



13784 - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

| <i>Name</i> | <i>Institution</i> | <i>E-Mail</i> |
|--|------------------------------------|--------------------------------|
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| Dr. Jeff Cooke (CoI) | Swinburne University of Technology | cooke@astro.caltech.edu |

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) SLSN | COS/FUV COS/NUV | 5 | 24-Apr-2015 21:09:57.0 | yes |
| 02 | (1) SLSN | COS/FUV COS/NUV | 5 | 24-Apr-2015 21:09:59.0 | yes |
| 03 | (1) SLSN | STIS/CCD STIS/NUV-MAMA | 4 | 24-Apr-2015 21:10:02.0 | yes |
| 04 | (2) LSQ15ABL | COS/FUV COS/NUV | 5 | 24-Apr-2015 21:10:04.0 | yes |
| 05 | (2) LSQ15ABL | COS/FUV COS/NUV | 5 | 24-Apr-2015 21:10:06.0 | yes |
| 06 | (2) LSQ15ABL | STIS/CCD STIS/NUV-MAMA | 4 | 24-Apr-2015 21:10:08.0 | yes |

28 Total Orbits Used

ABSTRACT

There is a rare class of supernovae with peak luminosities ten times greater than a typical Type Ia supernovae in the optical and hundreds of times greater in the UV. Some of these "superluminous" supernovae (SLSNe) show evidence for hydrogen in their spectra, and some do not. There are now spectroscopically confirmed examples of these hydrogen poor SLSN-I out to redshift 1.6, but, surprisingly, there are no confirmed examples of any hydrogen-rich SLSN-II above redshift 0.4 even though SLSN-II can have peak luminosities comparable to or greater than SLSN-I. As a result, we have no rest-frame UV spectra of SLSN-II, the spectral range most critical for understanding the nature of these events and for verifying their utility as potential probes of the high redshift universe. Here we propose to obtain the first UV spectra of a SLSN-II. These data will serve as a guide to enable higher redshift SLSN-II to be identified and they will stand as a local reference to compare against these future, high-redshift discoveries against. HST is uniquely suited to these observations, which need to take place before our window into the UV universe closes.

OBSERVING DESCRIPTION

We will obtain UV spectroscopy of one, hydrogen-rich superluminous supernova (SLSN-II). We have requested one, disruptive ToO trigger in order to rapidly ($\Delta t < 10$ days) respond to new SLSN-II discoveries to be made during Cycle 22. We may choose targets from publicly available sources, but we expect the best SLSN-II will come from the Intermediate Palomar Transient Factory (iPTF). We will trigger our ToO observations only on spectroscopically confirmed targets, and we will first request Swift UV photometry to verify the brightness of the targets in the NUV (this data will also help streamline bright-object checking for the MAMA detectors).

We will divide our allocated orbits between COS and STIS. We propose to acquire FUV spectra with the COS G140L grating, and NUV spectra with the STIS G230L grating. The exact division will be dictated by the redshift of the target, which will not be known until just prior to activation of or disruptive ToO observation. The goal is to obtain the broadest possible coverage of the rest frame UV light with $S/N > 10$. For a nearby, low-redshift source, we expect to use most of our orbits for COS and the remainder for STIS. However, we could use all allocated orbits for STIS if the target is sufficiently redshifted.

We have estimated exposure times using black body fits to Swift NUV observations of two previous SLSN-II discovered by PTF. We find that a relatively bright, nearby SLSN-II could be detected at $S/N > 10$ over a broad range in 27000s (10 orbits assuming 45 minutes on source per orbit. Four more orbits with STIS would deliver $S/N > 10$ across in the NUV as well. The COS and STIS observations could be performed together or

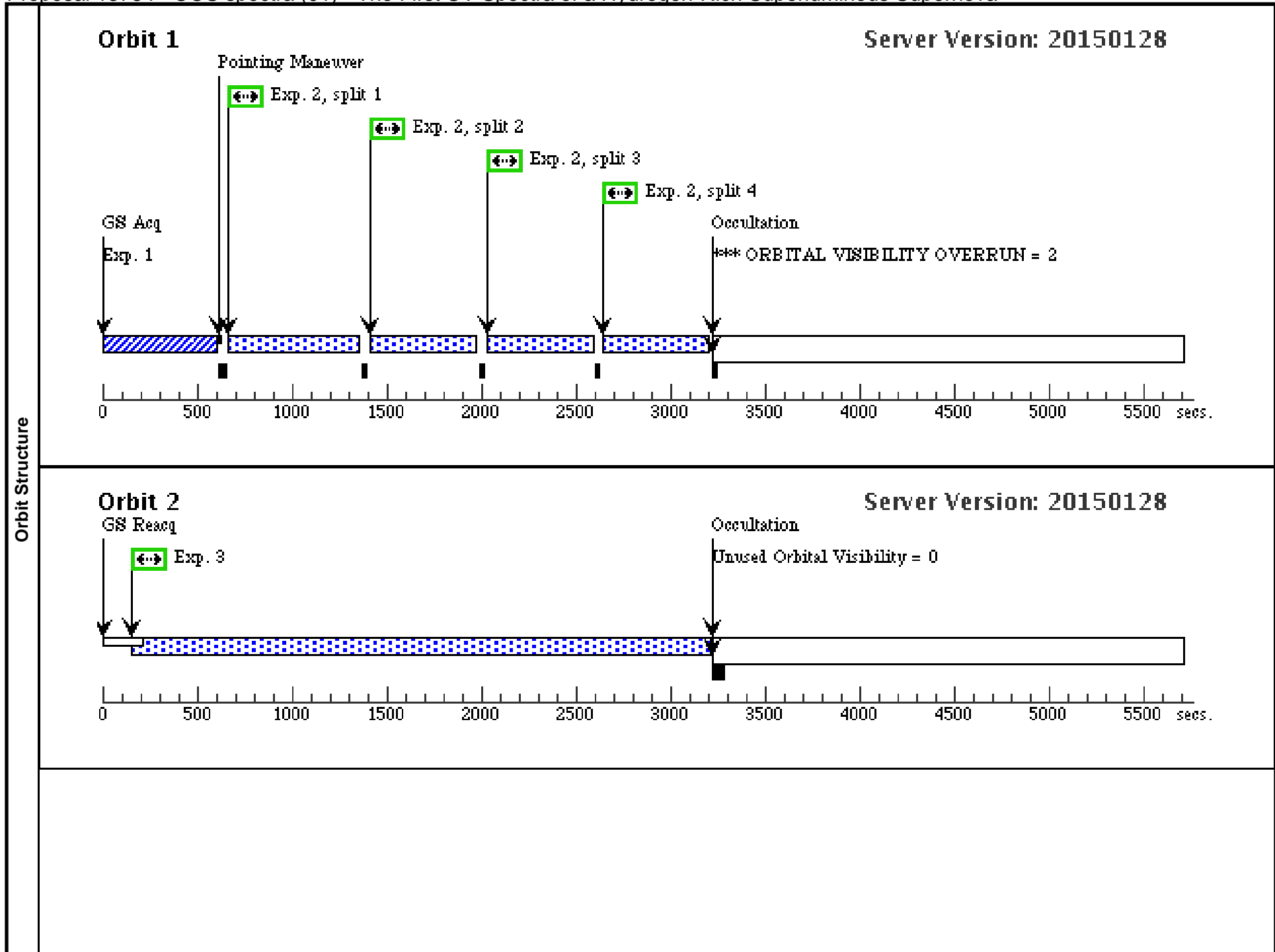
Proposal 13784 (STScI Edit Number: 1, Created: Friday, April 24, 2015 8:10:10 PM EST) - Overview

could take place within about 5 days of each other (COS first). For a more distant source we would use the full orbit allocation just for STIS as this would cover essentially the whole rest-frame UV range of interest.

Proposal 13784 - COS spectra (01) - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

Sat Apr 25 01:10:10 GMT 2015

| Visit | Proposal 13784, COS spectra (01), withdrawn Diagnostic Status: Warning Scientific Instruments: COS/NUV, COS/FUV Special Requirements: ON HOLD ; TOO RESPONSE TIME 10.0D <i>On Hold Comments: Target of Opportunity (disruptive)</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Orbit 3

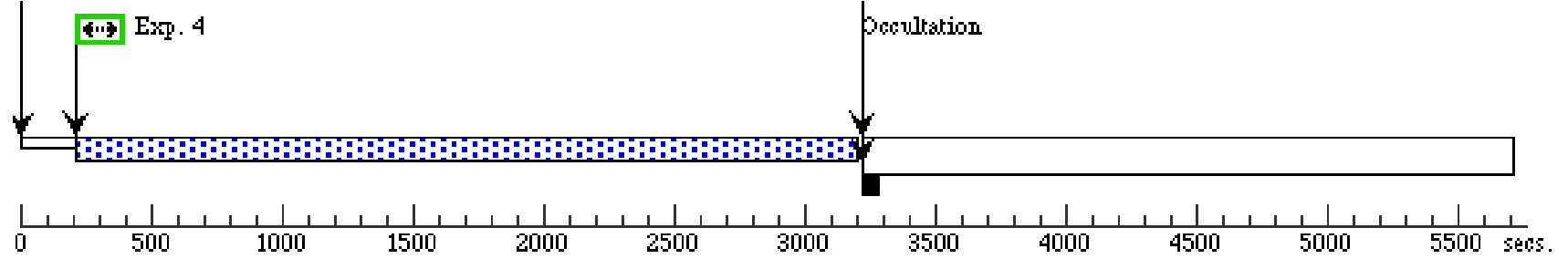
GS Reacq

Exp. 4

Server Version: 20150128

Unused Orbital Visibility = 0

Occultation



Orbit 4

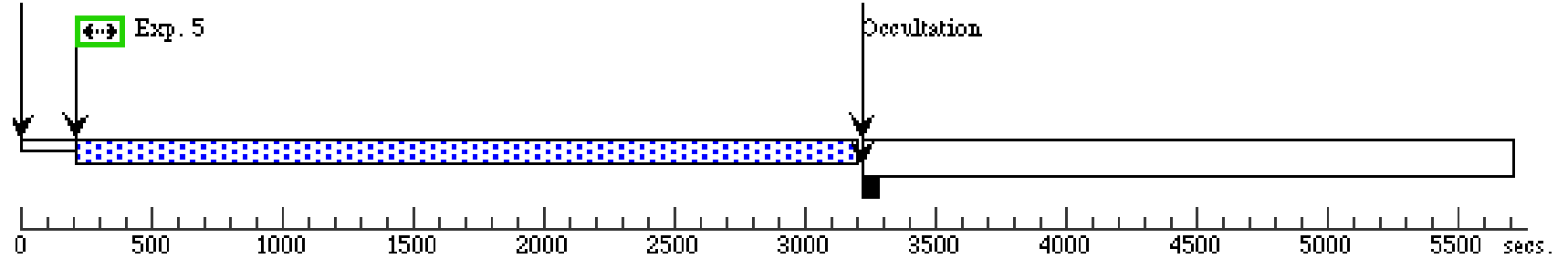
GS Reacq

Exp. 5

Server Version: 20150128

Unused Orbital Visibility = 0

Occultation



Orbit 5

GS Reacq

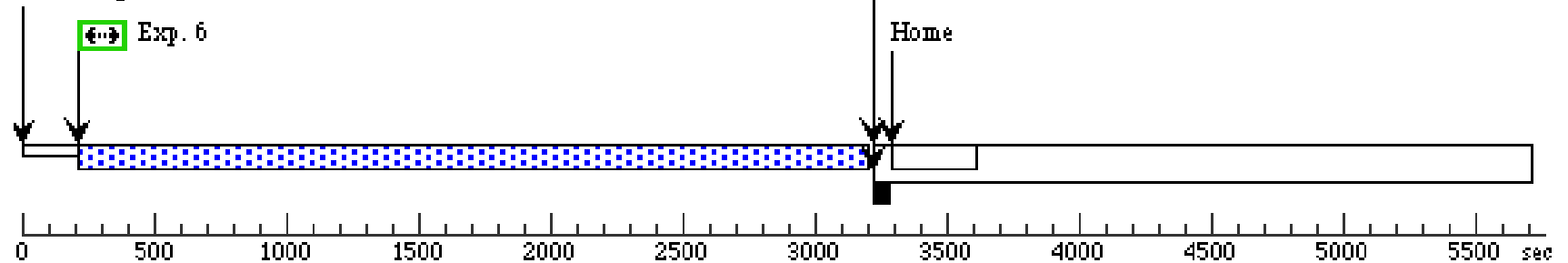
Exp. 6

Server Version: 20150128

Unused Orbital Visibility = 0

Occultation

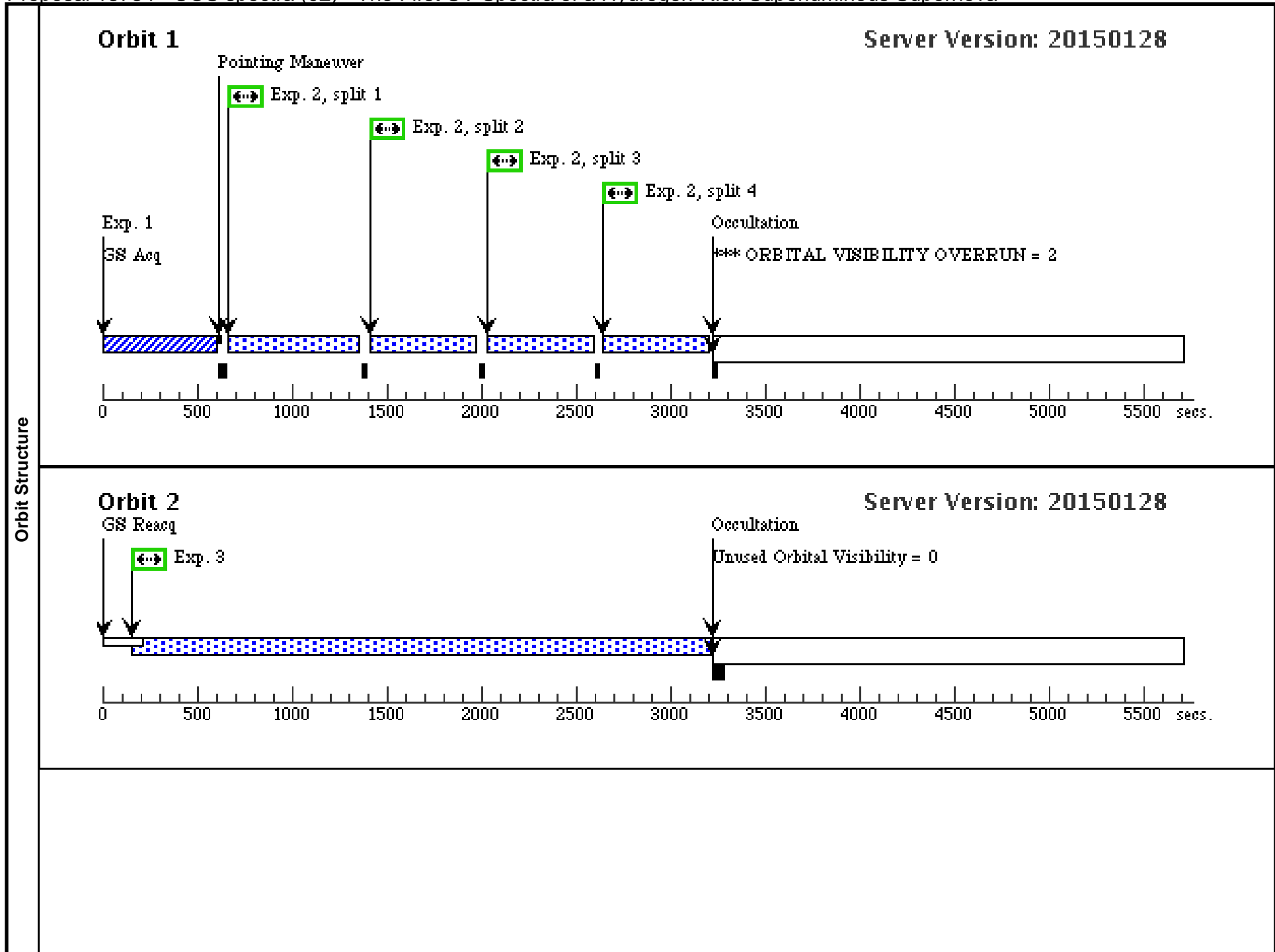
Home



Proposal 13784 - COS spectra (02) - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

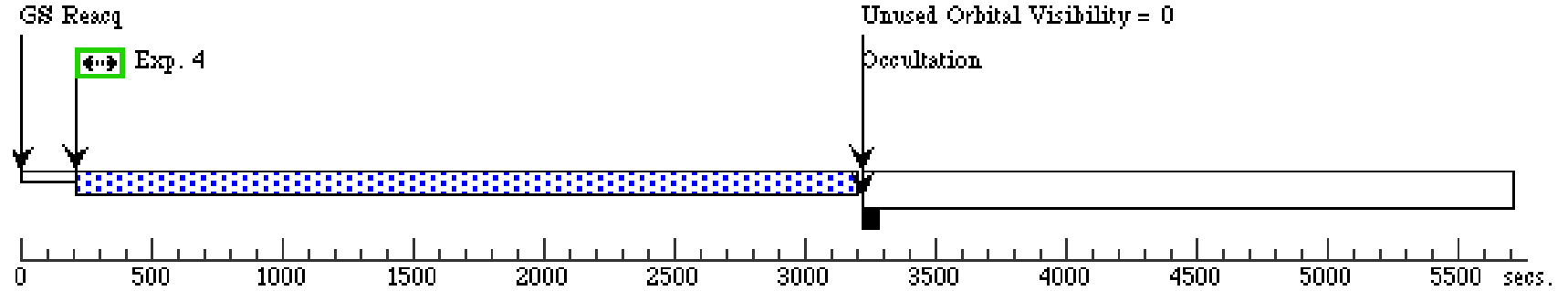
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| | | # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 1 | acquisition | (1) SLSN | COS/NUV, ACQ/IMAGE, PSA | MIRRORA | | | | 100 Secs (100 Secs) [==>] | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | spectra | (1) SLSN | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=ALL | | | 500 Secs (2044 Secs) [==>511.0 Secs (Split 1)] [==>511.0 Secs (Split 2)] [==>511.0 Secs (Split 3)] [==>511.0 Secs (Split 4)] | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | spectra | (1) SLSN | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=1 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [2] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | spectra | (1) SLSN | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=2 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [3] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5 | spectra | (1) SLSN | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=3 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [4] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | spectra | (1) SLSN | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=4 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [5] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



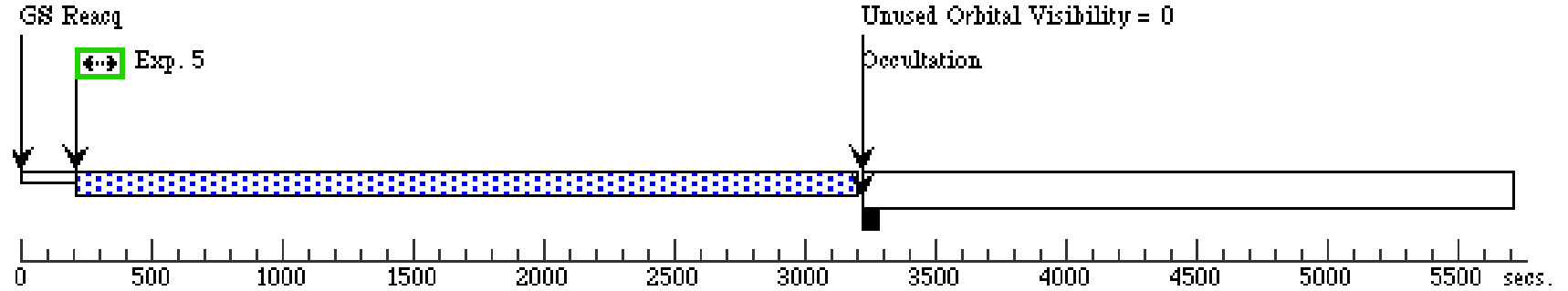
Orbit 3

Server Version: 20150128



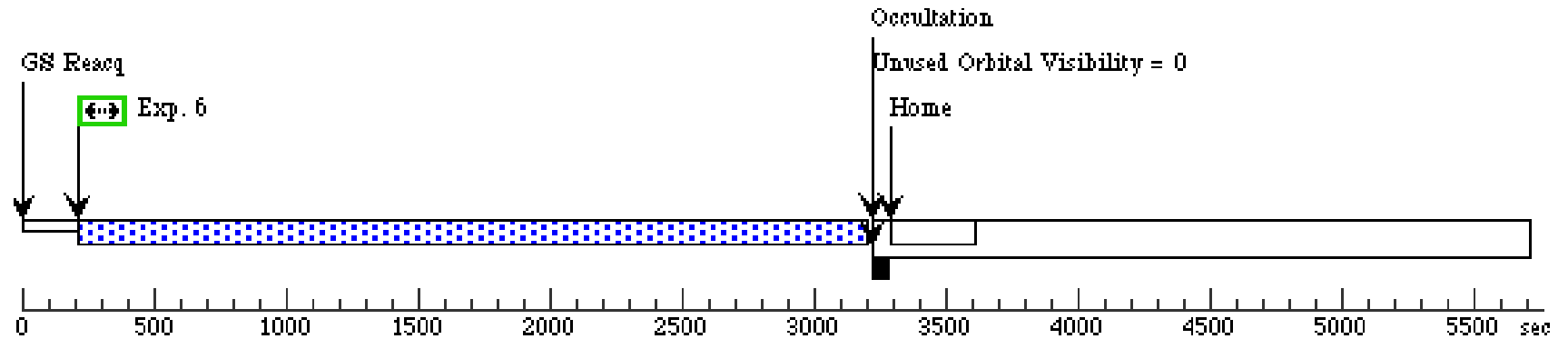
Orbit 4

Server Version: 20150128



Orbit 5

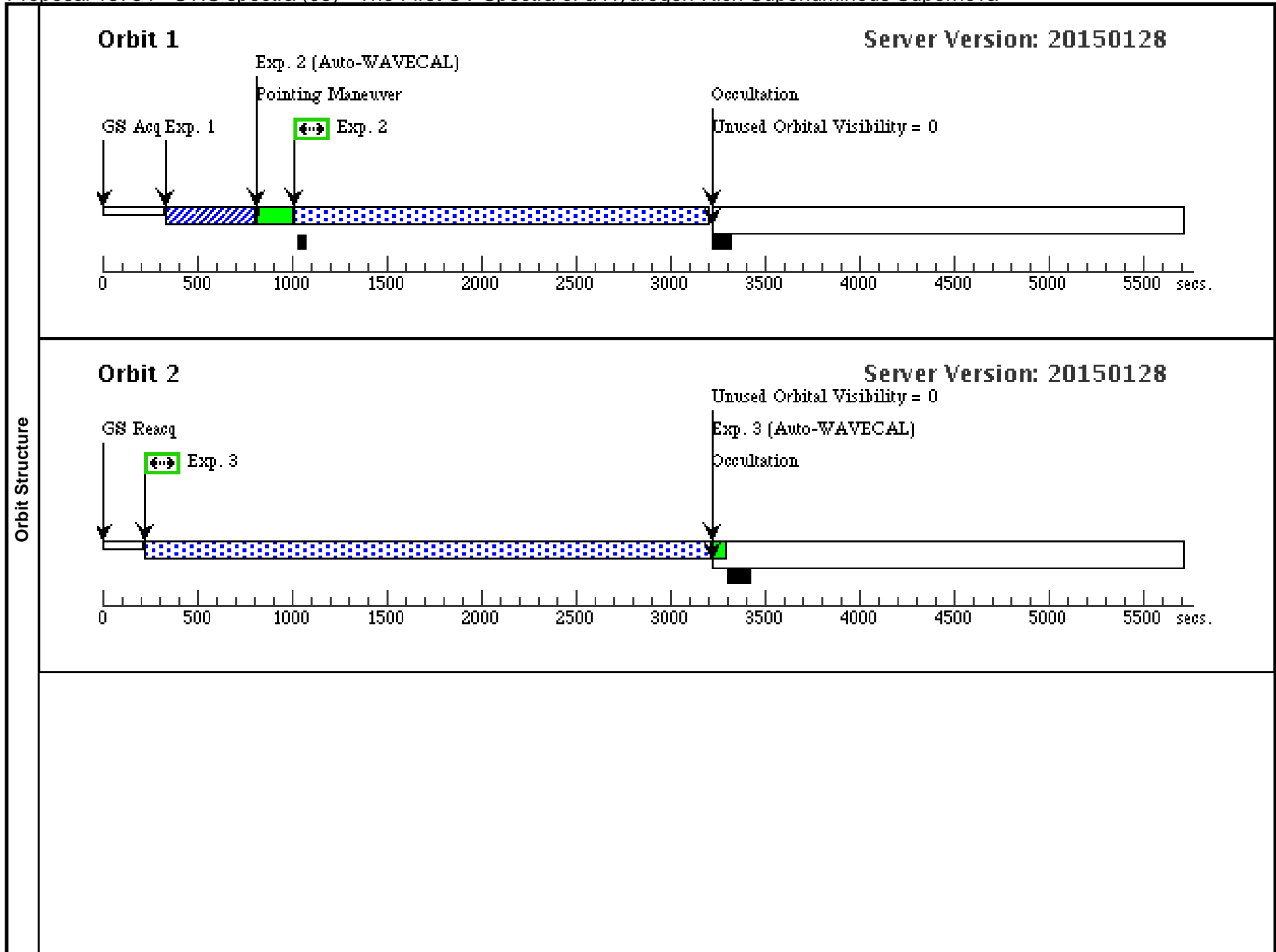
Server Version: 20150128



Proposal 13784 - STIS spectra (03) - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

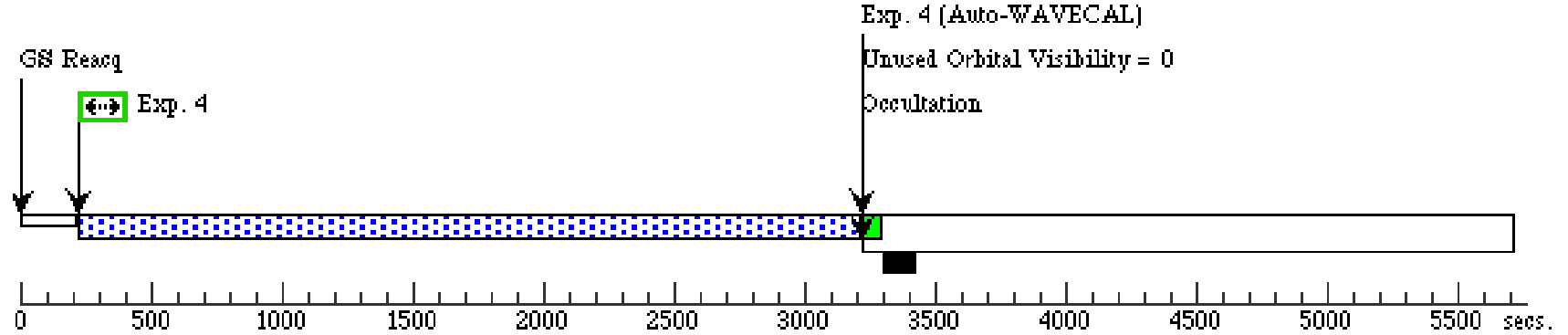
Sat Apr 25 01:10:10 GMT 2015

| Visit | Proposal 13784, STIS spectra (03), withdrawn Diagnostic Status: Warning Scientific Instruments: STIS/CCD, STIS/NUV-MAMA Special Requirements: ON HOLD <i>On Hold Comments: Target of Opportunity</i> | | | | | | | | | | | | | | | | | |
|------------------------|--|----------------------|------------------------------|------------------------------|----------------------|---------------------|----------------------|-----------------------|--|--------------|---|------|----------|-------------|-----|------|----------------------|--|
| | (spectra (03.002)) Warning (Form): Sensitive exposures should have an ETC run number provided. (spectra (03.003)) Warning (Form): Sensitive exposures should have an ETC run number provided. (spectra (03.004)) Warning (Form): Sensitive exposures should have an ETC run number provided. (spectra (03.005)) Warning (Form): Sensitive exposures should have an ETC run number provided. | | | | | | | | | | | | | | | | | |
| Diagnosics | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| Generic Targets | <table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Criteria</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>SLSN</td> <td>low-redshift SLSN-II</td> <td></td> </tr> </tbody> </table> | | | | | | | | | | # | Name | Criteria | Description | (1) | SLSN | low-redshift SLSN-II | |
| | # | Name | Criteria | Description | | | | | | | | | | | | | | |
| (1) | SLSN | low-redshift SLSN-II | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| Exposures | # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit | | | | | | | | |
| | 1 | acquisition | (1) SLSN | STIS/CCD, ACQ, F28X50LP | MIRROR | ACQTYPE=POINT | | | 60 Secs (60 Secs) | | | | | | | | | |
| | | | | | | | | | [==>] | [1] | | | | | | | | |
| | 2 | spectra | (1) SLSN | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2200 Secs (2180 Secs) | | | | | | | | | |
| | | | | | | | | | [==>2180.0 Secs] | [1] | | | | | | | | |
| | 3 | spectra | (1) SLSN | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2700 Secs (2972 Secs) | | | | | | | | | |
| | | | | | | | | | [==>2972.0 Secs] | [2] | | | | | | | | |
| 4 | spectra | (1) SLSN | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2700 Secs (2972 Secs) | | | | | | | | | | |
| | | | | | | | | [==>2972.0 Secs] | [3] | | | | | | | | | |
| 5 | spectra | (1) SLSN | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2700 Secs (2972 Secs) | | | | | | | | | | |
| | | | | | | | | [==>2972.0 Secs] | [4] | | | | | | | | | |



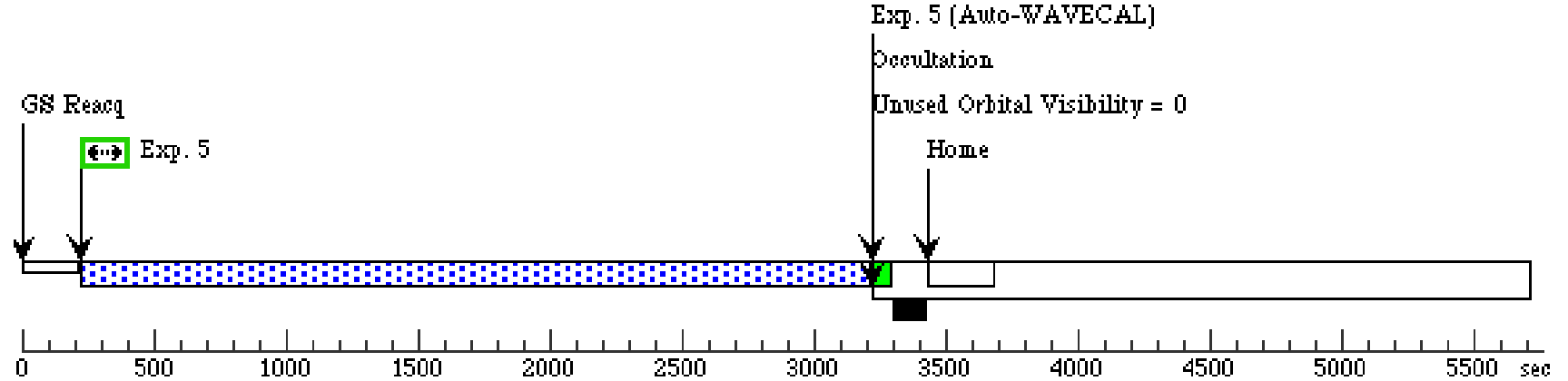
Orbit 3

Server Version: 20150128



Orbit 4

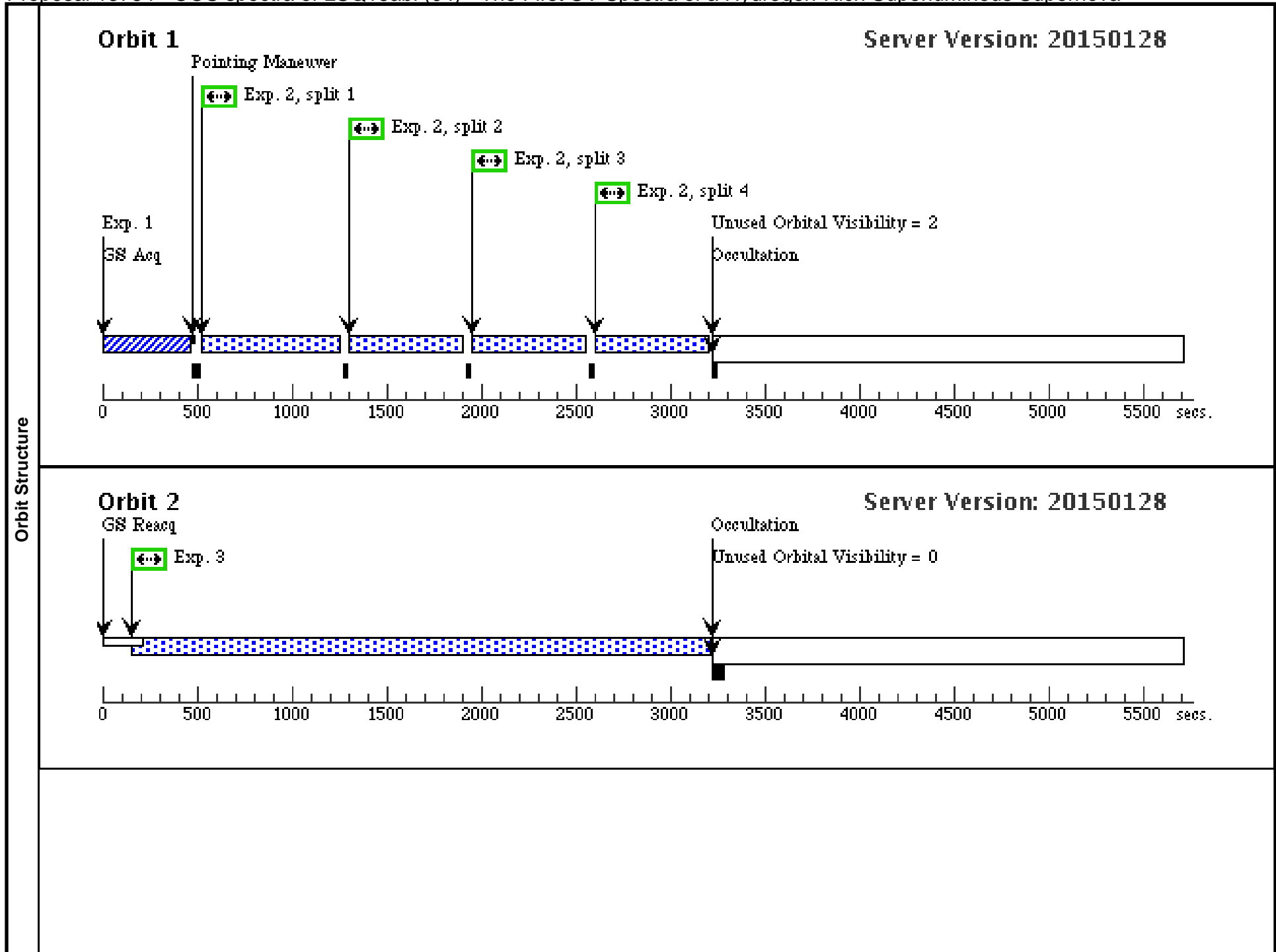
Server Version: 20150128



Proposal 13784 - COS spectra of LSQ15abl (04) - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

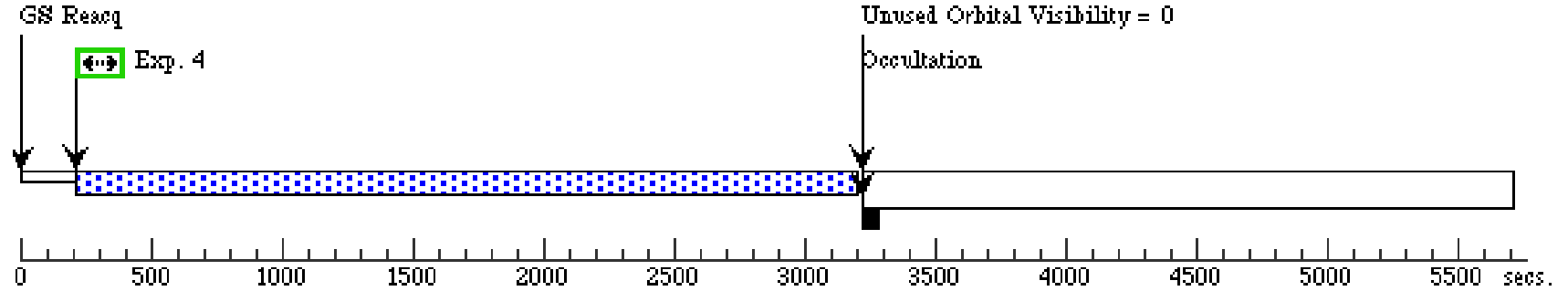
Sat Apr 25 01:10:11 GMT 2015

| | | | | | | | | | | |
|----------------------|---|---|---|-------------------------|--------------------------|---|---------------|--------|--|-------|
| Visit | Proposal 13784, COS spectra of LSQ15abl (04), implementation Diagnostic Status: Warning Scientific Instruments: COS/NUV, COS/FUV Special Requirements: (none) | | | | | | | | | |
| | Diagnostics | (COS spectra of LSQ15abl (04)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS (COS spectra of LSQ15abl (04)) Warning (Form): If the target coordinates are not known to 0.4" (or better), an ACQ/SEARCH should precede the ACQ/IMAGE. | | | | | | | | |
| Fixed Targets | | # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous | | | |
| | (2) | LSQ15ABL | RA: 09 40 29.5100 (145.1229583d) Dec: -04 11 32.11 (-4.19225d) Equinox: J2000 | | V=17 | Reference Frame: ICRS | | | | |
| Exposures | # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
| | 1 | acquisition (COS.ta.704 717) | (2) LSQ15ABL | COS/NUV, ACQ/IMAGE, PSA | MIRRORA | | | | 30 Secs (30 Secs) [==>] | [1] |
| | 2 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=ALL | | | 500 Secs (2180 Secs) [==>545.0 Secs (Split 1)] [==>545.0 Secs (Split 2)] [==>545.0 Secs (Split 3)] [==>545.0 Secs (Split 4)] | [1] |
| | 3 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=1 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [2] |
| | 4 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=2 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [3] |
| | 5 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=3 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [4] |
| | 6 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=4 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [5] |



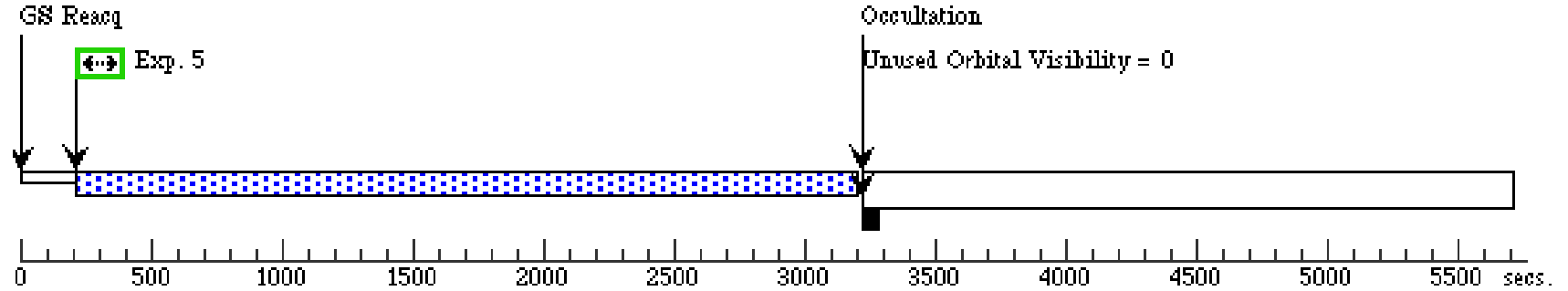
Orbit 3

Server Version: 20150128



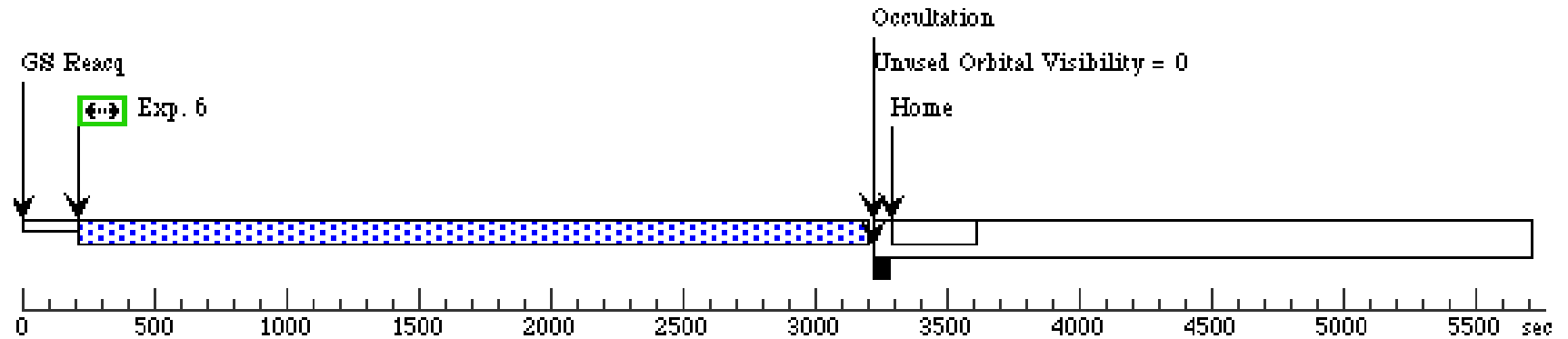
Orbit 4

Server Version: 20150128



Orbit 5

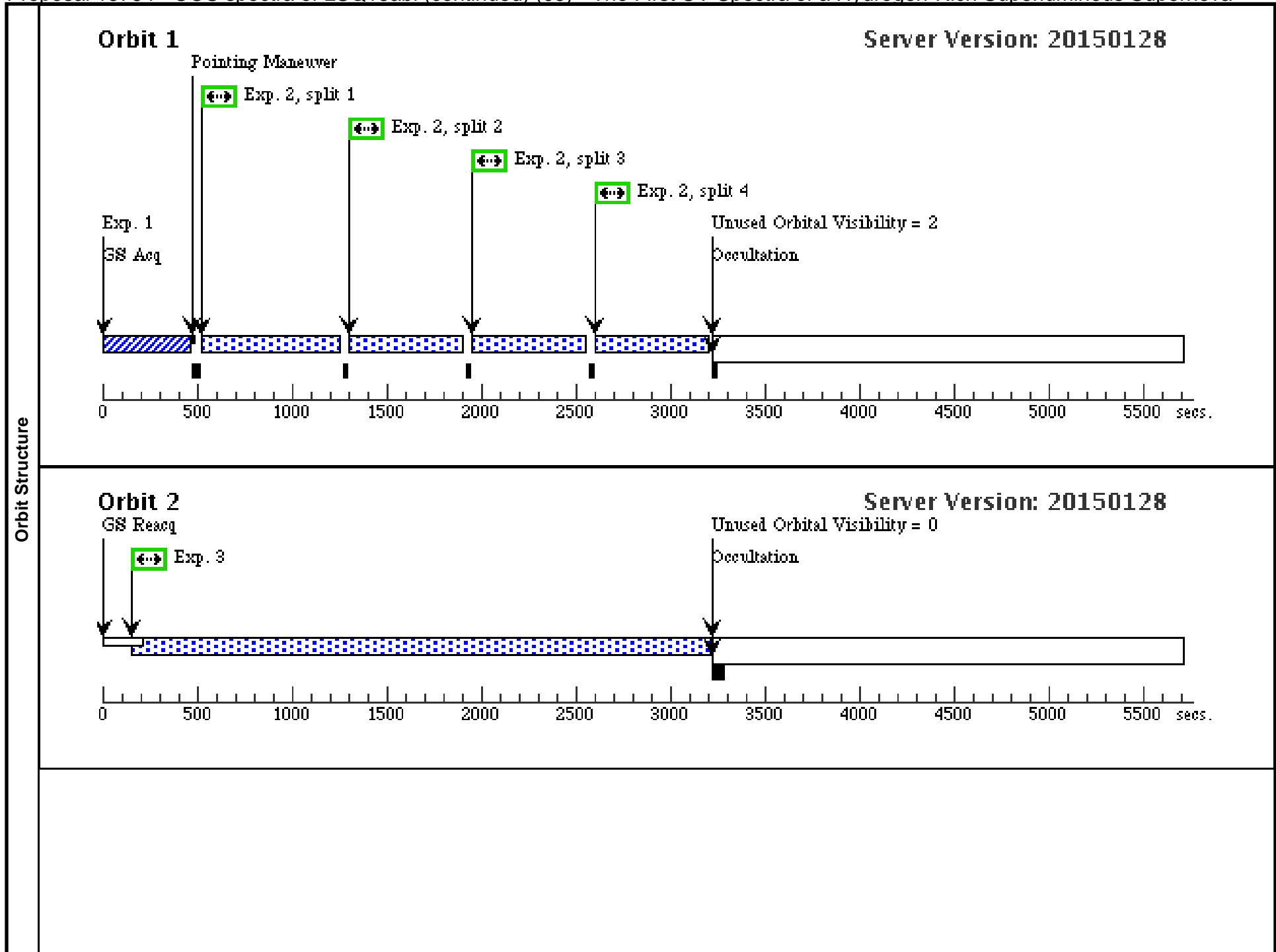
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Proposal 13784 - COS spectra of LSQ15abl (continued) (05) - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

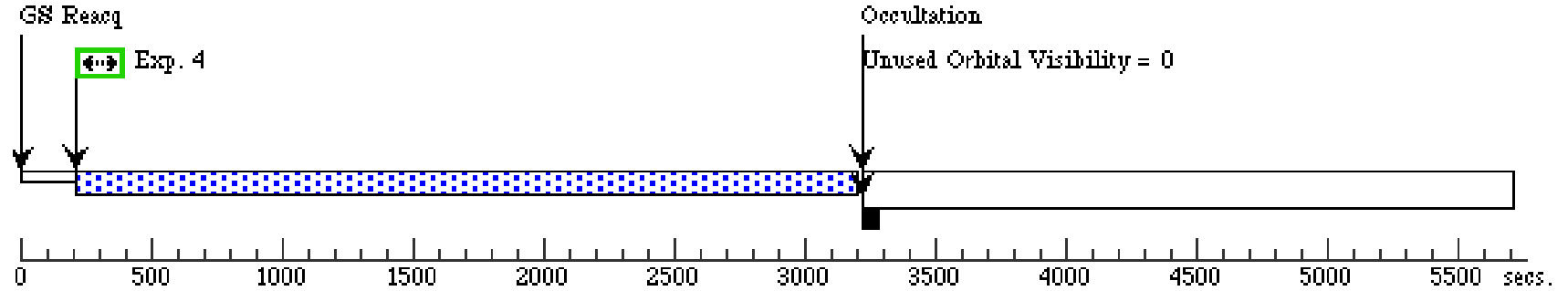
Sat Apr 25 01:10:11 GMT 2015

| | | | | | | | | | | |
|----------------------|---|---|---|-------------------------|--------------------------|---|---------------|--------|--|-------|
| Visit | Proposal 13784, COS spectra of LSQ15abl (continued) (05), implementation Diagnostic Status: Warning Scientific Instruments: COS/NUV, COS/FUV Special Requirements: (none) | | | | | | | | | |
| | Diagnostics | (COS spectra of LSQ15abl (continued) (05)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS (COS spectra of LSQ15abl (continued) (05)) Warning (Form): If the target coordinates are not known to 0.4" (or better), an ACQ/SEARCH should precede the ACQ/IMAGE. | | | | | | | | |
| Fixed Targets | | # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous | | | |
| | (2) | LSQ15ABL | RA: 09 40 29.5100 (145.1229583d) Dec: -04 11 32.11 (-4.19225d) Equinox: J2000 | | V=17 | Reference Frame: ICRS | | | | |
| Exposures | # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
| | 1 | acquisition (COS.ta.704 717) | (2) LSQ15ABL | COS/NUV, ACQ/IMAGE, PSA | MIRRORA | | | | 30 Secs (30 Secs) [==>] | [1] |
| | 2 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=ALL | | | 500 Secs (2180 Secs) [==>545.0 Secs (Split 1)] [==>545.0 Secs (Split 2)] [==>545.0 Secs (Split 3)] [==>545.0 Secs (Split 4)] | [1] |
| | 3 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=1 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [2] |
| | 4 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=2 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [3] |
| | 5 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=3 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [4] |
| | 6 | spectra (COS.sp.704 663) | (2) LSQ15ABL | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=60 00; FP-POS=4 | | | 2700 Secs (2936 Secs) [==>2936.0 Secs] | [5] |



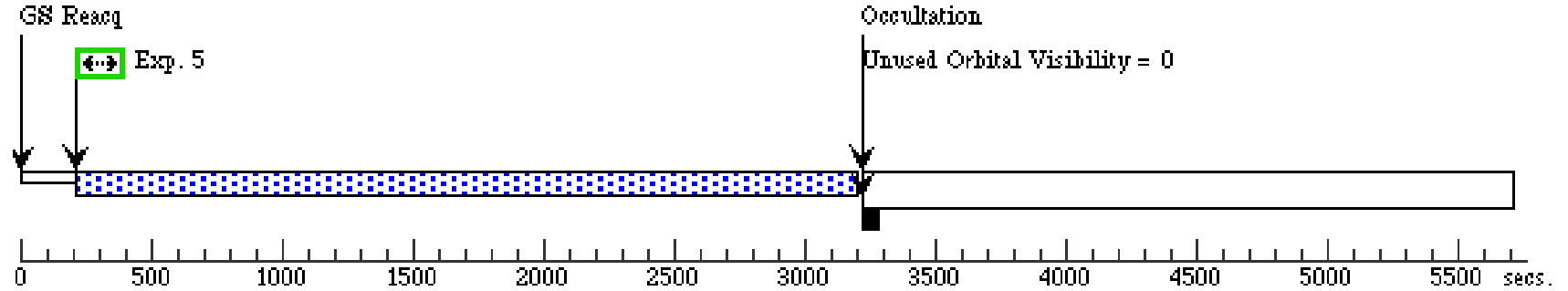
Orbit 3

Server Version: 20150128



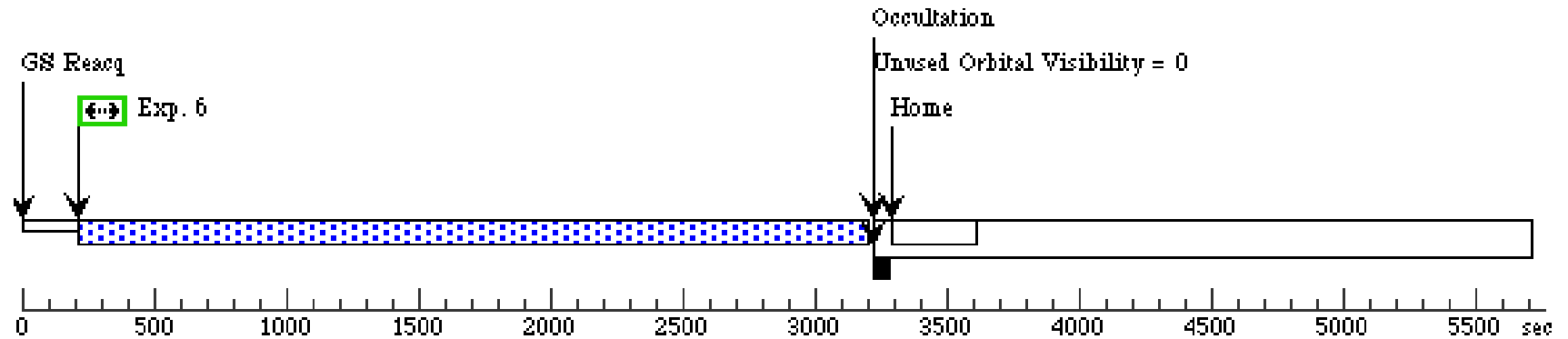
Orbit 4

Server Version: 20150128



Orbit 5

Server Version: 20150128

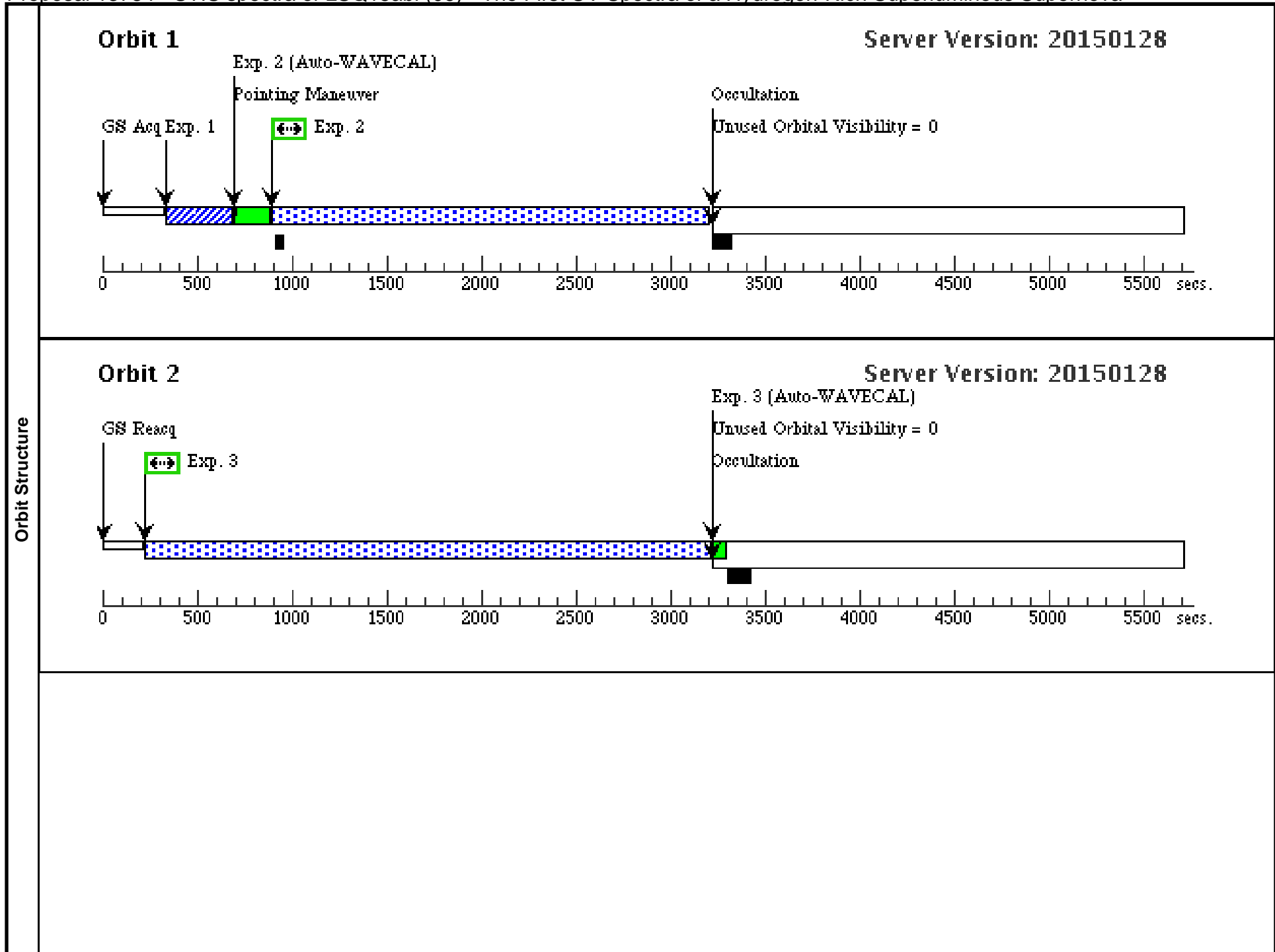


Proposal 13784 - STIS spectra of LSQ15abl (06) - The First UV Spectra of a Hydrogen-Rich Superluminous Supernova

Sat Apr 25 01:10:11 GMT 2015

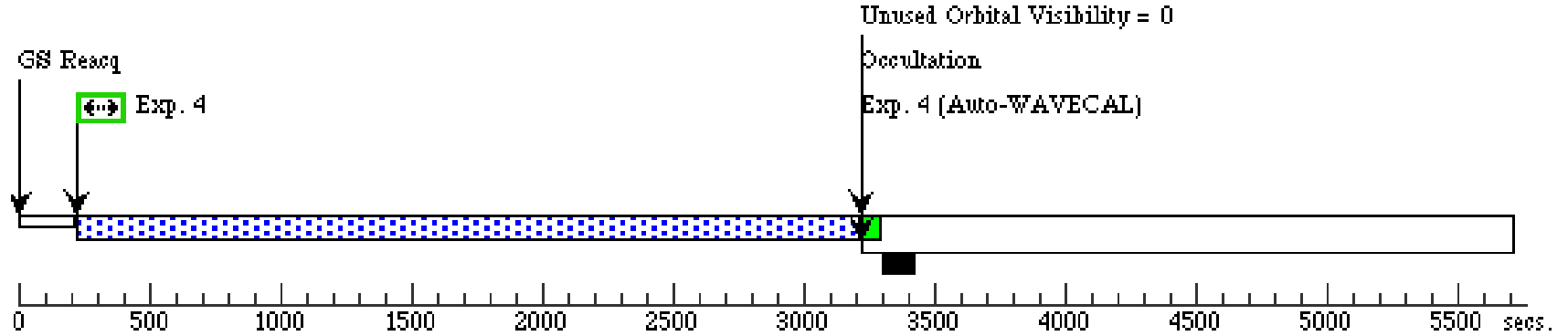
| Fixed Targets | # | | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---------------|---|-----|----------|---|--------------------------|--------|-----------------------|
| | | (2) | LSQ15ABL | RA: 09 40 29.5100 (145.1229583d) Dec: -04 11 32.11 (-4.19225d) Equinox: J2000 | | V=17 | Reference Frame: ICRS |

| Exposures | # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|-----------|---|-------------------------------|--------------|------------------------------|-----------------|---------------|---------------|--------|--|-------|
| | 1 | acquisition (STIS.ta.704 669) | (2) LSQ15ABL | STIS/CCD, ACQ, F28X50LP | MIRROR | ACQTYPE=POINT | | | 30 Secs (30 Secs) [==>] | [1] |
| | 2 | spectra (STIS.sp.70 4670) | (2) LSQ15ABL | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2200 Secs (2300 Secs) [==>2300.0 Secs] | [1] |
| | 3 | spectra (STIS.sp.70 4670) | (2) LSQ15ABL | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2700 Secs (2972 Secs) [==>2972.0 Secs] | [2] |
| | 4 | spectra (STIS.sp.70 4670) | (2) LSQ15ABL | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2700 Secs (2972 Secs) [==>2972.0 Secs] | [3] |
| | 5 | spectra (STIS.sp.70 4670) | (2) LSQ15ABL | STIS/NUV-MAMA, ACCUM, 52X0.2 | G230L 2376 A | | | | 2700 Secs (2972 Secs) [==>2972.0 Secs] | [4] |



Orbit 3

Server Version: 20150128



Orbit 4

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