

On the X-ray and optical properties of the Be star HD 110432: a very hard-thermal X-ray emitter

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HD 110432 is the first proposed, and best studied, member of a growing group of Be stars with X-ray properties similar to γ Cas. These stars exhibit hard-thermal X-rays that are variable on all measurable timescales. This emission contrasts with the soft emission of "normal" massive stars and with the nonthermal emission of all well known Be/X-ray binaries -- so far, all Be + neutron star systems. In this work we present X-ray spectral and timing properties of HD 110432 from three XMM-Newton observations in addition to new optical spectroscopic observations. Like γ Cas, the X-rays of HD 110432 appear to have a thermal origin, as supported by strongly ionized FeXXV and FeXXVI lines detected in emission. A fluorescent iron feature at 6.4 keV is present in all observations, while the FeXXVI Ly β line is present in two of them. Its X-ray spectrum, complex and time variable, is well described in each observation by three thermal plasmas with temperatures ranging between 0.2--0.7, 3--6, and 16--37 keV. Thus, HD 110432 has the hottest thermal plasma of any known Be star. A sub-solar iron abundance ($\sim 0.3\text{--}0.5 Z_{\text{Fe}}$) is derived for the hottest plasma, while lines of less excited ions at longer wavelengths are consistent with solar abundances. The star has a moderate 0.2--12 keV luminosity of $\sim 5 \times 10^{32} \text{ erg s}^{-1}$. The intensity of the X-ray emission is strongly variable. Recurrent flare-like events on time scales as short as ~ 10 seconds are superimposed over a basal flux which varies on timescales of $\sim 5\text{--}10^3$ seconds, followed by similarly rapid hardness variabilities. There is no evidence for coherent oscillations, and an upper limit of $\sim 2.5\%$ is derived on the pulsed fraction for short pulsations from 0.005 to 2.5 Hz. In the optical region the strong and quasi-symmetrical profile of the H α line (EW ~ -60 Å) as well as the detection of several metallic lines in emission strongly suggest a dense and/or large circumstellar disk. Also, the double-peaked profiles of metallic lines confirm the nearly edge-on projection of that disk noted recently by Smith & Balona. HD 110432 has several properties reminiscent of the cataclysmic variables such as a very hot X-ray temperature and some of its detailed spectral features. This suggests that it might be a Be star harbouring an accreting white dwarf. On the other hand, recent evidence of magnetic activity reported in the literature of HD 110432 suggests an interaction between the surface of the Be star and its disk can produce the X-rays.

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