15438 - Gamma-ray Quiet Novae: What Sets the Gamma-Ray Luminosity of Novae?

Cycle: 25, Proposal Category: GO

(Availability Mode: AVAILABLE)

INVESTIGATORS

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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) NOVA-SGR-2015-A	WFC3/UVIS	1	17-May-2018 19:02:04.0	yes
02	(1) NOVA-SGR-2015-A	STIS/CCD	2	17-May-2018 19:02:06.0	yes

3 Total Orbits Used

ABSTRACT

One of the most astounding discoveries in nova research has been the recent finding that many classical novae emit detectable levels of GeV gamma-rays. How do they do it? The correct answer to this question must also explain why some novae are intrinsically gamma-ray quiet. The goal of this proposal is to identify the differences between gamma-ray quiet and gamma-ray bright novae that explain their discrepant gamma-ray luminosities. We request 12.5 hours of JVLA time to spatially resolve and briefly monitor two carefully selected gamma-quiet classical novae--- V5667 Sgr and V2659 Cyg. We also request 3 orbits of HST imaging and spectroscopy to capture the full remnantand kinematics of V5667 Sgr. These observations will test the hypothesis that gamma-ray production in novae requires collisions between: 1) a slow, dense equatorial flow; and 2) a powerful, isotropic fast wind. This research is timely, requires the JVLA, and has implications for the physics of a wide variety of eruptive transients.

OBSERVING DESCRIPTION

This project is a coordinated campaign to use the highest-resolutions in both VLA interferometry and HST direct and spectral imaging to study the expanding thermal ejecta of recent classical novae that were NOT detected in gamma-ray emission. The goal of this proposal is to identify the differences between gamma-ray quiet and gamma-ray bright novae that explain their discrepant gamma-ray luminosities. We have been awarded 12.5 hours of JVLA A-configuration time to spatially resolve and monitor two carefully selected gamma-quiet classical novae--- V5667 Sgr and V2659 Cyg. We have also been awarded 3 orbits of HST time to observe V5667 Sgr.

We will use WFC3 to obtain narrow-band [OIII] and Halpha+[NII] images, with the F502N and F657N filters respectively, of the young remnant around gamma-ray faint nova V5667 Sgr. The WFC3-UVIS-DITHER-BOX patter will be used to take dithered images in each filter so that we can remove cosmic-ray and CCD artifacts as well as drizzle the images to improved spatial resolution of at least 0.03"/pixel. We will also use STIS, with the G430L grating, to obtain a spatially resolved spectrum. For the STIS observation, we will use a 4-point STIS-ALONG-SLIT dither pattern with CR-SPLIT=2 readouts at each dither point. Including one such exposure pattern in each spectroscopic orbit allows us to build up a total of approximately 3600 seconds of spectral exposure in approximately 400 second sub-exposures. We have found that the large number of STIS sub-exposures are necessary and minimally sufficient to reliably filter the large number of bad pixels found on the STIS detector. The goal of the WFC3 imaging is to detect, or place meaningful contraints on, emission from substracture within the remnant, for comparison with radio and HST images of gamma-ray-bright novae. The goal of the STIS specroscopy is to provide 3-D kinematics of the V5667 Sgr remnant in [O III] and H-beta, as well as evidence for resolved structure in high-ionization-state lines such as [NeV] and [FeVII] that tend to trace shocks. We will use both imaging and spectroscopy to obtain expansion parallax distance estimates to V5667 Sgr.

Visit

Proposal 15438, Visit 01: 1 orbit of WFC3 imaging on V5668 Sgr (01), completed Thu May 17 23:02:08 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%

Comments: The purpose of Visit 01 is to take WFC3 images of the expanding remnant of Nova Sgr 2105-A = V5667 Sgr, to pair with our awarded VLA A-configuration radio interfermetry (March through June 2018). The inherent schedulability of targets in Sagittarius naturally restricts Visit 01 to be relatively contemporaneous with the JVLA A-configuration observations. This visit should be scheduled before the STIS spectroscopic Visit 02, in order to provide contemporaneous spatial intensity mapping with the spectra, yet also to provide preview imaging to select a major axis for optimal slit orientation for the STIS spectra in Visit 02 to follow. This imaging visit is for one orbit, for a total of ~640 seconds in F502N ([O III]) and ~640 seconds in F657N (Halpha+[N II]). One science goal is to use WFC3 image expansion proper motion and STIS spectra to determine an expansion parallax distance to V5667 Sgr. There is a slight chance it will still be an unresolved point source in the WFC3 imaging. Hence the series of very short, yet well-dithered exposures to insure against saturation and yet provide a good test of a partially-resolved PSF. The longer exposures are to search for faint nebulosity out to 0.5 arcsec (at the expected size/surface brightness). Exposure times estimated from the ETC and by scaling our past F502N and F657N images of V339 Del and V959 Mon up to the anticipated maximum brightness of V5667 Sgr in early-2018. If newer ground-based photometry or spectra indicate dramatic or unexpected changes, we may request an adjustment of exposure times within this orbit. Flash levels are set using the minimum ETC recommendation that did not trigger a warning flag.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.519 Line Spacing=0.336	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(2), (4)
(5)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (3)

Fixed Targets

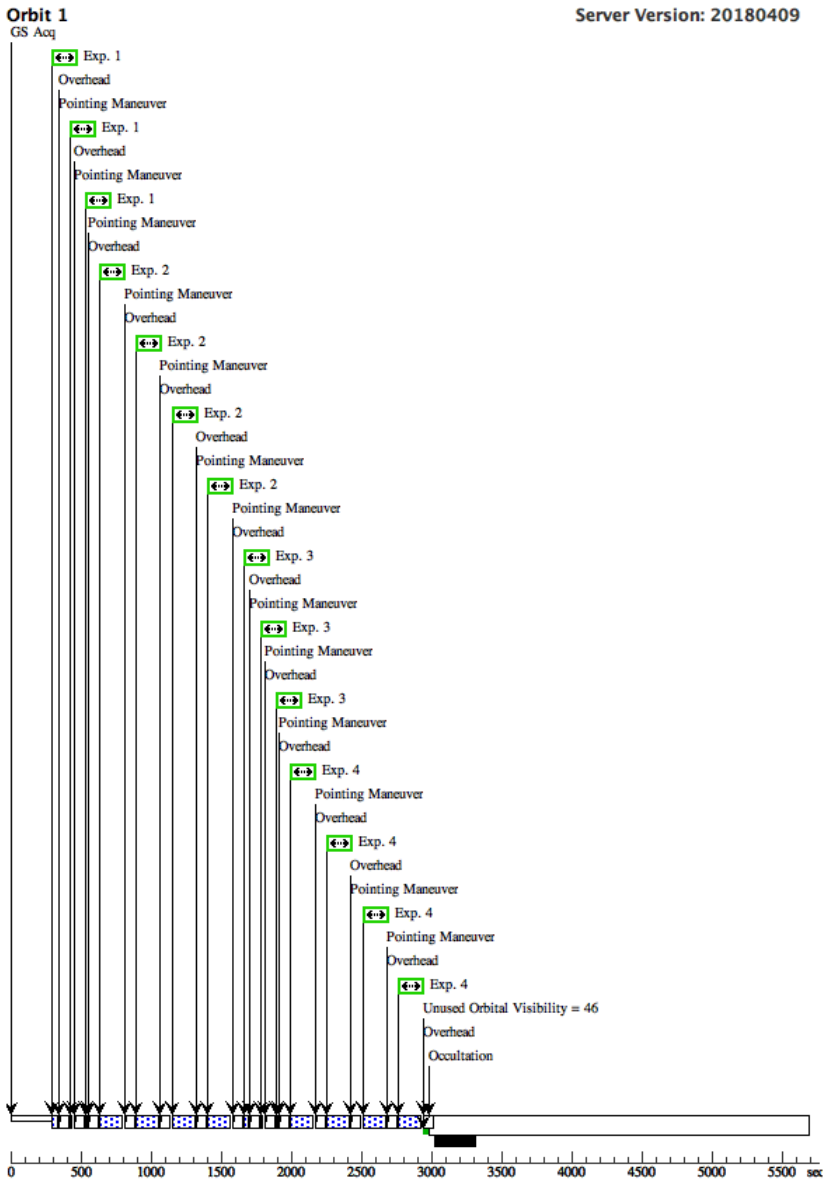
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NOVA-SGR-2015-A	RA: 18 14 25.1590 (273.6048292d) Dec: -25 54 34.58 (-25.90961d) Equinox: J2000	Epoch of Position: 2016.93	V=14.0+/-0.5	Reference Frame: ICRS

Comments: V-band flux from an AAVSO CCD measurement on 2017/06/25. At average, fairly linear fading rate in V from October 2015 to June 2017, it should fade by roughly 0.5 magnitudes more in the coming year, through June 2018.
Category=EXT-STAR
Description=[CLASSICAL NOVA, EJECTA, EMISSION LINE NEBULA, SHELL]
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Exp 01: 1x3 x5.0=15.0 second F502N integration (WFC3.im.1038861)	(1) NOVA-SGR-2015-A	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=12; BLADE=A		Pattern 5, Exps 1-1 in Visit 01: 1 orbit of WFC3 imaging on V5668 Sgr (01) (5)	5.0 Secs (15 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
	Comments: Post-flash = 12 e- based on ETC WFC3UVIS.im.1038861 *We use a single iteration of the 3-point WFC3-UVIS-DITHER-LINE-3PT with short 5.0 sec integrations at each point to provide insurance against saturation. Conservatively, 1) if the nova is an unresolved point source, and 2) if the V=14.0 flux levels detected by AASVSO observers is entirely [O III] 4959,5007 line emission, then 5 second exposures should not saturate, based on calculations using on ETC WFC3UVIS.im.1038856, WFC3UVIS.im.1038858 & WFC3UVIS.im.1038861.*								
2	Exp 02: 1x4 x160.0=640 second F502N integration (WFC3UVIS.im.1040153)	(1) NOVA-SGR-2015-A	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=12		Pattern 1, Exps 2-2 in Visit 01: 1 orbit of WFC3 imaging on V5668 Sgr (01) (1)	160.0 Secs (640 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
	Comments: Post-flash = 12 e- based on WFC3UVIS.im.1040153 *We use a single iteration of the 4-point WFC3-UVIS-DITHER-BOX with 3x expanded throws with 160 second subexposures: at V=14.0 these should not saturate the brightest few pixels of central point source in F502N; but if it does the larger dither pattern will help keep saturated and bloomed pixels/columns separated. Estimates based on the ETC WFC3UVIS.im.1040153 and on scaling our previous images of V959 Mon and T Pyx.*								
3	Exp 01: 1x3 x5.0=15.0 second F657N exposure (WFC3UVIS.im.1040161)	(1) NOVA-SGR-2015-A	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F657N	FLASH=12; BLADE=A		Pattern 5, Exps 3-3 in Visit 01: 1 orbit of WFC3 imaging on V5668 Sgr (01) (5)	5.0 Secs (15 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
	Comments: Post-flash = 12 e- based on WFC3UVIS.im.1040161 *We use a single iteration of the 3-point WFC3-UVIS-DITHER-LINE-3PT with short 5.0 sec integrations at each point to provide insurance against saturation. Scaling from [O III] to H-alpha using previous HST spectra of young nova remanants, these 5 second exposures should not saturate, based on calculations using on ETC WFC3UVIS.im.1040161 and exposures used on V339 Del and V5668 Sgr.*								
4	Exp 04: 1x4 x160.0=640 sec F657N exposure (WFC3UVIS.im.1040156)	(1) NOVA-SGR-2015-A	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F657N	FLASH=12		Pattern 1, Exps 4-4 in Visit 01: 1 orbit of WFC3 imaging on V5668 Sgr (01) (1)	160.0 Secs (640 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
	Comments: Post-flash = 12 e- based on WFC3UVIS.im.1040156 *We use a single iteration of the 4-point WFC3-UVIS-DITHER-BOX with 3x expanded throws with 160 second subexposures. Scaling from [O III] to H-alpha using previous HST spectra of young nova remanants, these exposures are unlikely to saturate at the central point source in F657N; but if it does the larger dither pattern will help keep saturated and bloomed pixels/columns separated. Estimates based on the ETC WFC3UVIS.im.1040156 and on scaling our previous images of V339 Del and V5668 Sgr.*								

Orbit Structure



Visit

Proposal 15438, Visit 02: 2 orbits of STIS CCD G430L spectra on V5667 Sgr (02), implementation Thu May 17 23:02:09 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SCHED 100%; ORIENT 110D TO 130 D; ORIENT 290D TO 310 D; AFTER 01 BY 60.0 D TO 550.0 D

Comments: The purpose of Visit 02 is to use 2 orbits to take STIS CCD G430L spectra of the expanding and fading remnant of Nova Sgr 2015-A = V5667 Sgr, after the remnant has been imaged by the WFC3 imaging Visit 01. The inherent schedulability of targets in Sagittarius naturally restricts Visit 01 to be relatively contemporaneous with JVLA A-configuration observations of V5667 Sgr (to be taken March through June 2018). Ideally, we would like to use the WFC3 imaging from Visit 01 to identify a major axis in the remnant to use as an optimal slit PA for the STIS spectra in Visit 02. But we are also accutely aware of the tight scheduling constraints in Cycle 25. As the determination of this broad roll angle range and scheduling window will need to wait until the Visit 01 WFC3 imaging is taken and then quickly analyzed, our current request for this visit to follow Visit 01 by at least 30 days, but not more than 550 days (1.5 years). While a specific PA to match the major axis is preferrable, we will provide up to +/-20 degrees of slop in our follow up request. The 550 day window and 40-degree roll range of should give plenty of scheduling opportunities, but if it does not, we are certainly willing to drop the PA requirement and take spectra at any arbitrary angle.
This spectroscopic visit is for a total of two orbits, for a total of ~1440+2160=3600 seconds in STIS CCD G430L. If new ground-based photometry or spectra indicate dramatic or unexpected changes in brightness, we may request an adjustment of exposure times within this orbit.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(3), (4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.5332	Center Pattern=true		
	Line Spacing=			

Fixed Targets

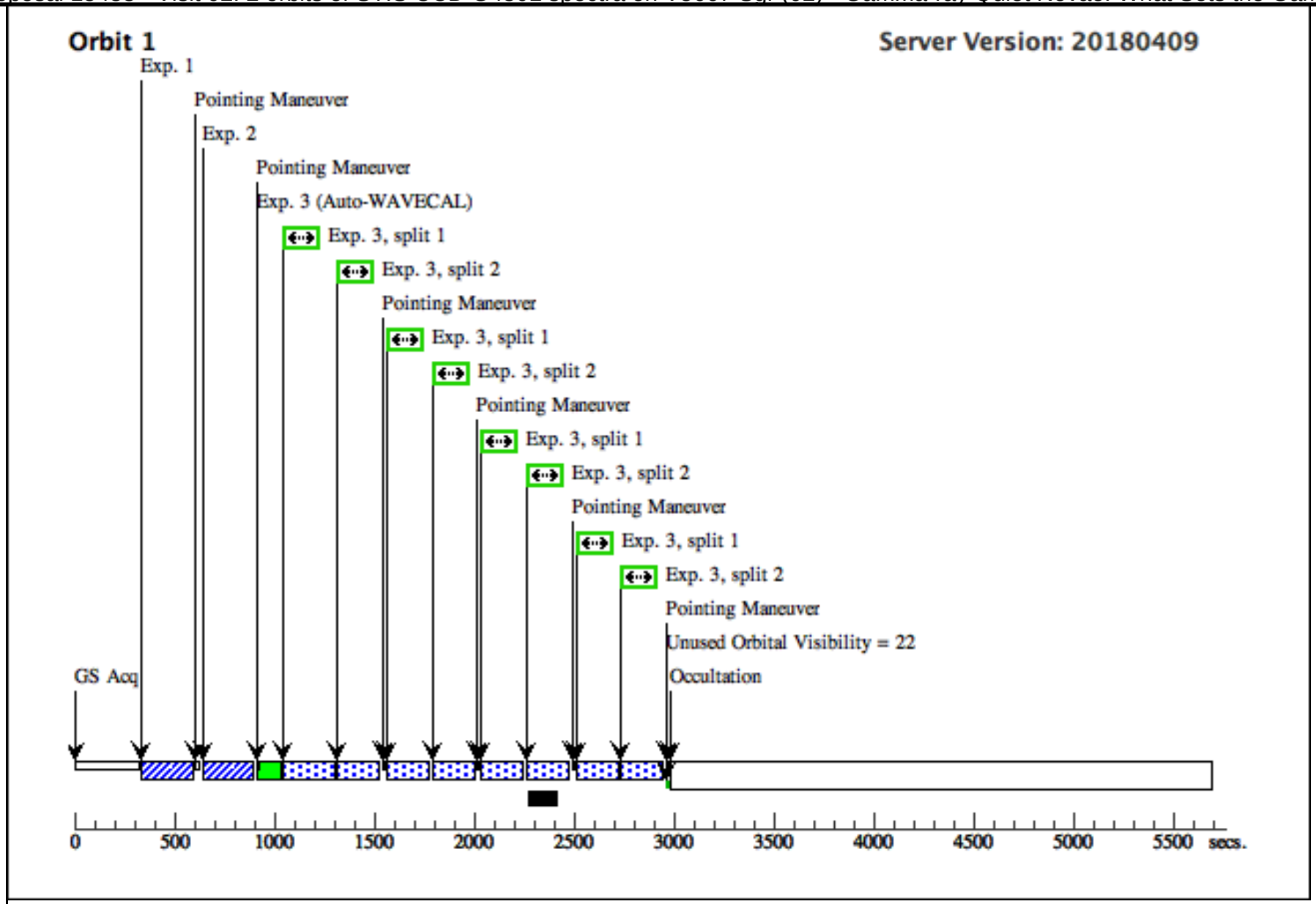
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NOVA-SGR-2015-A	RA: 18 14 25.1590 (273.6048292d)	Epoch of Position: 2016.93	V=14.0+/-0.5	Reference Frame: ICRS
		Dec: -25 54 34.58 (-25.90961d)			
		Equinox: J2000			

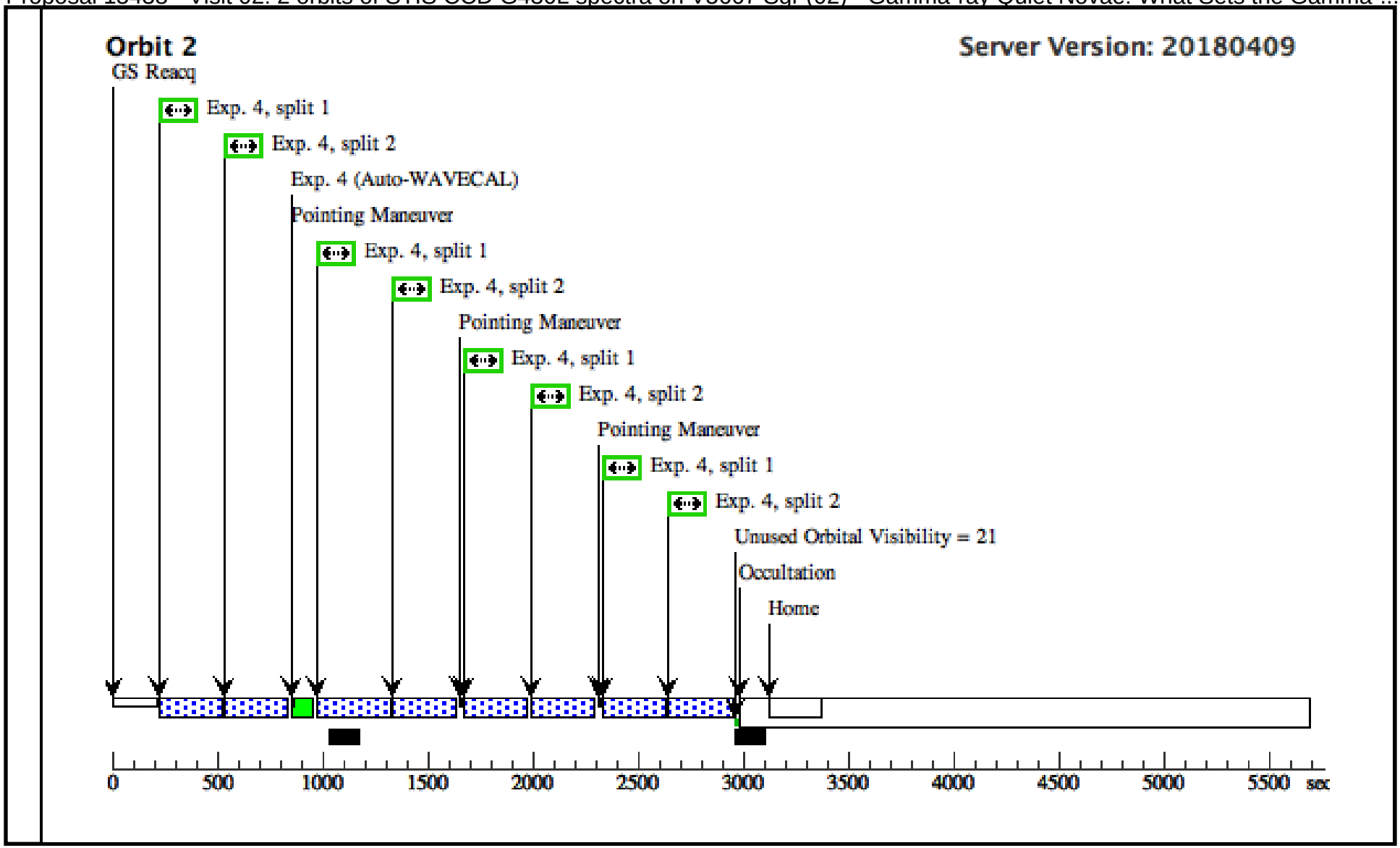
Comments: V-band flux from an AAVSO CCD measurement on 2017/06/25. At average, fairly linear fading rate in V from October 2015 to June 2017, it should fade by roughly 0.5 magnitudes more in the coming year, through June 2018.
Category=EXT-STAR
Description=[CLASSICAL NOVA, EJECTA, EMISSION LINE NEBULA, SHELL]
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	V5667Sgr-ACQ (SITS.ta.1039961)	(1) NOVA-SGR-2015-A	STIS/CCD, ACQ, 50CCD	MIRROR	ACQTYPE=DIFFUSE; CHECKBOX=5; DIFFUSE-CENTER=FLUX-CENTROID			3 Secs (3 Secs) *[==>]*	***[1]***
	Comments: Acquistion imaging for V5667 Sgr, which we expect to be a faint point source surrounded by small-scale (<0.5 arcsec) bright nebular structures of higher intensity. The most current AAVSO CCD photometry of V5667 Sgr has it at V=14.0, likely dominated by the [O III] 4959,5007 lines. An exposure time of 3 seconds should be below saturation, even assuming the worst case scenario of all 14.0 magnitudes of flux being concentrated in an unresolved point source and due entirely to the [O III] line source. Even if the ACQ exposure mildly saturates, we are using the 52x2 slit, so a small aperture centering error is not critical. Additionally, We will be able to use the WFC3 imaging from the preceding Visit 01 to determine whether the 3-second ACQ and ACQ-PEAK will be suitable, or if it needs to be shortened or lengthened, or if an OFFSET from a nearby star will be needed.								
2	V5667Sgr-PEAK (STIS.ta.1039963)	(1) NOVA-SGR-2015-A	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				3 Secs (3 Secs) *[==>]*	***[1]***
	Comments: Peak-up imaging for V5667 Sgr, which we expect to be a faint point source surrounded by small-scale (<0.5 arcsec) bright nebular structures of higher intensity. The most current AAVSO CCD photometry of V5667 Sgr has it at V=14.0, likely dominated by the [O III] 4959,5007 lines. An exposure time of 3 seconds should be below saturation, even assuming the worst case scenario of all 14.0 magnitudes of flux being concentrated in an unresolved point source and due entirely to the [O III] line source. Even if the ACQ-PEAK exposure mildly saturates, we are using the 52x2 slit, so a small aperture centering error is not critical. Additionally, we will be able to use the WFC3 imaging from the preceding Visit 01 to determine whether this 3-second ACQ and ACQ-PEAK will be suitable, or if it needs to be shortened or lengthened, or if an OFFSET from a nearby star will be needed.								
3	Orbit 1 V5667 Sgr G430L (STIS.sp.1040152)	(1) NOVA-SGR-2015-A	STIS/CCD, ACCUM, 52X2E1	G430L 4300 A	CR-SPLIT=2		Pattern 3, Exps 3-3 in Visit 02: 2 orbits of STIS CCD G430L spectra on V5667 Sgr (02) (3)	360 Secs (1440 Secs) *[==>(Pattern 1, Split 1)]* *[==>(Pattern 1, Split 2)]* *[==>(Pattern 2, Split 1)]* *[==>(Pattern 2, Split 2)]* *[==>(Pattern 3, Split 1)]* *[==>(Pattern 3, Split 2)]* *[==>(Pattern 4, Split 1)]* *[==>(Pattern 4, Split 2)]*	***[1]***
	Comments: We use a CR-SPLIT=2 at each of the 4-points of a centered STIS-ALONG-SLIT dither pattern with 0.5332 arcsec = 10.5 pixel steps, here with 300 second subexposures. In combination with the multiple orbits, the half-integer pixel step size will allow us to flag and remove cosmic rays, bad pixels and likely increase the STIS spatial resolution. Exposure estimates based on the ETC and on scaling our previous spectra of V339 Del and V959 Mon.								
4	Orbit 2 V5667 Sgr G430L (STIS.sp.1040152)	(1) NOVA-SGR-2015-A	STIS/CCD, ACCUM, 52X2E1	G430L 4300 A	CR-SPLIT=2		Pattern 3, Exps 4-4 in Visit 02: 2 orbits of STIS CCD G430L spectra on V5667 Sgr (02) (3)	540 Secs (2160 Secs) *[==>(Pattern 1, Split 1)]* *[==>(Pattern 1, Split 2)]* *[==>(Pattern 2, Split 1)]* *[==>(Pattern 2, Split 2)]* *[==>(Pattern 3, Split 1)]* *[==>(Pattern 3, Split 2)]* *[==>(Pattern 4, Split 1)]* *[==>(Pattern 4, Split 2)]*	***[2]***
	Comments: We use a CR-SPLIT=2 at each of the 4-points of a centered STIS-ALONG-SLIT dither pattern with 0.5332 arcsec = 10.5 pixel steps, here with 500 second subexposures. In combination with the multiple orbits, the half-integer pixel step size will allow us to flag and remove cosmic rays, bad pixels and likely increase the STIS spatial resolution. Exposure estimates based on the ETC and on scaling our previous spectra of V339 Del and V959 Mon.								

Orbit Structure




Orbit 2
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GS Reacq
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Exp. 4 (Auto-WAVECAL)
Pointing Maneuver
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Unused Orbital Visibility = 21
Occultation
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