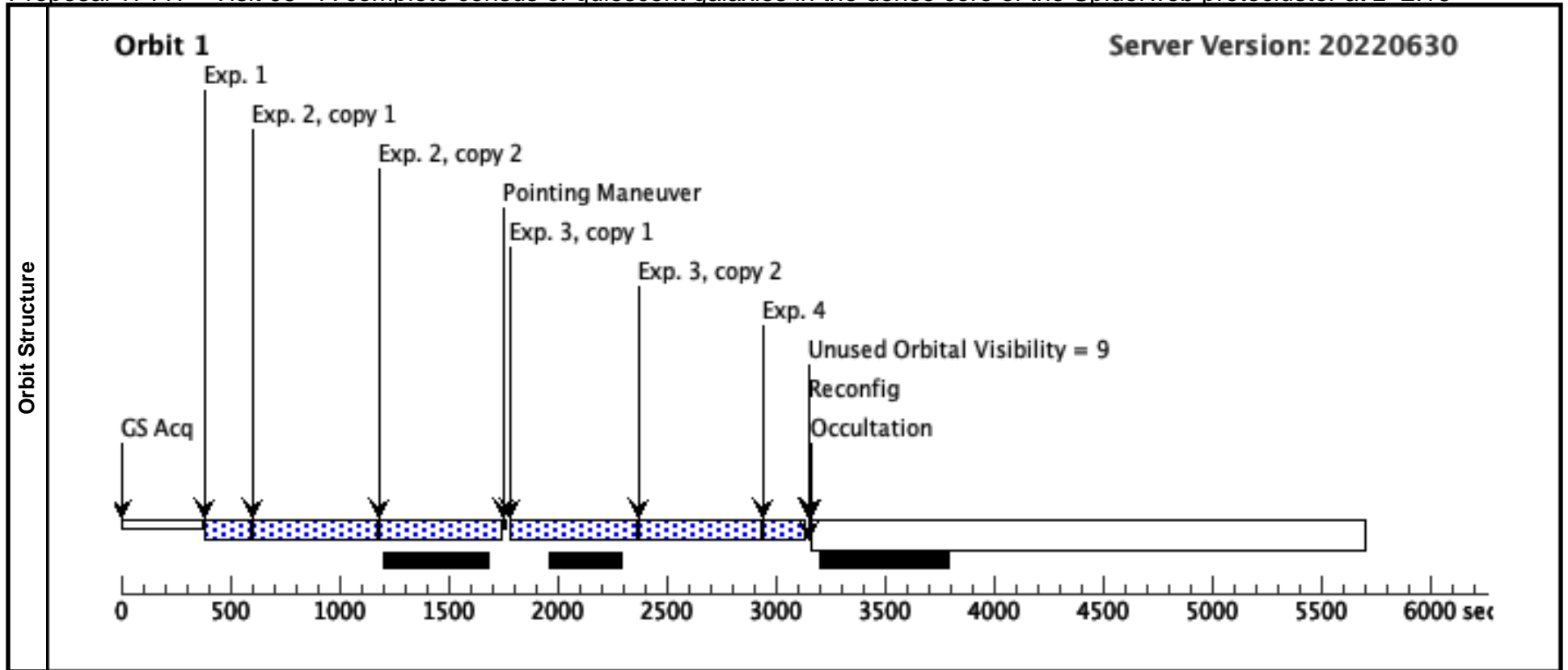
Visit	Proposal 17117, Visit 04, implementation Diagnostic Status: Warning Scientific Instruments: WFC3/IR Special Requirements: ORIENT 102D TO 102 D									
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Fixed Targets		#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(4)	SPIDERWEB-WFC3-2A	RA: 11 40 48.6254 (175.2026058d) Dec: -26 29 33.60 (-26.49267d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS			
	<i>Comments:</i> Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(4) SPIDERWEB-WFC3-2A	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 04	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 and 2	(4) SPIDERWEB-WFC3-2A	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 04	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 and 4	(4) SPIDERWEB-WFC3-2A	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 04	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(4) SPIDERWEB-WFC3-2A	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 04	177.935896 Secs (177.936 Secs) [==>]	[1]



Proposal 17117 - Visit 05 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

Mon May 01 14:00:19 GMT 2023

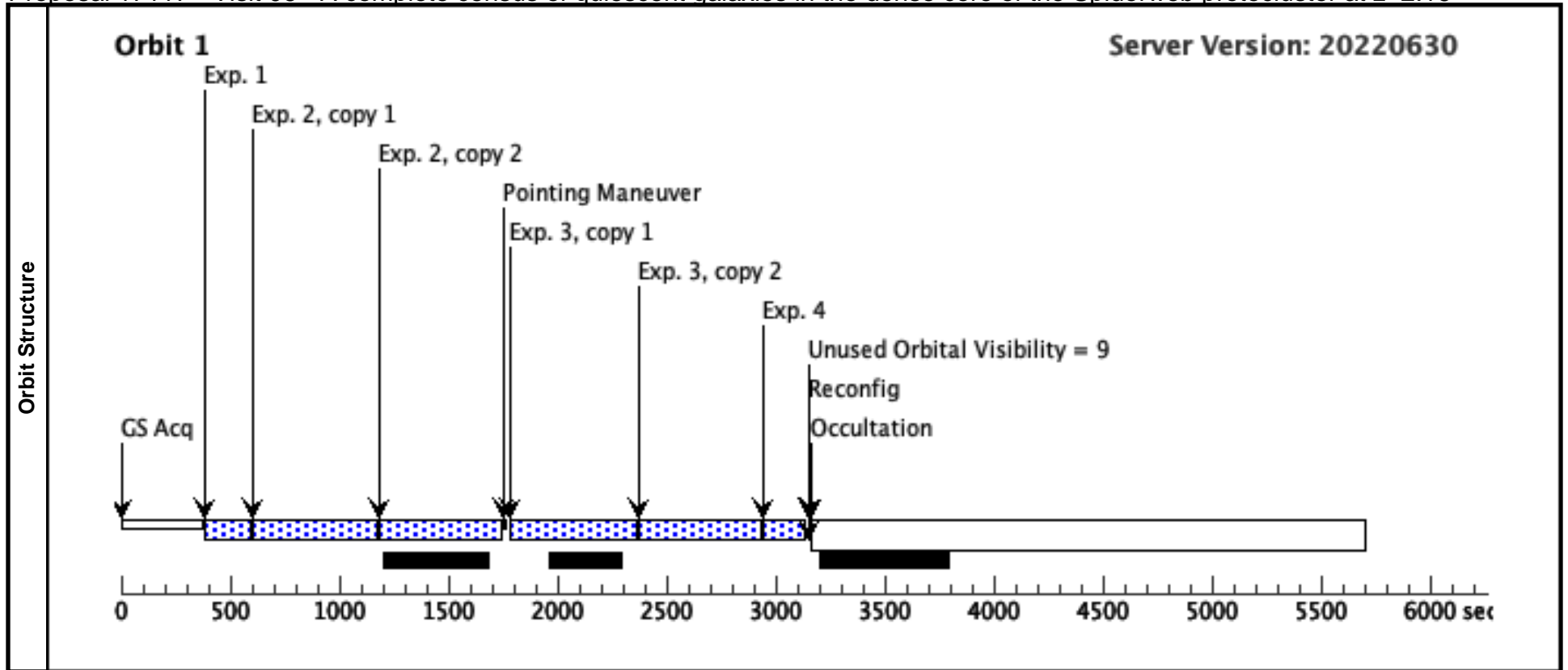
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Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(5)	SPIDERWEB-WFC3-2B	RA: 11 40 48.6254 (175.2026058d) Dec: -26 29 34.60 (-26.49294d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS				
Comments: Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(5) SPIDERWEB-WFC3-2B	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 05	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 a nd 2	(5) SPIDERWEB-WFC3-2B	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 05	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 a nd 4	(5) SPIDERWEB-WFC3-2B	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 05	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(5) SPIDERWEB-WFC3-2B	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 05	177.935896 Secs (177.936 Secs) [==>]	[1]



Proposal 17117 - Visit 06 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

Mon May 01 14:00:19 GMT 2023

Visit	Proposal 17117, Visit 06, scheduling Diagnostic Status: Warning Scientific Instruments: WFC3/IR Special Requirements: ORIENT 115D TO 115 D									
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Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(6)	SPIDERWEB-WFC3-3A	RA: 11 40 47.6972 (175.1987383d) Dec: -26 29 25.76 (-26.49049d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS				
Comments: Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(6) SPIDERWEB-WFC3-3A	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 06	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 and 2	(6) SPIDERWEB-WFC3-3A	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 06	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 and 4	(6) SPIDERWEB-WFC3-3A	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 06	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(6) SPIDERWEB-WFC3-3A	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 06	177.935896 Secs (177.936 Secs) [==>]	[1]



Proposal 17117 - Visit 07 - A complete census of quiescent galaxies in the dense core of the Spiderweb protocluster at z=2.16

Mon May 01 14:00:19 GMT 2023

Visit	Proposal 17117, Visit 07, scheduling Diagnostic Status: Warning Scientific Instruments: WFC3/IR Special Requirements: ORIENT 115D TO 115 D									
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Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(7)	SPIDERWEB-WFC3-3B	RA: 11 40 47.6972 (175.1987383d) Dec: -26 29 26.76 (-26.49077d) Equinox: J2000		V=(?) J<23.9 (AB mag), H<23.0 (AB mag)	Reference Frame: ICRS				
Comments: Category=CLUSTER OF GALAXIES Description=[GROUP, RICH CLUSTER]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Direct 1	(7) SPIDERWEB-WFC3-3B	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	POS TARG 0.0,0.0	Sequence 1-4 Non-Int in Visit 07	177.935896 Secs (177.936 Secs) [==>]	[1]
	2	Spectral 1 a nd 2	(7) SPIDERWEB-WFC3-3B	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	SAME POS AS 1	Sequence 1-4 Non-Int in Visit 07	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	3	Spectral 3 a nd 4	(7) SPIDERWEB-WFC3-3B	WFC3/IR, MULTIACCUM, GRISM1024	G141	NSAMP=12; SAMP-SEQ=SPAR S50	POS TARG 1.355,0.424	Sequence 1-4 Non-Int in Visit 07	552.937252 Secs X 2 (1105.875 Secs) [==>(Copy 1)] [==>(Copy 2)]	[1]
	4	Direct 2	(7) SPIDERWEB-WFC3-3B	WFC3/IR, MULTIACCUM, GRISM1024	F160W	NSAMP=8; SAMP-SEQ=SPAR S25	SAME POS AS 3	Sequence 1-4 Non-Int in Visit 07	177.935896 Secs (177.936 Secs) [==>]	[1]

