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THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

FINAL REPORT

BATSE OBSERVATIONS OF THE PICCINOTTI SAMPLE OF AGN II: VARIABILITY AND SPECTRAL ANALYSIS

NASA Grant NAG 5-6745

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INTRODUCTION

NASA Grant NAG 5-6745 provided funds for a portion of the research project "BATSE Observations of the Piccinotti Sample of AGN II: Variability and Spectral Properties" approved under the *Compton Gamma Ray Observatory* (CGRO) Guest Observer Program, Cycle 7 (NRA-97-CGRO-05). The overall Principal Investigator for the proposal was Dr. Loredana Bassani, from Istituto TESRE/CNR, Italy. This grant provided support for participation of one of the proposal's US Co-Investigators, Prof. William S. Paciesas.

The proposal was a continuation of the multi-year project first approved in cycle 5 of the CGRO Guest Investigator Program. BATSE data from two years of observations (November 1993 – October 1995) had already been analyzed in order to extract data on the Piccinotti sample in the 20–100 keV band. During this grant period we extended the analysis of data through September 1997.

OBSERVATIONS AND INTERPRETATION

The Piccinotti sample (Piccinotti et al 1982) is the hard X-ray-selected sample of active galactic nuclei (AGNs) best studied at energies below ~10 keV. It represents the only unbiased and complete high-energy survey of the sky down to a limiting flux of 3.1×10^{-11} erg^{-2} s^{-1}. As such, it has been used to study AGN properties such as X-ray spectral characteristics, log *N*–log *S* relation, and luminosity function. The BATSE data provide, for the first time, a systematic coverage of the whole sample at high energies.

BATSE data from nearly four years of observations (1993 November – 1997 September) were analyzed using standard BATSE occultation analysis software to extract a signal from sources in the Piccinotti sample. Although the BATSE sensitivity for individual source measurements is relatively poor on short time scales, the near-all-sky coverage and long CGRO lifetime allows us to improve our sensitivity considerably by summing data over many years. This significantly reduces our statistical errors at the expense of loss of temporal information. However, the systematic errors associated with the summation of data over such a long period are not negligible, and the study of systematic effects was a major part of our effort.

We evaluated two types of systematic error: those affecting the overall normalization (which are important for comparison with other instruments) and those affecting the size of the fluctuations (which are relevant for estimating the confidence level of a detection). The former was studied by comparison of BATSE data with other instruments, primarily CGRO/OSSE. The results indicate that our absolute flux values may be overestimated by as much as 35% for some sources. However, since this does not affect our estimation of the detection confidence, we made no corrections to our flux estimates.

The fluctuations were studied by examining "blank" fields distributed randomly around the sky. In this case, we found the results consistent with zero mean flux, but with a spread about 80% higher than would be expected from statistical errors alone. Thus, we adjusted our errors by 80% so as to be conservative in our detection confidence estimates.

Our results were reported by Malizia et al (1999), who also provide further details on the methodology. The sensitivity achieved using nearly four years of data was ~7.8×10^{-11} erg^{-2} s^{-1} (5σ) in the 20–100 keV band. Of the 36 sources in the sample, 14 were detected at $>5\sigma$ confidence, and 13 were detected at 3–5σ. Comparisons of BATSE fluxes with 2–10 keV X-ray fluxes indicate that a canonical power-law with index −1.7 adequately describes the broadband X-ray spectra of AGNs. Thus any spectral breaks implied by higher energy gamma-ray data must occur preferentially above 100 keV.

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