IREM Observations of the Initial Spike from the SGR1806-20 Giant Flare

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Abstract. Main spike of the giant flare from SGR1806-20 (27 Dec 04) released enormous energy that saturated most X-ray detectors onboard satellites [1]. Fortunately, several smaller instruments dedicated mainly for charged particle detection could gather reliable data. To date, spike fluences from various detectors agree within a factor of 3 while the spectra are described using different formulas. To the analysis performed with particle detectors from RHESSI and Wind [2] we add new data provided by IREM monitor onboard of INTEGRAL. It supports cooling blackbody spectrum with temperature of 230±50 keV and energy of 0.97±0.50 erg/cm^2.

Keywords: neutron stars, X-rays bursts, Gamma Ray Bursts
PACS: 95.55.Ka, 97.60.Jd, 98.70.Rz

INTRODUCTION

The extreme initial spike from the SGR1806-20 on 27 Dec 2004 saturated almost all X-ray and gamma-ray detectors onboard satellites. Fortunately, many small instruments could provide adequate quality data over the whole spike duration. Detailed description from such measurements can be found in reports from RHESSI and Wind [2], Geo-satellites and Swift [3] as well as Geotail [4] and Coronas-F [5] missions. Instruments used by above spacecraft differ substantially with respect to the detector parameters implying various techniques used to analyze the data. They provide values for the total spike energy spanned between 0.6 erg/cm^2 (Coronas-F) and 2.0 erg/cm^2 (Geotail). Spectral shapes are described using different functions: exponential power law for Geo-satellites and Coronas-F and cooling blackbody spectrum for RHESSI and Wind. Geotail data supports both shapes equally well. Such condition strongly requires more data from small instruments on other satellites.

Here we present new data and analysis based on measurements provided by the ESA Standard Environment Radiation Monitor IREM flying on the International Gamma Ray Astrophysical Laboratory INTEGRAL mission (ESA, launched in 2002).

CP801 Astrophysical Sources of High Energy Particles and Radiation
edited by Tomasz Bulik, Bronisław Rudak, and Grzegorz Madejski

IREM PARTICLE MONITOR

IREM consists of three Si-diodes embedded in the Al/Ta shielding. They have areas of 65 and 100 mm^2, thickness of 0.3 mm and are read out using 15 fast discriminators set at energy levels of: 85, 250, 600, 750, 2000 and 3000 keV. Data accumulation time is 60 sec. The monitor was carefully calibrated with protons, electrons and gammas at the PSI PIF facility [6] and its response was modeled using GIANT code. IREM is mounted on the INTEGRAL service module and was hit by the SGR1806-20 photons from behind. Therefore the full response matrix was generated taking into account the satellite mass model. Scattering from the Earth was negligible due to its large distance.

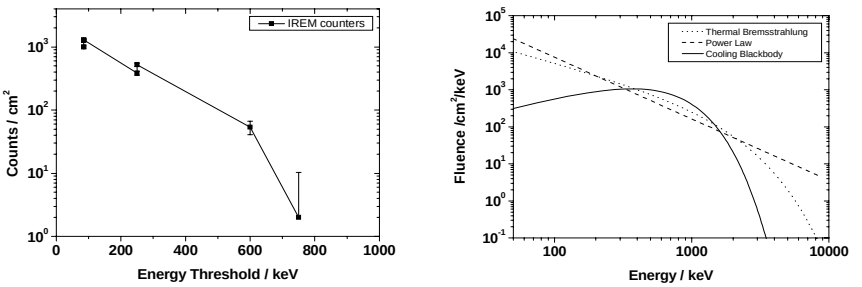

FIGURE 1. (Left) IREM(INTEGRAL) counts vs. discriminator energy thresholds; (Right) spectral shapes of the initial spike obtained with three different fit functions.

SGR1806-20 DATA ANALYSIS

For all detectors the sensitive areas and threshold values were taken from the calibration data. Dead-time and pile-up corrections were found negligible. Background consisted mainly from the Cosmic-Ray events that were subtracted using data sets before and after the transient. Raw IREM data were convoluted with the exact gamma-ray response matrix calculated for the direction of the SGR1806-20.

Spectral fits were performed using cooling blackbody, thermal bremsstrahlung, power law and exponential power law functions. Both power law fits gave very hard spectra (photon index Γ~1.5) and high fluences (hundreds of ergs/cm^2). The thermal bremsstrahlung fit had temperature of 1240 keV and fluence of 1.25 erg/cm^2 (g-factor neglected). The cooling blackbody fit resulted in radiation temperature of 230±50 keV and energy fluence of 0.97±0.50 erg/cm^2 consistent with the RHESSI/Wind analysis.

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