Overlay - Calibrating

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Overlay Sample Calibration

Due to its nature, the overlay sample, consisting of both data and MC components, will demand its own calibration scheme.

Nowadays, calibration for a regular MC or data sample is applied to the tracks only.

As calibration depends on an energy deposition coordinates, and those can be easily found for each hit associated with a three dimensional reconstructed track.

Overlay Sample Calibration

Motivation

The derivation of the calibration constants is the same for data and MC but the resulting calibration constants are different due to:

- The time dependencies existing only in data and not regular MC.
- The detector simulation is not perfect and causing different detector effects between data and MC.

When considering calibration procedure for an overlay sample:

- Should we vary the MC signal in time?
- Should we care for tracks only?
- Which calibration constants should we apply?

Overlay Sample Calibration

approaches

Treat overlay sample as MC

Treat MC part part as MC and data per as data

Treat overlay sample as data

Overlay Sample Calibration

Overlay as data

Premises:

- We want to consider the entire sample as data.
- Every beam induced signal on channel can be traced back to its energy deposition.

Method:

- Apply a gain to each waveform: $$\frac{K_{MC}(x,y,z)}{K_{data}(x,y,z,t)}$$
- Apply data calibration to all tracks $K_{data}(x,y,z,t)$

Drawbacks / implied assumptions:

- The same energy deposition causes waveforms in all planes
- The convolution of the charge is linear

Overlay Sample Calibration

Overlay MC part as MC and Data part as data

Method:

- Don't vary gain values.
- Apply MC calibration to beam induced tracks, $K_{MC}(x, y, z)$
- Apply data calibration to cosmic induced tracks, $K_{data}(x, y, z, t)$

Drawbacks:

- Problematic where beam induced track crosses a cosmic induced one
- Unreliable non-tracks objects (showers, energy depositions around vertices)

Overlay Sample Calibration

Overlay as MC

Premises:

- Data calibration is irrelevant to MC part,
- Noise from the data (in overlay sample) similar to simulated noise

Method:

- Don't vary pedestal and gain values in time for MC part.
- Apply MC dedicated calibration constant to sample, $K_{MC}(x, y, z)$
- Accept non calibrated cosmic data.

Drawbacks:

- Non cosmic data
- Problematic where beam induced track crosses a cosmic induced one
- Unreliable non-tracks objects (showers, energy depositions around vertices)

Overlay Sample Calibration

approaches

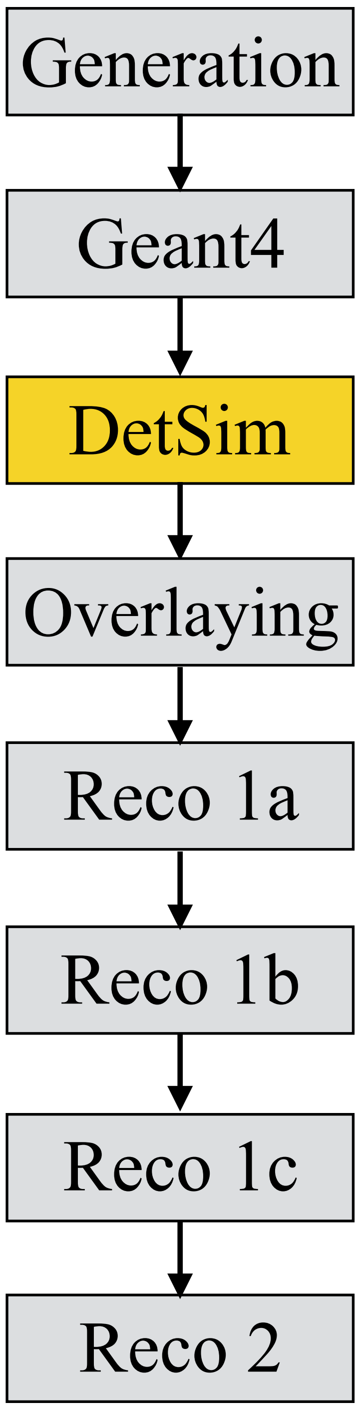
Treat overlay sample as MC

Treat MC part part as MC and data per as data

Treat overlay sample as data

Overlay Production

Detector Simulation no noise



Premise: We want to consider the entire sample as data.

Method:
Apply a gain to each generated waveform :

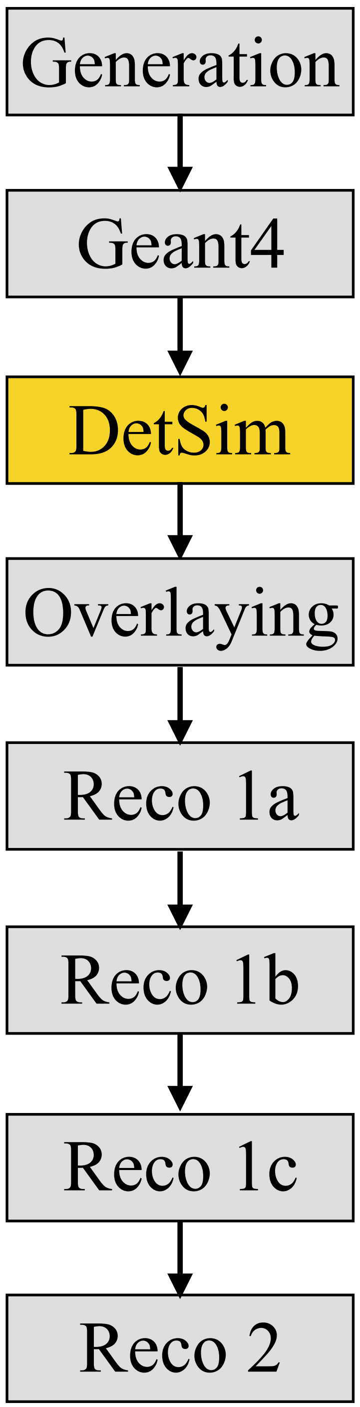
$$\frac{K_{\mathrm{MC}}(x, y, z, \mathrm{plane})}{K_{\mathrm{data}}(x, y, z, t, \mathrm{plane})}$$

YZ correction maps:
The maps are being read inside uboonecode (ubsim)
A new wirecell component `DepoTransform` is reading the maps
Gain is applied within wirecell code

Electron lifetime (for X correction)
Takes electron life value from database

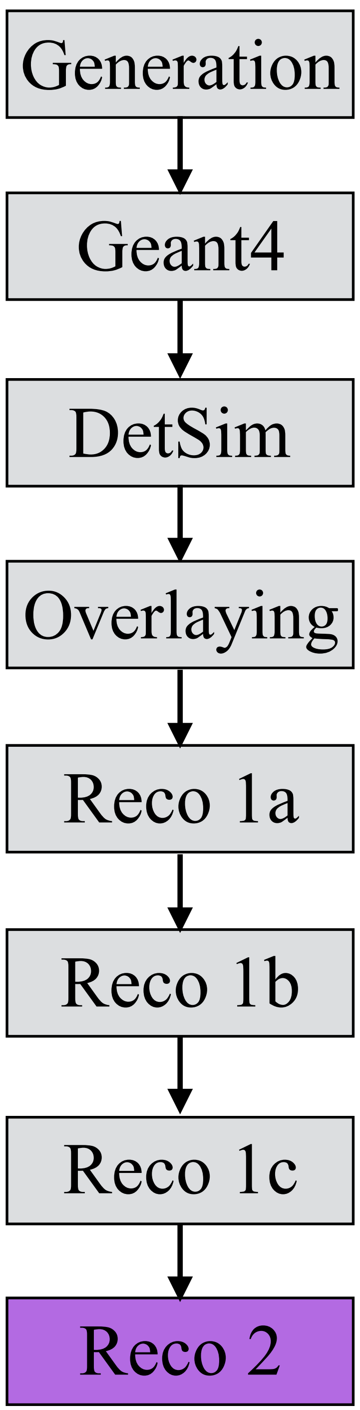
Overlay Production

Detector Simulation no noise



The calibration constants are being read using an art provider, automatically taking the event timestamp.

Currently, we are able to call only one provider.
We chose to use the provider to read the
data variables, and the MC variable, which are currently not using the time stamps are being read directly from the maps.



Overlay Production

Reco2

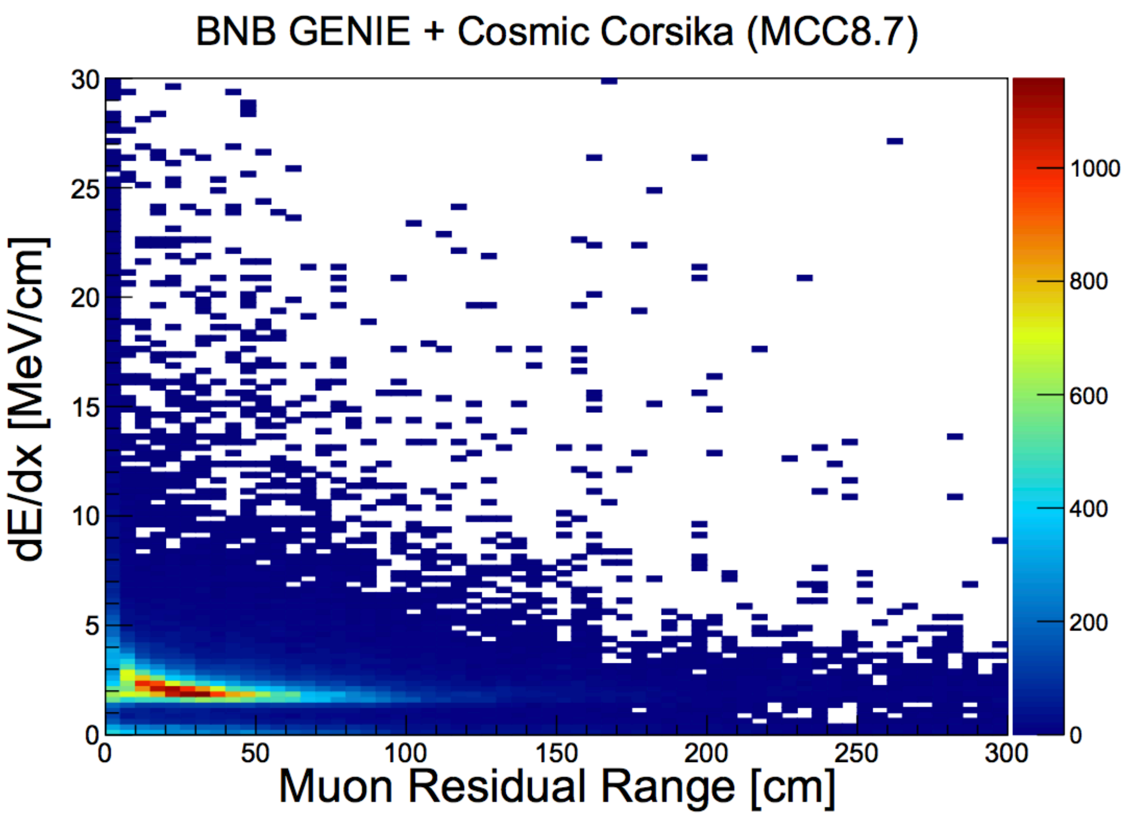
Reco2 is similar to the Data Reco2 stage

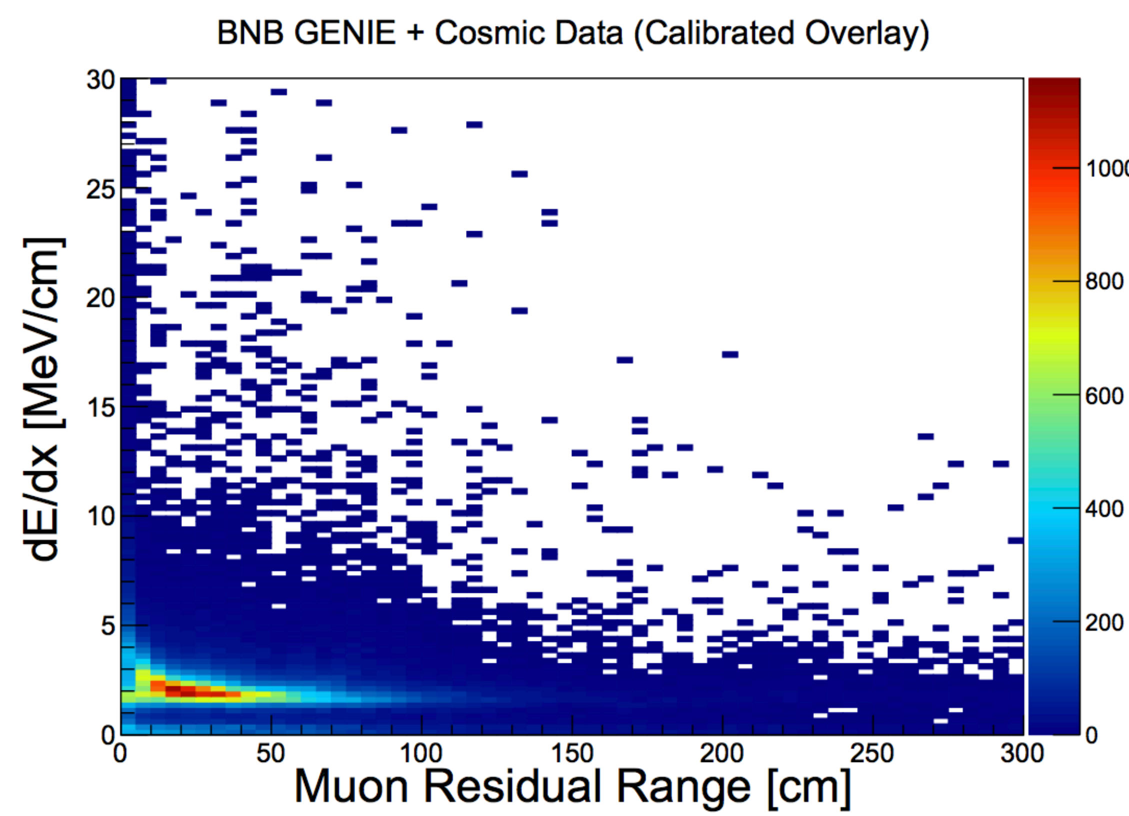
Applying:

$$K_{data}(x, y, z, t)$$

To all hits in all tracks (MC and data parts of the overlay)

Validation using previous production





Validation using previous production