17425 - Mapping the Collision of the Nearest Interstellar Medium Clouds

Cycle: 31, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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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) HD73752	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	5	11-Jun-2024 16:01:12.0	yes
02	(2) HD52698	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	11-Jun-2024 16:01:13.0	yes
03	(3) HD57095	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	11-Jun-2024 16:01:14.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
04	(4) HD27274	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	11-Jun-2024 16:01:15.0	yes

14 Total Orbits Used

ABSTRACT

Evidence is emerging from different observations that the clouds in the local interstellar medium, which surround the Sun and the nearest stars, are young, low-density, and colliding with each other. Indeed, the Sun may be currently moving through the collision zone of the Local Interstellar Cloud and the G Cloud. Archival observations support the high column density that would result from this interaction, but the densest region of the interaction remains unobserved. We propose to obtain high resolution spectra of four nearby stars in this region to measure the kinematic and physical properties of the interaction zone. Coupling E230H and E140M spectra will enable a direct test of the mixing by modeling the absorption features in narrow and strong LISM features (i.e., MgII) while also leveraging the numerous ions that are likely to show LISM absorption (e.g., HI, DI, CII, NI, OI, SiII) to obtain gas abundances, depletion patterns, temperatures, and turbulent velocities. The kinematics and the fundamental physical properties in the collision zone can be compared to the average cloud properties already derived in the literature. The collision and mixing of LISM clouds have important implications for our understanding of the timing and magnitude that the heliosphere expands and contracts. This, in turn, impacts the severity of the modulation of energetic cosmic rays into the solar system and on to the tops of planetary atmospheres. The proposed observations will test a new model of LISM cloud collisions that could significantly change the view we have of our immediate Galactic neighborhood.

OBSERVING DESCRIPTION

Target Selection and Availability: We plan to observe four nearby stars that lie along the collision zone of the nearest LISM clouds, the LIC and G clouds. The most important factors in target selection were location along this narrow strip that defines the longest path length through the mixed region and proximity. Three of our targets are <15 pc and the fourth is <20 pc away.

Desired Spectral Coverage and Resolution: The high spectral resolution capabilities of STIS are necessary to model the ISM absorption line profiles. Only by resolving the velocity components of the mixed LIC and G clouds, can accurate physical measurements of gas abundances, dust depletion, temperature, and turbulent velocity be made. We will use the high resolution E230H grating to observe MgII and FeII. These heavy ions are not

significantly broadened thermally, and provide sharp line profiles to resolve the velocity structure of the ISM along the line of sight. These transitions will be key to our kinematic analysis of the mixed absorption profiles. Hydrogen has a broad absorption profile, and does not necessarily require high spectral resolution, and therefore, to maximize S/N, we plan to use the E140M setting. Due to the wide spectral range of STIS, we would obtain practically the entire far-UV band from 1150-1700 A and several more ISM absorption lines (e.g., DI, CII, NI, OI, SiII, SiIII, AlII) in addition to Lyman-alpha. The velocity structure of the absorption can be derived by absorption of FeII and MgII at high spectral resolution and used for all transitions detected at medium resolution.

Desired Aperture Size and Geocoronal Emission: The narrow aperture sizes of STIS are critical in order to minimize the contamination by the geocoronal Lyman-alpha emission. Depending on the time of year, the Earth's motion can Doppler shift the geocoronal line into the region of astrospheric absorption and contaminate our measurement. Our targets will require a minimal timing constraint to ensure that the geocoronal line is in the core of the ISM absorption (still allowing >7 months to perform observations).

Desired Signal-to-Noise and Exposure Times: Because cool stars (even late-A and early-F stars) are emission line sources in the far-UV, estimating expected S/N for our planned spectra requires first estimating Lyman-alpha and MgII fluxes, which we can do by extrapolating from previously observed stars. Chromospheric line fluxes (such as MgII and Lyman-alpha) are related to X-ray fluxes. Wood et al. (2005) provide Lyman-alpha spectra for many stars, which serve as the comparison stars for our purposes here. All of our targets have X-ray observations and therefore have well determined X-ray luminosities (L_X). After acquisition, peakup, and observational overhead are considered, we expect at least 28 minutes to be available in the first orbit for the E230H exposure. This provides time to attain high S/N of >25 at the half-maximum (that is, one half FWHM from the line center, because it is unlikely that the ISM absorption will be centered at the same velocity as the star) of the strong MgII lines. After acquisition and overheads are considered, we expect at least 41 minutes of exposure time to be available in the second orbit for the E140M exposure, and 48 minutes in subsequent orbits. To obtain a S/N >15, which is required to model the Lyman-alpha profile, requires 2-4 orbits.

Brightness Limits: The coolest stars in our sample have UV spectra characterized by minimal continua, but strong emission lines. For this reason, they all fall far short of the global brightness limit. For example, in the E230H setting, our earliest spectral type target (HD73752; G3V) only results in 23,700 counts s^-1, 12% of the MAMA bright limit. The emission lines for all targets also fall far short of the local brightness limit. The two emission lines of interest in this proposal (Lyman-alpha and MgII) are also the brightest, and therefore, the procedure given above for estimating the S/N near their peaks is also utilized to test for brightness limit violations. Again, HD73752 is the strongest MgII emission line sources in our sample, and in the brightest pixel, only generates 0.7 counts s^-1.

Visit

Proposal 17425, Visit 01, implementation Tue Jun 11 20:01:16 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 19-JUL-2023:00:00:00 AND 04-MAR-2024:00:00:00; BETWEEN 19-JUL-2024:00:00:00 AND 04-MAR-2025:00:00:00; BETWEEN 19-JUL-2025:00:00:00 AND 04-MAR-2026:00:00:00

Fixed Targets

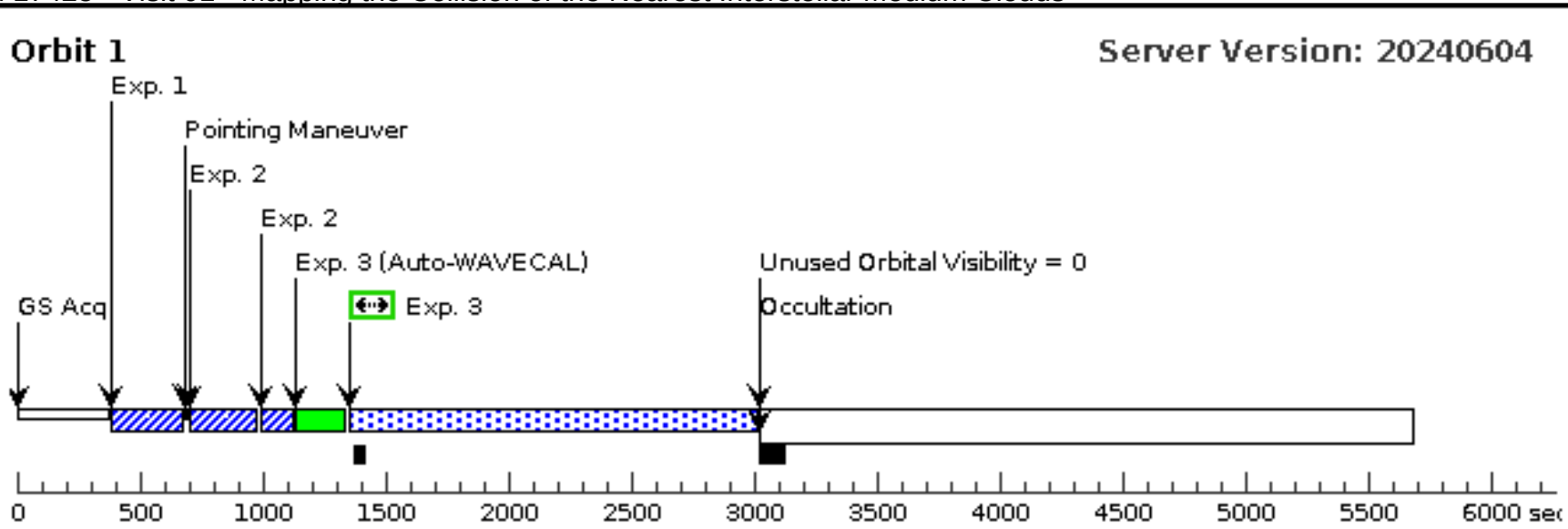
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD73752 Alt Name1: HR3430 Alt Name2: HIP42430	RA: 08 39 7.6296 (129.7817900d) Dec: -22 39 35.70 (-22.65992d) Equinox: J2000	Proper Motion RA: -0.017361433195635892 sec of time/yr Proper Motion Dec: 0.459973 arcsec/yr Parallax: 0.0509663" Epoch of Position: 2015.5 Radial Velocity: 52.13 km/sec	V=5.17+/-0.99 TYPE=G3V, B-V=0.83, E(B-V)=0, F-LINE(2796)=2.56e-12, W-LINE(2796)=0.6, F-LINE(1215)=0.65e-12, W-LINE(1215)=0.7	Reference Frame: ICRS

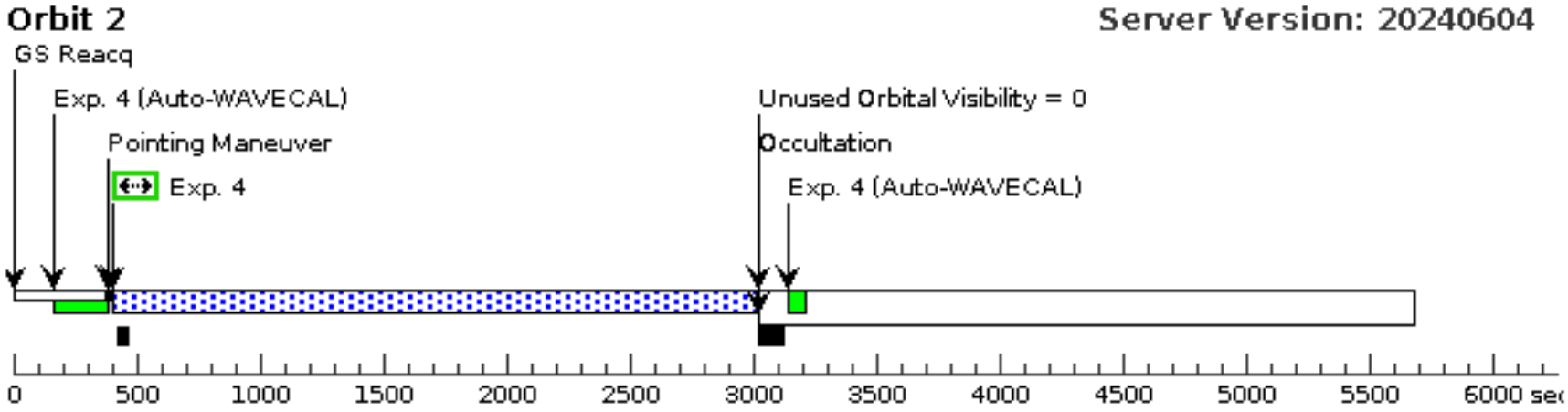
Comments: No target star was identified by the BOT in the observed field. DSS images clearly indicate a bright isolated target star (brightest within 100 arcsec). Clearly the target star is the dominant object in the field of view.
Category=STAR
Description=[G V-IV]
Extended=NO

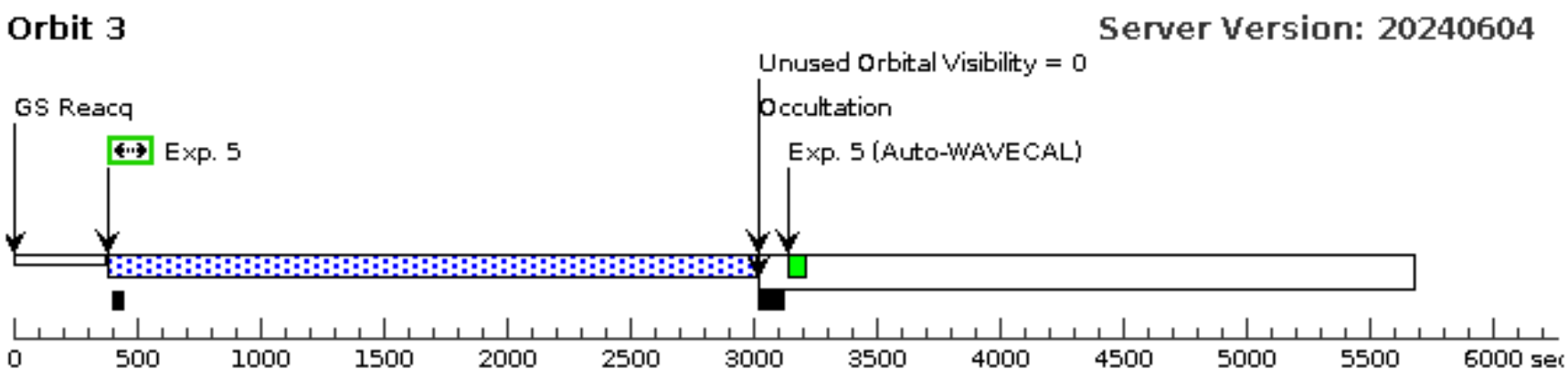
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.1892233)	(1) HD73752	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.2 Secs (0.2 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 209.6709 *Brightest Pixel = 18,286.41 e*								
2	(STIS.sp.1892237)	(1) HD73752	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430L 4300 A				0.2 Secs (0.2 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 137.5656 *Brightest Pixel = 2,383.32 e* *Global Source Counts = 7,735,739.289 e*								
3	(STIS.sp.1892496)	(1) HD73752	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1695 Secs (1647 Secs) *[==>1647.0 Secs]*	 ***[1]***
	Comments: SNR = 45.6222 *Brightest Pixel = 1,152.72 e*								
4	(STIS.sp.1892497)	(1) HD73752	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2717 Secs (2598 Secs) *[==>2598.0 Secs]*	 ***[2]***
	Comments: SNR = 9.9279 *Brightest Pixel = 51.95 e*								
5	(STIS.sp.1892497)	(1) HD73752	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2717 Secs (2618 Secs) *[==>2618.0 Secs]*	 ***[3]***
	Comments: SNR = 9.9279 *Brightest Pixel = 51.95 e*								
6	(STIS.sp.1892497)	(1) HD73752	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2717 Secs (2618 Secs) *[==>2618.0 Secs]*	 ***[4]***
	Comments: SNR = 9.9279 *Brightest Pixel = 51.95 e*								
7	(STIS.sp.1892497)	(1) HD73752	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2717 Secs (2618 Secs) *[==>2618.0 Secs]*	 ***[5]***
	Comments: SNR = 9.9279 *Brightest Pixel = 51.95 e*								

Orbit Structure



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GS Reacq
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Exp. 5 (Auto-WAVECAL)
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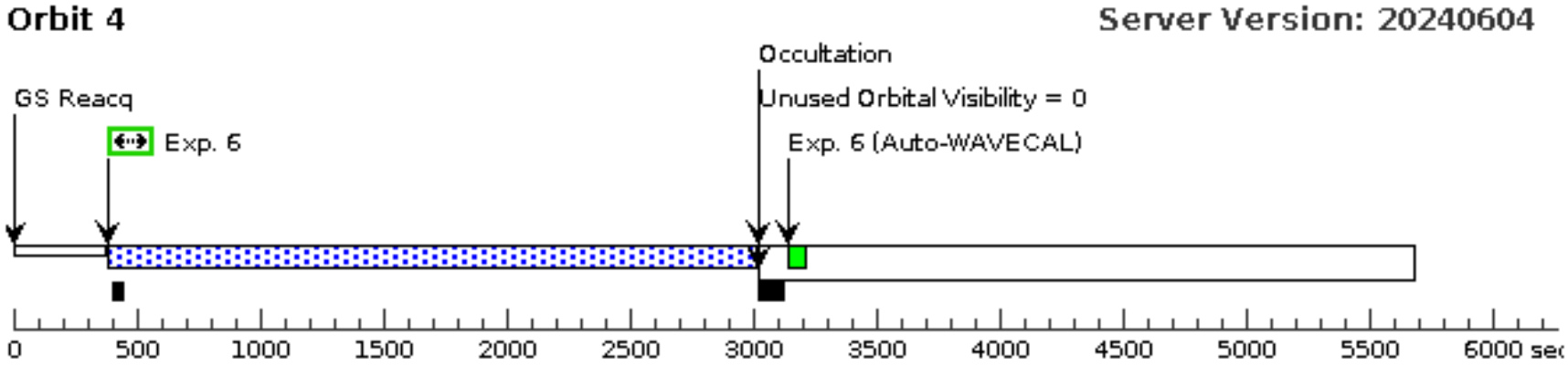
5500
6000 sec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Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 6
Exp. 6 (Auto-WAVECAL)
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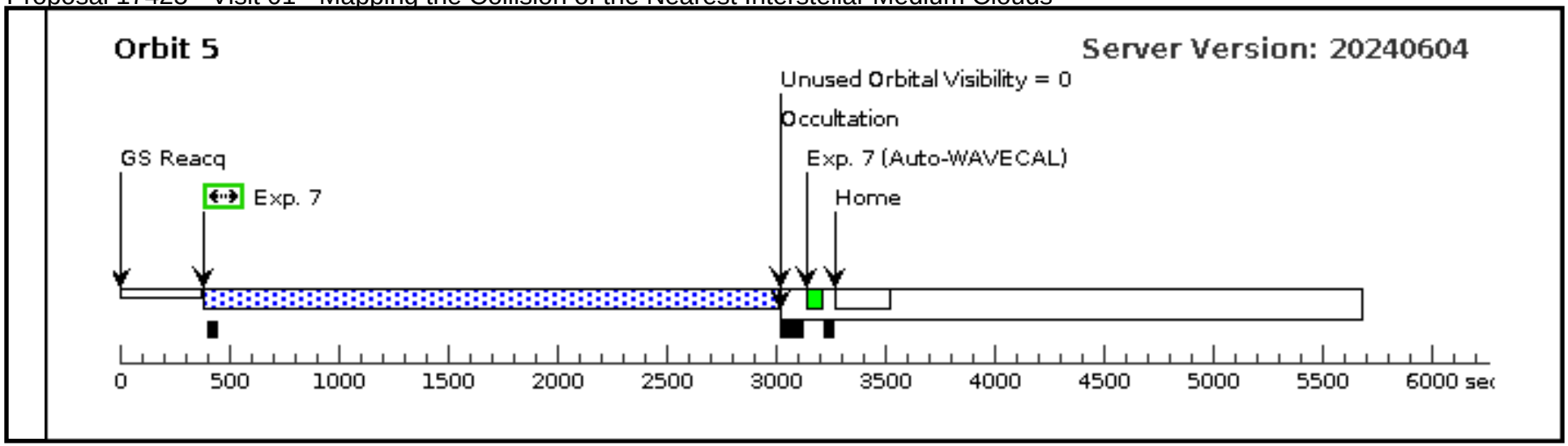
Orbit 5
Server Version: 20240604
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 7
Exp. 7 (Auto-WAVECAL)
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6000 sec

Visit

Proposal 17425, Visit 02, implementation Tue Jun 11 20:01:16 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 17-JUN-2023:00:00:00 AND 04-FEB-2024:00:00:00; BETWEEN 17-JUN-2024:00:00:00 AND 04-FEB-2025:00:00:00; BETWEEN 17-JUN-2025:00:00:00 AND 04-FEB-2026:00:00:00

Fixed Targets

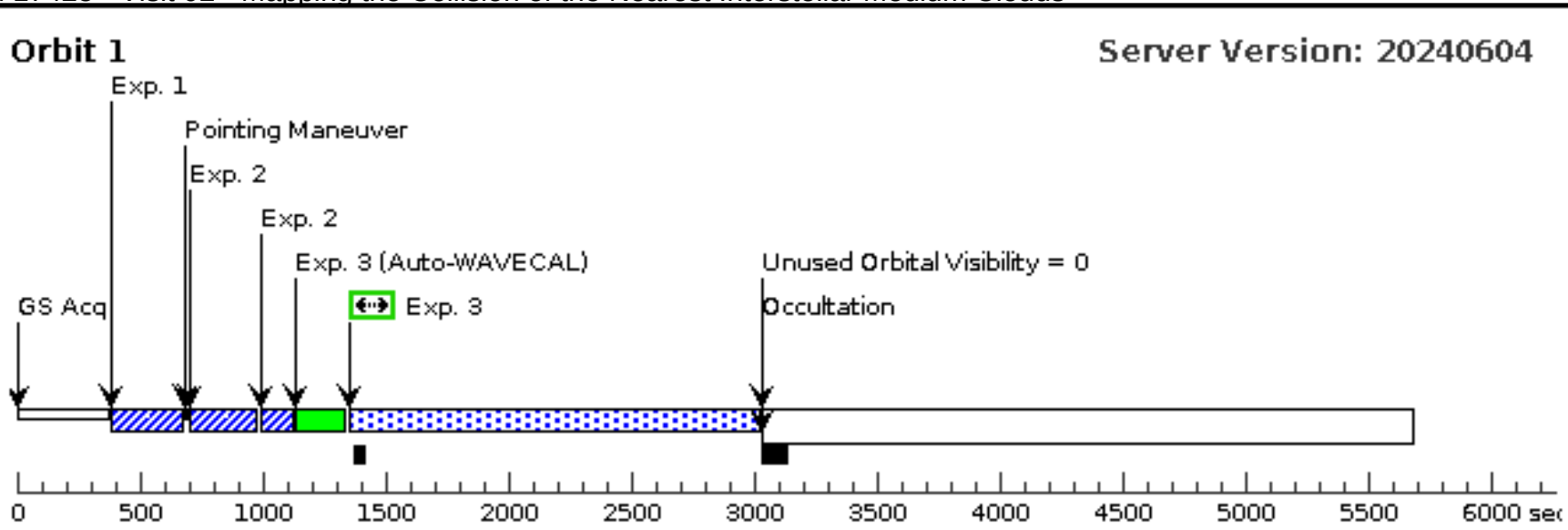
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	HD52698 Alt Name1: GJ259 Alt Name2: HIP33817	RA: 07 01 13.9682 (105.3082008d) Dec: -25 56 54.84 (-25.94857d) Equinox: J2000	Proper Motion RA: 0.015269271140055255 sec of time/yr Proper Motion Dec: 0.042341000000000004 arcsec/yr Parallax: 0.0678007" Epoch of Position: 2015.5 Radial Velocity: 12.42 km/sec	V=6.688 TYPE=K1V, B-V=0.89, E(B-V)=0, F-LINE(2796)=3.59e-12, W-LINE(2796)=0.6, F-LINE(1215)=2.04e-12, W-LINE(1215)=0.7	Reference Frame: ICRS

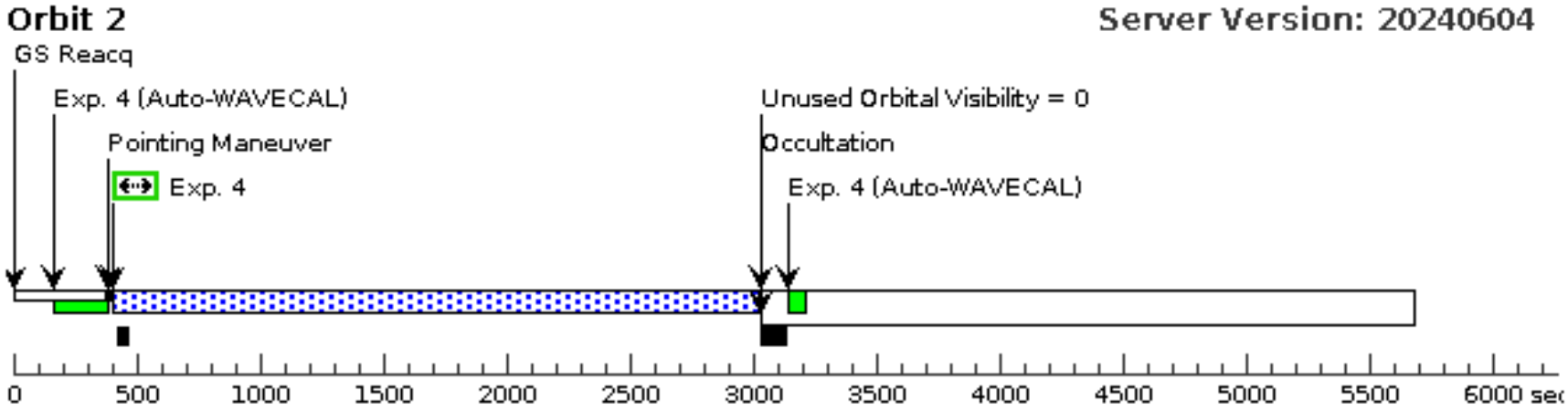
Comments: IUE SPECTRUM: LWP24840
Target star was identified by the BOT in the observed field. DSS images clearly indicate a bright isolated target star (brightest within 100 arcsec). Clearly the target star is the dominant object in the field of view.
Category=STAR
Description=[K V-IV]
Extended=NO

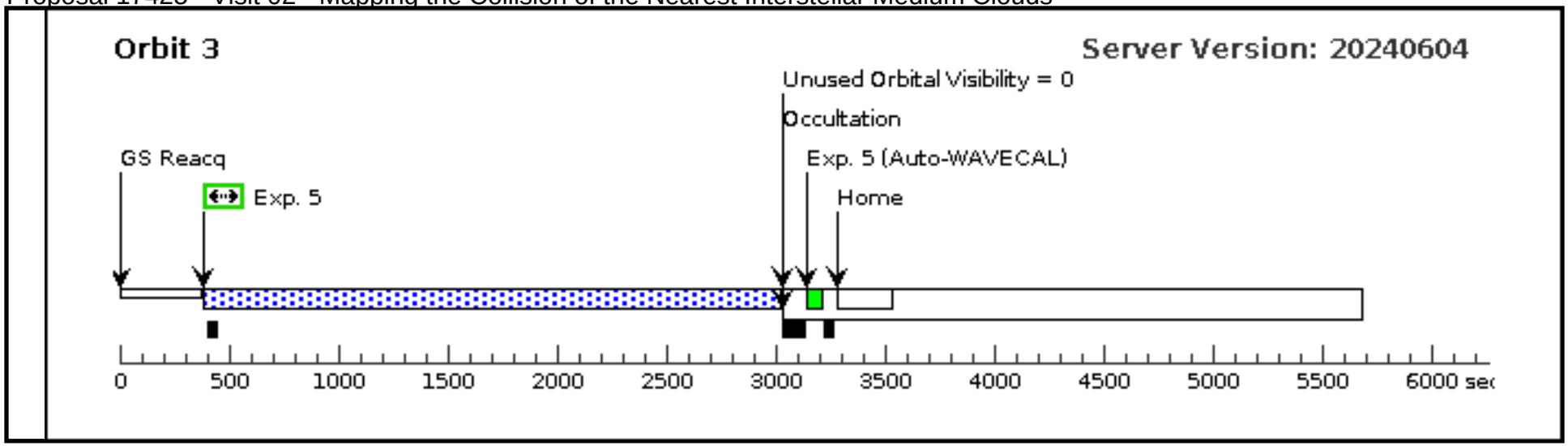
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.1892239)	(2) HD52698	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.4 Secs (0.4 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 152.3254 *Brightest Pixel = 9,499.47 e*								
2	(STIS.sp.1892241)	(2) HD52698	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430L 4300 A				0.2 Secs (0.2 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 58.8344 *Brightest Pixel = 594.77 e* *Global Source Counts = 1,749,165.675 e*								
3	(STIS.sp.1892498)	(2) HD52698	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1700 Secs (1651 Secs) *[==>1651.0 Secs]*	 ***[1]***
	Comments: SNR = 46.1826 *Brightest Pixel = 805.47 e*								
4	(STIS.sp.1892499)	(2) HD52698	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2722 Secs (2602 Secs) *[==>2602.0 Secs]*	 ***[2]***
	Comments: SNR = 17.6863 *Brightest Pixel = 162.89 e*								
5	(STIS.sp.1892499)	(2) HD52698	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2722 Secs (2622 Secs) *[==>2622.0 Secs]*	 ***[3]***
	Comments: SNR = 17.6863 *Brightest Pixel = 162.89 e*								

Orbit Structure



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Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 5
Exp. 5 (Auto-WAVECAL)
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1500
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Visit

Proposal 17425, Visit 03, implementation Tue Jun 11 20:01:16 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 01-JUN-2023:00:00:00 AND 26-MAR-2024:00:00:00; BETWEEN 01-JUN-2024:00:00:00 AND 26-MAR-2025:00:00:00; BETWEEN 01-JUN-2025:00:00:00 AND 26-MAR-2026:00:00:00

Fixed Targets

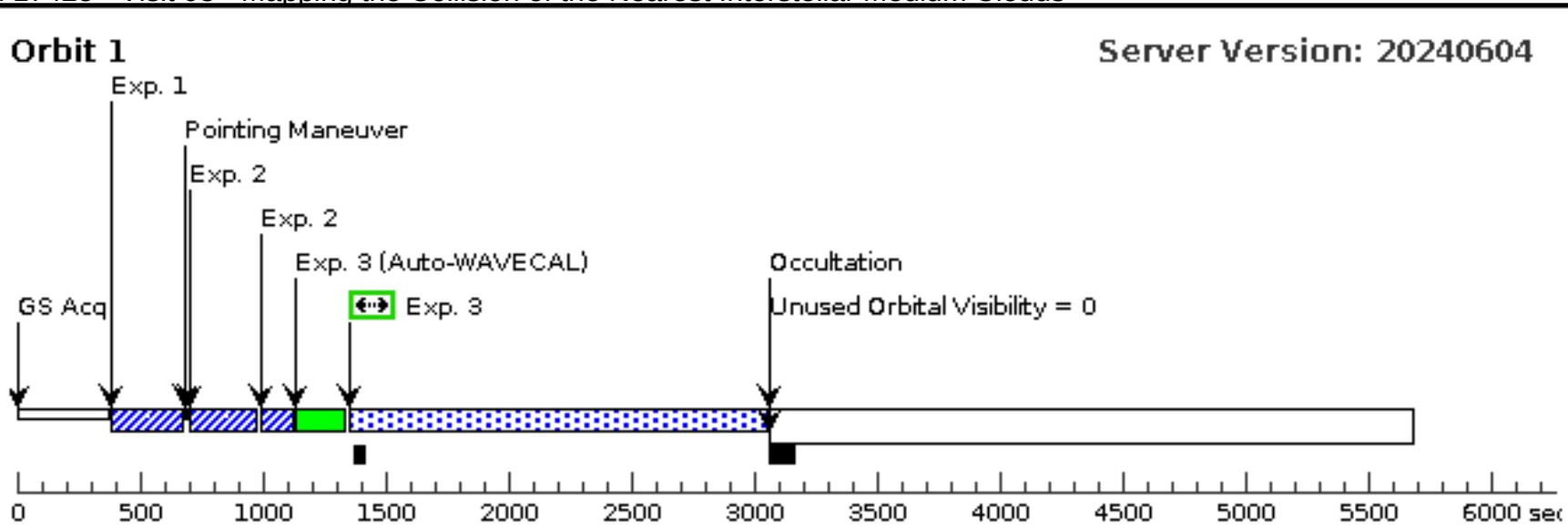
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HD57095 Alt Name1: GJ269.0 Alt Name2: HIP35296	RA: 07 17 29.5343 (109.3730596d) Dec: -46 58 36.21 (-46.97672d) Equinox: J2000	Proper Motion RA: -0.0017822192835580863 sec of time/yr Proper Motion Dec: 0.58472 arcsec/yr Parallax: 0.06852" Epoch of Position: 2015.5 Radial Velocity: 59.00 km/sec	V=6.669 TYPE=K1V, B-V=0.977, E(B-V)=0, F-LINE(2796)=3.94e-12, W-LINE(2796)=0.6, F-LINE(1215)=2.24e-12, W-LINE(1215)=0.7	Reference Frame: ICRS

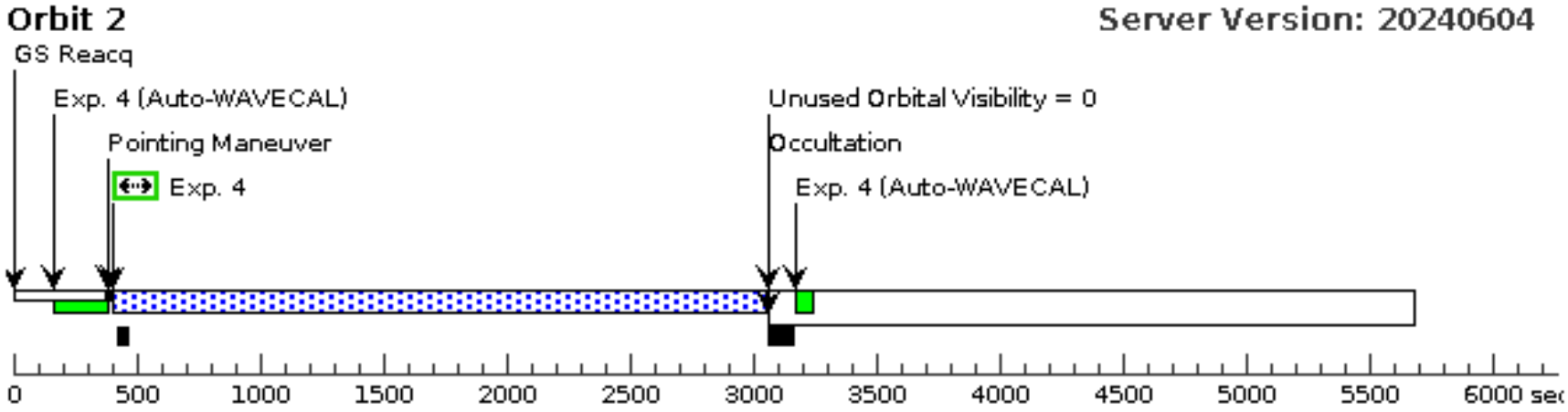
Comments: No target star was identified by the BOT in the observed field. DSS images clearly indicate a bright isolated target star (brightest within 100 arcsec). Clearly the target star is the dominant object in the field of view.
Category=STAR
Description=[K V-IV]
Extended=NO

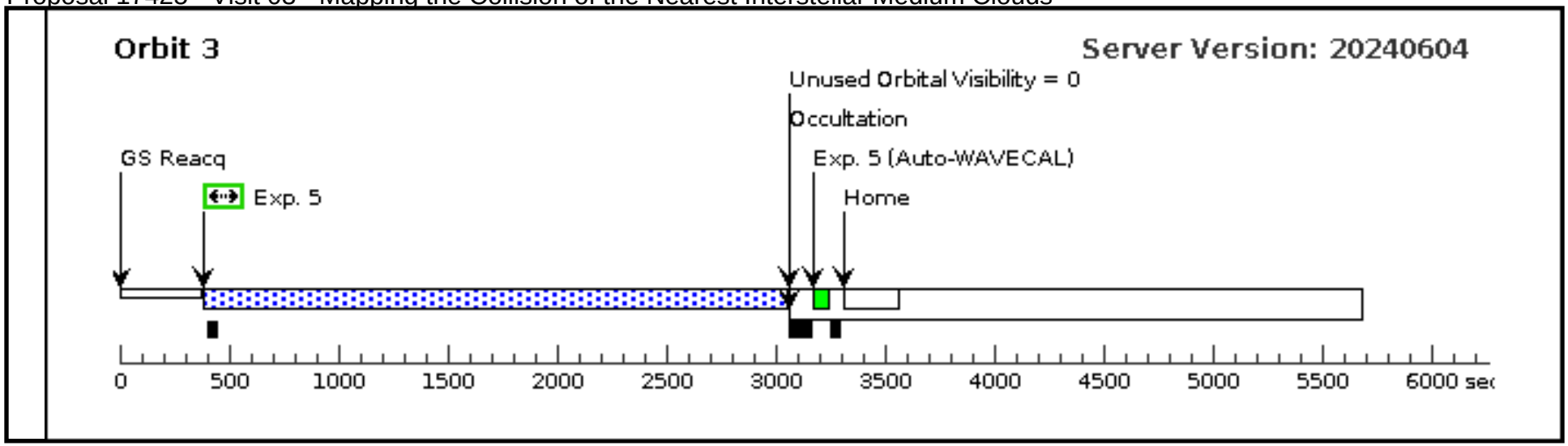
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.1892243)	(3) HD57095	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.4 Secs (0.4 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 152.3254 *Brightest Pixel = 9,499.47 e*								
2	(STIS.sp.1892244)	(3) HD57095	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430L 4300 A				0.2 Secs (0.2 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 58.8344 *Brightest Pixel = 594.77 e* *Global Source Counts = 1,749,165.675 e*								
3	(STIS.sp.1892500)	(3) HD57095	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1819 Secs (1681 Secs) *[==>1681.0 Secs]*	 ***[1]***
	Comments: SNR = 50.0030 *Brightest Pixel = 943.84 e*								
4	(STIS.sp.1892501)	(3) HD57095	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2841 Secs (2632 Secs) *[==>2632.0 Secs]*	 ***[2]***
	Comments: SNR = 18.9375 *Brightest Pixel = 186.66 e*								
5	(STIS.sp.1892501)	(3) HD57095	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2841 Secs (2652 Secs) *[==>2652.0 Secs]*	 ***[3]***
	Comments: SNR = 18.9375 *Brightest Pixel = 186.66 e*								

Orbit Structure






Orbit 3
Server Version: 20240604
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 5
Exp. 5 (Auto-WAVECAL)
Home
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500
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1500
2000
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4500
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6000 sec

Visit

Proposal 17425, Visit 04, implementation Tue Jun 11 20:01:16 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: BETWEEN 24-FEB-2023:00:00:00 AND 25-DEC-2023:00:00:00; BETWEEN 24-FEB-2024:00:00:00 AND 25-DEC-2024:00:00:00; BETWEEN 24-FEB-2025:00:00:00 AND 25-DEC-2025:00:00:00

Fixed Targets

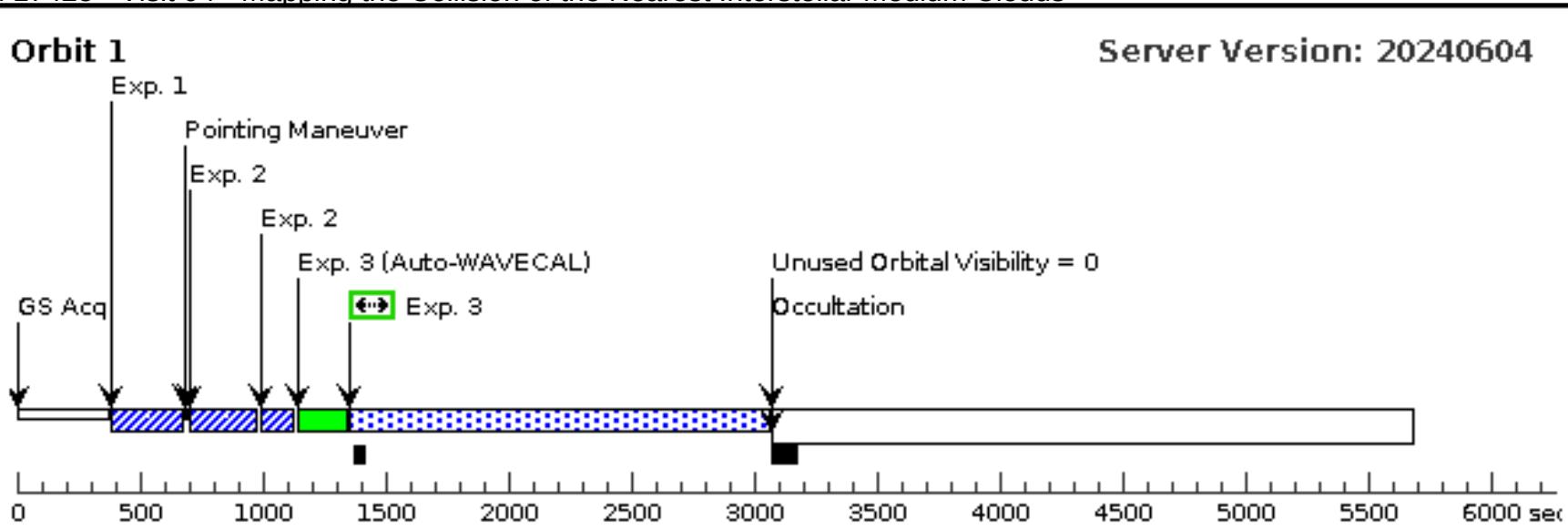
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	HD27274 Alt Name1: GJ167 Alt Name2: HIP19884	RA: 04 15 58.2583 (63.9927429d) Dec: -53 18 29.16 (-53.30810d) Equinox: J2000	Proper Motion RA: 0.08753288730564074 sec of time/yr Proper Motion Dec: 0.396695 arcsec/yr Parallax: 0.0766638" Epoch of Position: 2015.5 Radial Velocity: -23.09 km/sec	V=7.634 TYPE=K5V, B-V=1.125, E(B-V)=0, F-LINE(2796)=1.22e-12, W-LINE(2796)=0.6, F-LINE(1215)=2.06e-12, W-LINE(1215)=0.7	Reference Frame: ICRS

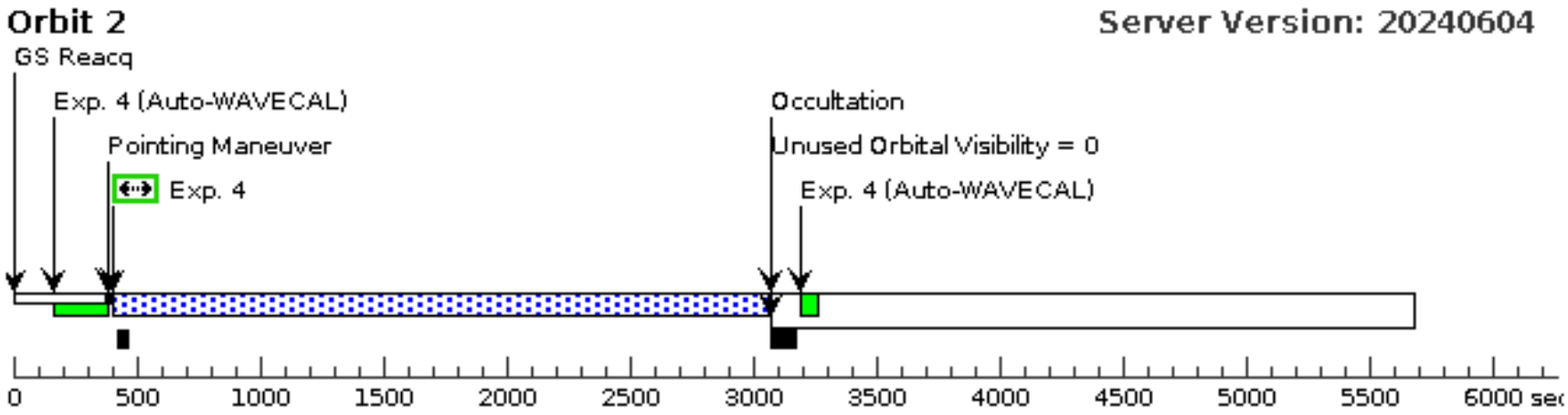
Comments: No target star was identified by the BOT in the observed field. DSS images clearly indicate a bright isolated target star (brightest within 100 arcsec). Clearly the target star is the dominant object in the field of view.
Category=STAR
Description=[K V-IV]
Extended=NO

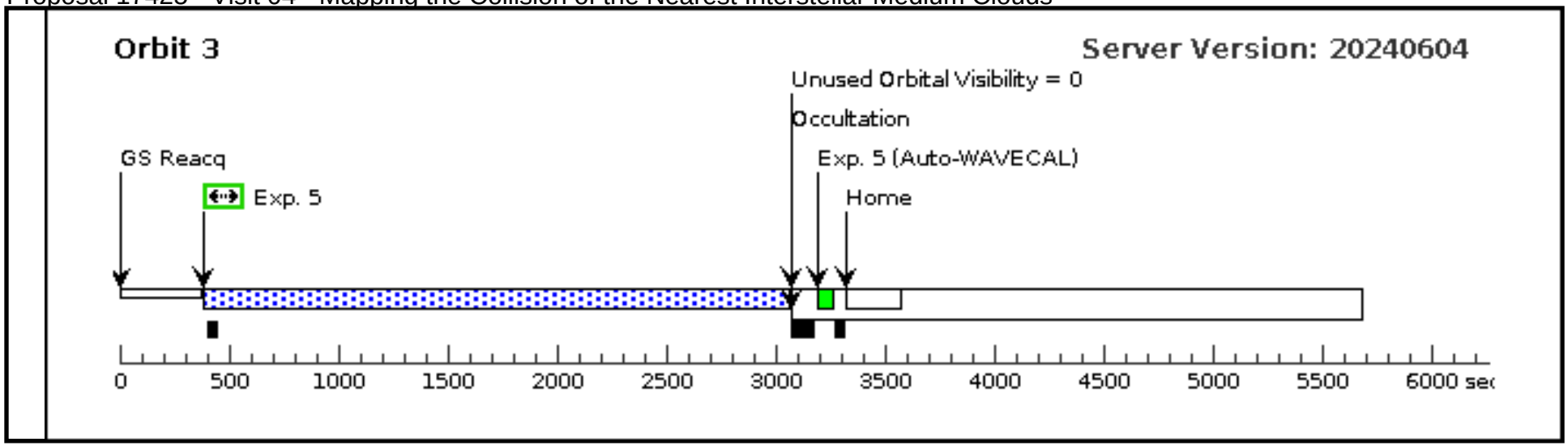
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.1892246)	(4) HD27274	STIS/CCD, ACQ, F25ND3	MIRROR	ACQTYPE=POINT			0.7 Secs (0.7 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 154.2964 *Brightest Pixel = 9,013.04 e*								
2	(STIS.sp.1892331)	(4) HD27274	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430L 4300 A				0.2 Secs (0.2 Secs) *[==>]*	 ***[1]***
	Comments: SNR = 28.5556 *Brightest Pixel = 276.62 e* *Global Source Counts = 615,814.596 e*								
3	(STIS.sp.1892502)	(4) HD27274	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A				1877 Secs (1695 Secs) *[==>1695.0 Secs]*	 ***[1]***
	Comments: SNR = 27.3049 *Brightest Pixel = 300.06 e*								
4	(STIS.sp.1892503)	(4) HD27274	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2901 Secs (2648 Secs) *[==>2648.0 Secs]*	 ***[2]***
	Comments: SNR = 18.3482 *Brightest Pixel = 175.31 e*								
5	(STIS.sp.1892503)	(4) HD27274	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2901 Secs (2668 Secs) *[==>2668.0 Secs]*	 ***[3]***
	Comments: SNR = 18.3482 *Brightest Pixel = 175.31 e*								

Orbit Structure






Orbit 3
Server Version: 20240604
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 5 (Auto-WAVECAL)
Exp. 5
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec