TEMPERATURE AND DENSITY OF A FLARE ON AU MIC OBSERVED BY THE EUVE SPECTROMETERS

B.C. MONSIGNORI FOSSI
Osservatorio Astrofisico di Arcetri, Firenze, Italy

M. LANDINI AND G. DEL ZANNA
Dipartimento di Astronomia, Università di Firenze, Italy

S. BOWYER
Center for EUV Astrophysics, Berkeley, USA

ABSTRACT  The time evolution of the X-ray-EUV emission during the July 14-18, 1992 observation of AU Mic has been studied in several lines detected by Short, Medium and Long Wavelength (SW, MW, LW) channels of the Extreme Ultraviolet Explorer (EUV) spectrometers. On July 15, 1992 a large flare was observed. An estimate of the density and volume of the emitting plasma is provided from the analysis of density sensitive lines of Fe XXI and Fe XXII during the flare.

INTRODUCTION

AU Mic is known to be a single rapidly rotating star (Bopp & Fekel 1977) and a flare star of the BY Dra type variables (Torres & Ferraz Mello 1973). AU Mic was observed for four days (14 to 18 July 1992), during the calibration phase of EUVE instruments both with the SW, MW and LW spectrometers (Monsignori Fossi & Landini 1993) and the broad-band Lexan/boron deep survey detector (Cully et al. 1993). On July 15 1992, a large flare was detected.

THE DATA ANALYSIS: TEMPERATURE AND DENSITY EVALUATION

We have analysed the three Quick Position Ordered Event (QPOE) files containing the spectra observed by EUVE SW, MW and LW spectrometers. Version 1.3.beta of the IRAF/EUV software package, IRAF version V2.10.2, and version 1.7.1.beta of the reference data set (EGODATA) were used to analyse the data. The so called “Telescope Interface (TIF) deadtime and Primschings” effects were taken into account (Abbott et al. 1993). These effects can cause a loss of events (i.e. underestimate the fluxes).

The spectra were extracted using IRAF task apall. The source plus background spectra were summed over 17 lines, while the background was averaged over a larger region, above and below the source, and then subtracted. Since a curvature was evident in the SW images, “tracing” of these spectra was accom-
FIGURE I  (a) The light curves of the AU Mic flare for the lines of Fe XXIII (triangles) and Fe XXII (dots). (b) The intensity line ratios versus density. Dotted and full curves are the theoretical ratios for Fe XXII and FE XXI (Monsignori Fossi & Landini 1994). Different symbols refer to the data collected in different time intervals: before flare cross, first flare triangle, between flares dot and second flare square.

plished during the extraction. A gaussian best-fit on the most prominent lines, with a fixed sigma, was used in order to evaluate the count rates.

A large increase of radiation lasts approximately 2 hours and is followed by a decaying phase of about one day. During this decay phase, a second smaller flare and other variations of brightenings were observed (Fig. 1a). By means of the intensity ratio of the lines (132.9/117.2) we estimate the temperature, which shows fluctuations between 7 and 10 × 10^6 K.

During the flare an evaluation of the count rate in the density sensitive lines 114.4 Å of Fe XXII and 142.14 Å of Fe XXI was made. The theoretical (Monsignori Fossi & Landini 1994) ratios of Fe XXII (114.4/117.18) and Fe XXI (142.14/128.7) as a function of the density are shown in Fig. 1b together with the values evaluated at different times. Apart from the peak of the flare, the count rate is usually very low and the signal to noise ratio is very poor. Therefore, it is difficult to draw accurate conclusions about the density variation; both peaks have comparable densities (10^{13} cm^{-3}) with lower densities probably occurring during the other phases. Using the peak temperature of ∼10^7 K, an estimated density of 10^{13} cm^{-3} and the emission measure, an estimate of 4 × 10^{28} cm^3 for the volume involved was made. The present analysis, based on the spectral diagnostic technique, provides results that are different than those obtained by Cully et al. (1993) who used the broad-band Lexan/boron deep survey. In particular the much lower density that they obtained is in disagreement with the line ratios that we have measured at the peak.

The most prominent features of the MW and LW spectra are Fe XXIV (192.02 Å) and He II (303.78 Å). Their light curves are shown in Fig. IIa and IIb. For He II the light curves of both the MW and LW channels are presented. There is a general agreement in the time behaviour of the lines that we have
measured. It must be noted that the second flare is much less prominent in He II Lyα than in the high temperature lines. Fe XXIV is the highest stage of ionization which was detected in the AU Mic spectra; at the peak of the flare the intensity ratio of Fe XXIV 192.02 to Fe XXIII 132.86 indicates a temperature of $2.5 \times 10^7$ K; this one is probably a more representative value for the maximum temperature of the flare.

CONCLUSIONS

The time evolution of the X-ray-EUV emission during the July 14 - 18, 1992 observation of AU Mic was studied. Both high temperature lines (i.e. Fe XXIV 192.02, Fe XXIII 132.86, Fe XXII 128.7, Fe XI 117.2) and low temperature ones (i.e. He II 303.78) have similar time behaviour and show two bright flares that occurred during the observations.

The increase of two density sensitive lines (Fe XXII 114.4 and Fe XXI 142.14) during the flares provides an estimate of the density. This density is about $10^{13}$ cm$^{-3}$. This value is much higher than the one established using the broad band Lexan/boron detector for the deep sky survey (Cully et al. 1993).

REFERENCES

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PART I
(continued)

RESULTS OF RECENT SPACE MISSIONS
(HST)