



18064 - Are Novae Galactic Lithium Factories ?

Cycle: 33, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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>
04	(2) NOVA2	STIS/CCD STIS/NUV-MAMA	1	31-Jul-2025 15:00:27.0	yes
05	(2) NOVA2	STIS/CCD STIS/NUV-MAMA	2	31-Jul-2025 15:00:29.0	yes
06	(2) NOVA2	STIS/CCD STIS/NUV-MAMA	3	31-Jul-2025 15:00:30.0	yes

<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>
07	(1) NOVA1	STIS/CCD STIS/NUV-MAMA	1	31-Jul-2025 15:00:31.0	yes
08	(1) NOVA1	STIS/CCD STIS/NUV-MAMA	2	31-Jul-2025 15:00:32.0	yes
09	(1) NOVA1	STIS/CCD STIS/NUV-MAMA	3	31-Jul-2025 15:00:33.0	yes

12 Total Orbits Used

ABSTRACT

The astrophysical origin of lithium in the Galaxy represents one of the major open questions in modern astrophysics. While lithium is destroyed by stellar evolution, many astrophysical processes and sources actively produce lithium. However, galactic chemical evolution studies suggest that none of these latter sources except novae appears sufficiently efficient to synthesize the total amount of Li. Detection of the ${}^7\text{Be}$ II 313.0 nm resonance doublet transition in novae has finally confirmed theoretical predictions that ${}^7\text{Be}$ is produced during the thermonuclear runaway on the surface of an accreting white dwarf that drives nova explosions. ${}^7\text{Be}$ decays into ${}^7\text{Li}$ with a half-life of 53.2 days, but when ${}^7\text{Be}$ abundances are measured relative to calcium (current technique) the derived abundance of ${}^7\text{Li}$ is 4 to 5 dex higher than the meteoritic value. The Ca result hints novae could be the major factories of ${}^7\text{Li}$. We propose a synoptic ToO study using the HST UV STIS echelle to set stringent constraints on in situ ${}^7\text{Li}$ production using ${}^7\text{Be}$ and Mg II as novel proxies. The objective is to derive an independent and accurate estimate of the nova ${}^7\text{Be}$ (= ${}^7\text{Li}$) yields, its evolution as it decays, and the dependence of lithium yield on nova type (classical novae or recurrent) using Mg II 280.0 nm as a reference element. The goal is to determine whether novae are the Galactic lithium factories. Two novae targets are proposed to enable comparison of ${}^7\text{Li}$ yields in different nova types which will constrain the tension between theoretical models and observations.

OBSERVING DESCRIPTION

HST/STIS echelle spectra will be analyzed to quantify the amount of ${}^7\text{Be}$ produced in CNeby using the Mg II 280.0 nm doublet transitions as a proxy. Simultaneous observations of both the Mg II 280.0 nm and the ${}^7\text{Be}$ II 313.0 nm lines at high spectral resolution require HST/STIS. The use of HST/STIS in echelle mode is crucial to identify and analyze the resonance lines of Be II and Mg II and disentangle their narrow absorption troughs from possible Fe, Cr, Ti and V contaminants. HST observations will be conducted with the E230H grating, an a 0.2 x 0.2 arcsec slit (novae are point-sources), and tilt centered on 276.2 nm and 301.2 nm, reaching a resolving power of approximately 2.5 km/s at 280.0 nm. This resolution is well-suited to unambiguously resolve narrow non-saturated absorption features necessary to identify possible multiple components.

The science goal will be achieved by observing two bright (V_{peak} approximately 7) novae at three distinct epochs sampling over the time of the ${}^7\text{Be}$ half-life (53 days). The ToO trigger observations will be executed within ~ 21 -30 days after the nova discovery (non-disruptive ToO; 21 day from submission of trigger request to scheduling and execution) when the nova brightness is around $V \geq 7.5$ mag. These STIS wavelengths are chosen to provide direct information on Mg II 280.0 nm, and ${}^7\text{Be}$ II 313.0 nm lines, respectively. All three epochs will use the same instrumental setup and will be planned as a non-disruptive ToO, with an observing cadence of approximately 10-20 days between consecutive visits. The exact execution plan of HST/STIS observations depends on the nova evolution (which will be followed by ancillary facilities both ground- and space-based).

The ToO trigger will be reserved for for classical novae (CNe) or recurrent novae (RNe), with $V_{\text{max}} \geq 7$ mag, and with low extinction, $E(B-V) \sim 0.5$ mag (corresponding to $N_{\text{H}} = 3 \times 10^{21} \text{ cm}^{-2}$) as determined from extinction and $N(\text{H})$ maps and ancillary observations.

Use of the NASA Gehrels Swift Observatory will provide UVOT monitoring to estimate the UV brightness and ensure the safety of the MAMA detectors. To calculate exposure times, we assume a Bruzual synthetic spectrum of a V approximately 7.5, 8.5, and 9.5 mag A0-type star selected from the templates in the STIS ETC, available on the HST website, which best resembles the spectrum during the late-bright phases of a nova. The exposure times are chosen to obtain S/N per spectral resolution element of ≥ 12 , enough to disentangle narrow features from the bright continuum and to measure their equivalent widths for the abundance estimates. This implies initial (epoch#1) exposure times of ~ 600 s (optimized to account for full utilization of a given orbit) and ~ 1100 s (optimized to account for full utilization of a given orbit) for the 276.2 and 301.2 tilts, respectively. Likely the nova brightness will fade by approximately 1-2 magnitudes over the epochs of the synoptic observations, hence the requisite increase of one to two orbits per visit. HST/STIS data will be reduced using the calstis pipeline, available in the AstroConda python environment through the stistool packages if high level data products are not directly available from the MAST.

The final exposure times have been adjusted according to the Orbit Planner in the APT v2025.3.04 software during Phase II. TIME-TAG mode for the MAMA detectors is used, as it offers several advantages and increases the legacy value of the observations. BUFFER-TIME is 4/5 of STIS ETC returned simulation buffer time.

The average number of observed novae in the whole sky is approximately 3 novae per year brighter than $V_{\text{max}} \leq 9.0$. The requested time is conservatively benchmarked to be 2 CNe/RNe in HST proposal Cycle 33. The selection of the targets and epochs of observations will be based on their brightness in order to not exceed the bright-object limit values (V_{mag} approximately 6 mag for the E230H echelle observations). The safety of the STIS MAMA detectors is of paramount importance and to ensure their safety we will use the appropriate STIS archival spectrum, scaled to the

latest Swift UVOT and AAVSO photometry, to confirm that the source does not exceed the MAMA bright source limits. Finally, the observational strategy uses the STIS MAMA detectors, the observations must be taken in non-SAA impacted orbits and have a bright source check of the field done prior to release for scheduling.

One of the most important requirements for the success of our proposal consists in measuring equivalent widths from Mg II and 7Be II absorption features that are not affected by saturation, and this condition is generally obtained from approximately 40-50 days after the nova outburst. However, this constraint is dependent on the speed class of the nova. Accompanying, complementary ground-based spectroscopic programs and Swift ToO requests will be activated to determine the spectral evolution of the nova, its speed class and to control that its brightness does not exceed the bright-object limit along the entire wavelength range. Once a suitable target has been identified, we will construct and trigger the final HST observing plan according to our early results from our complementary observations. The initial visit (#1) is a non-disruptive ToO, followed by two additional observations (#2 nominally 10-20 days after #1; and #3 nominally 10-20 days after #2) for three epochs total. We will work with the HST planners to implement a cadence to maximize science return. In total, this ToO is comprised of two non-disruptive triggers. The multi-epoch observations of the same selected target(s) triggered in this ToO program are required as CNe/RNe are temporally (i.e., variable) evolving objects. The exact execution plan of HST/STIS observations depends on the nova evolution.

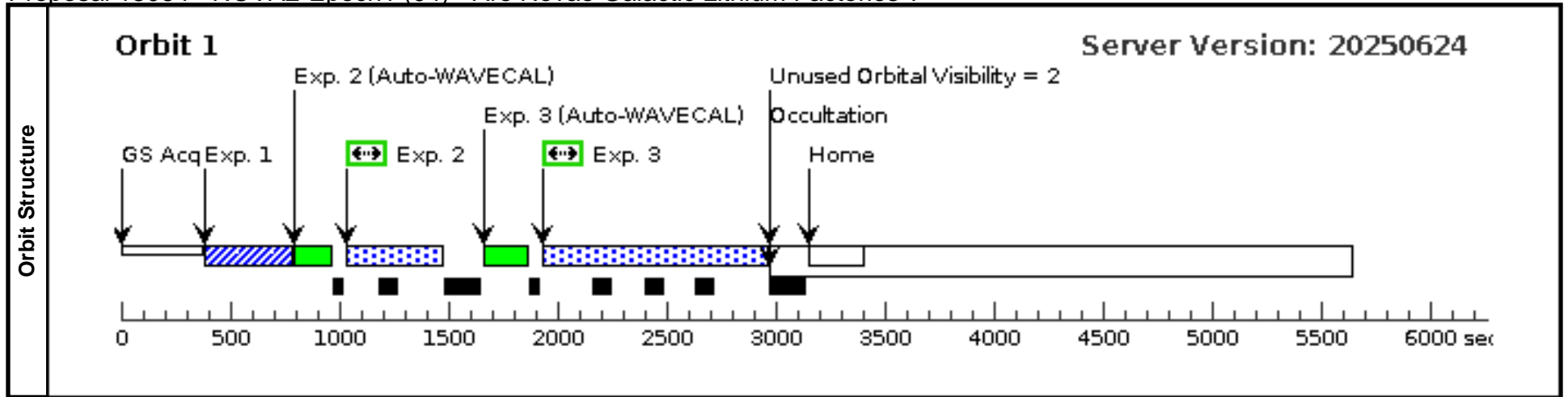
If not triggered during the cycle, a request to the TTRB for carry-over consideration will be sent (using the N+1 cycle policy). The proposed ToO trigger could take advantage of the Flexible Thursday scheduling opportunities only in Cycle 33as outlined in the proposal narrative.

We will update the astrometric coordinates of the generic targets for the specific targeted novae when they become available.

Proposal 18064 - NOVA2-Epoch1 (04) - Are Novae Galactic Lithium Factories ?

Thu Jul 31 19:00:34 GMT 2025

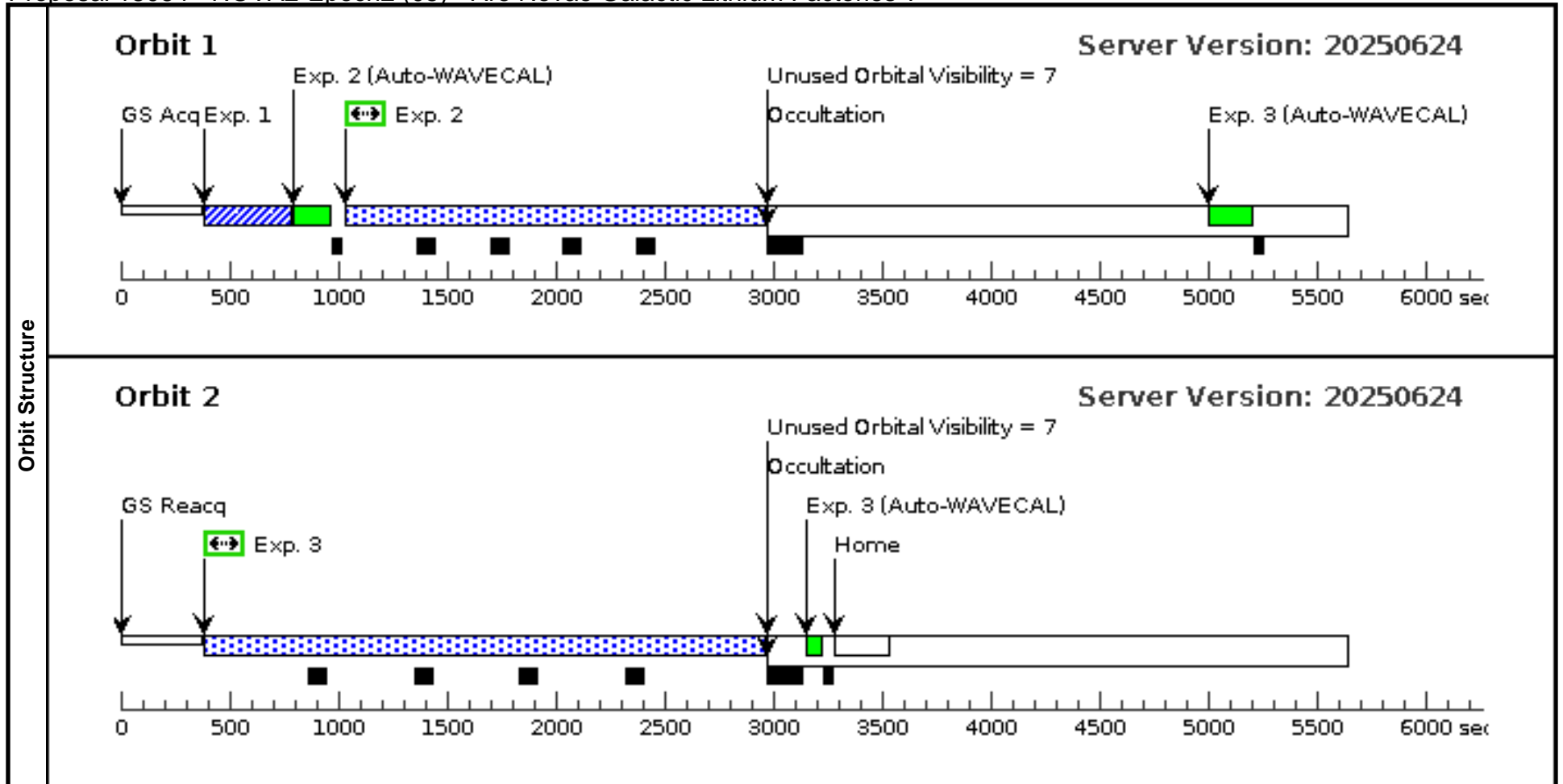
Visit	Proposal 18064, NOVA2-Epoch1 (04), implementation Diagnostic Status: No Diagnostics Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: ON HOLD ; TOO RESPONSE TIME 25.0D Comments: <i>FIRST spectroscopic epoch of NOVA2 target. The ToO trigger will be reserved for a bright novae or recurrent novae, with $V_{max} \geq 7$ mag, and with low extinction, $E(B-V) \sim 0.5$ mag (corresponding to $NH = 3 \times 10^{21} \text{ cm}^{-2}$) as determined from extinction and $N(H)$ maps and ancillary observations. The Epoch 1 observations will be executed within ~21-30 days after the nova discovery (non-disruptive ToO trigger) when the nova brightness is around $V \sim 7$ to 7.5 mag. Both grating settings (c2762 and c3012) must be observed during a single visit to achieve the proposal science goals, as the source is temporally variable.</i> On Hold Comments: <i>Generic Target is a ToO. The ToO trigger will request the first target visit (Epoch 1) to occur ~21-30 observations days after the nova discovery when the nova brightness is around $V \sim 7.5$ mag.</i>																																																																															
	Generic Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Criteria</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>(2)</td> <td>NOVA2</td> <td>Next bright nova 2</td> <td>CLASSICAL NOVA RECURRENT NOVA</td> </tr> </tbody> </table> Comments: <i>The ToO trigger will be reserved for a bright novae or recurrent novae, with $V_{max} \geq 7$ mag, and with low extinction, $E(B-V) \sim 0.5$ mag (corresponding to $NH = 3 \times 10^{21} \text{ cm}^{-2}$) as determined from extinction and $N(H)$ maps and ancillary observations.</i>										#	Name	Criteria	Description	(2)	NOVA2	Next bright nova 2	CLASSICAL NOVA RECURRENT NOVA																																																													
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2	TILT-2762-NOVA2-Epoch1 (2022811)	(2) NOVA2	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230H 2762 A	BUFFER-TIME=15 2.0			421.0 Secs (421 Secs) [==>]	[1]																																																																							
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Proposal 18064 - NOVA2-Epoch2 (05) - Are Novae Galactic Lithium Factories ?

Thu Jul 31 19:00:34 GMT 2025

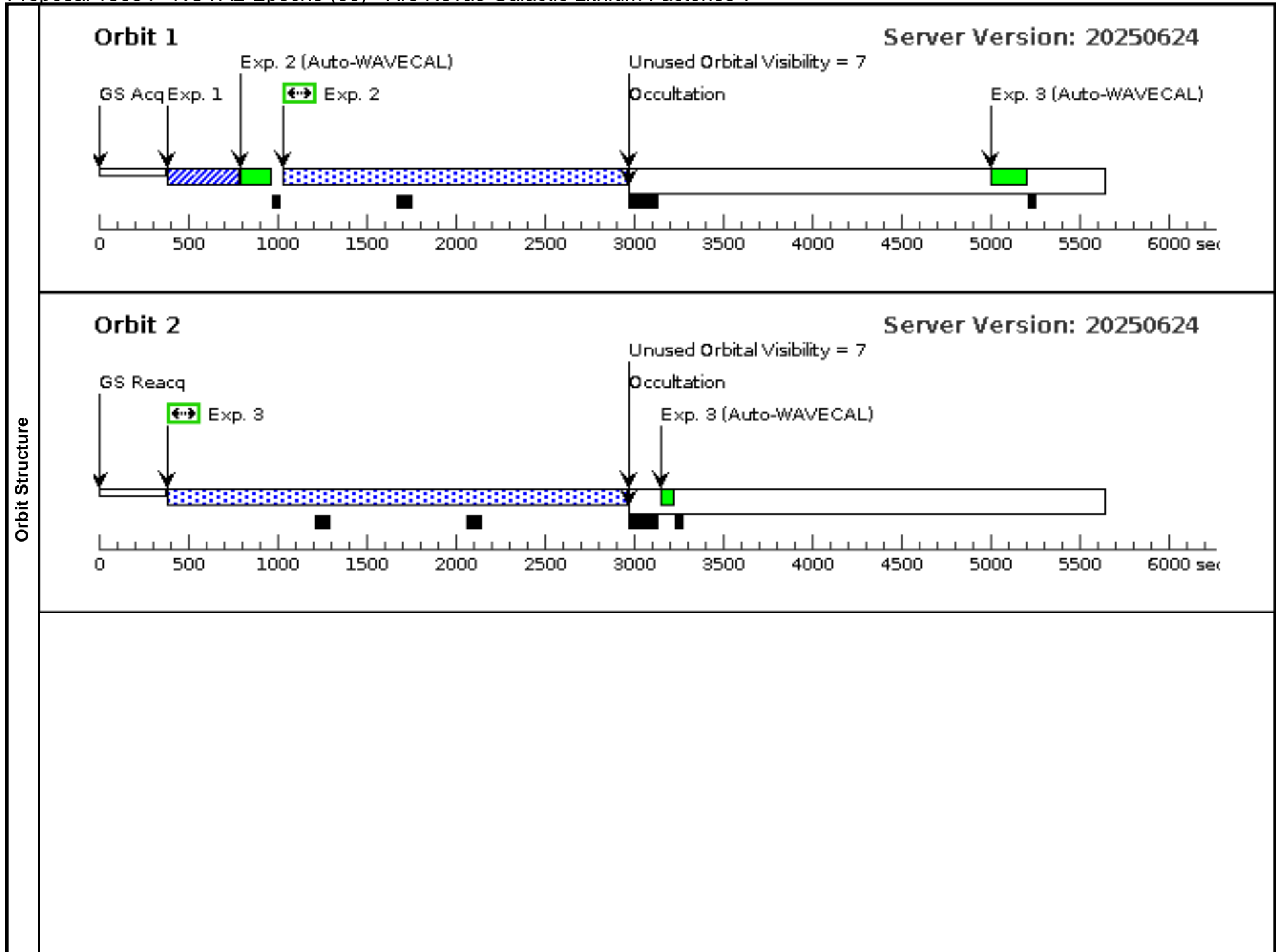
Visit	Proposal 18064, NOVA2-Epoch2 (05), implementation Diagnostic Status: Informational Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: SAME ORIENT AS 04; AFTER 04 BY 10 D TO 20 D; ON HOLD ; TOO RESPONSE TIME 25.0D <i>Comments: SECOND spectroscopic epoch of NOVA2 target. The observations of Visit 2 should occur within ~10-20 days after Visit 1 (Epoch1 the ToO trigger visit). We will work with assigned StSci contact scientist to optimize follow-on cadence as the HST/STIS observations depends on the nova evolution (as described in the proposal). Both grating settings (c2762 and c3012) must be observed during a single visit to achieve the proposal science goals, as the source is temporally variable.</i> <i>On Hold Comments: Generic Target is a ToO. The Epoch 2 observations are designed to follow Epoch 1 visit by ~10-20 days (when nova brightness has declined to V~8.5 mag).</i>										
	(NOVA2-Epoch2 (05)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.										
Diagnosics											
Generic Targets	#	Name	Criteria	Description							
	(2)	NOVA2	Next bright nova 2	CLASSICAL NOVA RECURRENT NOVA <i>Comments: The ToO trigger will be reserved for a bright novae or recurrent novae, with $V_{max} \geq 7$ mag, and with low extinction, $E(B-V) \sim 0.5$ mag (corresponding to $NH = 3 \times 10^{21} \text{ cm}^{-2}$) as determined from extinction and $N(H)$ maps and ancillary observations.</i>							
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	1	ACQ-NOV A2-Epoch2 (2021755)	(2) NOVA2	STIS/CCD, ACQ, F25ND5	MIRROR				26.6 Secs (26.6 Secs) [==>]	[1]	
	<i>Comments: Epoch 2 Visit to NOVA 2 (ON-HOLD) for cadence assessment and science optimization after initial ToO trigger visit (Epoch 1).</i>										
	2	TILT-2762-NOVA2-Epoch2 (2022833)	(2) NOVA2	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230H 2762 A	4.0	BUFFER-TIME=33			1910 Secs (1910 Secs) [==>]	[1]
	<i>Comments: OB for target with $V = 8.5$ mag, STIS ETC v33.2 AOV Bruzual spectral type, $E(B-V) = 0.3$, $SNR \geq 12$ @ 2800AA (near MgII line position). TIME-TAG mode for the MAMA detectors is used, as it offers several advantages and increases the legacy value of the observations.</i>										
3	TILT-3012-NOVA2-Epoch2- ExposureA (2022835)	(2) NOVA2	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230H 3012 A	5.0	BUFFER-TIME=48			2562.0 Secs (2562 Secs) [==>]	[2]	
<i>Comments: OB for target with $V = 8.5$ mag, STIS ETC v33.2 AOV Bruzual spectral type, $E(B-V) = 0.3$, $SNR \geq 12$ @ 3130AA (near 7BeII line position). Split between orbits. TIME-TAG mode for the MAMA detectors is used, as it offers several advantages and increases the legacy value of the observations.</i>											

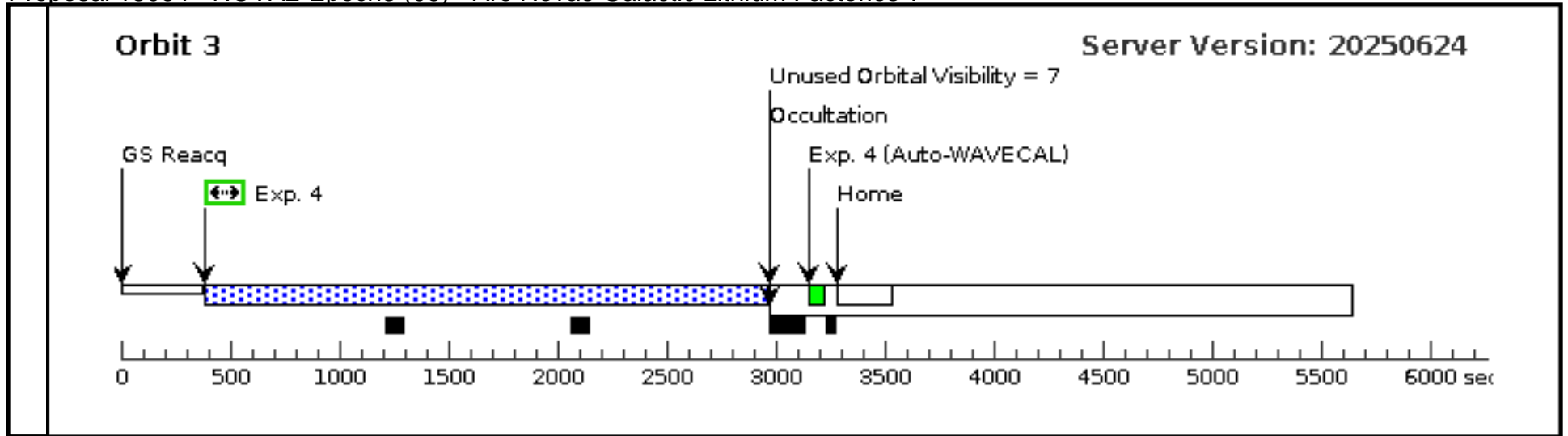


Proposal 18064 - NOVA2-Epoch3 (06) - Are Novae Galactic Lithium Factories ?

Thu Jul 31 19:00:34 GMT 2025

Visit	Proposal 18064, NOVA2-Epoch3 (06), implementation Diagnostic Status: Informational Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: SAME ORIENT AS 04; AFTER 05 BY 10 D TO 20 D; ON HOLD ; TOO RESPONSE TIME 25.0D <i>Comments: THIRD spectroscopic epoch of NOVA2 target. The observations of Visit 3 should occur within ~10-20 days after Visit2. We will work with assigned StScI contact scientist to optimize follow-on cadence as the HST/STIS observations depends on the nova evolution (as described in the proposal). Both grating settings (c2762 and c3012) must be observed during a single visit to achieve the proposal science goals, as the source is temporally variable.</i> <i>On Hold Comments: Generic Target is a ToO. The Epoch 3 observations are designed to follow Epoch 2 visit by ~10-20 days (when nova brightness has declined to V~9.5 mag).</i>																																																																																																		
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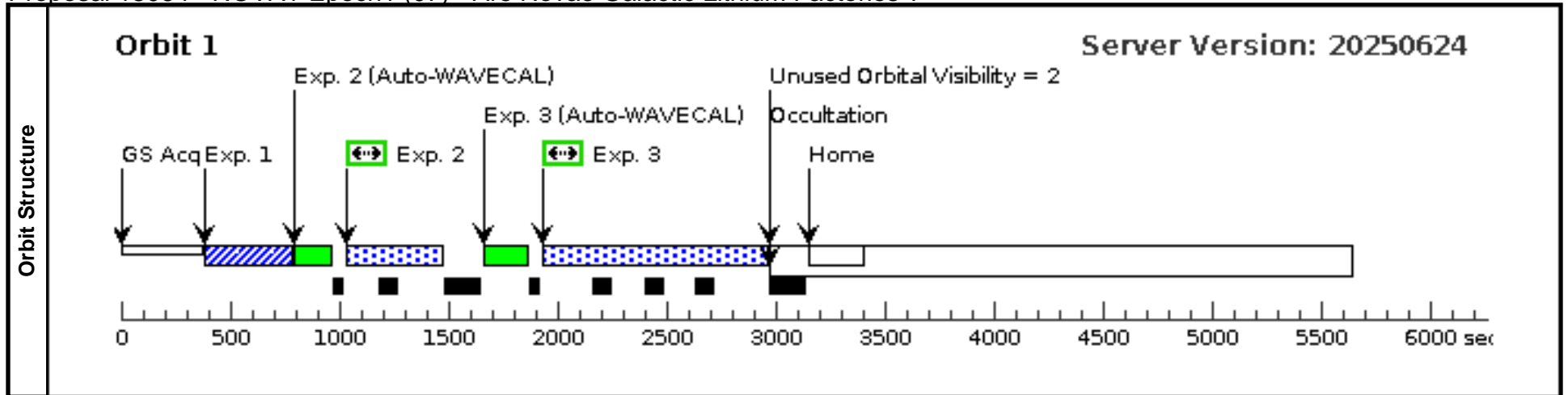




Proposal 18064 - NOVA1-Epoch1 (07) - Are Novae Galactic Lithium Factories ?

Thu Jul 31 19:00:34 GMT 2025

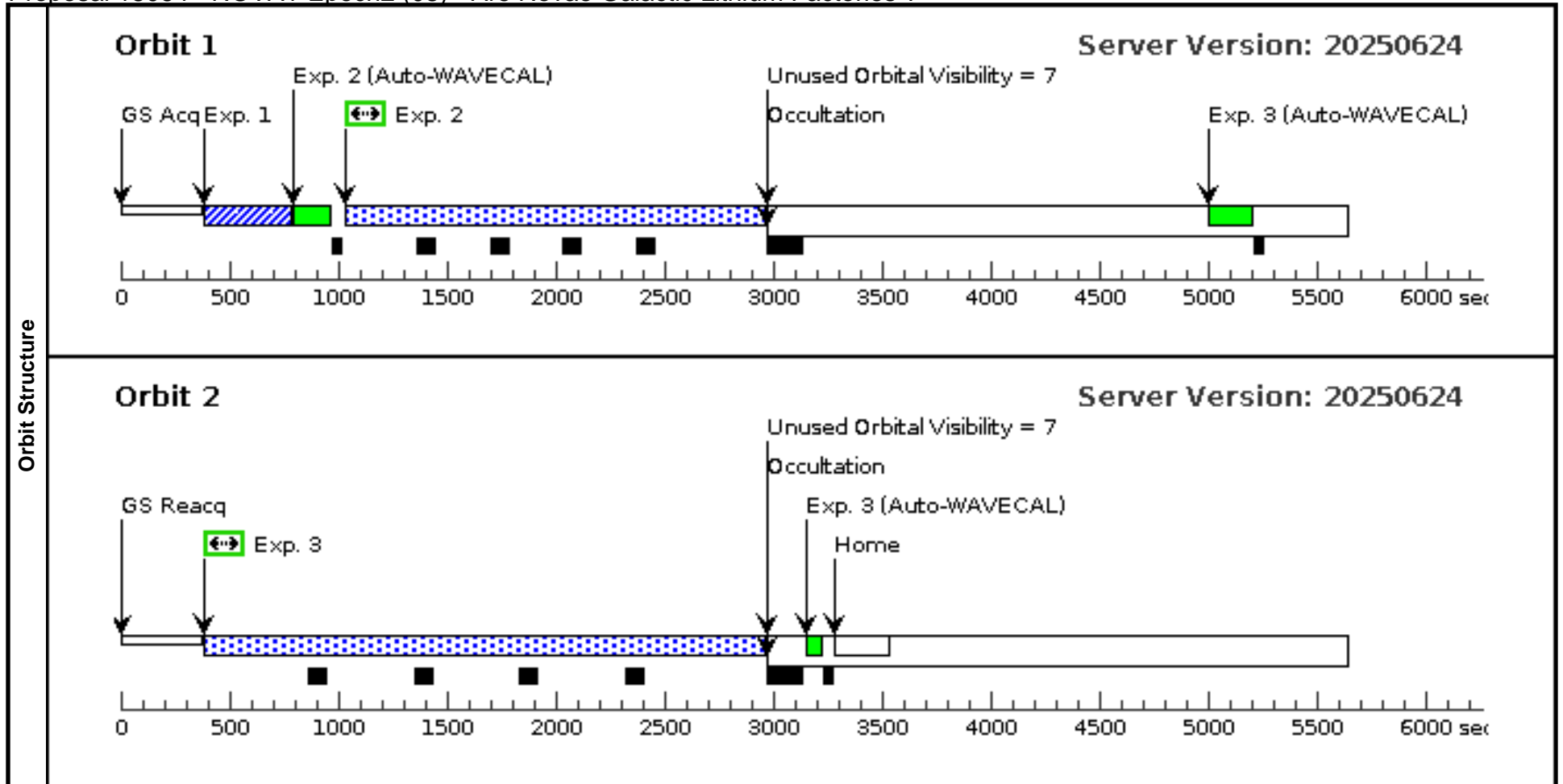
Visit	Proposal 18064, NOVA1-Epoch1 (07) Diagnostic Status: No Diagnostics Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: ON HOLD ; TOO RESPONSE TIME 25.0D Comments: <i>FIRST spectroscopic epoch of NOVA1 target. The ToO trigger will be reserved for a bright novae or recurrent novae, with $V_{max} \geq 7$ mag, and with low extinction, $E(B-V) \sim 0.5$ mag (corresponding to $NH = 3 \times 10^{21} \text{ cm}^{-2}$) as determined from extinction and $N(H)$ maps and ancillary observations. The Epoch 1 observations will be executed within ~21-30 days after the nova discovery (non-disruptive ToO trigger) when the nova brightness is around $V \sim 7$ to 7.5 mag. Both grating settings (c2762 and c3012) must be observed during a single visit to achieve the proposal science goals, as the source is temporally variable.</i> On Hold Comments: <i>Generic Target is a ToO. The ToO trigger will request the first target visit (Epoch 1) to occur ~21-30 observations days after the nova discovery when the nova brightness is around $V \sim 7.5$ mag.</i>																																																																																			
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Proposal 18064 - NOVA1-Epoch2 (08) - Are Novae Galactic Lithium Factories ?

Thu Jul 31 19:00:34 GMT 2025

Visit	Proposal 18064, NOVA1-Epoch2 (08) Diagnostic Status: Informational Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: SAME ORIENT AS 04; AFTER 04 BY 10 D TO 20 D; ON HOLD ; TOO RESPONSE TIME 25.0D <i>Comments: SECOND spectroscopic epoch of NOVA1 target. The observations of Visit 2 should occur within ~10-20 days after Visit 1 (Epoch1 the ToO trigger visit). We will work with assigned StSci contact scientist to optimize follow-on cadence as the HST/STIS observations depends on the nova evolution (as described in the proposal). Both grating settings (c2762 and c3012) must be observed during a single visit to achieve the proposal science goals, as the source is temporally variable.</i> <i>On Hold Comments: Generic Target is a ToO. The Epoch 2 observations are designed to follow Epoch 1 visit by ~10-20 days (when nova brightness has declined to V~8.5 mag).</i>																																																																														
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3	TILT-3012-NOVA1-Epoch2- ExposureA (2022835)	(1) NOVA1	STIS/NUV-MAMA, TIME-TAG, 0.2X0.2	E230H 3012 A	5.0	BUFFER-TIME=48		2562.0 Secs (2562 Secs) [==>]	[2]																																																																						
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Proposal 18064 - NOVA1-Epoch3 (09) - Are Novae Galactic Lithium Factories ?

Thu Jul 31 19:00:34 GMT 2025

Visit	Proposal 18064, NOVA1-Epoch3 (09) Diagnostic Status: Informational Scientific Instruments: STIS/NUV-MAMA, STIS/CCD Special Requirements: SAME ORIENT AS 04; AFTER 05 BY 10 D TO 20 D; ON HOLD ; TOO RESPONSE TIME 25.0D <i>Comments: THIRD spectroscopic epoch of NOVA1 target. The observations of Visit 3 should occur within ~10-20 days after Visit2. We will work with assigned StScI contact scientist to optimize follow-on cadence as the HST/STIS observations depends on the nova evolution (as described in the proposal). Both grating settings (c2762 and c3012) must be observed during a single visit to achieve the proposal science goals, as the source is temporally variable.</i> <i>On Hold Comments: Generic Target is a ToO. The Epoch 3 observations are designed to follow Epoch 2 visit by ~10-20 days (when nova brightness has declined to V~9.5 mag).</i>																																																																																																		
	Diagnosics (NOVA1-Epoch3 (09)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.																																																																																																		
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>NOVA1</td> <td>Next bright nova 1</td> <td>CLASSICAL NOVA RECURRENT NOVA</td> </tr> </tbody> </table> <i>Comments: The ToO trigger will be reserved for a bright novae or recurrent novae, with $V_{max} >= 7$ mag, and with low extinction, $E(B-V) \sim 0.5$ mag (corresponding to $NH = 3 \times 10^{21} \text{ cm}^{-2}$) as determined from extinction and $N(H)$ maps and ancillary observations.</i>										#	Name	Criteria	Description	(1)	NOVA1	Next bright nova 1	CLASSICAL NOVA RECURRENT NOVA																																																																																	
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