10999 - Testing the first direct measurement of cataclysmic variable evolution: the search for a circumbinary disk or a low?mass companion around NN Serpentis

Cycle: 15, 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) NN-SER	WFPC2	1	27-Feb-2007 21:12:20.0	yes

1 Total Orbits Used

ABSTRACT

We obtained high time-resolution photometry using the high speed CCD camera ULTRACAM between 2002 and 2004, which revealed a gradual reduction in the orbital period of the pre-cataclysmic variable NN Serpentis. There are three possible explanations for this period change: firstly, we may have been successful in obtaining the first and only direct measurement of the braking rate of a close binary system, in which case our measured values are approximately 2

orders of magnitude greater than predicted, and pose serious problems for the theory of close binary evolution. Secondly, the unusually high braking rate may be caused by the presence of a circumbinary disk, which would help to answer two of the outstanding problems with current CV theory - namely the high mass-transfer rates seen in some CVs, and the fact that the minimum observed value in the CV period distribution is approximately 15% longer than expected. Finally, our observations could be explained by a light travel-time effect caused by a third body in orbit around the binary, which would raise major questions about the evolutionary history of the system, in particular how a third body has managed to remain in a stable orbit throughout periods of intense mass-loss in the central binary. We intend to use IRAC observations to search for a mid-infrared excess in the spectral energy distribution of NN Ser, which would confirm the presence of either a disk or a third body. We then propose to use HST imaging to attempt to resolve a third body, allowing us to discriminate between the two possibilities. If both methods fail to reveal any extra system components, we will have ruled out our only remaining alternatives to a genuinely high angular momentum loss rate in this system, with profound implications for CV evolution.

OBSERVING DESCRIPTION

We will use the WFPC2 with both the F555W and F814W filters to obtain deep images of NN Ser. The goal is to detect a tertiary red dwarf companion, therefore we require the colour information to differentiate between the known central binary components and any third body. In order to remove cosmic rays, hot pixels and detector blemishes, minimise flat-fielding errors, and, most importantly, oversample the PSF, we will utilise an 4-point box dither pattern. To be certain that we image deeply enough, we have estimated the likely V- and I-band brightness of the central system and the tertiary companion. We used the WFPC2 ETC to obtain total- and sub-exposure times required to obtain a S/N of 30 for V=22 and I=20 respectively, while ensuring that the brighter central binary system is never over-exposed.

Proposal 10999 - Visit 01 - Testing the first direct measurement of cataclysmic variable evolution: the search for a circumbinary disk or a low?mass companion around NN Serpentis

Visit

Proposal 10999, Visit 01, scheduling Wed Feb 28 02:12:25 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFPC2-BOX	Coordinate Frame=POS-TARG		(1), (2)
	Purpose=DITHER	Pattern Orientation=26.6		
	Number Of Points=4	Angle Between Sides=143.1		
	Point Spacing=0.559	Center Pattern=false		
	Line Spacing=0.559			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NN-SER	RA: 15 52 56.2000 (238.2341667d)		V=17.0+/-0.5	Reference Frame: ICRS
		Dec: +12 54 47.20 (12.91311d)		I=17+/10.5	
		Equinox: J2000			

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	f814w_1	(1) NN-SER	WFPC2, IMAGE, WF2	F814W			Same Obset	60.0 Secs	
							Pattern 1-1 (1)	*[==>(Pattern 1)]*	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
2	f555w_1	(1) NN-SER	WFPC2, IMAGE, WF2	F555W			Same Obset	100.0 Secs	
							Pattern 2-2 (1)	*[==>(Pattern 1)]*	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	