



15904 - Spatially Resolving the Winds of Red Giant Stars

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Brian Erland Wood (PI) (Contact)	Naval Research Laboratory	brian.wood@nrl.navy.mil
Dr. Graham M. Harper (CoI)	University of Colorado at Boulder	graham.harper@colorado.edu
Dr. Hans-Reinhard Mueller (CoI)	Dartmouth College	hans.mueller@dartmouth.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) HD29139	STIS/CCD STIS/FUV-MAMA	4	24-Sep-2019 10:00:51.0	yes
02	(2) HD108903	STIS/CCD STIS/FUV-MAMA	4	24-Sep-2019 10:00:53.0	yes

8 Total Orbits Used

ABSTRACT

We propose to use long-slit STIS/G140M spectroscopy to spatially resolve red giant winds for the first time. Specifically, we will study the H I Lyman-alpha wind scattering around two red giant stars, Alpha Tau (K5 III) and Gamma Cru (M3.5 III). This project is stimulated by the very recent realization that in existing STIS/E140M spectra of these giants and others, the Lyman-alpha emission is to a large extent uniformly filling the 0.2x0.2 arcsecond STIS aperture, especially for the M giants. The only obvious way to explain this surprising result is to propose that H is actually ionized close to the stars, only becoming neutral far from the star ($>10 R_{\text{star}}$). Such a picture could dramatically alter our understanding of red giant winds,

Proposal 15904 (STScI Edit Number: 0, Created: Tuesday, September 24, 2019 at 9:00:54 AM Eastern Standard Time) - Overview potentially increasing mass loss rate estimates for such stars by over an order of magnitude. Our proposed new observations will determine exactly how far the Lyman-alpha scattering region truly extends around K and M giants. In combination with constraints on the winds from existing STIS echelle spectra, we will be able to make more accurate mass loss rate measurements, involving better constrained assessments of wind temperature and ionization structure. Finally, as these winds are known to be variable, we could potentially be able to detect and study spatial structure in red giant winds for the first time.

OBSERVING DESCRIPTION

We propose to observe the Lyman-alpha lines of alpha Tau (K5 III) and gamma Cru (M3.5 III) for 4 orbits each with the G140M grating (1222 setting) through the 52" x 0.2" long slit. Both targets are comfortably in compliance with STIS/MAMA bright object limits, as verified using both Table 13.44 in the STIS Instrument Handbook and the online STIS exposure time calculator.

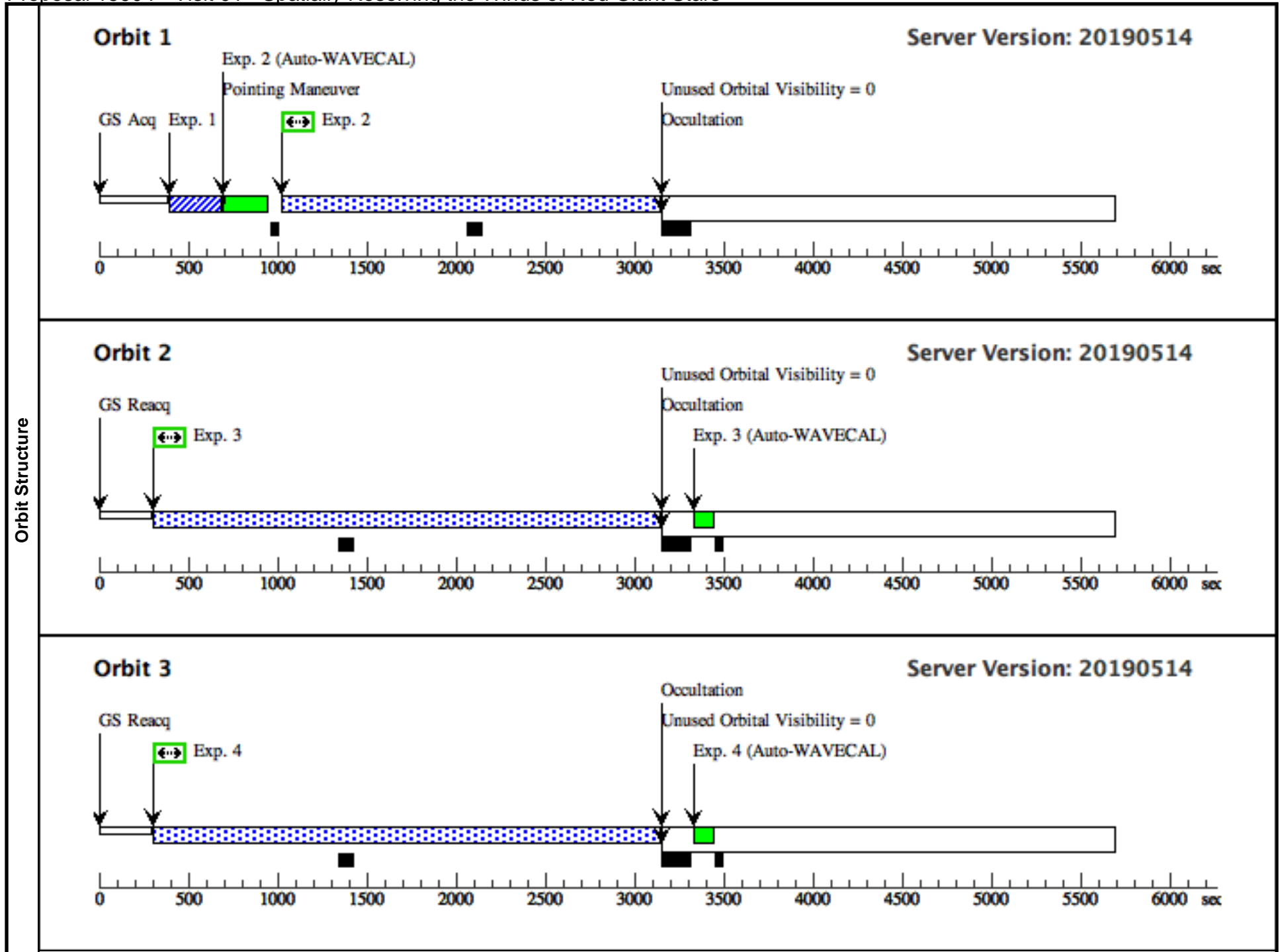
After acquisition and overheads are considered, we expect our 4-orbit G140M exposures to amount to about 180 minutes of total exposure per target. This information can be combined with the Lyman-alpha scattering model shown in Figure 4 to estimate expected signal-to-noise (S/N) for our planned observations, as a function of distance along the slit. The STIS exposure time calculator predicts $S/N=10$ for a surface brightness of $\sigma_{\lambda}=2e-13$ ergs/cm²/s/A/arcsec², corresponding to distances from the star of roughly 20 AU (0.98") and 30 AU (1.11") for alpha Tau and gamma Cru, respectively, according to Figure 4. These two distances correspond to roughly 85 R_{*} for both stars, meaning that it is entirely possible that we may actually be able to detect scattered wind emission at $>100 R_{*}$ from each star. The exposure time calculator suggests a detectable $S/N=3$ down to $\sigma_{\lambda}=2.5e-14$ ergs/cm²/s/A/arcsec², though at that point the limiting factor may be the brightness of the extended wings of the PSF of the bright emission from close to the star.

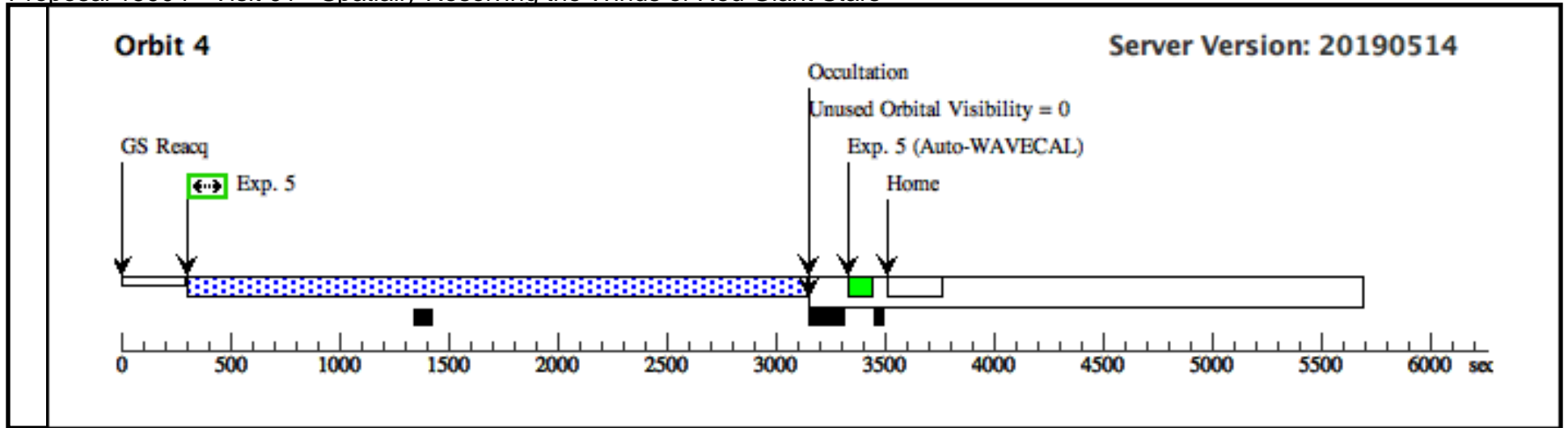
We considered using the 0.5" occulting bar available with the 52" x 0.2" slit in order to block the stellar chromospheric flux, but ultimately decided against it. The PSF wings of the chromospheric emission will be a potentially significant contaminant for the circumstellar wind-scattered flux in which we are interested. Blocking this emission would simplify the analysis and maximize the spatial extent to which we might detect the scattered flux, but it would also obscure the spatial flux profile close to the star, which is a region that is very much of interest. Thus, we ultimately decided not to use the occulter, meaning we will have to utilize deconvolution procedures to derive a true spatial flux profile from the observed one, which is convolved with the spatial PSF. We note that there is already a G140M Lyman-alpha spectrum of a white dwarf (WD1056-384) in the HST archives made through the 52" x 0.2" long slit, which will provide an excellent empirical point source PSF for our purposes.

Proposal 15904 - Visit 01 - Spatially Resolving the Winds of Red Giant Stars

Tue Sep 24 14:00:54 GMT 2019

Visit		Proposal 15904, Visit 01, implementation 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)	HD29139 Alt Name1: ALPHA-TAU Alt Name2: ALDEBARAN	RA: 04 35 55.2391 (68.9801629d) Dec: +16 30 33.49 (16.50930d) Equinox: J2000	Proper Motion RA: 63.45 mas/yr Proper Motion Dec: -188.94 mas/yr Parallax: 0.04894" Epoch of Position: 2000.0 Radial Velocity: 54.26 km/sec	V=0.86+/-0.01 TYPE=K5III, F-LINE(1216)=4.7+/-0.5E-11, W-LINE(1216)=2.5	Reference Frame: ICRS				
Comments: Category=STAR Description=[K III-I, WIND]										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.138 0957)	(1) HD29139	STIS/CCD, ACQ, F25ND5	MIRROR				0.1 Secs (0.1 Secs)	
									[==>]	[1]
	2	(STIS.sp.13 69383)	(1) HD29139	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 45			2100 Secs (2106 Secs)	
									[==>2106.0 Secs]	[1]
	3	(STIS.sp.13 69383)	(1) HD29139	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 45			2100 Secs (2824 Secs)	
								[==>2824.0 Secs]	[2]	
4	(STIS.sp.13 69383)	(1) HD29139	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 45			2100 Secs (2824 Secs)		
								[==>2824.0 Secs]	[3]	
5	(STIS.sp.13 69383)	(1) HD29139	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 45			2100 Secs (2824 Secs)		
								[==>2824.0 Secs]	[4]	





Proposal 15904 - Visit 02 - Spatially Resolving the Winds of Red Giant Stars

Tue Sep 24 14:00:54 GMT 2019

Visit	Proposal 15904, Visit 02, implementation 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)	HD108903 Alt Name1: GAMMA-CRU	RA: 12 31 9.9596 (187.7914983d) Dec: -57 06 47.57 (-57.11321d) Equinox: J2000	Proper Motion RA: 28.23 mas/yr Proper Motion Dec: -265.08 mas/yr Parallax: 0.03683" Epoch of Position: 2000.0 Radial Velocity: 21.0 km/sec	V=1.64+/-0.01 TYPE=M3.5III, F-LINE(1216)=1.2+/-0.2E-11, W-LINE(1216)=3.0	Reference Frame: ICRS			
	<i>Comments:</i> Category=STAR Description=[M III-I, WIND]									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.138 0958)	(2) HD108903	STIS/CCD, ACQ, F25ND5	MIRROR				0.1 Secs (0.1 Secs)	
									[==>]	[1]
	2	(STIS.sp.13 69388)	(2) HD108903	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 50			2100 Secs (2339 Secs)	
									[==>2339.0 Secs]	[1]
	3	(STIS.sp.13 69388)	(2) HD108903	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 50			2100 Secs (3057 Secs)	
								[==>3057.0 Secs]	[2]	
4	(STIS.sp.13 69388)	(2) HD108903	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 50			2100 Secs (3057 Secs)		
								[==>3057.0 Secs]	[3]	
5	(STIS.sp.13 69388)	(2) HD108903	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140M 1222 A	BUFFER-TIME=10 50			2100 Secs (3057 Secs)		
								[==>3057.0 Secs]	[4]	

