# Test of the Event Builder

C. Diarra M.M. Aleonard translated by L.C. Pratt

draft

This document gives very simply an idea of the principle that was used to simulate the events provided by the ROCO and explains how to use the program which performs the simulation. A complete document will be issued later when the program is released. In the mean time, your suggestions will be welcome and will allow us to improve the program.

# 1 PRINCIPLE

The program "eb" does random generation of some number of events which is chosen by the user. The different events produce 3 files:

- the data file (extension ".dat") which contains the equivalent of the words provided by the ROCO.
- the spectra: each file of data results in 2 spectra
  1. a spectrum file with extension "LGain" which corresponds to the spectrum of gammas in the energy range 0–4 MeV (gain = 0.5 keV/channel).
  2. a spectrum file with extension "HGain" which is the spectrum of gammas in the energy range 0–20 MeV. (gain = 2.5 keV/channel).

  Spectra 1 and 2 are the ones that should be compared to the spectra output by the sorter. One will therefore be able to tell if the Event Builder (EB) handled the file of data correctly. In principle, the spectra produced by the program "eb" and those produced by the histogrammer should be identical if there are no errors in the treatment of the data.

# 2 CONSTANTS AND CONVENTIONS

## 2.1 ROCO Event Format (edoc064, John Cresswell)

- Trigger Header: the trigger item with address 0x34 (External sumbus) is not generated. The value of the data word item with address 0x30 (Trigger type) will always be zero.
- all the TAC words are fixed at the same value (10 ns)

- qualifier bits (qHqL): qH is set to 1 for Compton suppressed and qL is set to 1 for PILE UP. The default values are 0.
- word count: the word for the End Subevent Token is included in the count.

## 2.2 Constants used in the Program

- multiplicity: this is centred at RAW0=5 and varies between 2 and 10.
- number of ROCOs = 3
- number of Ge and BGO cards in each crate = 10
- number of channels (ADCs) per card = 6
- probability of Compton suppression = 1/2
- maximum number of bgo hits in a pattern word = 3
- it is assumed that for a Compton scattered gamma, 60% of the incident energy is detected in the Ge.

# 3 MAGNETIC TAPE FILES

The program "eb" uses the tape in the following manner:

- If the tape is initialised with "eb" and the tape is empty there is an EOM (End Of recorded Media) mark at the start.
- If there are files on the tape, the first thing on the tape is an EOF mark followed by the files. The files are themselves separated by EOF marks. Each file corresponds to one of the 3 files described in §?? above.
- The last file on the tape is terminated by an EOM mark.
- Note: At present the program can only be used with a 150 Mbyte streamer. The functions ioctl() and fcntl() will be used in the final version of the program instead of making a call to the system command.

# 4 DISC FILES

There will be 3 files (if all the data are saved on disc) for each run simulation on the disc: the data file and 2 spectrum files. If the data are written straight to magnetic tape, there will only be 2 files on the disc (the 2 spectra), which may then be saved to tape.

The file with extension ".log" contains all the details of each event. The option to log all the information about individual events must only be chosen for a small number of events and was provided for checking this program.

# 5 FILE HEADERS

There will be the same headers for both tape and disc files: one header (entete) in ascii of 512 bytes at the start of the file an EOF header at the end.

## 5.1 The Data Files

- Header: the header comprises the following fields:

  — 1–15 file name
  — 16–30 creation date (DD–MMM–YYYY)
  — 31–45 record length
  — 46–512 space

  The data file block size is fixed at 128 kbytes (128 kbytes = the size of the HSM, where 1 kbyte = 1024 bytes).

- EOF header: The following fields are present:

  — 1–3 "EOF"
  — 4–15 space
  — 16–30 file name
  — 31–512 space

## 5.2 The Spectrum Files

- Header: This comprises of the following fields:

  — 1–15 spectrum name
  — 16–30 creation date
  — 31–45 number of channels
  — 46–60 first channel number
  — 61–75 last channel number
  — 76–512 space

- EOF header:

  — 1–3 "EOF"
  — 4–15 space
  — 16–30 spectrum name
  — 31–512 space

# 6 CHOICE OF GAMMA ENERGIES

The point of the simulation is to verify in a simple fashion the handling of the data from the ROCO by the event builder. The chosen method is to compare the 2 spectra obtained once the event builder has rejected bad events and gammas that have undergone Compton scattering.

The gamma energies were calculated according to a simple formula in order to get the clearest spectrum possible:

$$E = RAW * (E0 + 10.0 * SUPP + BGOSUMBUS)$$

where
RAW = raw multiplicity
SUPP = number of clean Ge detector hits (i.e. no Compton scattering)
BGOSUMBUS = number of Compton scattered gammas detected

$$BGOSUMBUS = 1/2 * RAW$$

This choice is arbitrary. It means that 50% of the gammas undergo Compton scattering.

$$SUPP = RAW - BGOSUMBUS$$

Note: These calculations are valid since a Compton scattered gamma is assumed to remain in the BGO shield of the Ge where it was detected.

It can be seen from the gamma-ray energy formula that all the events with the same RAW multiplicity will have the same energies. This energy is unique because SUPP and BGOSUMBUS themselves depend upon RAW.

For example, suppose we generate 10 events with 5 events of RAW = 4 and 5 others with RAW = 7 we will have one spectrum with 2 gamma-rays, since all the events of the same multiplicity contribute to the same channel.

E0 is a constant (E0 = 500 keV) and can be modified in the program.

# 7 SPECTRUM PRODUCTION

The spectrum is updated continuously as the events are generated. In fact, 2 spectra are generated for each data file, both comprising of 8192 channels.

The first spectrum is only for gammas in the energy range 0–4 MeV and the second from 0–20 MeV.

- rejected gammas: all gammas where Compton suppression or pile-up has occurred are rejected.
- rejected events: all events with errors in are rejected.

The possible errors that may appear in an event are as follows:

1. One of the error indication bits (EE) is set to 1
2. BAD FOLD: the multiplicity given by the Trigger does not tally with that found by counting the words from the ROCO. This means that not all the expected words were received.
3. BAD END: one of the ROCO's has not sent its End Sub-Event Token.
4. ROCO missing: a ROCO has not sent any data at all.

# 8 UTILISATION OF PROGRAM eb

To run the program, type "eb".

## 8.1 Create or modify config-file

This option permits the creation or modification of the configuration file. All the information about the location of different detectors is in this file. For each group there is an entry to indicate the VXI crate number, slot number and channel number on the Ge or BGO card.

Note: slot number 1 corresponds to the first BGO card in the VXI crate. Slot 2 is the Ge card to the right of slot 1 and slot 3 the following BGO, etc. This slot number is an arbitrary one needed to provide the alternate sequence BGO-GE.

Creation options for the configuration file:

- Automatic creation: The Ge and BGO cards are assumed to occupy alternate slots in the VXI crate in the order BGO-GE-BGO-GE-BGO-... The channels (6 per card) in the same EUROGAM face and for 2 adjacent cards correspond to the same group. E.g. in crate 1, channel 4 of the BGO card in slot 1 and channel 4 of the Ge card in slot 2 correspond to group 4. This methodology allows, therefore, the creation of an entry in the configuration file corresponding to each group.
- Step by step creation: The user must enter the crate number, the slot number,... the type of shield (5 or 10 BGO), etc.... However, the automatic creation option is recommended in preference to this one at present, when the detectors are ordered sequentially.
- Modify config-file: If a detector is repositioned, it will be necessary to modify the config-file by giving the detector number concerned and the new location parameters for the detector (crate, slot, channel, ...)

Note: it is possible to create additional configurations by modifying the initial file (having saved the original file under another name before the modification).

The configuration file is only created on the first use of the program eb. The extension ".cfg" is added onto the name of the file given as the configuration file.

## 8.2 Magnetic tape initialisation

To be used only if it is desired to save the data file on magnetic tape. This option serves to initialise a new tape and so must only be used once.

## 8.3 Event simulation

This allows the generation of $n$ (the program will request the number $n$ as input) events. For each of these events, the multiplicity is chosen randomly in the range given above. This range can be altered in the program.

## 8.4 Saving a spectrum on magnetic tape

The spectra created by the simulation are kept on disc. It is necessary to use the option "restore spectrum on tape" in order to put the spectra on the tape with the data file. This option must be used twice to save the 2 spectra (low and high gain).

## 8.5 File naming conventions

Data file name: Give the name under which you wish to keep the spectrum in the header to identify the data file. The extension ".dat" will automatically be added on the end. For example, to generate events for which the error type is eH=1 (the most significant error bit from the ROCO is set to 1), it is necessary to enter:

1. The file name where all the words output by the ROCO's will be saved: for example eHset. The name of the file will then appear in the header in the form eHset.dat. If the data are saved on disc the name of the file will be eHset.dat.

2. The name of the spectrum files: it may be different to the ".dat" file. Equally, the same name, eHset, may be chosen for simplicity. After the event simulation there will be 2 spectra on disc: eHsetLGain and eHsetHGain. The component "LGain" or "HGain" is added automatically to the spectrum name.

3. The names of the files to save: to save the 2 disc spectra onto tape, the full names must be given, e.g. eHsetLGain to save the low energy spectrum. To save the second spectrum the spectrum name must be given as eHsetHGain.