ASCA OBSERVATIONS OF 44I BOOTIS AND VW CEPHEI

CHUL-SUNG CHOI
Korea Astronomy Observatory, 36-1 Hwaam, Yusong, Taejon 305-348, Korea; cschoi@hanul.issa.re.kr.

AND

TADAYASU DOTANI
Institute of Space and Astronautical Science, 3-1-1 Yoshinodai, Sagamihara, Kanagawa 229, Japan; dotani@astro.isas.ac.jp.

Abstract.
We analyze X-ray archive data of the W UMa-type binaries 44i Boo and VW Cep, taken with ASCA on 1994 May 10 and 1993 November 5, respectively. By analyzing the light curve of VW Cep, we find a long-duration flare of $\approx$ 7.5 hrs with the peak luminosity of 1.2×10^{30} ergs s^{-1} (0.4–3.0 keV) for the assumed distance of 23.2 pc. We also find appreciable flux variations from the light curve of 44i Boo, and the variations are erratic and are not orbital phase dependent. From the spectral analysis of both data, we see that the spectra could be reproduced by the variable abundance plasma model with a combination of two different temperatures, kT = 0.64 – 0.65 keV and kT = 1.85 – 1.91 keV.

1. Results

From the light curve analysis of VW Cep observed with the SIS0 detector, we find a typical pattern of X-ray flare: a sudden increase of flux from 0.35 to about 1 counts s^{-1} during 1 – 1.5 hrs, followed by a decrease (almost exponentially) down to a quiescent level with a time scale of $\approx$ 6 hrs. The maximum flux level is $\sim$ 2.5 times larger than the quiescent level, and the flux ratio is consistent with the previously detected X-ray flares (Vihlu et al. 1988; McGale et al. 1996). On the other hand, from the 44i Boo data, we find no significant flare-like event. Instead, the light curve shows erratic variations of X-ray flux with an amplitude of about a few tens percent,

K. Koyama et al. (eds.), The Hot Universe, 226-227.

from ~ 1.0 to ~ 1.4 counts s^{-1}. We calculate χ^2-value to be χ^2/ν (degree of freedom) = 139.4/29 to the constant flux of 1.1 counts s^{-1}. This value implies that the flux fluctuation is substantial. We also investigate folded light curve of 44i Boo. However, we find no evidence that the flux variations are orbital-phase dependent.

To fit the energy spectrum, we use two-temperature "mekal" model with the elemental abundances which were allowed to be varied independently from the solar photospheric values (e.g., O, Ne, Mg, Si, Fe). From the spectral fitting, we see that both spectra are well explained by the combination of the two different temperatures, kT = 0.65 keV + 1.85 keV for 44i Boo and kT = 0.64 keV + 1.91 keV for VW Cep. When the results for VW Cep are compared with those of 44i Boo, we find that the elemental abundances for O, Mg, and Fe are almost the same as those of 44i Boo, while the abundances of Ne and Si are larger by a factor of 1.5 – 2. Details of VW Cep results are found in Choi and Dotani (1998).

2. Discussion

When the present flare is compared with the stellar X-ray flares observed by EXOSAT (Pallavicini et al. 1990), it is very similar to those of Algol and YY Gem in its general profile and the long decay time. From these analogies, the flare is considered to be "two-ribbon flare" similar to the one observed from the Sun. We did not observed any flare-like event from the 44i Boo system, but observed an X-ray flux variation which shows no orbital phase-dependence. This fact may indicate that coronal plasma are distributed inhomogeneously within the 44i Boo system.

We derived the coronal abundances of the elements O, Ne, Mg, Si, and Fe. The relatively high Ne and Si abundances of the VW Cep system are thought to be related with the flare, because an enhancement of the coronal abundances is inevitable during the flare activity. From the spectral analysis, we also found that the VW Cep spectrum is well reproduced by the variable abundance two-temperature model. The hotter component is believed to be associated with the flare. The 44i Boo observation shows no flare features, but its spectrum also required two-temperature model to be fitted acceptably. However, unlike the VW Cep case, the X-ray emission of 44i Boo is dominated by the cooler component.

References

Choi, C. S., & Dotani, T. 1998, *ApJ*, **492**, in press
McGale, P. A., Pye, J. P., & Hodgkin, S. T. 1996, *MNRAS*, **280**, 627
Pallavicini, R., Tagliaferri, G., & Stella, L. 1990, *A&A*, **228**, 403
Vilhu, O., Caillault, J.-P., & Heise, J. 1988, *ApJ*, **330**, 922