11623 - Shaping the pre-supernova circumstellar environment

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

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) HD--005980	STIS/CCD STIS/FUV-MAMA	2	10-Jul-2008 21:15:08.0	yes

2 Total Orbits Used

ABSTRACT

Recent discoveries of very luminous supernovae associated with luminous blue variable-type objects (LBV's) raise the interesting possibility that an LBV phase may be the prelude to core collapse. Alternatively, the LBV events may be occuring in binary systems where the LBV phase is reached by one of the stars shortly before its more evolved companion becomes a supernova. The Small Magellanic Cloud binary system HD 5980 is believed to consist precisely of such two objects: a massive hydrogen-poor Wolf-Rayet star in orbit around an even more massive variable star that recently underwent an LBV-type eruption. The wind velocity and the mass-loss rate of the LBV-component have changed remarkably over the past $\sim$40 years, providing a glimpse of the detailed information of how a binary LBV-type star may shape the circumstellar environment into which

the eventual supernova ejecta will collide. One process that is shaping the CSM around HD 5980 is the interaction between the slow wind ejected during eruption and the fast wind that was subsequently ``turned on''. In order to model the evolution of this interaction region, an accurate determination of the mass-loss rate and the wind velocity of HD 5980 is required. Because the optical emission lines are contaminated by other sources, only the P Cygni profiles observable in the UV spectral region provide unambiguous values for the current wind speed and mass-loss rate. In this proposal we are requesting 2 HST orbits to observe HD 5980 with STIS in order to obtain one FUV MAMA spectrum from which we will determine the current wind velocity and mass-loss rate of the LBV-type star. These data will also allow a more detailed analysis of the atmospheric structure of the LBV-type object in its quiescent state and, combined with ground-based observations, an analysis of the emission arising in the wind-wind collision region may be performed. Although HD5980 may be unique in our Galactic vicinity, it may be typical of massive star systems formed in low-metallicity regions in distant galaxies and thus, an understanding of HD5980 can provide further insight into the energetic phenomena present in the more distant, low-metallicity star-forming regions.

OBSERVING DESCRIPTION

We propose to observe HD 5980 with STIS using the MAMA Echelle FUV E140M grating with the 0.2x0.2 slit in the 1170--1730 A wavelenth range. A signal-to-noise ratio S/N=30--35 per resolution element at 1445 A is adequate for the objectives of this proposal. The visibility in three-gyro mode for the declination of HD5980 is between 43--51 minutes. If we assume that the current UV spectral energy distribution of HD5980 is similar to its UV spectral distribution in 1979 (IUE spectrum SWP4345, obtained at orbital phase 0.91), and adopting E(B-V)+0.07 (Koenigsberger et al. 1998), an exposure of 4200 seconds will provide S/N=31 (ETC model ID20408). Adding in the time required for the guide star acquisition (360 s), the target acquisition (360 s) and the instrumental overheads (480 s), yields a total of 5400 seconds, corresponding to 2 HST orbits, assuming a visibility of 45 minutes per orbit. Similar results are obtained if we assume that the spectral distribution is more similar to that of 2002 than 1979. Monitoring of HD5980 from ground-based observatories will alow us to determine whether any significant changes are occurring in the spectral energy distribution that could affect these exposure time calculations.

Using APT's Orbit Planner for this Phase II proposal, we find that HD 5980 may be observed with STIS+MAMA/E140M with two exposures, 2548 s+2627 s, allowing for a short (300 s) exposure using STIS+CCD/G230LB. The PCR for adding the short exposure was approved and is added to the Visits list.

Visit

Proposal 11623, Visit 01, implementation Fri Jul 11 01:15:12 GMT 2008

Diagnostic Status: No Diagnostics

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

Special Requirements: Period 19.2654 D AND ZERO-PHASE HJD2443158.701

Fixed Targets

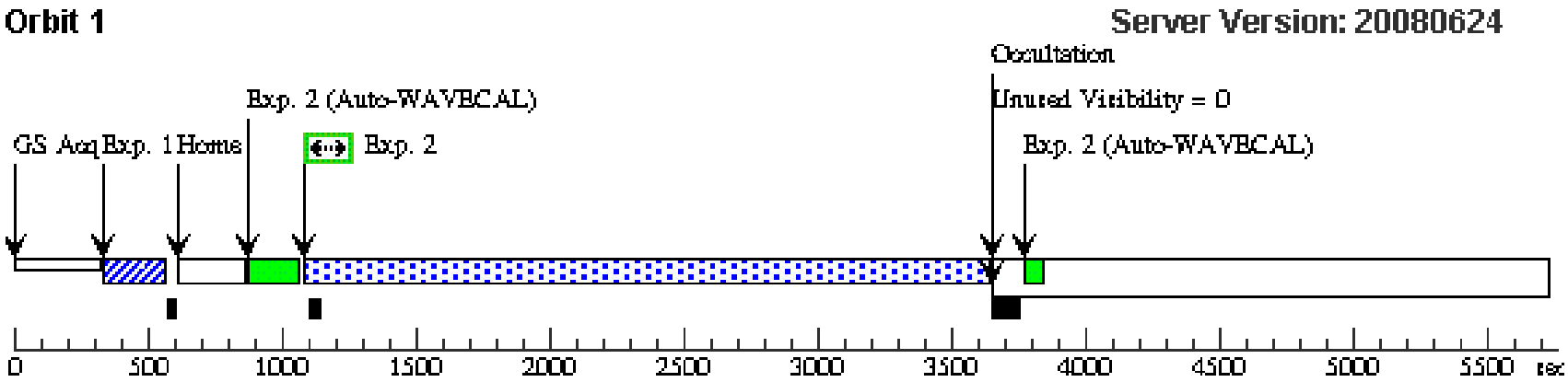
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD--005980	RA: 00 59 26.7000 (14.8612500d) Dec: -72 09 54.00 (-72.16500d) Equinox: J2000		V=11.4+/-0.4	Reference Frame: ICRS

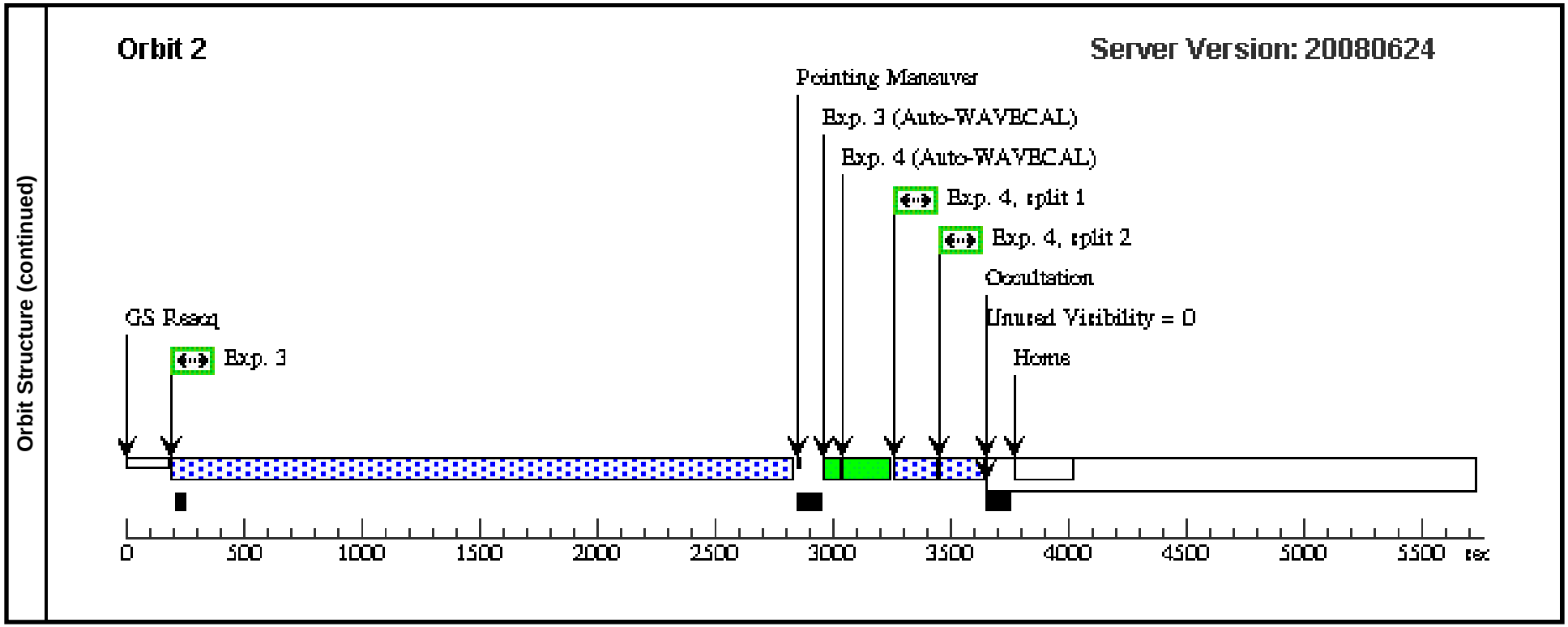
Comments: This object was generated by the targetselector and retrieved from the NED database.This object was generated by the targetselector and retrieved from the NED database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) HD--005980	STIS/CCD, ACQ, F28X50LP	MIRROR		PHASE 0.99 TO 0.0 1		0.2 Secs *[==>]*	*[1]*
2		(1) HD--005980	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A		PHASE 0.99 TO 0.0 1		2548 Secs *[==>]*	*[1]*
3		(1) HD--005980	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A				2627 Secs *[==>]*	*[2]*
4		(1) HD--005980	STIS/CCD, ACCUM, 52X0.2	G230LB 2375 A				300 Secs *[==>(Split 1)]* *[==>(Split 2)]*	*[2]*

Orbit Structure




Orbit Structure (continued)
Orbit 2
Server Version: 20080624
Pointing Maneuver
Exp. 3 (Auto-WAVECAL)
Exp. 4 (Auto-WAVECAL)
Exp. 4, split 1
Exp. 4, split 2
Occultation
Unused Visibility = 0
Home
GS Reacq
Exp. 3
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec