



12799 - The Unique Recurrent Nova T Pyxidis: The Transition to Quiescence

Cycle: 19, Proposal Category: GO/DD

(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>
01	(1) NOVA-PYX-1890	STIS/CCD STIS/FUV-MAMA	2	12-Mar-2012 21:06:49.0	yes
02	(1) NOVA-PYX-1890	COS/FUV COS/NUV	1	12-Mar-2012 21:06:57.0	yes

3 Total Orbits Used

ABSTRACT

Proposal 12799 (STScI Edit Number: 0, Created: Monday, March 12, 2012 8:07:00 PM EST) - Overview

The surprising April, 2011 explosion of the recurrent nova T Pyxidis offers a unique opportunity to catch T Pyx as it transitions into quiescence where we expect to see the FUV continuum fade, emission lines weaken and transition to the continuum in quiescence. Our three earlier STIS observations of T Pyx centered on the outburst maximum. By obtaining a complete cooling curve of the heated, bloated white dwarf in the FUV where the white dwarf and (possibly) the accretion disk dominate, we will discriminate between the cooling of a massive (near Chandrasekhar mass) post-nova white dwarf versus the cooling of a less massive white dwarf. We predict it will reach quiescence by the Fall of 2012 when a standard GO is planned. New post-recurrent nova cooling calculations are being done by Starrfield et al. (2012) in support of this proposal. Our modeling of this unique sequence should yield or constrain the white dwarf mass, detail the accretion environment, discover how much the WD was heated by the outburst, constrain the accretion rate, and possibly help explain why its latest nova outburst was delayed by 44 years. If, as we expect for its short recurrence time, the white dwarf is massive (1.35 solar mass) and near the Chandrasekhar limit. This is very likely the last time that an observation of a complete cooling curve, at least for the lifetime of COS, will be possible. Nothing is known about the cooling behavior of the white dwarf in recurrent novae so soon after outburst in the FUV with the necessary resolution.

OBSERVING DESCRIPTION

As discussed with the STScI staff, we decide to use STIS with the E140M configuration (for safety reason) and COS with the G130 configuration (1055A).

We discuss below safety issues and exposure time.

T Pyx was observed last with STIS E140M several months ago (STIS spectrum n.3) and its flux was found to be 5 times larger than when observed in quiescence with IUE (see Figure 3 of proposal).

To a good accuracy we estimate that the continuum flux level of T Pyx at the time of the observations will be at least twice that of the IUE continuum flux level (as shown in Figure 3 of our proposal) with the possible addition of emission lines. We first check a 100,000K WD using our stellar atmosphere code TLUSTY and SYNSPEC (from I. Hubeny). At a distance of 3,500pc, even with a bloated radius, the WD flux is found to be only a fraction of the existing STIS (n.3) or IUE spectra flux level. It is clear that from the WD itself there is no restriction nor safety concern as no emission lines are expected from the WD at all.

For safety reasons we assume that at the time of the observations, the spectrum of T Pyx could have a flux as large as the one in its STIS spectrum n.3 and that the main dominating emission line will be from Nitrogen 5 (N V 1240 - a doublet), all the other lines will have decreased in strength as they already did (though it is very likely that even that NV will have much decreased).

We put this STIS (n.3) spectrum into the ETC for STIS with E140M. Requesting a SNR of 10 at 1440A (where there is no emission lines only continuum) we obtained an exposure time of 4584s and no warning.

For COS (G130 1055A) the existing STIS spectrum does not cover the shorter wavelengths and therefore it cannot be used in the ETC. We estimate the disk to dominate the spectrum, and its peak temperature will also reach about 100,000K. We therefore assume a 100,000K spectrum and we scale it to fit the flux level of the STIS spectrum around 1300-1400A (continuum). We then use this scaled spectrum in the ETC for COS. For a 2000s exposure time the ETC returns a SNR of about 4 at 1000A (2/3 of the buffer is less than 2000s). The count rate returned for segment A is 767 and 60 for segment B. We do not expect the flux to be that high, but put this maximum flux here as an upper limit for safety purpose.

Since the possibility of using only segment B of COS was raised by the COS team, with a lower sensitivity, we will use the segmented COS spectrum only to assess the flux level of the continuum as a lower or upper limit and we do not require a high quality spectrum in that region (otherwise the exposure time would increase drastically).

The guide star time, the target acquisition time and the instrument overhead time totals about 1,600s for COS and 1200s for STIS for the first orbit and about half of that for the second orbit. The estimated visibility time is 55min or 3,300s. First orbit for STIS has 2100s of observing time, and 2500s for the second orbit, totalling about 4600s - that's the estimate, the exact time appears after running the orbit planner.

In the present configuration and with the present restriction and using COS to estimate the flux level as an upper or lower limit, we request 2 orbits for STIS and only one orbit for COS.

On the overall the emission from the ejecta has decreased substantially and now the central object is the main source. So we can now more easily observe the decline of the system itself to quiescence and for the target acquisition we consider the source to be a point source. Its accuracy is known to less than 0.4arcsec.

REAL TIME JUSTIFICATION

We request that the STIS observation and COS observation be carried out one after the other, to ensure that the target has the same flux level and is exactly in the same state. Though it is unlikely that the target will change significantly even over a period of days, as it is cooling from its outburst (recurrent nova), we want to minimize the effect of any unpredictable (but small) change.

CALIBRATION JUSTIFICATION

We are aware that the calibration for the present configuration of COS will not be available until Summer 2012 and we will first work on the STIS spectrum.

ADDITIONAL COMMENTS

Additional emission lines are expected to be showing up in the COS spectrum, such as N iv (9201-925), S vi (933.5 and 944.5), C iii (977), N iii (991.6), O vi (1031.9, 1037.6). Additional lines would be on the segment A. All these lines are not expected to be as strong the N V (1240) line and should all be similar to the lines seen in the STIS spectrum n.3 or lower, therefore causing no safety problem to COS (these lines are usually broad but not too strong). Since that STIS spectrum was taken (3 months) the magnitude of the source has declined and we don't anticipate any strong lines to cause any problems to the instruments.

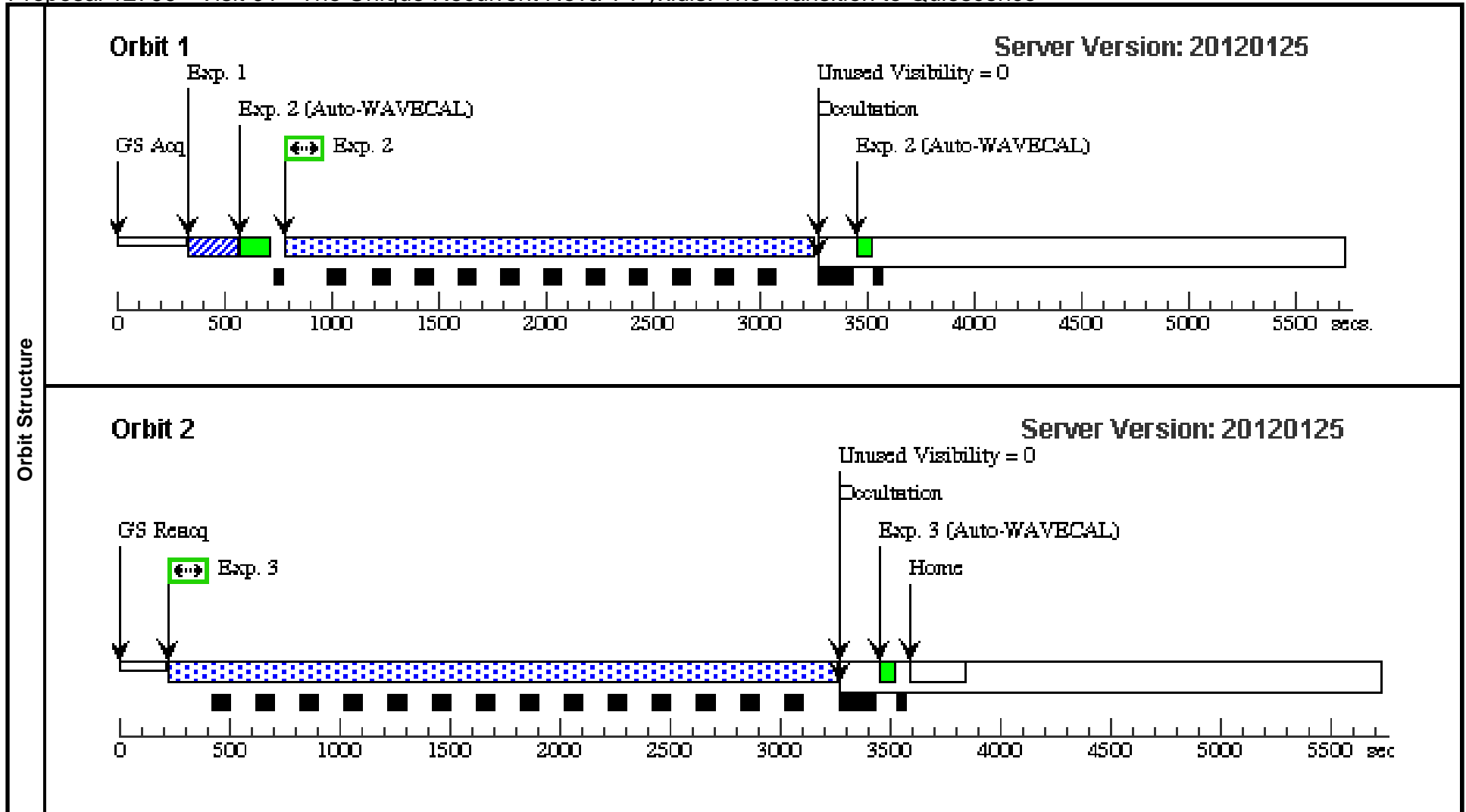
As to the ejecta, from the shape and changes in the 3 STIS spectra obtained last year (the lines have decreased in strength and the continuum has begun to appear), it is already in the optically thin phase as the continuum from the central source is being revealed. We do not expect these ejecta lines to increase at this stage as the ejecta has dimmed a lot. The N V line is possibly from the central source all indicates it should also have decreased (as discussed at length in the email exchanges).

Proposal 12799 - Visit 01 - The Unique Recurrent Nova T Pyxidis: The Transition to Quiescence

Tue Mar 13 01:07:01 GMT 2012

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	NOVA-PYX-1890	RA: 09 04 41.5000 (136.1729167d) Dec: -32 22 47.50 (-32.37986d) Equinox: J2000			V=13.0+/-1.0
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>						

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(STIS.ta.390 388)	(1) NOVA-PYX-189 0	STIS/CCD, ACQ, F28X50LP	MIRROR					1 Secs [==>]
2	(STIS.sp.39 0037)	(1) NOVA-PYX-189 0	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A		BUFFER-TIME=20 0			2300 Secs [==>2457.0 Secs]	[1]
3	(STIS.sp.39 0037)	(1) NOVA-PYX-189 0	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A		BUFFER-TIME=20 0			2300 Secs [==>3023.0 Secs]	[2]



Proposal 12799 - Visit 02 - The Unique Recurrent Nova T Pyxidis: The Transition to Quiescence

Tue Mar 13 01:07:02 GMT 2012

Visit	Proposal 12799, Visit 02, implementation Diagnostic Status: Warning Scientific Instruments: COS/NUV, COS/FUV Special Requirements: SCHED 30%; AFTER 01 BY 1.9 Orbits TO 2.2 Orbits: BEFORE 01-APR-2012:00:00:00									
	(Visit 02) Warning (Form): If the target coordinates are not known to 0.4" (or better) an ACQ/SEARCH should precede the ACQ/IMAGE.									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	NOVA-PYX-1890	RA: 09 04 41.5000 (136.1729167d) Dec: -32 22 47.50 (-32.37986d) Equinox: J2000		V=13.0+/-1.0	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(COS.ta.390 401)	(1) NOVA-PYX-189 0	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				100 Secs [==>]	[1]
	2	(COS.sp.390 226)	(1) NOVA-PYX-189 0	COS/FUV, TIME-TAG, PSA	G130M 1055 A	BUFFER-TIME=46 1; FP-POS=ALL			479 Secs [==>461.0 Secs (Split 1)] [==>461.0 Secs (Split 2)] [==>461.0 Secs (Split 3)] [==>461.0 Secs (Split 4)]	[1]

