Abstract. We present a spectral catalogue of gamma-ray bursts detected by the INTEGRAL satellite. In the period between December 2002 and February 2012 INTEGRAL observed 83 GRBs. The spectral parameters were derived by combining the data from the two main instruments on board INTEGRAL, the spectrometer SPI (Spectrometer on INTEGRAL) nominally covering the energy range 18 keV - 8 MeV, and the imager IBIS (the Imager on Board the INTEGRAL Satellite) with spectral sensitivity in the range 15 keV - 10 MeV. In addition to the spectral analysis performed over a broad energy range for the complete sample of INTEGRAL GRBs, we have derived the IBIS light curves and durations for the previously unpublished 28 events observed between September 2008 and February 2012. We compare the prompt emission properties of the INTEGRAL GRB sample with the BATSE and Fermi samples.

Keywords: gamma-rays burst: general - catalogs - methods: data analysis

1 Introduction

To date the most complete catalogues of spectral GRB properties comprise the events observed by BATSE (Burst And Transient Source Experiment) on board the Compton Gamma Ray Observatory in operation from 1991 to 2000 (Gehrels et al. 1994), by the Swift satellite launched in 2004 (Gehrels et al. 2004), and by the Fermi satellite launched in 2008 (Gehrels & Razzaque 2013). The spectral parameters - peak energy, low- and high-energy power law indices - are associated with the parameters of the energy dissipation and the emission mechanisms of the prompt emission and provide the constraints for the gamma-ray burst models.

INTEGRAL (Winkler et al. 2003) is an ESA mission launched on October 17, 2002 dedicated to high resolution imaging and spectroscopy in the hard X-/soft γ-ray domain. It carries two main coded-mask instruments, SPI (Vedrenne et al. 2003), and IBIS (Ubertini et al. 2003). SPI is made of 19 Ge detectors, working in the 20 keV–8 MeV energy range, and is optimized for high resolution spectroscopy. IBIS is made of two pixellated detection planes: the upper plane, ISGRI – INTEGRAL Soft Gamma-Ray Imager (Lebrun et al. 2003), is made of 128 × 128 CdTe detectors and operates in the 15 keV–1 MeV energy range. The lower detection plane, PICsIT – Pixellated CsI Telescope (Di Cocco et al. 2003), is made of 64 × 64 pixels of CsI, and is sensitive between 150 keV and 10 MeV. In order to provide a broad energy coverage and a good sensitivity for the INTEGRAL GRB spectra, we combined the data from the IBIS/ISGRI and the SPI instruments for the spectral analysis. The SPI data can provide better spectral information at energies where IBIS/ISGRI effective area becomes low, and therefore are suitable to determine the GRB spectral peak energy (typically at ~ a few 100 keV).

2 Spectral and temporal analysis

The spectra were analysed using the C-statistic (Cash 1979); for the C-statistic to be applied, we needed to provide on-burst spectra and background spectra separately for every GRB. This cannot be obtained by the INTEGRAL standard Off-line Scientific Analysis software (OSA), and therefore we developed additional tools
to extract the spectra in the required format. For the SPI instrument, a spectrum for each of the 19 (where applicable) Ge detectors was computed. The net individual GRB spectra (i.e. on-burst – off-burst spectra) have the advantage (with respect to the global spectra produced by OSA software) of being more accurate since the background spectra were computed for each GRB and each detector, taking into account the local spectral and temporal background evolution. The response function takes into account the exposed fraction of each detector given the GRB direction. For the IBIS/ISGRI spectra, we selected only the pixels that were fully illuminated by the GRB in order to compute the off-burst and on-burst spectra. A corresponding ARF was computed, taking into account the reduced (∼30%) area of the detector plane we used. For each GRB we computed and fitted the time-integrated spectrum, using all the available SPI spectra and one ISGRI spectrum.

We report the results of the spectral analysis for 59 out of 83 GRBs, and make a comparison of our results with the BATSE and Fermi/GBM samples (see Fig. 1) of gamma-ray bursts of equivalent brightness and duration. We found that INTEGRAL sample of GRBs has spectral peak energies consistent with the distribution obtained by Fermi/GBM (KS probability = 0.55), and not consistent with the distribution of BATSE GRBs (KS probability = 6 × 10⁻³) in a given fluence range. The distribution of the low energy power law slopes obtained for ISGRI/SPI GRBs is consistent with both, Fermi/GBM (KS probability = 0.23) and BATSE (KS probability = 0.92) GRB samples.

We determined the T₉₀ duration for sample of GRBs observed after September 2008 (for the GRBs observed before September 2008, see Vianello et al. 2009). The GRB durations were determined using only the IBIS/ISGRI light curves obtained for 20–200 keV energy band (see Fig. 2). The maximum of the T₉₀ distribution for INTEGRAL GRB sample is at ∼30 s, which is comparable to the samples obtained by BATSE and Fermi/GBM. The distribution of long GRB durations from Swift/BAT sample is shifted towards longer times, coherently with the longer BAT triggering time scales (see Sakamoto et al. 2011). The paucity of the short events in INTEGRAL sample (6%) is expected for the imaging instruments, as e.g. the Swift/BAT, where a minimum number of counts is required to localize an excess in the derived image, making confirmation of real bursts with fewer counts difficult.

3 Conclusions

The GRB catalog we presented contains a limited number of events with respect to other missions’ databases. Our results offer however an important insight in the possible instrumental biases in spectral and temporal parameters distributions, and also provide the spectral parameters for a sample of faint GRBs with good statistics.
The spectral catalogue of **INTEGRAL GRBs**

**Fig. 2.** Distribution of the duration $T_{90}$. **Top:** Distribution of durations derived from BATSE (violet) and Fermi/GBM (red) light curves in the 50-300 keV band (c.f. Kouveliotou et al. [1993]). **Middle:** The $T_{90}$ durations derived using Swift/BAT instrument on 15-150 keV (c.f. Sakamoto et al. [2011]). **Bottom:** Distribution of durations for 20-200 keV light curves obtained from IBIS/ISGRI.

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**References**

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