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PRELIMINARY CALIBRATION RESULTS FOR THE BATSE INSTRUMENT ON CGRO

G. N. Pendleton, W. S. Paciesas, G. J. Fishman, R. B. Wilson, C. A. Meegan, F. E. Roberts, J. P. Lestrade, J. M. Horack, M. N. Brock, M. D. Flickinger
BATSE Science Team

ABSTRACT

Preliminary results pertaining to spectral reconstruction using BATSE Large Area Detector measurements of solar flares will be presented. These solar flare measurements are currently being used to fine tune the calibration of our data analysis software. The current status of the stability of spectral analysis given the systematic errors present in burst location at the time of the writing of this paper discussed. A brief description of enhancements to the input data for the atmospheric scattering algorithm that will be implemented in the data analysis software is presented.

SOLAR FLARE SPECTRAL MEASUREMENTS

Power law fits to a strong solar flare occurring May 30 th at 09:37 UT using large area detector continuous data are presented here in order to show the variability in spectral intensity encountered when coping with location errors of 5°. The current solar flare location accuracy averages about 5°. Spectra are calculated for a location on the sun and for a set of four locations around the sun about 5° away from the sun position. At each location the detector response matrices (DRM's) are evaluated for each of the three brightest detectors. The response depends primarily on the angle between the source direction and the detector normal. For this flare the angles between the sun direction and the first, second, and third detectors are 34.4°, 53.1°, and 61.43° respectively. These angles change for the locations offset from the sun by 5° hence the corresponding DRM's generated at these locations are different. The fits are performed for 6 continuous channels covering the energy range 63-203 keV. The channel to energy conversion is most reliable in this range currently and the flare intensity is significant here as well.

Figure 1 shows power law fits to the data in the brightest detector convolved through the detector response matrix for that detector evaluated at each of the five assumed source directions. The spread in spectral intensity of 13% is due to the differences in the DRM's. Figures 2 and 3 show the same set of fits to the second and third brightest detectors respectively. The spread in intensity for these fits is 27% for the second brightest detector and 27% for the third brightest detector.

Figure 4 shows power law fits to the three brightest detectors' data convolved through the DRM's simultaneously. This gives the best fit to the total data set for each assumed flare location. The spread in spectral intensity for these fits is 5%. These fits are subject to the least variability due to the fact that as one moves the apparent source location some detectors see the flare more directly while others see it less directly. For a set of three detectors these effects tend to cancel out resulting in a fairly stable measurement of the source intensity over a 5° range in assumed source direction. As systematic errors in the detector response are identified and eliminated the errors on source location will decrease producing a corresponding decrease in the systematic errors in spectral analysis.

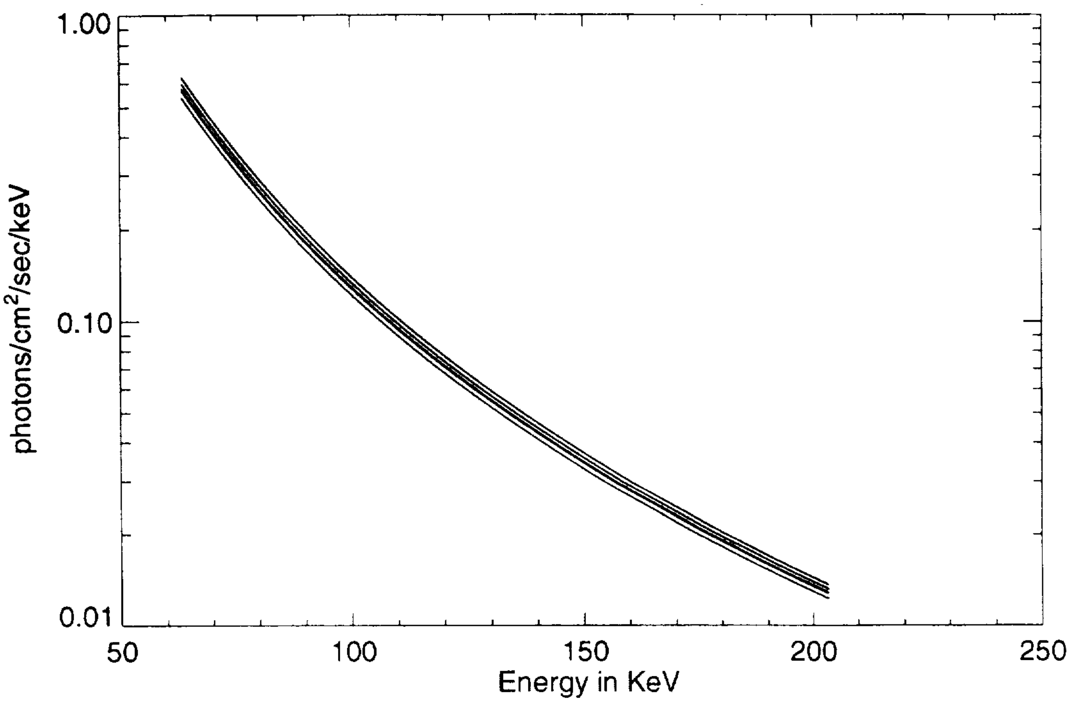

Figure 1: Power Law Fits to Brightest Detector

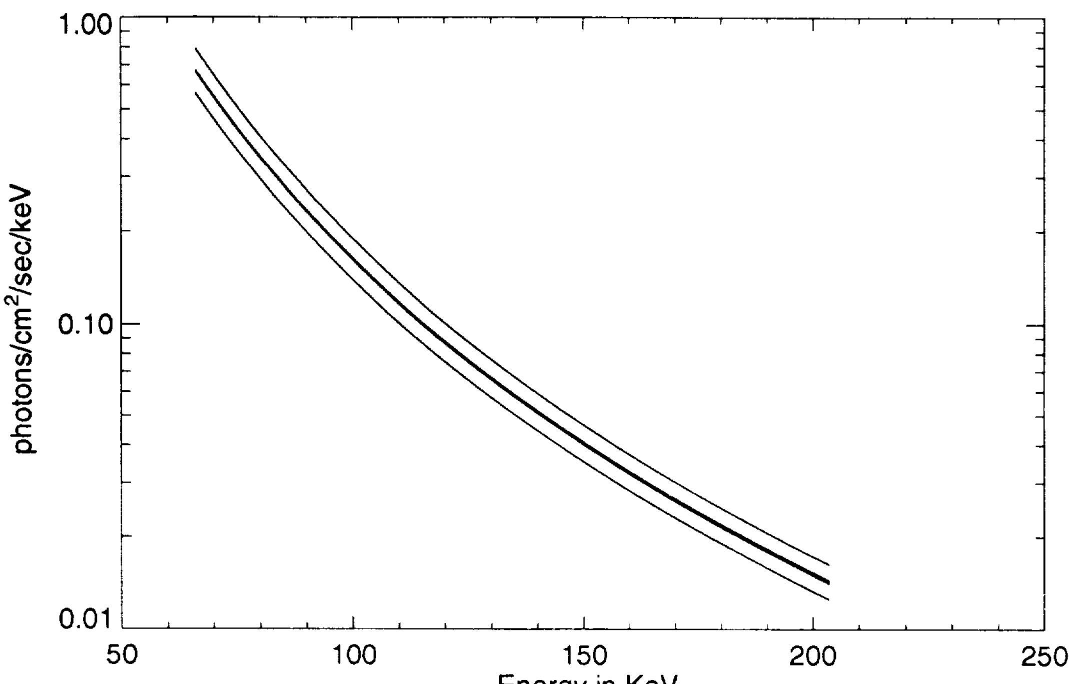

Figure 2: Power Law Fits to Second Brightest Detector

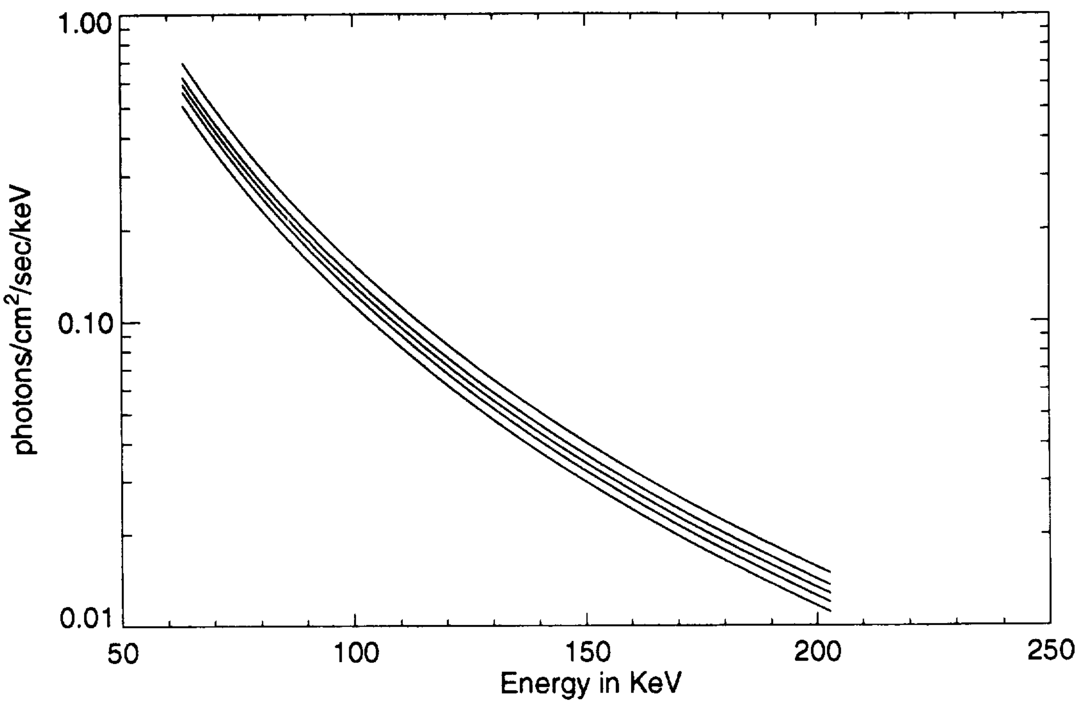

Figure 3: Power Law Fits to Third Brightest Detector

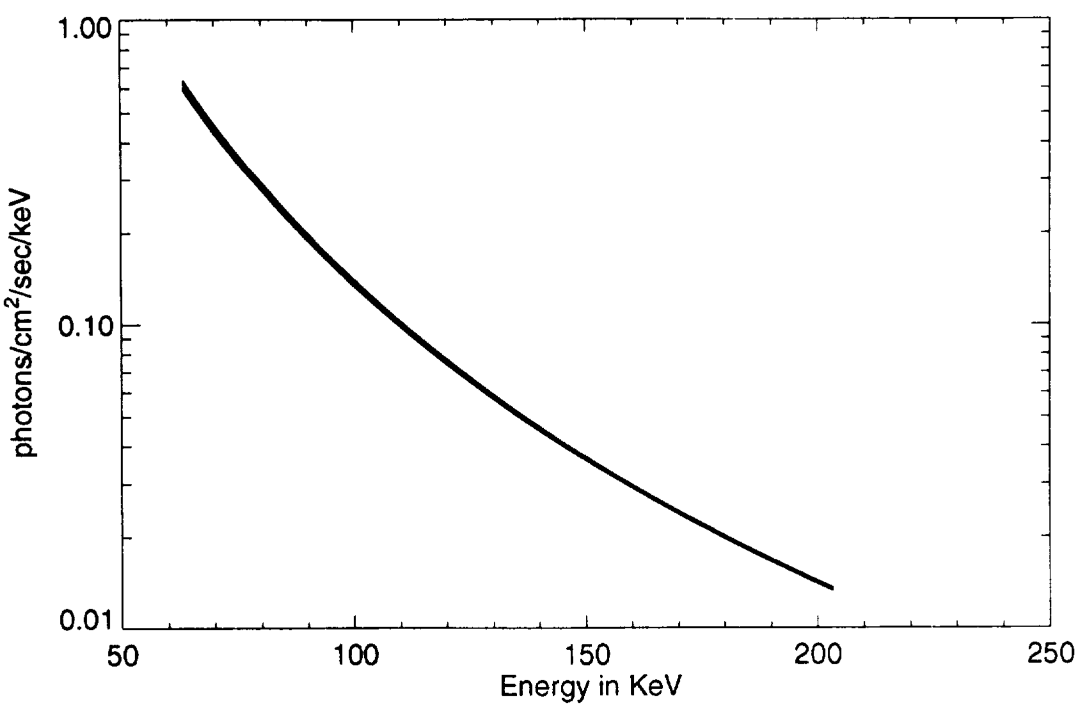

Figure 4: Power Law Fits to Three Brightest Detectors

ATMOSPHERIC SCATTERING

The atmospheric scattering algorithm currently employed in the burst location software calculates the scattered flux observed by a detector by numerically integrating an expression representing the single Compton scattering of photons off the earth into the detector. An atmospheric scattering algorithm has been created using the results of a Monte Carlo code that takes into account both single and multiple Compton scattering. This algorithm was used in the calculations performed above pertaining to solar flare intensity measurements. Figures 5 through 7 show spectra produced by the Monte Carlo code for monoenergetic plane waves of photons incident on the earth at a specific zenith angle of 60°. The spectra are for the photons collected at the spacecraft orbital altitude that have Compton scattered in the earth's atmosphere. Photoelectric absorption is also present in the simulation to account properly for the absorption of the lower energy photons. These figures show single scatter spectra for photons that have scattered only once in the atmosphere and multiple scatter spectra for photons that have scattered two or more times in the atmosphere before reaching orbital altitude. These results indicate that a significant number of the atmospherically scattered photons observed by the detectors have scattered two or more times in the atmosphere before hitting a detector.

At the time of the writing of this paper a data product incorporating these Monte Carlo results has been created and is ready for implementation into the burst location algorithm. The implementation of this algorithm should result in a significant decrease in the magnitude of our systematic errors.

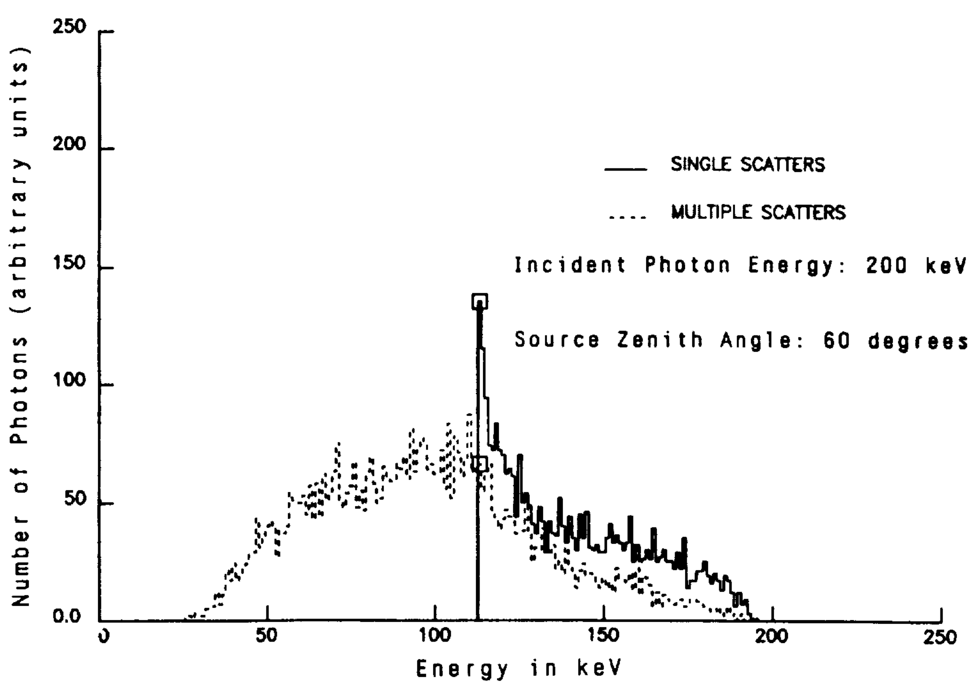

Figure 5: Energy Spectra of Collected Photons

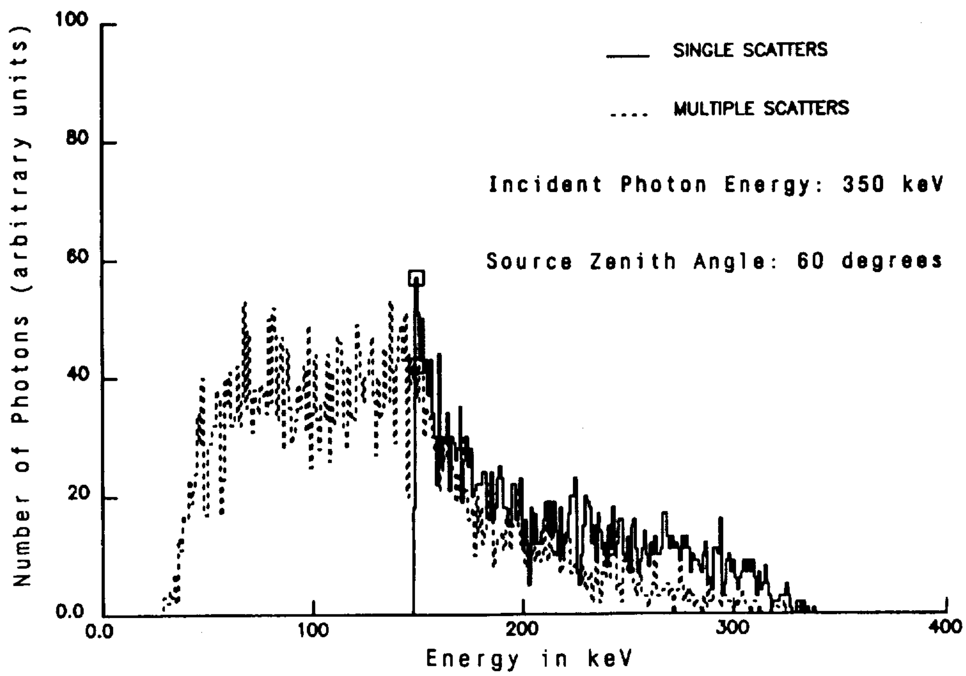

Figure 6: Energy Spectra of Collected Photons

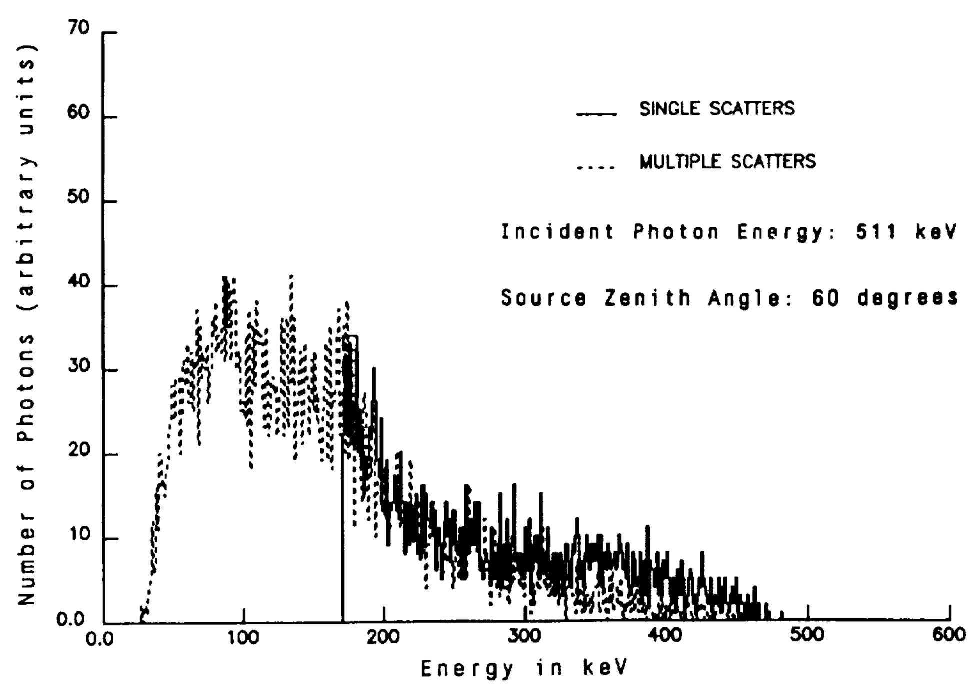

Figure 7: Energy Spectra of Collected Photons

REFERENCES

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