GBM Automatic Gain Control
C. Meegan
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Each of the GBM detectors will have Automatic Gain Control (AGC) to maintain a constant channel to energy conversion. We will use a similar approach as was used successfully for BATSE. We will monitor the position of the 511 keV background line and adjust high voltage on the photomultiplier tubes (PMTs) to keep the line peak at a specific channel number. On BATSE, a five-minute integration of the background spectrum provided statistical accuracy comparable to the gain change of a single step in the high voltage control, and gain control was maintained to an accuracy much better than the detector resolution. The smaller size of the GBM detectors means we will have to integrate longer, but the better resolution of the GBM detectors offers some compensation. Using a factor of 16 smaller size and an improvement in resolution by a factor of 1.5, we estimate that a 50 minute integration of the background spectra will provide satisfactory estimates of the line peaks. The on-board calibration will not be able to compensate for the small temperature changes within each orbit or for changes due to magnetic field variations, but will compensate for longer-term variations. Note that there is not a requirement to handle an arbitrarily large deviation from the desired gain, only to prevent long-term excursions from nominal.

The GBM flight software will integrate the 128 channel ISPEC data from each of the detectors. After about 50 minutes (time interval adjustable by command), the flight software will perform a quadratic fit to the count rates as a function of energy channel, using only specific channel intervals above and below the 511 keV region. This fit is subtracted from the counts in the 511 keV region, and the average channel of the residual counts is computed. The difference between the measured and desired channel time is converted to a PMT voltage adjustment, which the flight software then commands. All the various parameters used to perform these calculations are commandable and are different for the NaI and BGO detectors. The resolution of the high voltage adjustment is 2 volts, which translates to about 1.4% control of the gain for the NaI detectors. The BGO detectors have two PMTs, resulting in a factor of two better resolution on the gain control, with the added complication that the flight software most make adjustments alternately to the PMTs to maintain approximate gain balance.

The flight software will perform several error tests. Gain adjustment will not occur if a reasonable good fit to the background cannot be achieved, if the data are not current, or if there are insufficient counts to detect the 511 keV line. Background data will not be accumulated during triggers. The size of the voltage step will be limited to prevent erroneous large deviations from which recovery may not be possible.