

A Multi-Phase {it Suzaku} Study of X-rays from τ Sco

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We obtained relatively high signal-to-noise X-ray spectral data of the early massive star τ Sco (B0.2V) with the {it Suzaku} XIS instrument. This source displays several unusual features that motivated our study: (a) redshifted absorption in UV P-Cygni lines to approximately $+250 \text{ km s}^{-1}$ suggestive of infalling gas, (b) unusually hard X-ray emission requiring hot plasma at temperatures in excess of 10-MK whereas most massive stars show relatively soft X-rays at a few-MK, and (c) a complex photospheric magnetic field of open and closed field lines. In an attempt to understand the hard component better, X-ray data were obtained at six roughly equally spaced phases within the same epoch of τ Sco's 41-day rotation period. The XIS instrument has three operable detectors: XIS1 is back illuminated with sensitivity down to 0.2-keV; XIS0 and XIS2 are front illuminated with sensitivity only down to 0.4-keV and have overall less effective area than XIS1. The XIS0 and XIS3 detectors show relatively little variability. In contrast, there is a $\approx 4\sigma$ detection of a $\approx 4\%$ drop in the count rate of the XIS1 detector at one rotational phase. In addition, all three detectors show a $\approx 3\%$ increase in count rate at the same phase. The most optimistic prediction of X-ray variability allows for a 40% change in the count rate, particularly near phases where we have pointings. Observed modulations in the X-ray light curve on the rotation cycle is an order of magnitude smaller than this, which places new stringent constraints on future modeling of this interesting magnetic massive star.

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Comments:

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