BeamCal background parametrisation

FCAL clustering, 16/02

Andrey Sapronov

Background simulation in BeamCal reco.

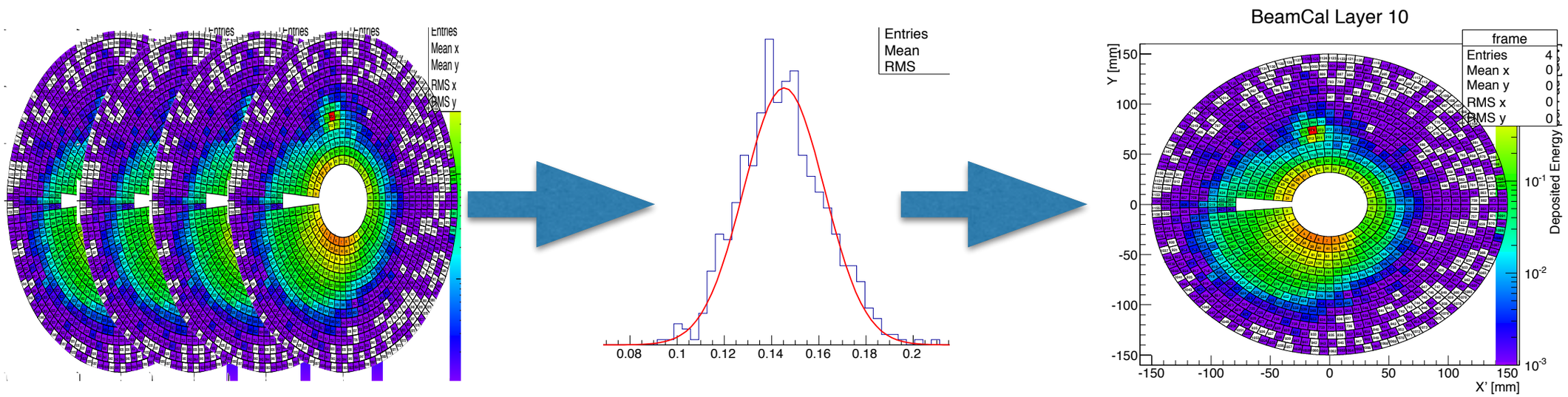
- Currently the beamstrahlung induced background is managed in a Monte-Carlo style:
  - a large set of pregenerated BG distributions (=1 BX) is stored
  - upon reconstruction a desired number of BX's is randomly selected, added and overlaid with signal.
  - cluster search and reconstruction is performed

```
BeamCal_100_313.root
BeamCal_100_314.root
BeamCal_100_315.root
BeamCal_100_316.root
BeamCal_100_317.root
BeamCal_100_318.root
BeamCal_100_319.root
BeamCal_100_320.root
BeamCal_100_321.root
...
BeamCal_100_932.root
BeamCal_100_933.root
BeamCal_100_934.root
BeamCal_100_935.root
```

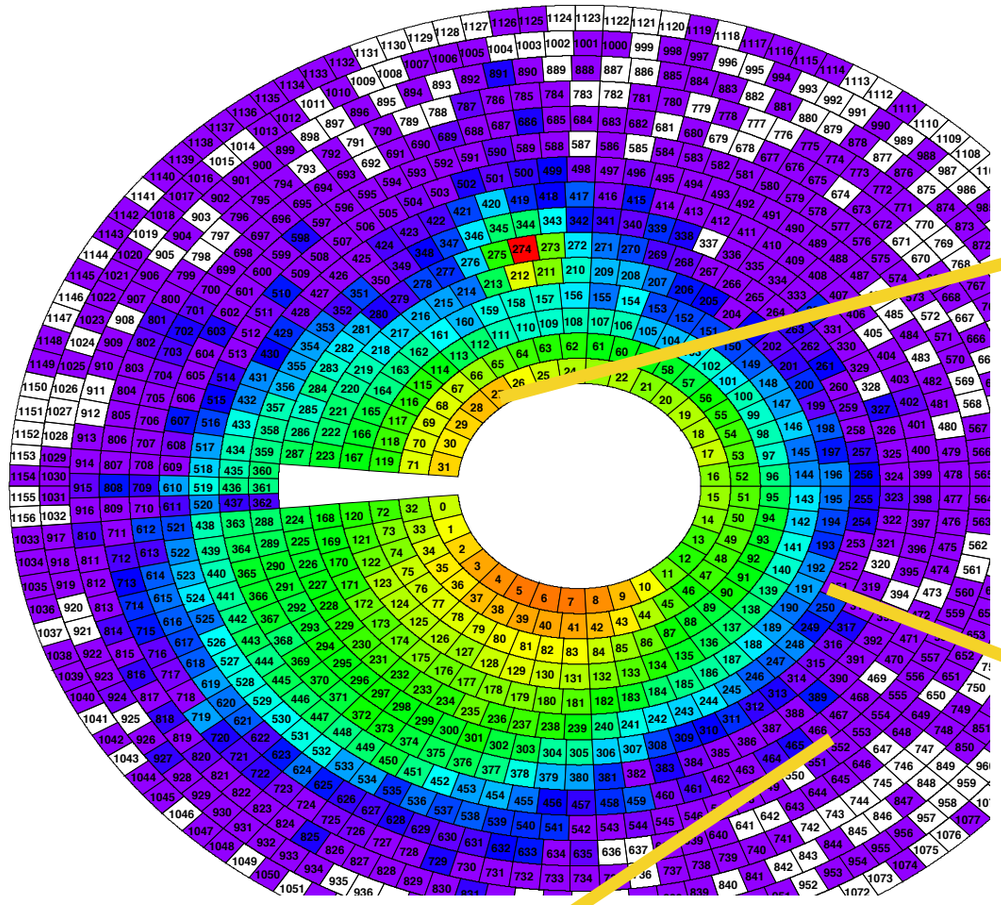
600 files
∑ ~ 0.5Gb

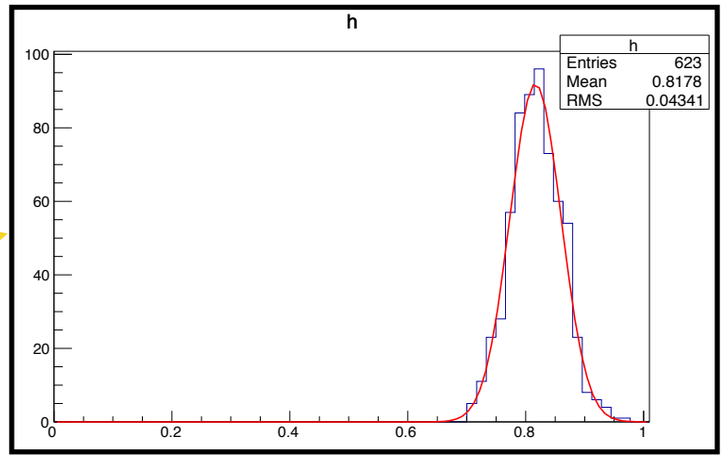
Background parametrisation

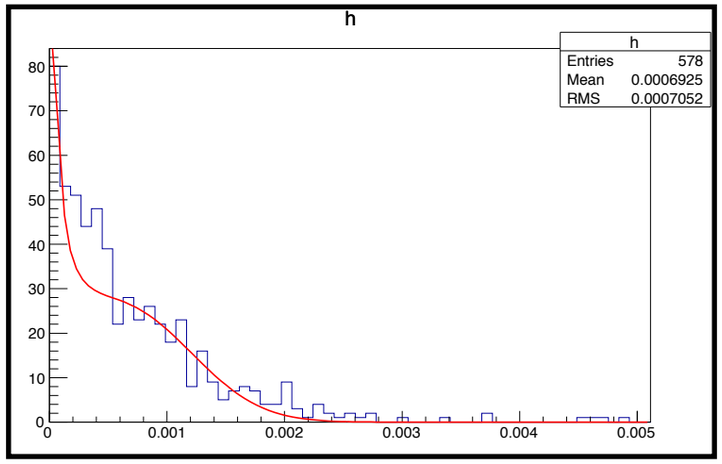
- To avoid management of all the files, initial idea was to
  - parametrise the distributions of BX-to-BX energy deposition in pads, assuming gaussian shape
  - for reconstruction, simulate the background by random generation in each pad according to their distributions.
- overlay the bg, etc.

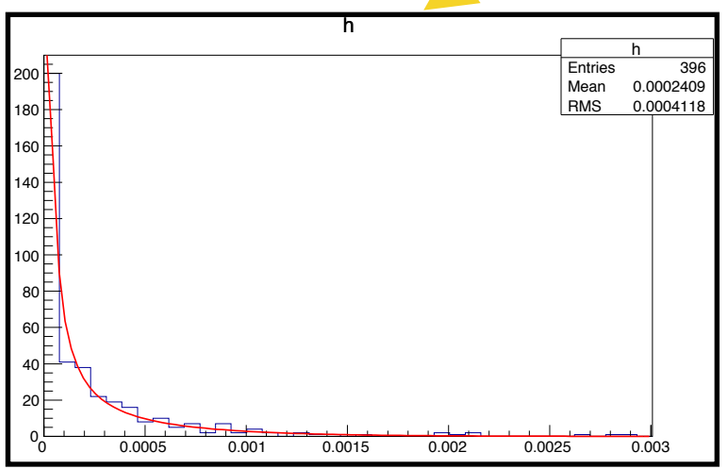


Background parametrisation: fits









General formula:

$$f(x) = \frac{[1]}{x} \exp\left[-\left(\frac{x-[2]}{[3]}\right)^2\right]$$

Problem: correlations

- However to provide a realistic background simulation one has to take into account the correlations between energy depositions
- There are two ways: Cholesky matrix and spectral decomposition.
- Both involve calculation and manipulation with matrices of size ~number of pads in whole BeamCal, i.e. 80000x80000 elements if we want to preserve correlations for whole calorimeter.
- Even with reasonable reduction of number of elements, this is a gigabyte level of memory space.

Correlations: possible solutions

- Leave it as it is now, but maybe use this approach in detectors with smaller number of sensitive elements.

- Try to optimise the correlations management, i.e. keep pad-pad correlations only within layers, and scale the energy in whole layer according to layer-layer correlations. This estimate the file size to be equal to 0.5Gb (still same as now)

- Your ideas?