

HIGH-RESOLUTION SPECTRUM OF CYGNUS X-1

J. C. Ling, W. A. Mahoney, Wm. A. Wheaton, and A. S. Jacobson
Jet Propulsion Laboratory 169-327
California Institute of Technology
Pasadena, CA 91109
USA

We present a high-resolution spectrum of Cygnus X-1 in the 45 to 600 keV range. The measurement was made by the HEAO 3 gamma-ray spectrometer (1) during 82 days in the fall of 1979 and spring of 1980, when the source was in its normal low state (2). This paper reports results of a search for narrow emission lines from the source.

The average source spectrum appears in Figure 1. It was obtained by fitting the observed data to a model consisting of a single point source at the position of Cygnus X-1, plus a simple background model. Since no component corresponding to Cygnus X-3 (8° distant from Cygnus X-1) was included in the model, we expect Cygnus X-3 to contribute to our spectrum at the level of $\sim 10\%$ in the lower energy region, due to the $\sim 30^\circ$ (FWHM) angular response of the HEAO 3 spectrometer. The bins are 2 keV wide from 45 to 302 keV, and 4 keV wide from 302 keV to 600 keV. The solid line is the best-fit Comptonized model (4) to the data, with a temperature $kT \sim 60$ keV and optical depth $\tau \sim 2$. The errors in these parameters are probably dominated by the idealized single-temperature model, as the statistical errors are small.

The spectrum in Figure 1 shows no significant narrow features. The 3σ upper limit to a narrow 511 keV annihilation line is 3×10^{-4} photons $\text{cm}^{-2} \text{s}^{-1}$. There is also no evidence in HEAO 3 broad-band data above 500 keV for the broad annihilation feature observed by HEAO 1 (3).

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

References

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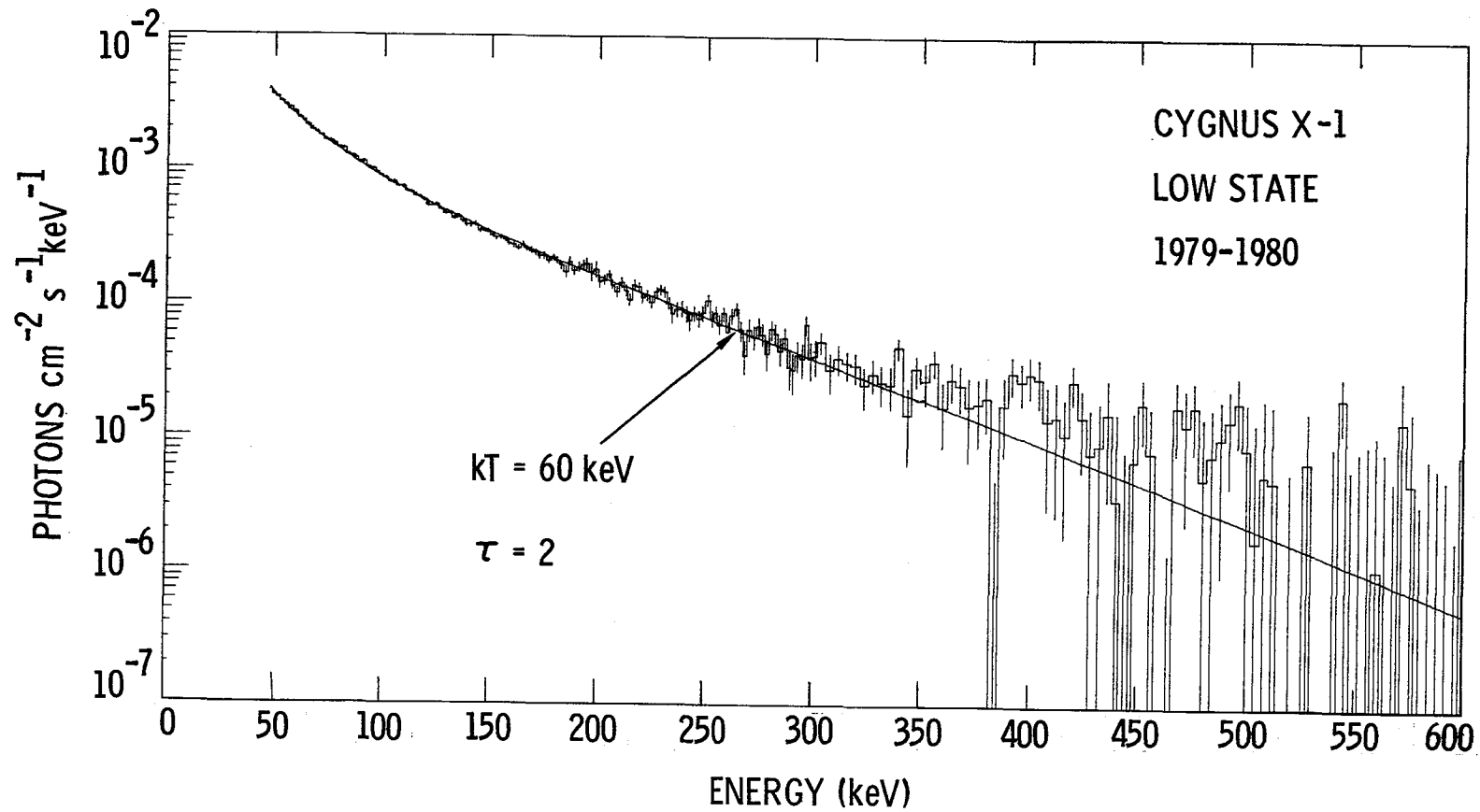


Figure 1. High resolution spectrum of Cygnus X-1 in its low state.