16668 - Monitoring Earendel, the Lensed z~6 Star

Cycle: 29, 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?*
11	(1) WHL0137-08 ANY	ACS/WFC WFC3/IR	1	29-Jul-2021 13:00:22.0	yes
22	(1) WHL0137-08 ANY	ACS/WFC WFC3/IR	1	29-Jul-2021 13:00:23.0	yes
33	(1) WHL0137-08 ANY	ACS/WFC WFC3/IR	1	29-Jul-2021 13:00:25.0	yes
44	(1) WHL0137-08 ANY	ACS/WFC WFC3/IR	1	29-Jul-2021 13:00:26.0	yes

4 Total Orbits Used

ABSTRACT

Three strongly magnified individual stars have been discovered in z~1 galaxies thanks to temporary boosts from microlensing. All were discovered as transient events that have since faded. Now a more persistent and distant lensed star has been discovered at z~6, named "Earendel" ("morning light"). Its extremely high magnification has persisted for 3.5 years between HST observations, consistent with microlensing simulations of this object. But HST monitoring of the z~1 stars revealed things weren't always as they seemed.

Here we propose the first repeat monitoring of Earendel in the same WFC3/IR filter, with 4 more epochs F110W imaging. These data will yield Earendel's baseline flux to better constrain its magnification, and thus luminosity and mass.

Current HST data suggest it is likely very massive > 50 M_sun. And at z~6, it is likely low metallicity < 0.2 Z_sun. Very massive low metallicity

stars are extremely rare in the local group and thus hard to study locally. Such stars are the likely progenitors of ~30 M_sun black holes measured by LIGO gravitational wave detections. But models of their evolutionary tracks are highly uncertain. Remarkably, this isolated z~6 star may offer the best opportunity to pinpoint the giant branch of a low metallicity massive star. Approved JWST GO observations will constrain the star's temperature, putting a z~6 star on the H-R diagram with a luminosity (and mass) precision significantly improved by this HST proposal.

To support the various communities interested in these results, we waive any proprietary period to the data, in the same spirit as the previous HST observations and approved JWST observations of this exciting target.

OBSERVING DESCRIPTION

We will obtain 4 orbits of WFC3/IR F110W imaging of WHL0137-08, aligned with the previous HST imaging of that galaxy cluster core. We request 4 separate visits, each 1 orbit long, separated by 3 or more months.
*** Longer time baselines are preferable: Visit #1 as early as possible in Cycle 29 and Visit #4 as late as needed to accommodate scheduling other programs.

Within each orbit, we will obtain 4 images in a single filter, using small dithers to optimally sample the PSF and ultimately improve the spatial resolution of the stacked drizzled images. Between orbits / epochs, we will perform a larger dither (and/or different roll angle) to cover the WFC3/IR "death star" and other artifacts (IR blobs), as well as the ACS chip gap in parallel.

Special Requirements:
1) 4 epochs (1 orbit per epoch), each 3 or more months apart (e.g., Oct, Feb, Jun, Sept.)
2) Low backgrounds when possible
3) Position Angle to overlap parallel imaging with existing HST imaging when possible

We do not request mitigation of helium Earthshine, which is rare and not expected to impact a significant fraction of our data. We prefer to perform all dithers in the same orbit for optimal pixel sampling rather than splitting orbits to avoid helium.

Visit

Proposal 16668, 1 IR/F110W-ACS/F814W (11), implementation Thu Jul 29 17:00:27 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: (none)

Fixed Targets

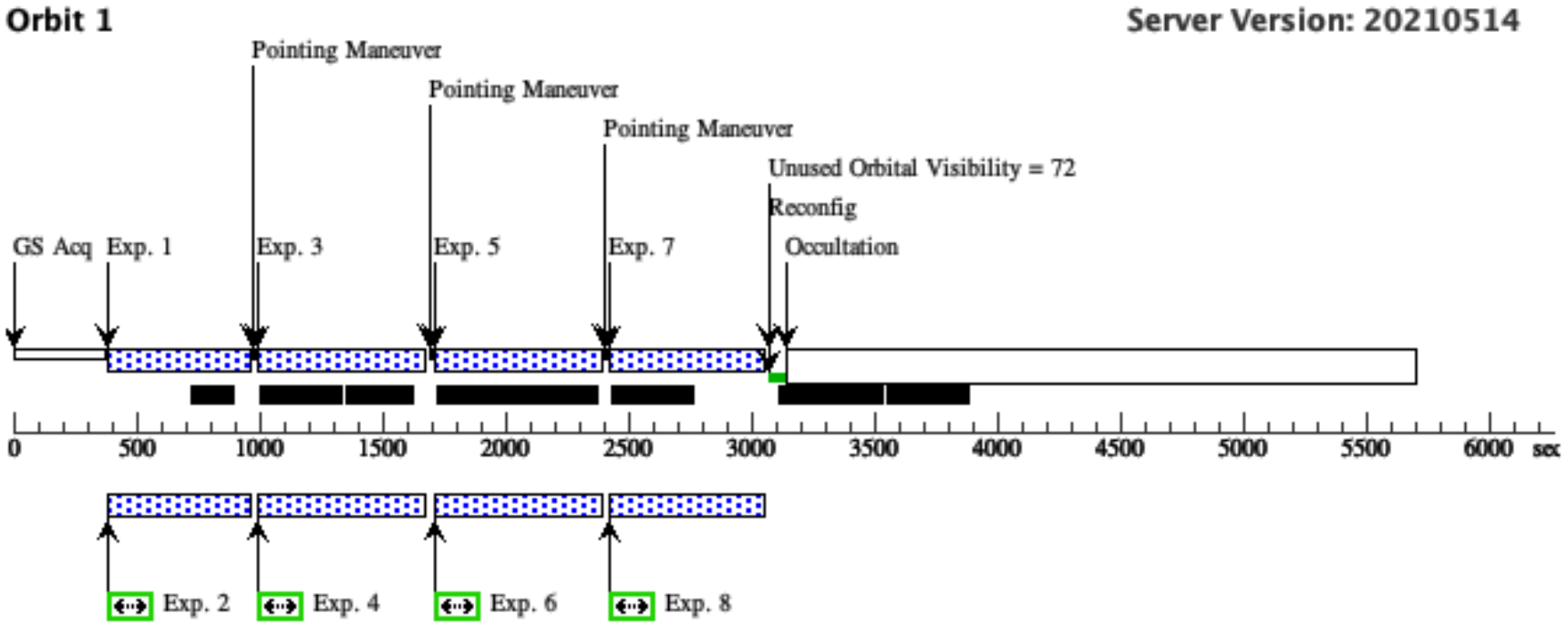
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WHL0137-08 Alt Name1: WHL-J24.3324-8.477	RA: 01 37 25.0000 (24.3541667d) Dec: -08 27 25.00 (-8.45694d) Equinox: J2000		V=18	Reference Frame: ICRS

Comments:
Category=CLUSTER OF GALAXIES
Description=[GRAVITATIONAL LENS, RICH CLUSTER]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=12		Prime + Parallel Group 1-2 in 1 IR/F110W-ACS/F814W (11)	552.937252 Secs (552.937 Secs) *[==>]*	*[1]*
2		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 1-2 in 1 IR/F110W-ACS/F814W (11)	497 Secs (375 Secs) *[==>375.0 Secs]*	*[1]*
3		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 0.542,0.182	Prime + Parallel Group 3-4 in 1 IR/F110W-ACS/F814W (11)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
4		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 3-4 in 1 IR/F110W-ACS/F814W (11)	557 Secs (557 Secs) *[==>]*	*[1]*
5		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 0.339,0.485	Prime + Parallel Group 5-6 in 1 IR/F110W-ACS/F814W (11)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
6		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 5-6 in 1 IR/F110W-ACS/F814W (11)	557 Secs (557 Secs) *[==>557.0 Secs]*	*[1]*
7		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=13	POS TARG -0.203,0.303	Prime + Parallel Group 7-8 in 1 IR/F110W-ACS/F814W (11)	602.937703 Secs (602.938 Secs) *[==>]*	*[1]*
8		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 7-8 in 1 IR/F110W-ACS/F814W (11)	507 Secs (507 Secs) *[==>507.0 Secs]*	*[1]*

Orbit Structure



Visit

Proposal 16668, 2 IR/F110W-ACS/F435W (22), implementation Thu Jul 29 17:00:27 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 50D TO 75 D; ORIENT 215D TO 240 D; AFTER 11 BY 60 D TO 300 D

Fixed Targets

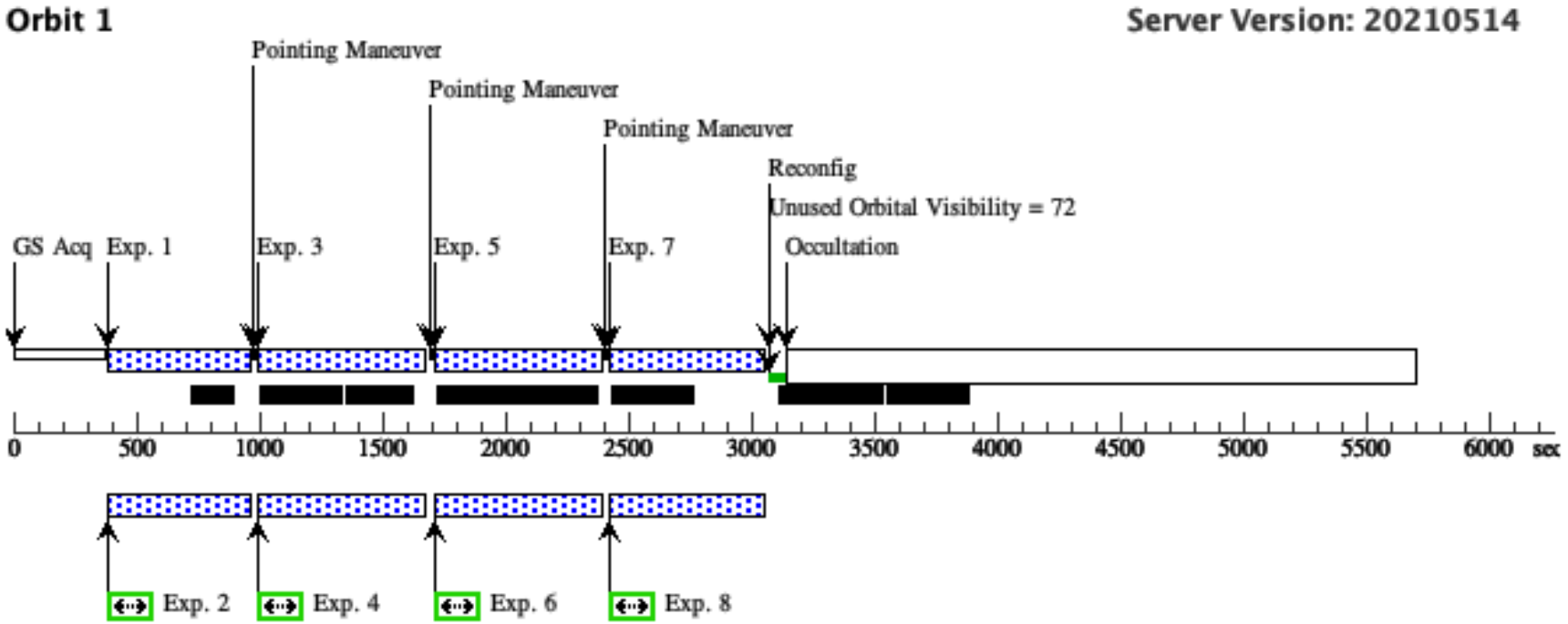
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WHL0137-08 Alt Name1: WHL-J24.3324-8.477	RA: 01 37 25.0000 (24.3541667d) Dec: -08 27 25.00 (-8.45694d) Equinox: J2000		V=18	Reference Frame: ICRS

Comments:
Category=CLUSTER OF GALAXIES
Description=[GRAVITATIONAL LENS, RICH CLUSTER]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=12	POS TARG 7.317,0.908	Prime + Parallel Group 1-2 in 2 IR/F110W-ACS/F435W (22)	552.937252 Secs (552.937 Secs) *[==>]*	*[1]*
2		ANY	ACS/WFC, ACCUM, WFCENTER	F435W			Prime + Parallel Group 1-2 in 2 IR/F110W-ACS/F435W (22)	497 Secs (375 Secs) *[==>375.0 Secs]*	*[1]*
3		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 7.859,1.090	Prime + Parallel Group 3-4 in 2 IR/F110W-ACS/F435W (22)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
4		ANY	ACS/WFC, ACCUM, WFCENTER	F435W			Prime + Parallel Group 3-4 in 2 IR/F110W-ACS/F435W (22)	557 Secs (557 Secs) *[==>]*	*[1]*
5		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 7.656,1.393	Prime + Parallel Group 5-6 in 2 IR/F110W-ACS/F435W (22)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
6		ANY	ACS/WFC, ACCUM, WFCENTER	F435W			Prime + Parallel Group 5-6 in 2 IR/F110W-ACS/F435W (22)	557 Secs (557 Secs) *[==>557.0 Secs]*	*[1]*
7		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=13	POS TARG 7.114,1.211	Prime + Parallel Group 7-8 in 2 IR/F110W-ACS/F435W (22)	602.937703 Secs (602.938 Secs) *[==>]*	*[1]*
8		ANY	ACS/WFC, ACCUM, WFCENTER	F435W			Prime + Parallel Group 7-8 in 2 IR/F110W-ACS/F435W (22)	500 Secs (507 Secs) *[==>507.0 Secs]*	*[1]*

Orbit Structure



Visit

Proposal 16668, 3 IR/F110W-ACS/F814W (33), implementation Thu Jul 29 17:00:27 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 215D TO 240 D; ORIENT 50D TO 75 D; AFTER 11 BY 150 D TO 450 D

Fixed Targets

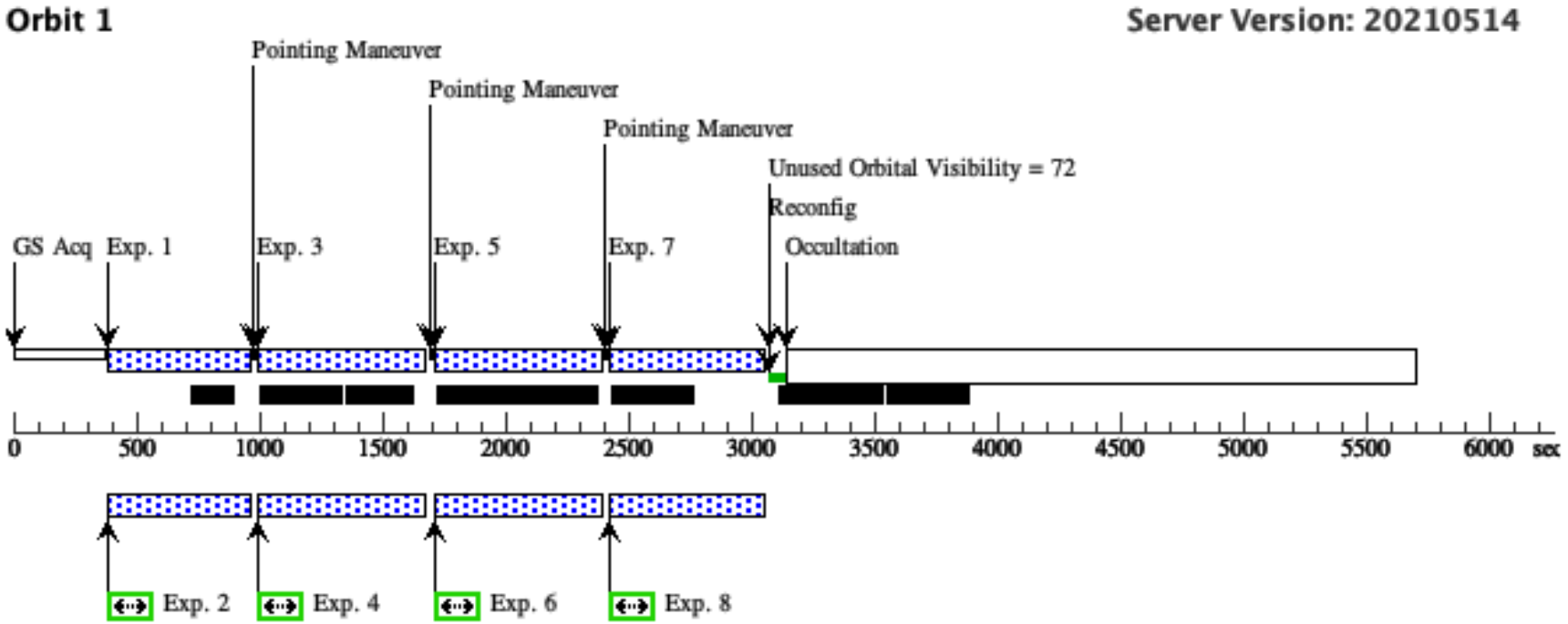
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WHL0137-08 Alt Name1: WHL-J24.3324-8.477	RA: 01 37 25.0000 (24.3541667d) Dec: -08 27 25.00 (-8.45694d) Equinox: J2000		V=18	Reference Frame: ICRS

Comments:
Category=CLUSTER OF GALAXIES
Description=[GRAVITATIONAL LENS, RICH CLUSTER]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=12		Prime + Parallel Group 1-2 in 3 IR/F110W-ACS/F814W (33)	552.937252 Secs (552.937 Secs) *[==>]*	*[1]*
2		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 1-2 in 3 IR/F110W-ACS/F814W (33)	497 Secs (375 Secs) *[==>375.0 Secs]*	*[1]*
3		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 0.542,0.182	Prime + Parallel Group 3-4 in 3 IR/F110W-ACS/F814W (33)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
4		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 3-4 in 3 IR/F110W-ACS/F814W (33)	557 Secs (557 Secs) *[==>]*	*[1]*
5		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 0.339,0.485	Prime + Parallel Group 5-6 in 3 IR/F110W-ACS/F814W (33)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
6		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 5-6 in 3 IR/F110W-ACS/F814W (33)	557 Secs (557 Secs) *[==>557.0 Secs]*	*[1]*
7		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=13	POS TARG -0.203,0.303	Prime + Parallel Group 7-8 in 3 IR/F110W-ACS/F814W (33)	602.937703 Secs (602.938 Secs) *[==>]*	*[1]*
8		ANY	ACS/WFC, ACCUM, WFCENTER	F814W			Prime + Parallel Group 7-8 in 3 IR/F110W-ACS/F814W (33)	507 Secs (507 Secs) *[==>507.0 Secs]*	*[1]*

Orbit Structure



Visit

Proposal 16668, 4 IR/F110W-ACS/F606W (44), implementation Thu Jul 29 17:00:27 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 50D TO 75 D; ORIENT 215D TO 240 D; AFTER 11 BY 300 D TO 750 D

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	WHL0137-08 Alt Name1: WHL-J24.3324-8.477	RA: 01 37 25.0000 (24.3541667d) Dec: -08 27 25.00 (-8.45694d) Equinox: J2000		V=18	Reference Frame: ICRS

Comments:
Category=CLUSTER OF GALAXIES
Description=[GRAVITATIONAL LENS, RICH CLUSTER]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=12	POS TARG 7.317,0.908	Prime + Parallel Group 1-2 in 4 IR/F110W-ACS/F606W (44)	552.937252 Secs (552.937 Secs) *[==>]*	*[1]*
2		ANY	ACS/WFC, ACCUM, WFCENTER	F606W			Prime + Parallel Group 1-2 in 4 IR/F110W-ACS/F606W (44)	497 Secs (375 Secs) *[==>375.0 Secs]*	*[1]*
3		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 7.859,1.090	Prime + Parallel Group 3-4 in 4 IR/F110W-ACS/F606W (44)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
4		ANY	ACS/WFC, ACCUM, WFCENTER	F606W			Prime + Parallel Group 3-4 in 4 IR/F110W-ACS/F606W (44)	557 Secs (557 Secs) *[==>]*	*[1]*
5		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=14	POS TARG 7.656,1.393	Prime + Parallel Group 5-6 in 4 IR/F110W-ACS/F606W (44)	652.938154 Secs (652.938 Secs) *[==>]*	*[1]*
6		ANY	ACS/WFC, ACCUM, WFCENTER	F606W			Prime + Parallel Group 5-6 in 4 IR/F110W-ACS/F606W (44)	557 Secs (557 Secs) *[==>557.0 Secs]*	*[1]*
7		(1) WHL0137-08	WFC3/IR, MULTIACCUM, IR-FIX	F110W	SAMP-SEQ=SPARS50; NSAMP=13	POS TARG 7.114,1.211	Prime + Parallel Group 7-8 in 4 IR/F110W-ACS/F606W (44)	602.937703 Secs (602.938 Secs) *[==>]*	*[1]*
8		ANY	ACS/WFC, ACCUM, WFCENTER	F606W			Prime + Parallel Group 7-8 in 4 IR/F110W-ACS/F606W (44)	500 Secs (507 Secs) *[==>507.0 Secs]*	*[1]*

Orbit Structure