Using MEGAlib with Real Measurements

Version of 3 May 2018

1. Overview

MEGAlib was originally designed for the MEGA Compton and pair telescope prototype, so using it with real measurements is as straight forward as using it with simulations. You need two things to use MEGAlib with measurements, an evta-file (which is very similar to the sim file) and a geometry file with the detectors at the correct position. Both can then be used with Revan. Alternatively, you can also create a tra file, if you know the sequence of interactions, and then directly use the tra file with Mimrec. Please see the Mimrec documentation, for information on the tra file format.

2. The evta file format

If you use MEGAlib's calibration framework Fretalon, you will automatically get the right evta format. However, if you use your own calibration tools, you have to convert your data into the evta file format. Here is how a typical start of an evta file looks like:

Attention 1: This is the format for MEGAlib 2.99 (experimental branch on github) / 3.x

Attention 2: Do NOT name this file "sim" file. If Revan reads a sim file, it starts the detect effects engine and noises the data. If Revan reads an evta file, it does not start the detector effects engine, and does not noise the data since it assumes the data are real measurements.

```
Version 200
Type EVTA

SE
ID 1
TI 1465776080.278382500
GX 169.27901 -8.0520075
GZ 252.52139 39.753109
HX 303.49681 0.62073623
HZ 82.847332 89.181876
HT 3;-4.4184;-7.02935;-5.1143287;71.886297;0.05773502;0.05773502;0.03690222;0.6632136
HT 3;-4.8184;-6.02935;-5.1999273;70.696487;0.05773502;0.05773502;0.05418522;0.7177678
SE
ID 2
...
```

The various elements in the evta file are:

Key: Type

Parameters: 1: File type

Description: The unique type of this file. In case of a evta file "EVTA".

Key: Version

Parameters: 1: integer

Description: The version of the evta file format

Key: SE

Parameters: -

Description: "Start Event": Marks the beginning of a new event

Key: ID

Parameters: 1: ID of event

Description: Represents a unique ID of the event

Key: TI

Parameters: 1: Time in seconds

Description: Observation time of the event

The ID and TI are mandatory. If you do not have times or IDs, just make sure you have something increasing in your evta files, e.g. 1, 2, 3, …

The EVTA file formats differ mostly be the amount of information contained in the HT, the hit, keyword:

Version: 100

Key: HT

Parameters: 1: Detector ID (see table of detector IDs)
2: x position of the interaction in detector coordinates in cm
3: y position of the interaction in detector coordinates in cm
4: z position of the interaction in detector coordinates in cm
5: Energy deposition in keV

Description: The hit information in the active detector material.
The position must be within an active detector in the geometry file!

Version: 101

Key: HT

Parameters: 1: Detector ID (see table of detector IDs)
2: x position of the interaction in detector coordinates in cm
3: y position of the interaction in detector coordinates in cm
4: z position of the interaction in detector coordinates in cm
5: Energy deposition in keV
6: Time hit was measured in seconds

Description: The hit information in the active detector material.
The position must be within an active detector in the geometry file!

Key: EN

Parameters: -

Description: "End": Marks the end of the event block. No events are allowed beyond this keyword.

Version: 200

Key: HT

Parameters: 1: Detector ID (see table of detector IDs)
2: x position of the interaction in detector coordinates in cm
3: y position of the interaction in detector coordinates in cm
4: z position of the interaction in detector coordinates in cm
5: Energy deposition in keV
6: x position uncertainty of the interaction in detector coordinates in cm
7: y position uncertainty of interaction in detector coordinates in cm
8: z position uncertainty of interaction in detector coordinates in cm
9: Energy deposition uncertainty in keV

Description: The hit information in the active detector material.
The position must be within an active detector in the geometry file!

Version: 201

Key: HT

Parameters: 1: Detector ID (see table of detector IDs)
2: x position of the interaction in detector coordinates in cm
3: y position of the interaction in detector coordinates in cm
4: z position of the interaction in detector coordinates in cm
5: Energy deposition in keV
6: Time, the hit was measured in seconds
7: x position uncertainty of the interaction in detector coordinates in cm
8: y position uncertainty of interaction in detector coordinates in cm
9: z position uncertainty of interaction in detector coordinates in cm
10: Energy deposition uncertainty in keV
11: Time uncertainty in seconds

Description: The hit information in the active detector material.
The position must be within an active detector in the geometry file!

Since a real detector might be rotated in the world coordinate system, MEGAlib allows to define those rotations. For satellites, the keywords GX, GZ (Galactic coordinates) and HX, HZ (Horizon coordinates) are relevant, for terrestrial applications, the RX & RZ are relevant and describe the detector orientation in the world coordinate system. If you do not have any rotations, you can skip all of them.

Key: RX & RZ

Parameters: 1: x-value [cm] of the detector orientation vector

2: y-value [cm] of the detector orientation vector
3: z-value [cm] of the detector orientation vector

Description: Describes the x and z-axis of the orientation of the detector in Cartesian coordinates. Use either (RX & RZ) or (GX & GZ), not both!

Key: GX & GZ

Parameters: 1: longitude [deg] of the detector orientation vector in Galactic coordinates
2: latitude [deg] of the detector orientation vector in Galactic coordinates

Description: Describes the x and z-axis of the orientation of the detector in Galactic coordinates. Use either (RX & RZ) or (GX & GZ), not both!

Key: HX & HZ

Parameters: 1: longitude [deg] of the detector orientation vector in Galactic coordinates
2: latitude [deg] of the detector orientation vector in Galactic coordinates

Description: Describes the x and z-axis of the orientation of the detector in a Horizon coordinates system. HX and HZ are different from (RX & RZ) and (GX & GZ), because they are not used for imaging, but for the Earth horizon cut.

ID	Description
1	2D Strip detector (no depth resolution)
2	MEGA style calorimeter – many scintillator bars in one enclosing volume
3	3D Strip detector with depth resolution
4	Universal detector without any position resolution (e.g. calorimeter)
5	**Not fully implemented**: Drift chamber
6	**Not fully implemented**: 3D Strip detector with depth resolution and limited directional resolution
7	Anger camera
8	3D Voxel detector

Table: List of detector IDs – the definition is identical to the definition throughout MEGAlib