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March 1, 1993

Gloria R. Blanchard, Grants Officer
Space Sciences Directorate
Goddard Space Flight Center
Greenbelt, MD 20771

Dear Ms. Blanchard,

Please find enclosed the final technical report for NASA grant NAG5-1829, on which I am the Principal Investigator.

Sincerely yours,

Edward L. Robinson
Blakemore Professor of Astronomy

Grant Report for NAG5-1829

Funded by NASA grant NAG5-1829, Wood visited the ROSAT Data Centre at the University of Leicester for 3 days in June 1992. The data discussed below were reduced in Leicester. She then spent a week at the Department of Physics, Keele University collaborating with Dr Tim Naylor on the analysis of the ROSAT data.

The serendipitious WFC sources under investigation, *i.e.* those which just happened to lie in the field of view while another object was being studied, were disappointing. The integration times were chosen to suit the primary target not the serendipitous targets. UX UMa, CZ Ori, BI Ori, WX Cet and AR And were not detected. A long (~17ksec) pointed observation of UX UMa (PI Wood) has since been carried out (February 1993) and the data is expected shortly.

The other observations were much more successful. V471 Tau was observed with the WFC for 6.5hrs with the S1 filter and 1.1hrs with the S2b filter. It was easily detected with a count rate of 0.03 cps in the S1 filter and 0.15 cps in the S2b filter. The oscillations were seen, even before the data was folded, as was expected from preliminary results from the survey (Barstow *et al.* 1992). The pointed observations provide a much better phase coverage of the oscillations than did the survey data where the coverage was sparse. These data will be presented in a paper with the PSPC data (PIs Robinson and Shipman) and the pulse profiles in the different wavelengths will be compared.

HT Cas was observed during a 24 hour period on August 17th 1991. During this time 8 hours of observations were obtained. These observations were originally intended to be time critical with the eclipses specifically targeted. However, because of the pointing problems at that time all targets were done for 24 hours and no arrangement for observing particular phases was made. As the orbital period of HT Cas is 96mins, this means that the phases observed between Earth occultations change only slowly. Unfortunately, at the start of the observations the eclipse was seen close to the edge of the viewing zone and it soon precessed out of this zone. Our observations, therefore, only covered 3 eclipses. HT Cas was detected in the PSPC with a count rate of 5×10^{-2} cps. In the WFC a 3σ upper limit of 0.003 cps was obtained The light curve obtained from the PSPC data was folded on the orbital period and rebinned. It is shown in Figure 1. This figure shows the presence of an eclipse, with a 3.6σ level of confidence. This eclipse is of an X-ray source close to the white dwarf, most probably the boundary layer. It is the first eclipse of the X-rays in a dwarf nova ever seen. The variability of the soft and hard parts of the PSPC spectra were compared. They appear to be due to one component rather than two separate ones. Surprisingly the spectrum is much softer than the very hard source that was expected. Model fits showed that the hydrogen column density is very low and a blackbody of temperature $kT = 0.21$ KeV fits the data well. A unique model could not be determined with the signal-to-noise ratio obtained, but in all types of model *e.g.* power law, brehmsstrahlung, or Raymond-Smith model the fitted column density was very low $\sim 10^{18}\ cm^{-2}$. The model suggested for HT

Cas from Einstein IPC data alone was a brehmsstrahlung model with $kT \sim 20$ KeV with $n_H \sim 6 \times 10^{20}\ cm^{-2}$. This model is completely ruled out by the new results. The variability of the X-ray data and the simultaneous UBVR photometry, which was obtained at McDonald observatory, is currently under investigation. A paper on all these results is in preparation.

VW Hyi was observed during the ROSAT survey for 8 days in November 1990. It was in the WFC camera window for approximately twice as long. AAVSO monitored all dwarf novae in the ROSAT window and informed us if any outbursts occurred. VW Hyi erupted and the target of opportunity on IUE was activated. A series of IUE spectra covering early rise to maximum light was obtained. Ground based optical observations were also obtained. A paper on the multiwavelength outburst behaviour of VW Hyi is in preparation. During the outburst the X-rays actually decreased while the optical and UV increased. This decrease was unexpected. Models indicated that the X-ray flux should rise, although a delay was expected with the optical rising first followed by the UV and then the X-rays. Unfortunately, the X-ray observations do not have a good enough signal-to-noise to investigate how the X-ray spectrum varies. Models to explain these observations are being investigated. It is possible that the wind, which develops during the outburst, hides the X-rays from view.

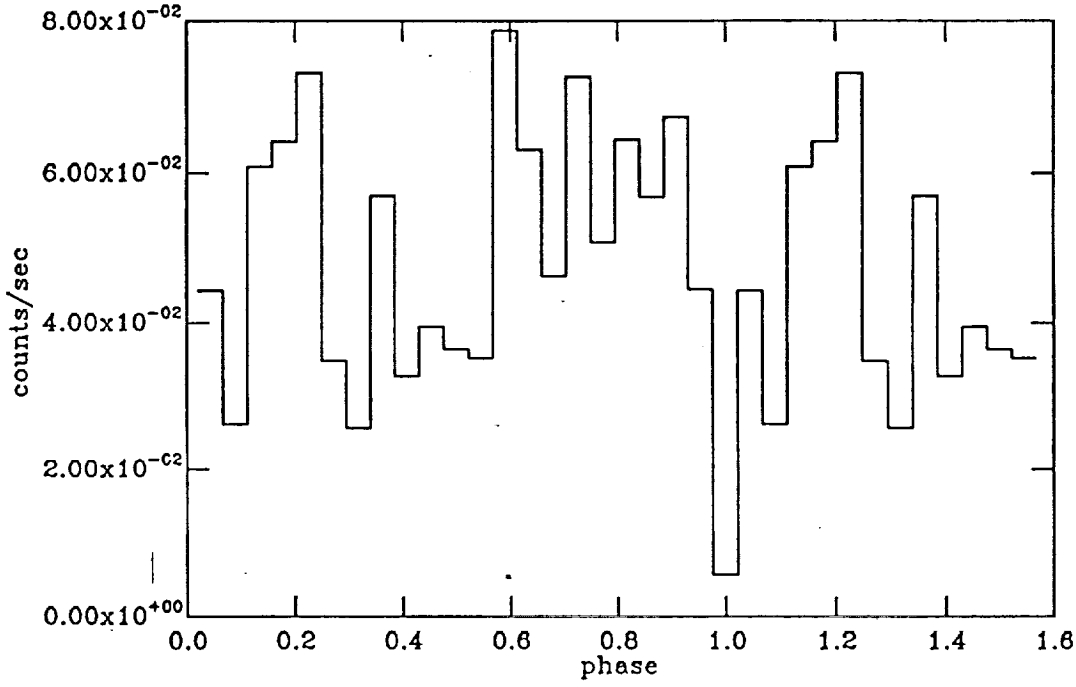

Figure 1: X-ray light curve of HT Cas.