17072 - From atomic physics to stellar evolution: decoding the heavy-metal subdwarfs with HST

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	***Institution***
Matti Dorsch (PI) (ESA Member) (Contact)	**Universitat Potsdam**
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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) LS-IV--14-116	STIS/CCD STIS/FUV-MAMA	3	15-Jul-2023 15:00:16.0	yes
02	(2) EC-22536-5304	STIS/CCD STIS/FUV-MAMA	3	15-Jul-2023 15:00:18.0	yes
03	(3) HD-127493	STIS/CCD STIS/FUV-MAMA	2	15-Jul-2023 15:00:19.0	yes
04	(1) LS-IV--14-116	STIS/CCD STIS/FUV-MAMA	1	15-Jul-2023 15:00:19.0	yes

9 Total Orbits Used

ABSTRACT

Hot subdwarf stars are helium-burning stars that are believed to form either via stripping of red giants' envelopes in binaries or by helium white dwarf mergers. They display a large variety of chemical peculiarities. Helium poor sdBs are found at Teff<35kK while extremely helium rich sdOs dominate at Teff>40kK. Particularly interesting are the rare mixed H/He composition iHe-sdOBs which bridge the gap. They may either be in a process of transition from red giant core to He-poor sdB, simply have insufficient hydrogen to quench the helium, or be the product of some other history. Several iHe-sdOBs show peculiar surface compositions with extraordinarily large enrichments of heavy elements (e.g. Zr, Pb by 4-6 dex). With two exceptions, these stars are completely unexplored in the space ultraviolet. We selected three "extreme chemistry" iHe-sdOBs that from a sequence of increasing Teff and helium abundance. This includes the recently discovered EC22536-5304, which resides in a binary with a very metal poor sdF-type companion, and likely formed via stripping by mass transfer to the sdF. UV spectra will allow us to determine

1) the abundances of a dozen or more species not observable in the optical, including the iron group,

2) the degree of stratification in the atmosphere (how thick is the enhanced layer?),

3) lead isotope ratios in the bright, lead-rich star HD127493.

The results will allow us to explore the processes that may lead to heavily stratified envelopes and to study the transformation of red giant cores or white dwarf mergers with a helium-enriched surface into helium-poor sdBs. In addition, they will test alternative scenarios, such as pollution by SN ejecta.

OBSERVING DESCRIPTION

First visit (LS IV -14 116):

The goal is a high S/N spectrum with the medium-resolution echelle E140M grism (using the standard 0.2x0.2 aperture). TIME-TAG is used when possible - for two out of three orbits, to limit the number of dumps. The ACCUM mode is used for the remaining orbit.

Second visit (EC22536-5304):

A STIS/E140M (0.2x0.2) spectrum with about S/N = 40 at 1350 AA is the goal. TIME-TAG is used when possible - for two out of three orbits, to limit the number of dumps. The ACCUM mode is used for the remaining orbit.

Third visit (HD127493):

A high-S/N (~100) observation with E140H/1271 using the 0.2x0.09 slit is the goal. The star is bright (V=10.08mag, Teff~41000K), and the

ACCUM mode will be used.

Proposal 17072 - LSIV-14 116 (01) - From atomic physics to stellar evolution: decoding the heavy-metal subdwarfs with HST

Visit

Proposal 17072, LSIV-14 116 (01), failed — Sat Jul 15 19:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

Fixed Targets

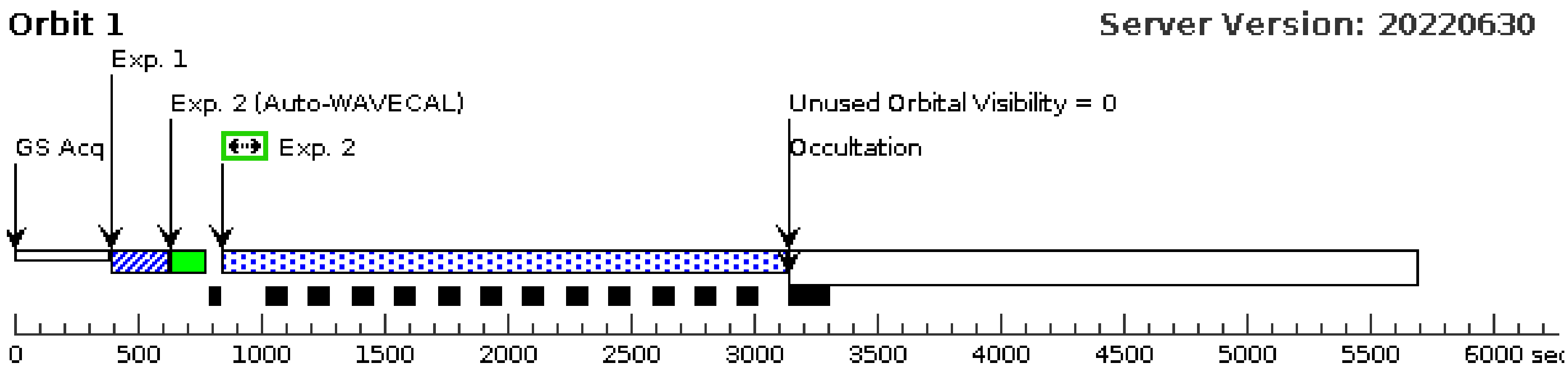
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LS-IV--14-116	RA: 20 57 38.8828 (314.4120117d) Dec: -14 25 46.04 (-14.42946d) Equinox: J2000	Proper Motion RA: 7.408676681721861 mas/yr Proper Motion Dec: -128.26540998821423 mas/yr Parallax: 0.0023405666220228413" Epoch of Position: 2016.0	V=12.956+/-0.02	Reference Frame: ICRS

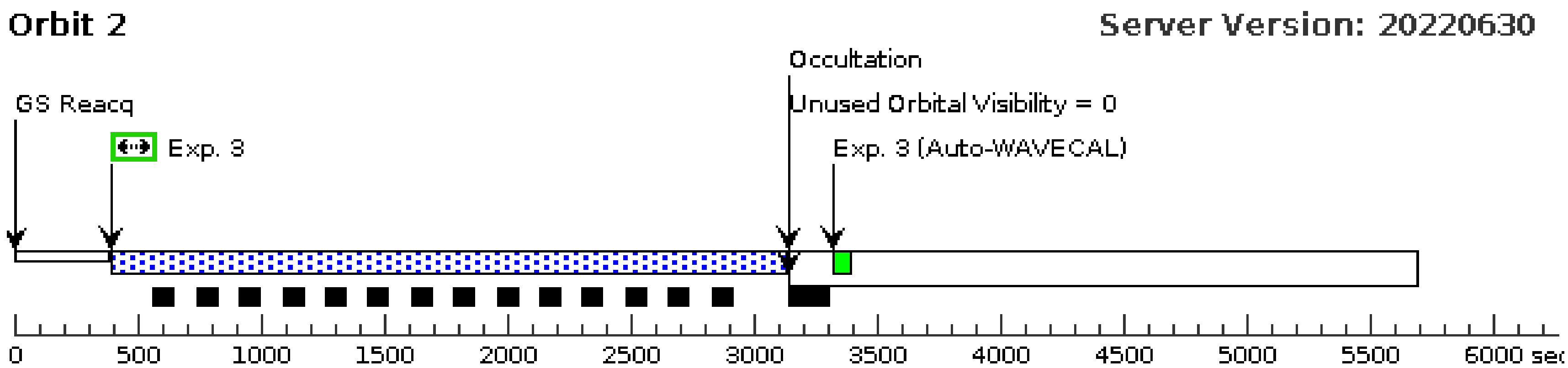
Comments:
Category=STAR
Description=[SDO]
Extended=NO

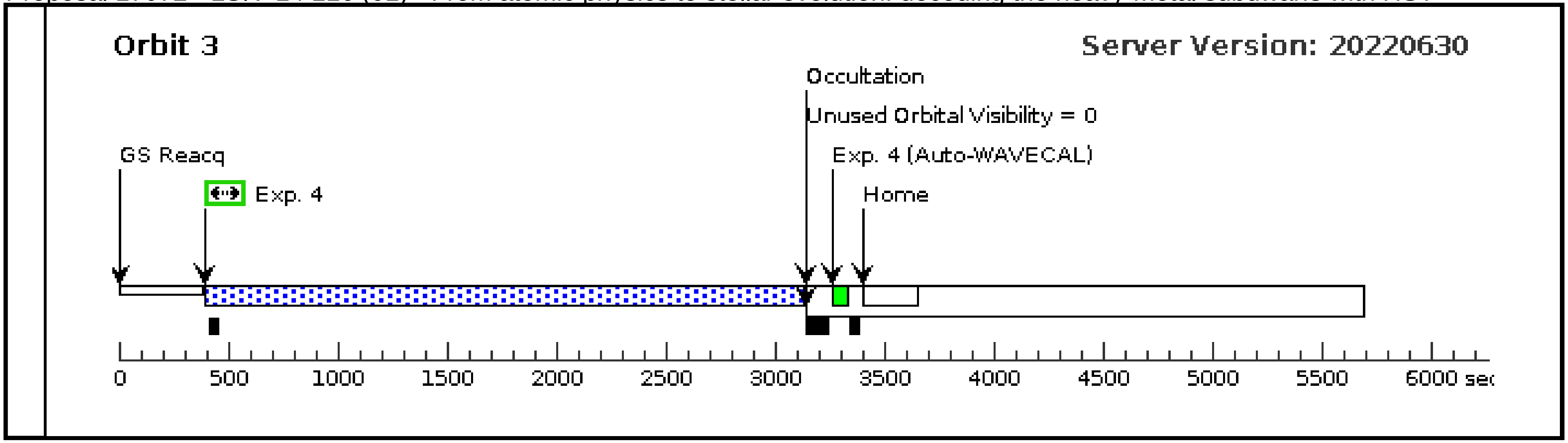
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition	(1) LS-IV--14-116	STIS/CCD, ACQ, F28X50LP	MIRROR				1 Secs (1 Secs) *[==>]*	***[1]***
2	science (STIS.sp.1507856)	(1) LS-IV--14-116	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=174			2270.3 Secs (2270.3 Secs) *[==>]*	***[1]***
3	science (STIS.sp.1507856)	(1) LS-IV--14-116	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=174			2726.3 Secs (2726.3 Secs) *[==>]*	***[2]***
4	science (STIS.sp.1507856)	(1) LS-IV--14-116	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2726.3 Secs (2726.3 Secs) *[==>]*	***[3]***

Orbit Structure






Orbit 3
Server Version: 20220630
Occultation
Unused Orbital Visibility = 0
Exp. 4 (Auto-WAVECAL)
Home
GS Reacq
Exp. 4
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17072, EC-22536-5304 (02), scheduling Sat Jul 15 19:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

Fixed Targets

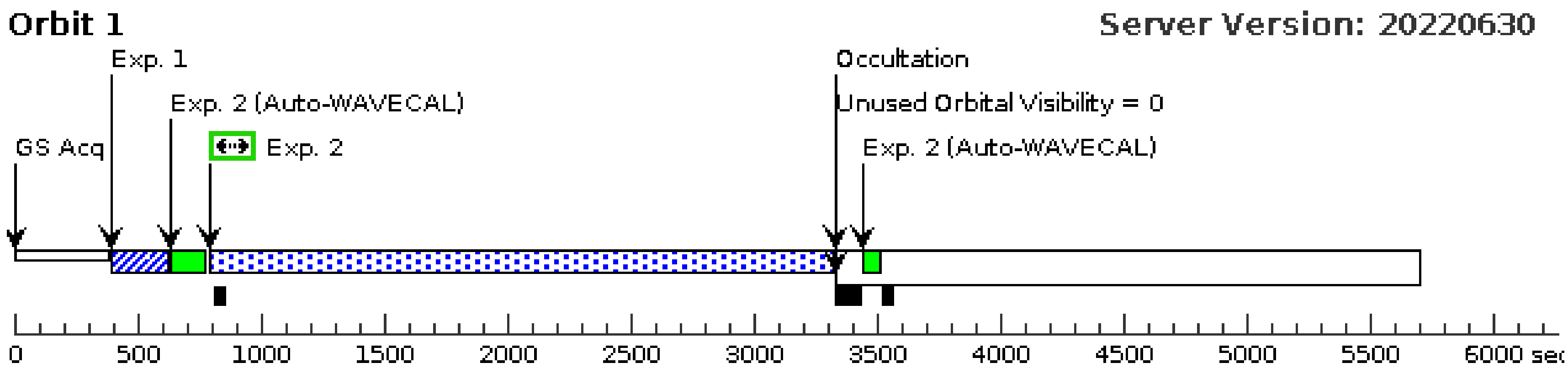
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	EC-22536-5304	RA: 22 56 35.9285 (344.1497021d) Dec: -52 48 36.77 (-52.81021d) Equinox: J2000	Proper Motion RA: 2.45337013584024 mas/yr Proper Motion Dec: -44.341088713731104 mas/yr Parallax: 0.0013682472167333315" Epoch of Position: 2016.0	V=13.323+/-0.03	Reference Frame: ICRS

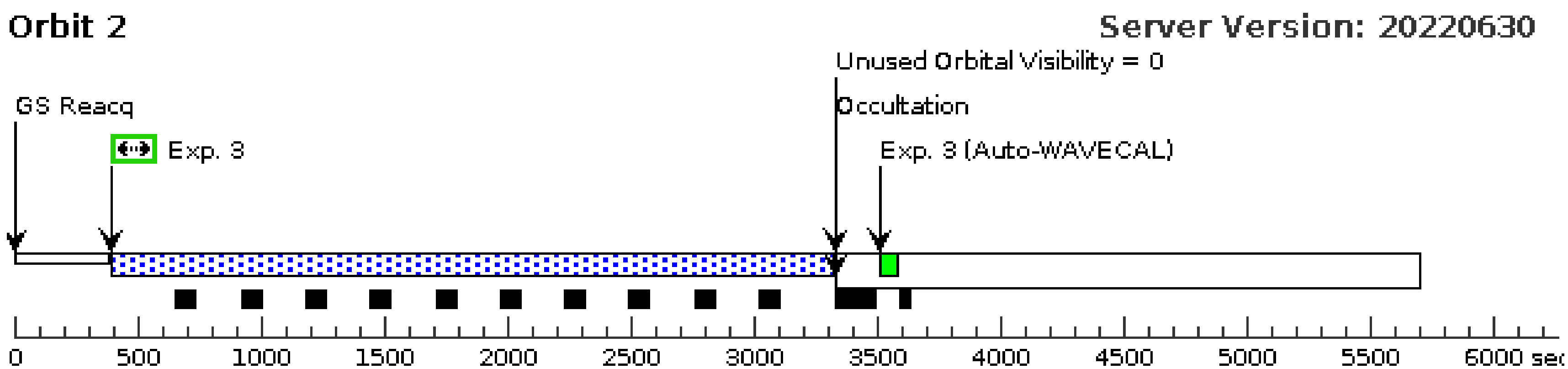
Comments:
Category=STAR
Description=[SDO]
Extended=NO

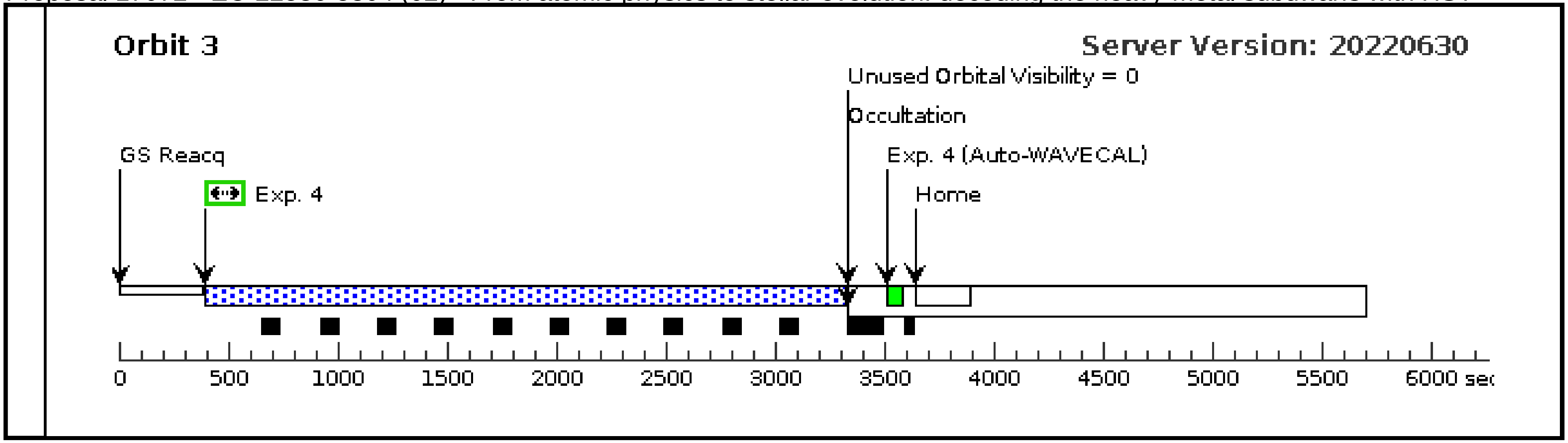
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition	(2) EC-22536-5304	STIS/CCD, ACQ, F28X50LP	MIRROR				1 Secs (1 Secs) *[==>]*	***[1]***
2	science (STIS.sp.1507868)	(2) EC-22536-5304	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2513 Secs (2513 Secs) *[==>]*	***[1]***
3	science (STIS.sp.1507868)	(2) EC-22536-5304	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=263			2910.3 Secs (2910.3 Secs) *[==>]*	***[2]***
4	science (STIS.sp.1507868)	(2) EC-22536-5304	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=263			2910.3 Secs (2910.3 Secs) *[==>]*	***[3]***

Orbit Structure






Orbit 3
Server Version: 20220630
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 4
Exp. 4 (Auto-WAVECAL)
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17072, HD127493 (03), completed Sat Jul 15 19:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

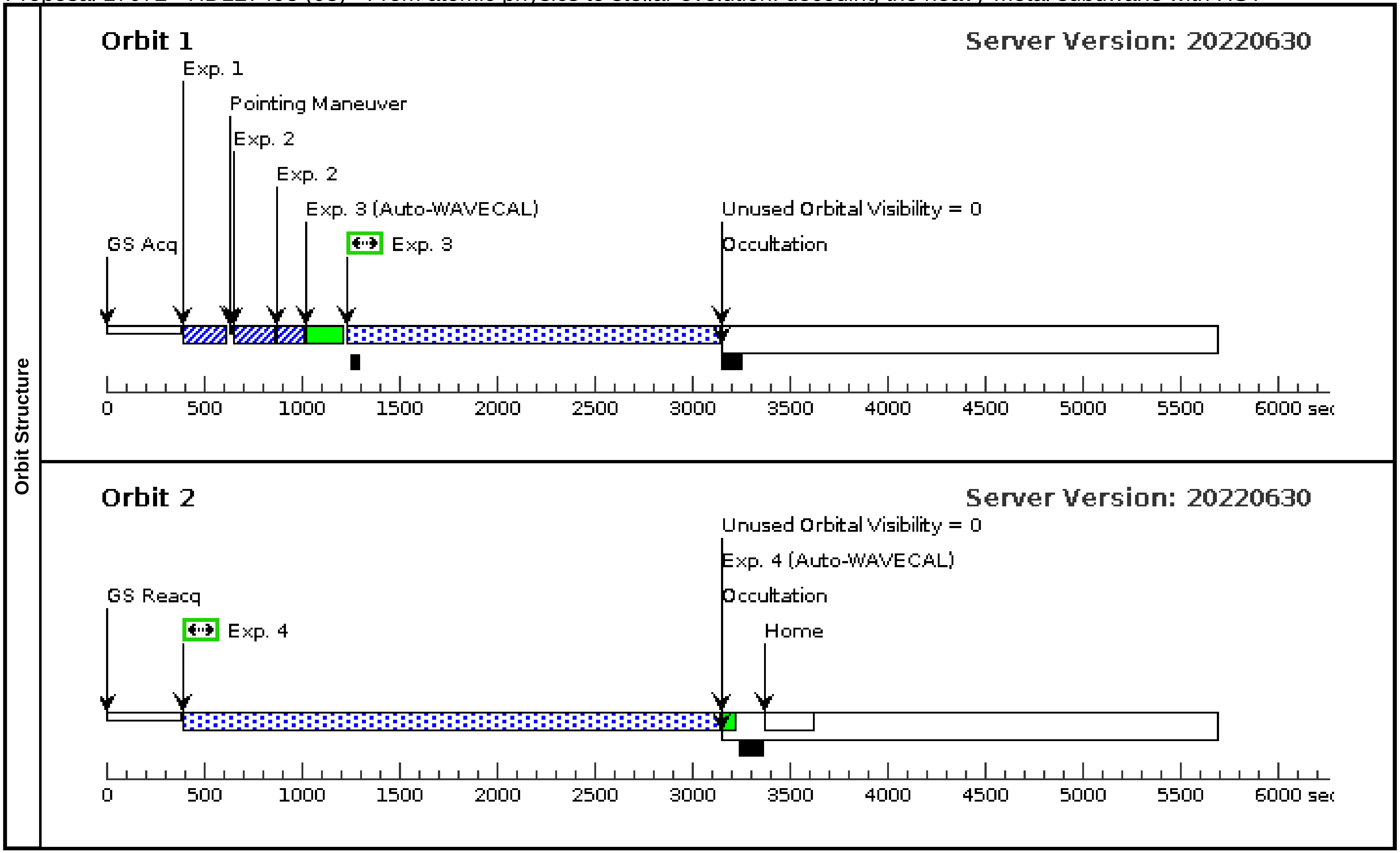
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HD-127493	RA: 14 32 21.4560 (218.0894000d) Dec: -22 39 25.93 (-22.65720d) Equinox: J2000	Proper Motion RA: -31.721662259931858 mas/yr Proper Motion Dec: -17.683558256879476 mas/yr Parallax: 0.005692375042818344" Epoch of Position: 2016.0	V=10.01+/-0.03	Reference Frame: ICRS

Comments:
Category=STAR
Description=[SDO]
Extended=NO

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.1811778)	(3) HD-127493	STIS/CCD, ACQ, F28X50LP	MIRROR				0.1 Secs (0.1 Secs) *[==>]*	***[1]***
2	acq/peak (STIS.ta.1811786)	(3) HD-127493	STIS/CCD, ACQ/PEAK, 0.2X0.09	MIRROR				0.1 Secs (0.1 Secs) *[==>]*	***[1]***
3	science (STIS.sp.1504499)	(3) HD-127493	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1271 A				1891.6 Secs (1891.6 Secs) *[==>]*	***[1]***
4	science (STIS.sp.1504499)	(3) HD-127493	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1271 A				2734.6 Secs (2734.6 Secs) *[==>]*	***[2]***


Orbit Structure
Orbit 1
Server Version: 20220630
Exp. 1
Pointing Maneuver
Exp. 2
Exp. 2
Exp. 3 (Auto-WAVECAL)
Unused Orbital Visibility = 0
GS Acq
Exp. 3
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec
Orbit 2
Server Version: 20220630
Unused Orbital Visibility = 0
Exp. 4 (Auto-WAVECAL)
GS Reacq
Occultation
Exp. 4
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Proposal 17072 - LSIV-14 116 (redo) (04) - From atomic physics to stellar evolution: decoding the heavy-metal subdwarfs with HST

Visit

Proposal 17072, LSIV-14 116 (redo) (04), scheduling Sat Jul 15 19:00:20 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: (none)

Comments: This is a new visit to repeat one orbit of Visit 01 of LS IV -14 116. During the original orbit HST failed to acquire the guide stars. Following HOPR 92568 for this HST program (17072), this single repeat orbit was approved by the TTRB.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LS-IV--14-116	RA: 20 57 38.8828 (314.4120117d) Dec: -14 25 46.04 (-14.42946d) Equinox: J2000	Proper Motion RA: 7.408676681721861 mas/yr Proper Motion Dec: -128.26540998821423 mas/yr Parallax: 0.0023405666220228413" Epoch of Position: 2016.0	V=12.956+/-0.02	Reference Frame: ICRS

Comments:
Category=STAR
Description=[SDO]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition	(1) LS-IV--14-116	STIS/CCD, ACQ, F28X50LP	MIRROR				1 Secs (1 Secs) *[==>]*	*[1]*
2	science (STIS.sp.1507856)	(1) LS-IV--14-116	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=174			2270.3 Secs (2270.3 Secs) *[==>]*	*[1]*

Orbit Structure