15200 - A case study of an extremely luminous, highly spatially extended starburst only 1.7Gyr after the Big Bang

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) SDSSJ160705.15+533558.9 ANY	ACS/WFC WFC3/IR	2	06-Sep-2017 13:05:50.0	yes
02	(1) SDSSJ160705.15+533558.9 ANY	ACS/WFC WFC3/IR	2	06-Sep-2017 13:05:53.0	yes

4 Total Orbits Used

ABSTRACT

Luminous starbursts, systems with SFRs exceeding ~1000Msun yr-1, are predicted to be extremely rare at z>3. However, recent observations find such systems at rates of tens to hundreds above predictions. This discrepancy is extremely difficult to explain. Case studies of such luminous starbursts are thus of profound importance to understand how star formation is triggered and quenched at z > 3, and help reconcile models with

observations.

Our group has been intensively studying the quasar SDSS J160705.16, at z = 3.65 (or 1.7Gyr after the Big Bang). This quasar is an excellent case study of luminous star formation at z > 3, and how AGN activity may affect such star formation. SDSS J160705.16 harbors both a broad-line, luminous quasar and an extremely high star formation rate, with an AGN luminosity of ~10^47 ergs s-1 and an SFR of ~2000 Msol yr-1. Sub-mm interferometry has further revealed that the star formation is highly spatially extended on scales up to 40kpc. Furthermore, VLA observations show an emerging ~4kpc radio jet.

We here propose WFC3 imaging with the following goals: (1) to set precise constraints on any lensing magnification, (2) to determine the morphology and color structure of the extended star formation, (3) to compare the optical morphology of the star formation to that seen in the sub-mm data, and (4) to search for evidence that SDSS J160705.16 resides in a protocluster.

OBSERVING DESCRIPTION

We observe with WFC3/IR as the high redshift of J160705 makes near-infrared observations optimal. Observations with e.g. F814W or shorter would be heavily contaminated by line emission, or sample below the Lyman break. We observe with two filters to estimate spatially resolved star formation rates and extinctions, and to use color gradient as a diagnostic of activity. At z=3.6, F110W and F160W sample rest-frame near-UV and U-band, respectively, and are both longward of the brightest ultraviolet emission lines, meaning that the morphologies and colors as a function of position can be translated into estimates of star formation rate and reddening straightforwardly.

To determine the total exposure time we normalize a set of starburst SED templates for slightly to moderately obscured star formation to the flux in the extended submm emission. The median SED shape in this library corresponds approximately to that of the starburst galaxy M82, but includes systems as obscured as Arp220. We then extract the {\itshape maximum-likelihood} flux densities at observed-frame wavelengths corresponding to F110W and F160W, and then assume that this emission is distributed over a comparable spatial scale to the sub-mm emission. Doing so yields m_AB=24.9 arcsec^-2 in F110W and m_AB=24.5 arcsec^-2 in F160W. Then, requiring an SN>4 per WFC3 pixel, leads to total required on-source times of 4000s in F110W and 4500s in F160W

We arrange the observations so that the possibility of significant He contamination in the F110W exposures is minimized. In each orbit we observe with both F160W and F110W, "padding" the F110W observations with F160W observations so that the F110W observations do not occur at the start

or end of the orbit. We also use SPARSE sampling so that the nucleus of the quasar cannot saturate. Since the submm structure is more than 0.5 arcsec from the quasar we do not request an observed PSF, but will instead construct a PSF from stars in the field, or use a Tinytim PSF.

Using this strategy, the total on-source time is 4044s in F110W and 4888s in F160W.

Visit

Proposal 15200, Visit 01 Wed Sep 06 17:05:54 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: PCS MODE FINE; BETWEEN 02-SEP-2017:00:00:00 AND 21-NOV-2017:00:00:00; BETWEEN 18-DEC-2017:00:00:00 AND 30-SEP-2019:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1-2), (3-4)

Fixed Targets

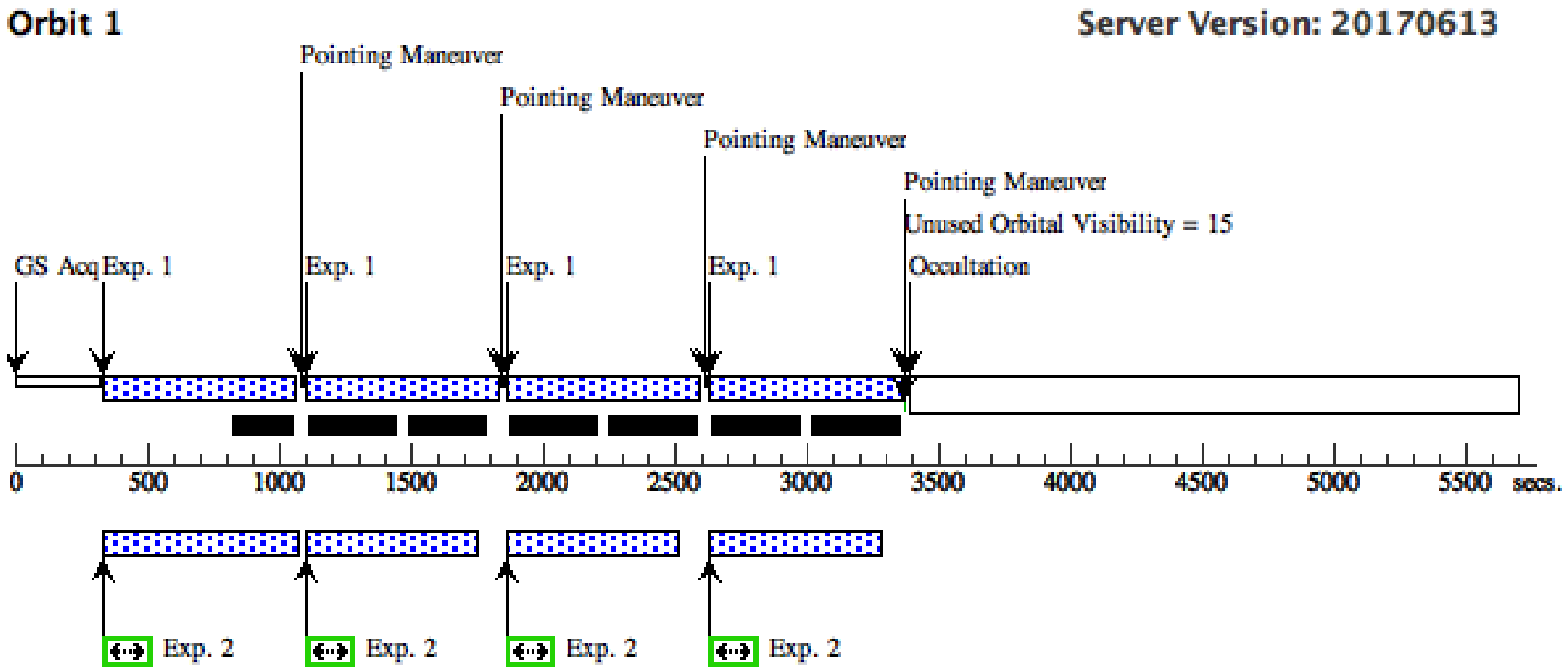
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSSJ160705.15+533558.9 Alt Name1: LQAC241+053015	RA: 16 07 5.1550 (241.7714792d) Dec: +53 35 58.58 (53.59961d) Equinox: J2000	Redshift: 3.635288	V=18.93	Reference Frame: SIMBAD

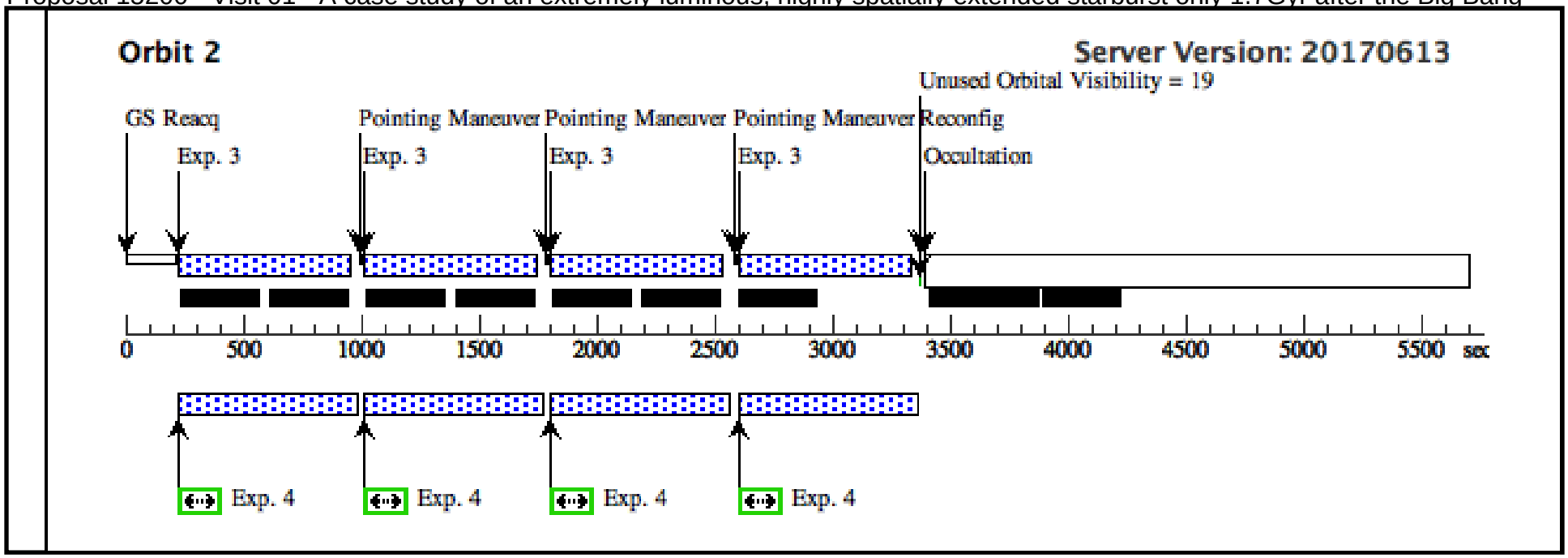
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SDSSJ160705.15+533558.9	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=15; SAMP-SEQ=SPARS50		Pattern 1, Exps 1-2 in Visit 01 (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Visit 01	702.938605 Secs (2811.754 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2		ANY	ACS/WFC, ACCUM, WFC	F814W	CR-SPLIT=NO; GAIN=2.0		Pattern 1, Exps 1-2 in Visit 01 (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Visit 01	530 Secs (2120 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3		(1) SDSSJ160705.15+533558.9	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS50		Pattern 1, Exps 3-4 in Visit 01 (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Visit 01	702.938605 Secs (2811.754 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
4		ANY	ACS/WFC, ACCUM, WFC	F814W	CR-SPLIT=NO; GAIN=2.0		Pattern 1, Exps 3-4 in Visit 01 (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Visit 01	635 Secs (2540 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure

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Pointing Maneuver
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Pointing Maneuver
Exp. 3
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Occultation
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500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Exp. 4
Exp. 4
Exp. 4
Exp. 4

Visit

Proposal 15200, Visit 02 Wed Sep 06 17:05:54 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: PCS MODE FINE; BETWEEN 02-SEP-2017:00:00:00 AND 21-NOV-2017:00:00:00; BETWEEN 18-DEC-2017:00:00:00 AND 30-SEP-2019:00:00:00

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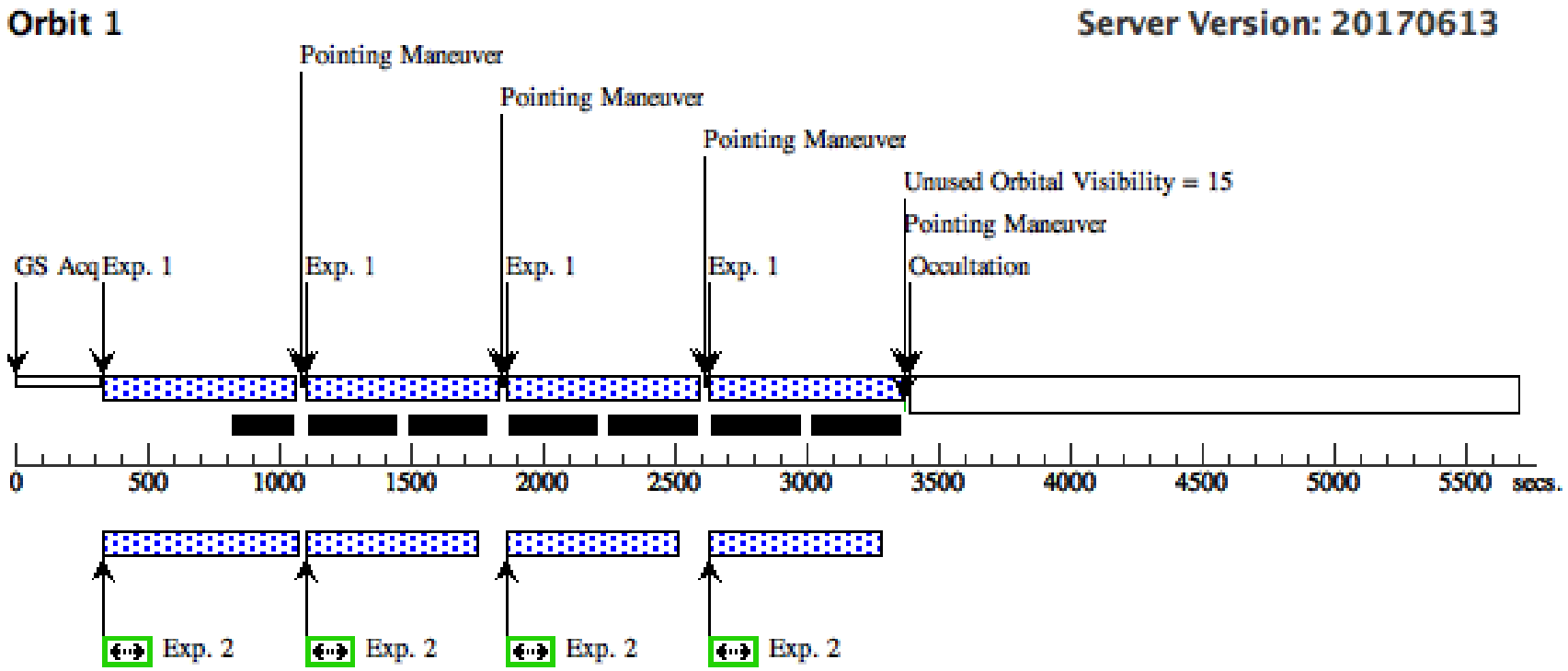
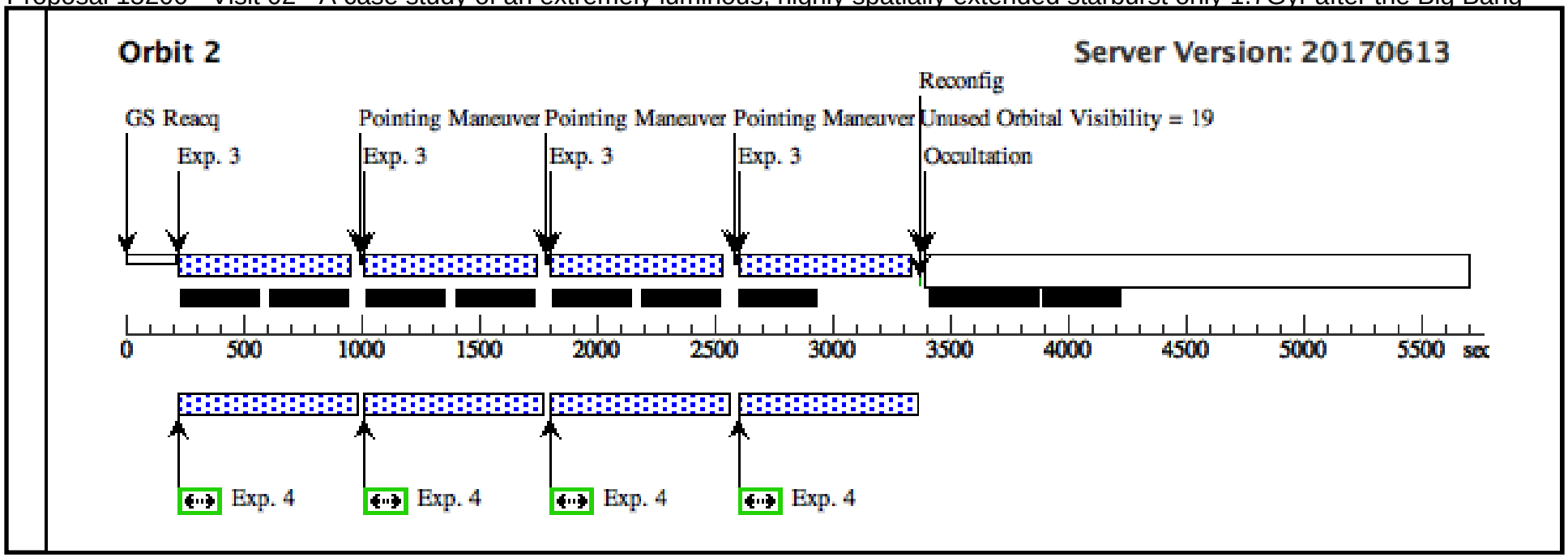
2		ANY	ACS/WFC, ACCUM, WFC	F814W	CR-SPLIT=NO; GAIN=2.0		Pattern 1, Exps 1-2 in Visit 02 (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Visit 02	530 Secs (2120 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3		(1) SDSSJ160705.15+533558.9	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS50		Pattern 1, Exps 3-4 in Visit 02 (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Visit 02	702.938605 Secs (2811.754 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
4		ANY	ACS/WFC, ACCUM, WFC	F814W	CR-SPLIT=NO; GAIN=2.0		Pattern 1, Exps 3-4 in Visit 02 (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Visit 02	635 Secs (2540 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20170613
Reconfig
GS Reacq
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 19
Exp. 3
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Exp. 3
Exp. 3
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sec
Exp. 4
Exp. 4
Exp. 4
Exp. 4