Chandra Observations of Coronal Variability on the RS CVn Binary σ^2 CrB

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Abstract

We report on a deep observation (86 ks) of the short period ($P_{\rm orb}$ =1.14 d) active binary system σ^2 CrB with *Chandra ACIS-S+HETGS* taken on 2000 June 18-20, embedded within a much longer *EUVE* observation and accompanied by radio observations with the VLA. During the *Chandra* observation, the system was in a quiescent state for the first 78 ks. In the remaining 8 ks, a flare was observed in which the MEG count rate increased to nearly four times the quiescent count rate. The rise and initial decline of the flare was recorded. We find no evidence for any line broadening or shifts due to orbital velocities, nor any flare-associated mass motions, in the bright lines Ne X λ12.13 Å and Mg XII λ 8.42 Å. The former behavior is consistent with both stars being active X-ray emitters. We describe our analysis techniques to determine the shape of the differential emission measure (DEM), and establish abundances relative to hydrogen. We use an iterative procedure to measure line fluxes, estimate and remove the effect of the continuum flux, and determine abundances. The strongest emission lines of iron present in the spectrum (Fe XVII-XXIV) are used to constrain the DEM over the temperature range $\log T$ =6.6-7.4. The shape of the continuum spectrum at short wavelengths places a constraint on higher temperatures. We are able to derive abundances of O, Ne, Mg, Al, Si, and S relative to Fe in this way, although the O/Fe ratio is less constrained due to the mismatch in formation temperature between the He- and H-like O lines and most of the Fe lines. We then use the continuum flux to constrain the ratio of Fe to H in the stellar corona. We repeat the process starting from initial abundance estimates, to achieve consistency between the continuum shape and measured emission line fluxes. We discuss our attempts to quantify the sources of error involved in this approach, and describe the resulting differences we find between the quiescent and flaring state of the binary system.

CATEGORY: NORMAL STARS AND WHITE DWARFS