# PRELIMINARY RESULTS OF COORDINATED OPTICAL UV AND X-RAY OBSERVATIONS OF MAGNETIC WHITE DWARFS IN BINARIES

L.Maraschi[1], K.Beuermann[2], J.M.Bonnet Bidaud[3], P.A.Charles[4], L.Chiappetti[5][6], G.Hammerschlag[7], I.Howarth[8], C.Motch[9], M.Mouchet[10], J.Osborne[5], L.Stella[5], E.G.Tanzi[6], A.Treves[1], J.Van Paradijs[7], A.J.Willis[8], R.Wilson[8]

1) Dipartimento di Fisica Università, Milano; 2) Technische Universitat, Berlin, FRG; 3) CEN Saclay, F; 4) University of Oxford, UK; 5) ESOC Darmstadt, FRG; 6) Istituto di Fisica Cosmica, CNR, Milano, I; 7) Astronomical Institute, Amsterdam, NL; 8) University College, London, UK 9) Observatoire de Besançon, F; 10) Observatoire de Paris, Meudon,F

## 1. E1405-451

Repeated coordinated UV and optical observations of the AM Her type system E1405-451 allowed the study of the energy distribution before, during and after a low state (February, March, April 1983). In the low state the ultraviolet spectrum can be interpreted as the emission from a hot white dwarf (T=26500 K, R=3x10$^8$ cm (d/100 pc). In the high state a steep component ($F_\lambda \propto \lambda^{-4}$) emerges shortwards of 2000 Å possibly indicating a hot polar cap, together with a flatter component ($F_\lambda \propto \lambda^{-1}$) probably due to cyclotron radiation (See Maraschi et al 1984).

The system was observed simultaneously with IUE, Exosat and from ESO on March 24,1984. The UV spectrum is shown in Fig.1. It is more intense than those of Feb and April 83 by ~ 50% with similar line equivalent widths. The partially simultaneous X-ray and IR light curves (J band) are shown in Figs. 2,3.

For converting the Exosat filter count rates to fluxes, assumptions on the spectral parameters are required. Assuming $N_H$=0 and a black body spectrum with low kT yields $F_{0.02-2\,KeV}$ =5x10$^{-11}$ erg/cm$^2$s. If the 1200 Å UV flux and the X-ray flux derive from the same blackbody, the temperature is 1.2x10$^5$ K, with an associated area of 10$^{16}$ cm$^2$ (d=100 pc).

## 2. E1013-477

E1013-477 was observed simultaneously with IUE and Exosat on March 23, 1984. The UV spectrum is shown in Fig.4. It is weaker by almost a factor 2 than that reported by Mason et al (1983). The X-ray flux measured with the Exosat telescope was extremely low corresponding to a count rate of 0.15 c/min in the Lexan filter (n.7), 1% of that of E1405-451. We suggest that the source is indeed an AM Her-like system which was in a low state at the time of our observations.

## 3. E2003+225

The AM-Her like object E2003+225 was observed with IUE (14-20 UT) and Exosat (02-09 UT) on October 12, 1983. The UV spectrum shown in Fig.5 is an average of two exposures where no significant variations appear, despite they refer to different fractions of the 222 min cycle. The long wavelength spectrum indicates low reddening, E(B-V)<0.03. The X-ray light curve is shown in Fig.6. It is strikingly similar to that of E1405-451. The black body temperature determined from the soft X-ray and far UV flux is T=1.3x10$^5$ K corresponding to an area A = 10$^{16}$ cm$^2$. This is consistent with the values of Nousek et al (1984).

## 4. E2215-086

The DQ Her-like system 2215-086 (P tterson and Steiner 1983) was observed on October 1983, with IUE (14-22 UT) and Exosat (04-11 UT). Four LWP and four SWP exposures were obtained showing variations of ~ 50% in intensity and changes in the continuum shape. Further observations are needed in order to establish whether these variations are correlated with orbital phase. The average UV spectrum is shown in Fig.7. It is much flatter than those of the polars reported above, being fitted by $-0.3 < \alpha_\lambda < 03$ in the short wavelength range. From power law fitting of the

LWP exposures a reddening value of E(B-V)=0.03 is indicated. The source was not detected by the Exosat telescopes but by the Medium Energy experiment. The rotation period of 1257±15 s is clearly present with a quasi sinusoidal light curve. Spectral analysis of these data indicates a high column density. Separate spectral fits of the high and low parts of the light curve show a large variation in column density with $N_H=5\times10^{21}$ cm$^{-2}$ around the peak and $N_H=10^{23}$ cm$^{-2}$ around minimum. The column density implied by the X-ray data is much larger than that expected from the extinction observed in the UV and therefore should be intrinsic to the source.

REFERENCES

Maraschi L. et al, 1984, Ap.J. 285,
Mason K.O. et al, 1983, P.A.S.P. 95, 370
Nousek J.A. et al, 1984, Ap.J. 277, 682
Patterson J. and Steiner J.E.,1983, Ap.J. Lett.264, L61

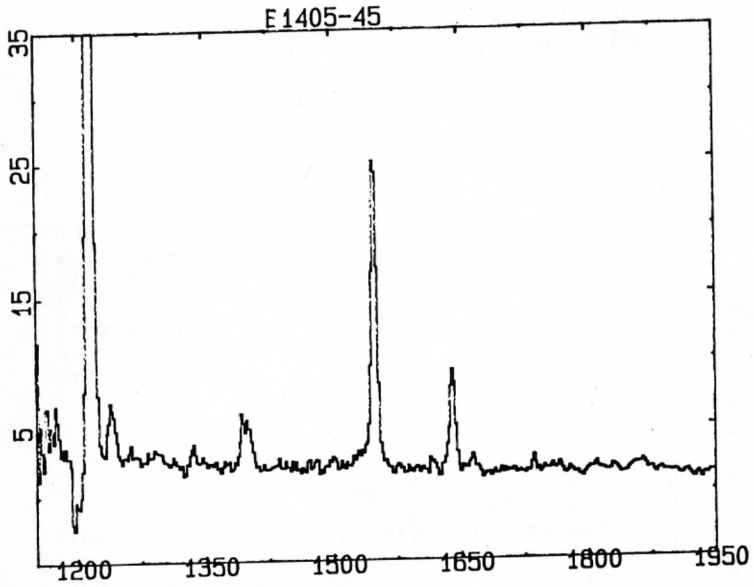


Fig.1 - UV spectrum of E1405-451 taken on 1984 March 24. Fluxes are in units of $10^{-14}$erg/(cm$^2$sec A), wavelengths in A.

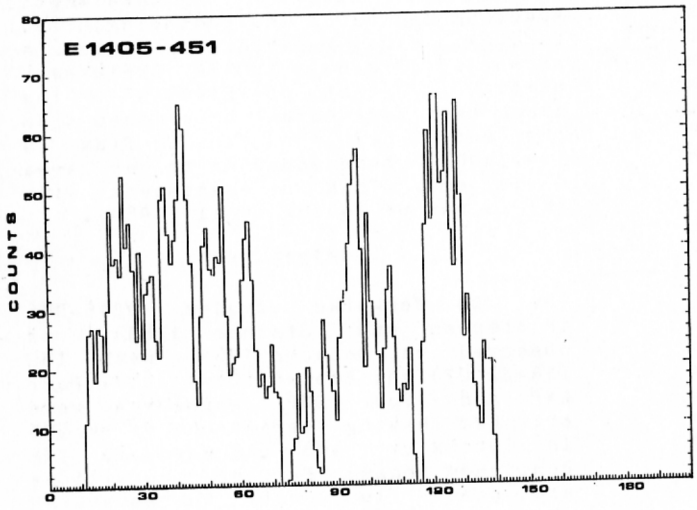


Fig.2 - X-ray light curve of E1405-451 Ordinate scale: EXOSAT CMA counts with the FW3 filter. Time is in minutes starting from 1984 March 24, $07^h43^m$UT.

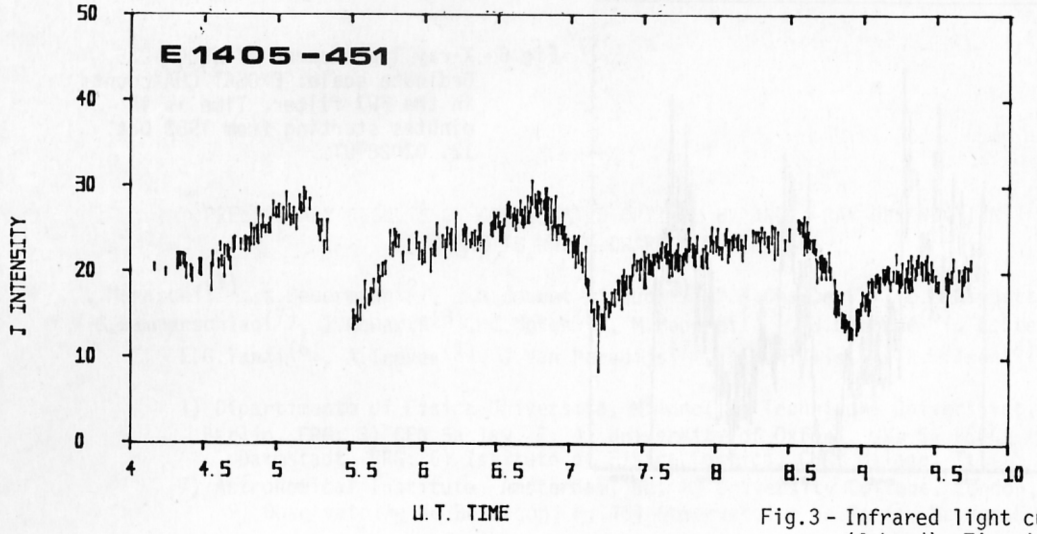


Fig.3 - Infrared light curve of E1405-451 (J band). Time is in hours (UT) of March 24, 1984.

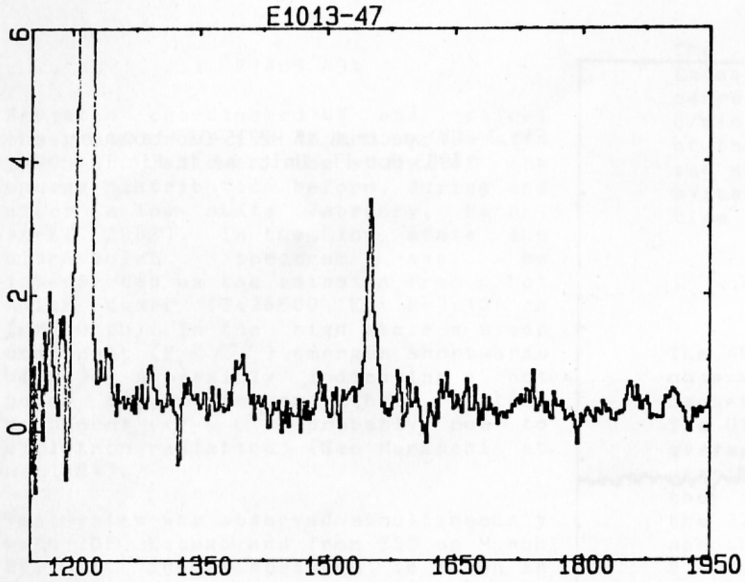


Fig.4 - UV spectrum of E1013-477 taken on 1984 March 23. Units as in Fig.1.

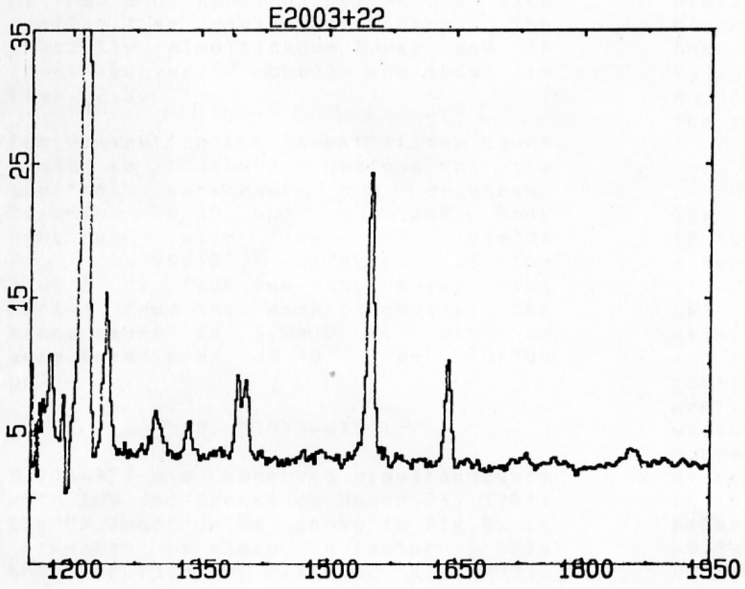


Fig.5 - UV spectrum of E2003+225 taken on 1983 Oct.12. Units as in Fig.1.

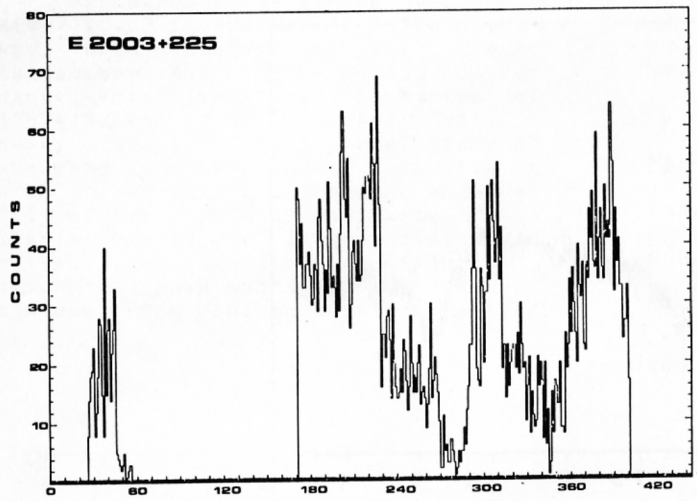


Fig.6 - X-ray light curve of E2003+225. Ordinate scale: EXOSAT CMA counts in the FW7 filter. Time is in minutes starting from 1983 Oct. 12, $02^h28^m$UT.

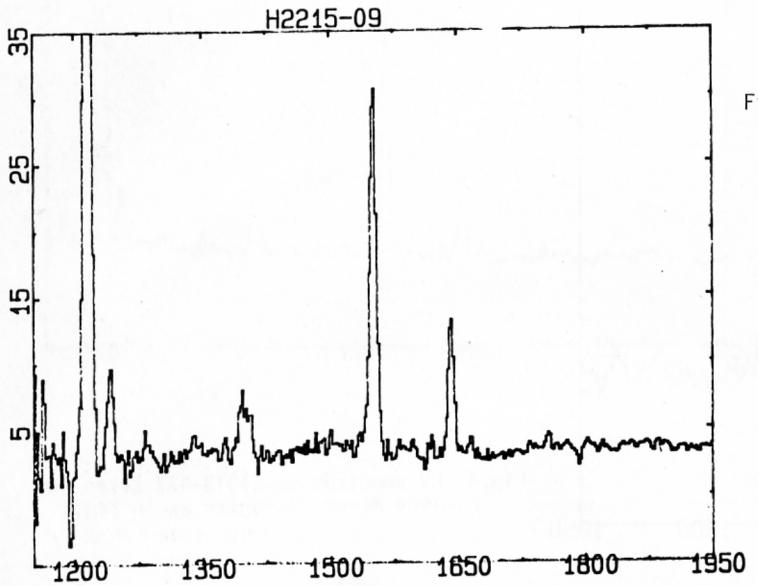


Fig.7 - UV spectrum of H2215-086 taken on 1983 Oct 11. Units as in Fig.1.