Gamma-Ray Spectra of Cygnus X-1 Observed by BATSE

J. C. Ling, Wm. A. Wheaton, P. Wallyn (JPL) W. S. Paciesas (UAH), B. A. Harmon, G. J. Fishman (NASA/MSFC), S. N. Zhang (USRA)

We present new observatiorrs of correlated 25 keV- 1.8 MeV spectral and flux variability of Cygnus X-1 by the Burst and Transient Source Experiment (BATSE) on the Compton Observatory. Our main results, based on 34 viewing period-average spectra spanning 330 days between May 1991 and May 1994, show that the normal Cygnus X-1 spectrum in this energy range consists of two components: (1) a Comptonized component in the 25–300 keV range with temperature of 50–80 keV and optical depth of 2-3, and (2) a power-law tail from about 200 300 keV to 1 2 MeV with photon index of 2.5--4. 1 During a ~ 300 day period between August 1993 and May 1994, the source underwent a significant excursion when the 45-140 keV flux first decreased steadily (~ 150 days) from the normal γ_2 level to an unusally low level (γ_0) roughly one- fourth of its normal intensity. It stayed at the γ_0 level for about 40 days before returning swiftly (~ 20 days) to near the γ_2 level 1 uring t. hese flux changes the corresponding spectra also changed d ramatically from the standard spectrum described above for γ_2 to a pure power law, with photon index of ~ 2.6 for γ_0. We interpret both the power law spectrum observed in γ_0, ant] the high-energy power-law tail seen in γ_2, as possible evidence for Compton up-scattering of soft and hard x rays, respectively, produced in the disk, from a population of non-thermal infalling relativistic electrons associated with the flow of inwardly converging matter immediately outside the event horizon of the black hole.

Abstract submitted for AAS [AAS] meeting

Date submitted: October 27, 1995 Electronic form version 1.6