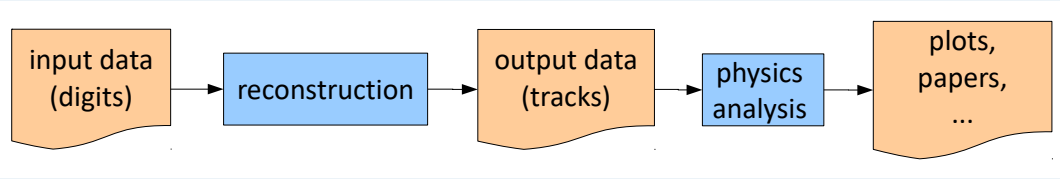
Event reconstruction chain in GEM detector of the BM@N experiment

~~Sergei Merts~~ Pavel Batyuk
on behalf of software group

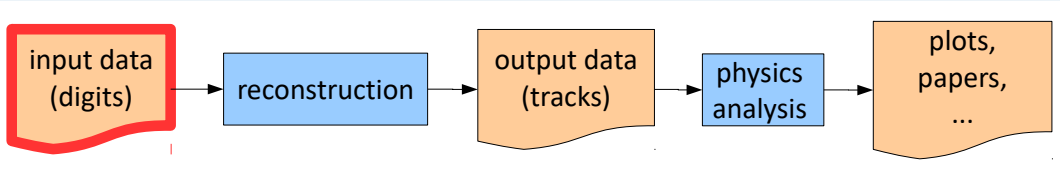
VBLHEP

April 13, 2018

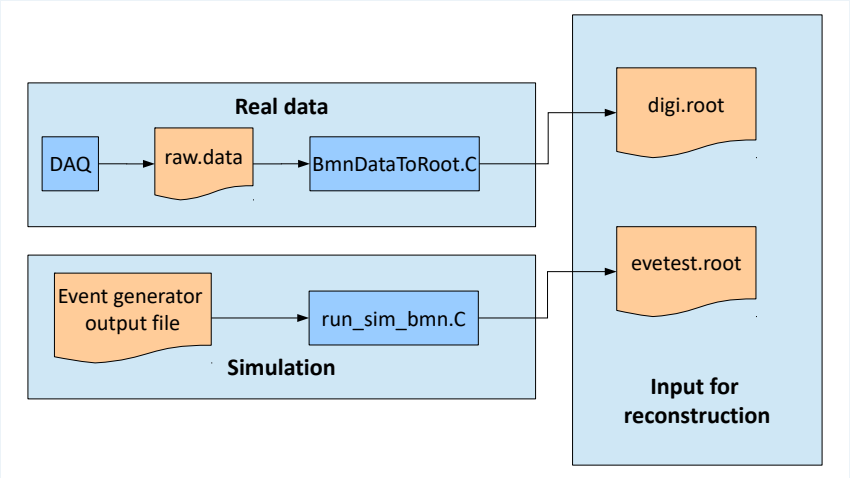
Common reconstruction chain



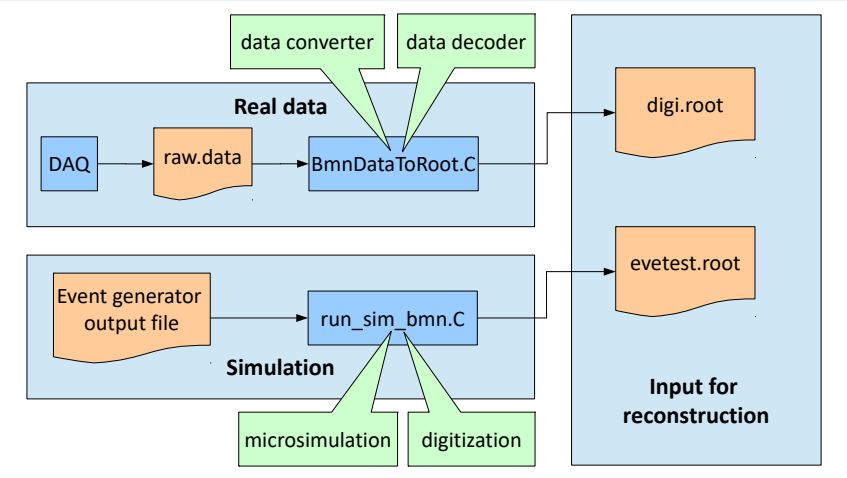
Common reconstruction chain. Input digits



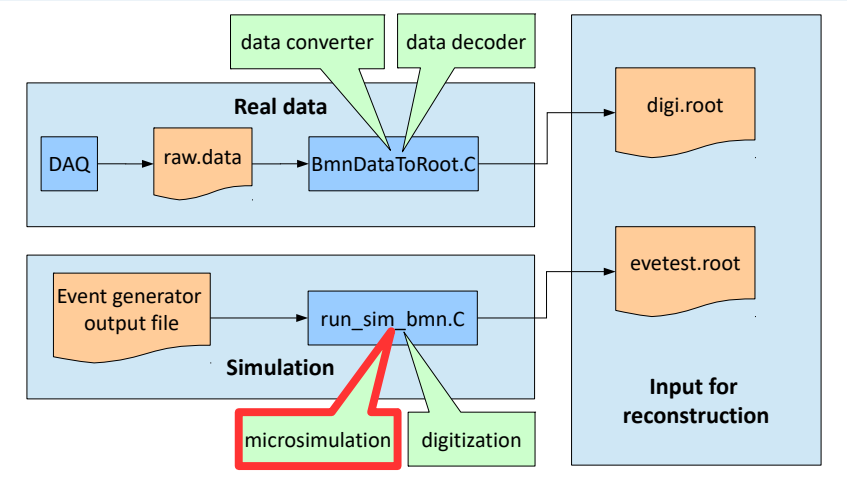
Where do we get data



Where do we get data



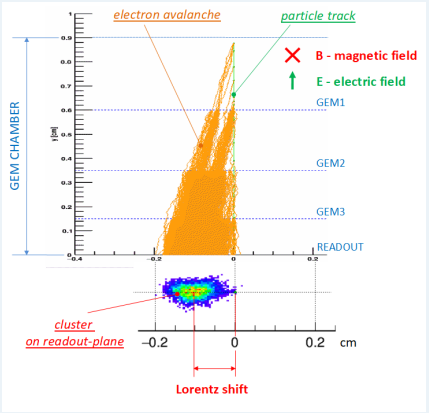
What do we have in Monte Carlo simulation

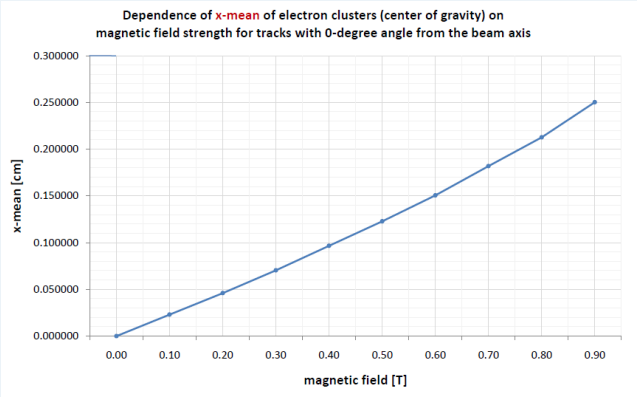


What do we have in Monte Carlo simulation

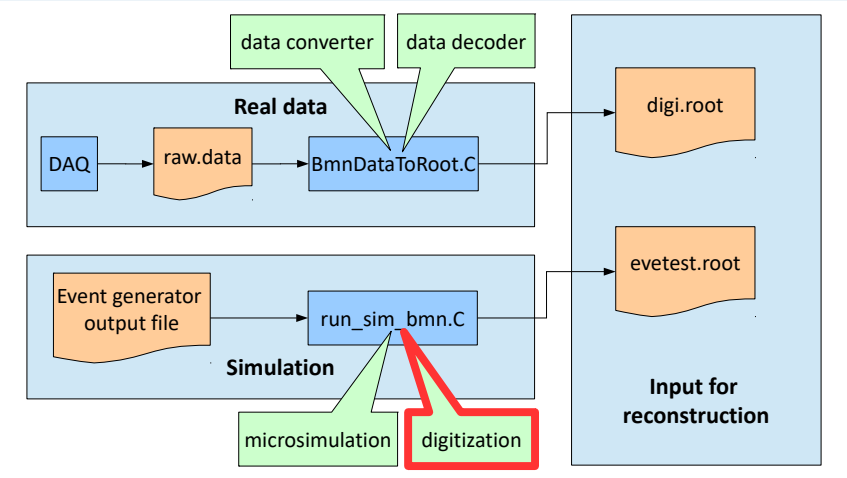
- GEM inefficiency - it's possible to exclude random number of fired strips (according chosen efficiency)
- Electron avalanches are implemented according to microsimulation in GARFIELD++
- Misalignment - microshifts of geometry.
- Lorentz shifts - see the next slide.

Lorentz shifts

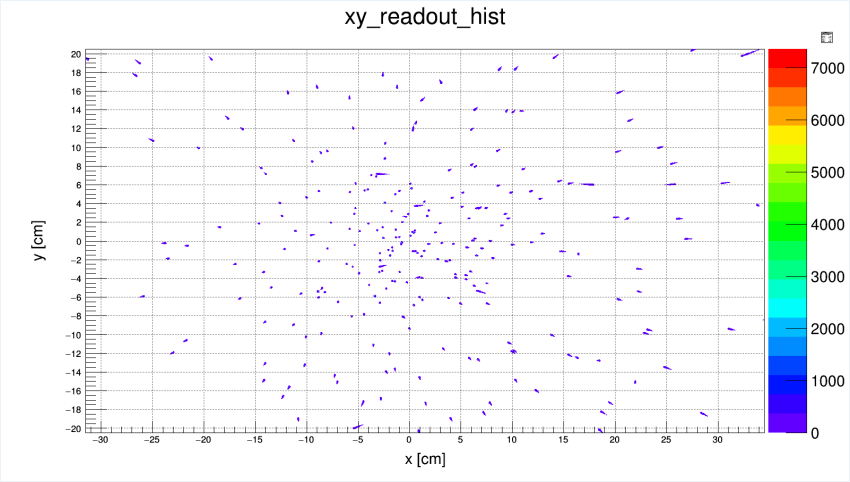




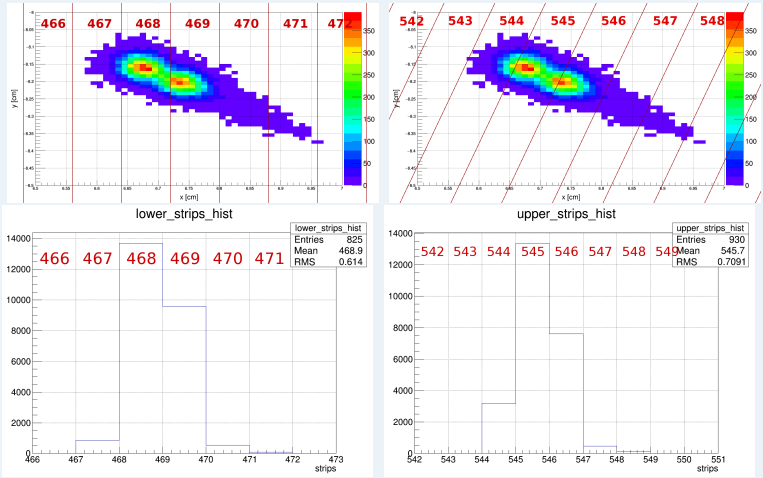
How do we produce digits from Monte Carlo



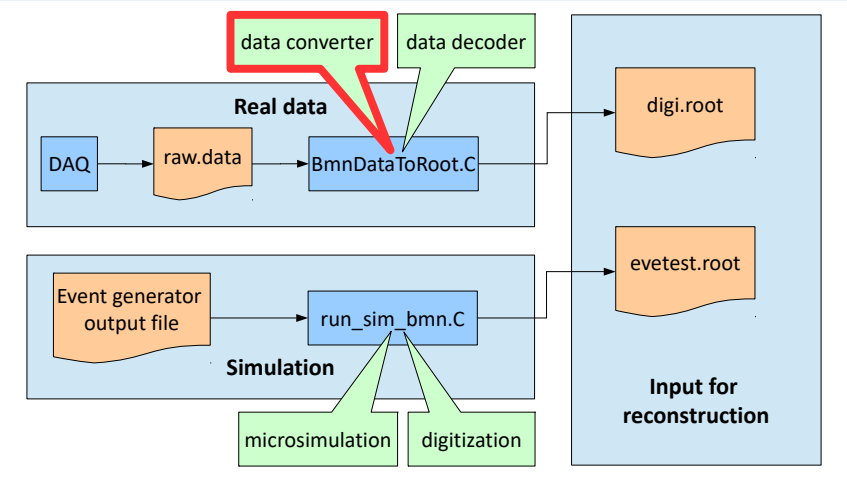
How do we produce digits from Monte Carlo



How do we produce digits from Monte Carlo



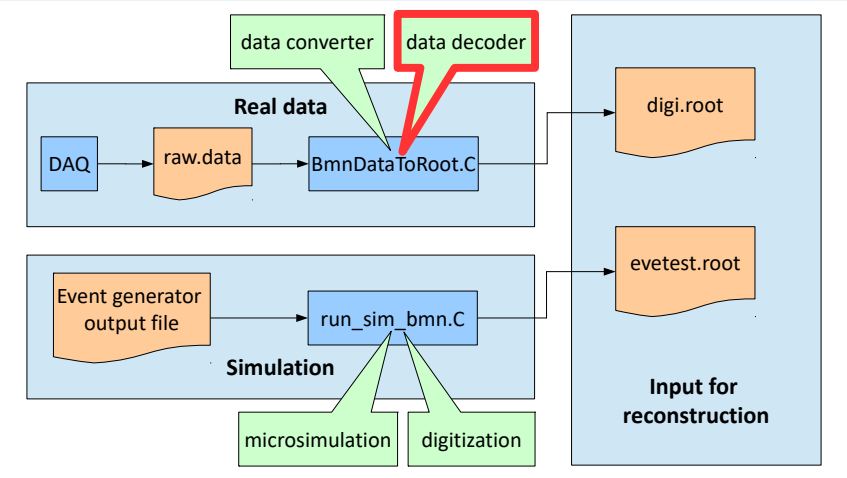
Experimental data converter



Experimental data converter

- takes binary data file and produces ROOT-file accordingly DAQ-data-format
- reads macro parameters (event number, run number, event type, etc.) and put them into DB on fly
- output ROOT-file contains tree with «DAQ-digits» (ADC, TDC, HRB, etc.)

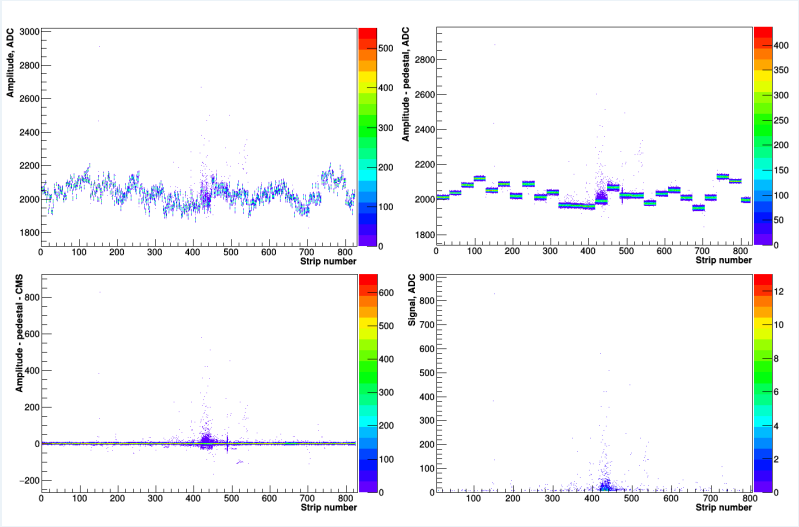
Experimental data decoder



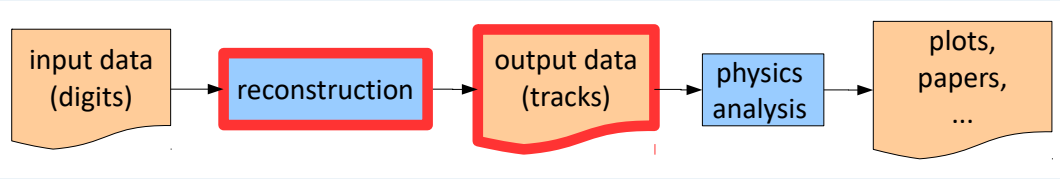
Experimental data decoder

- takes ROOT-file with DAQ-digits and decodes it into ROOT-file with detector-digits (BmnGemDigit, BmnTofDigit, etc.)
- connects to DB to read mappings (channel-to-strip)
- calculates pedestals and common modes of channels
- clears noisy channels

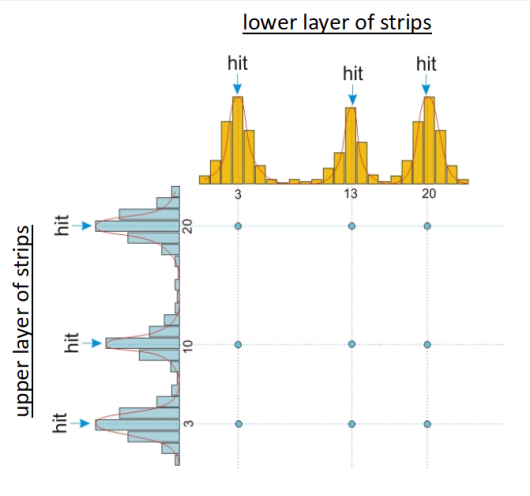
Digitization. Real data



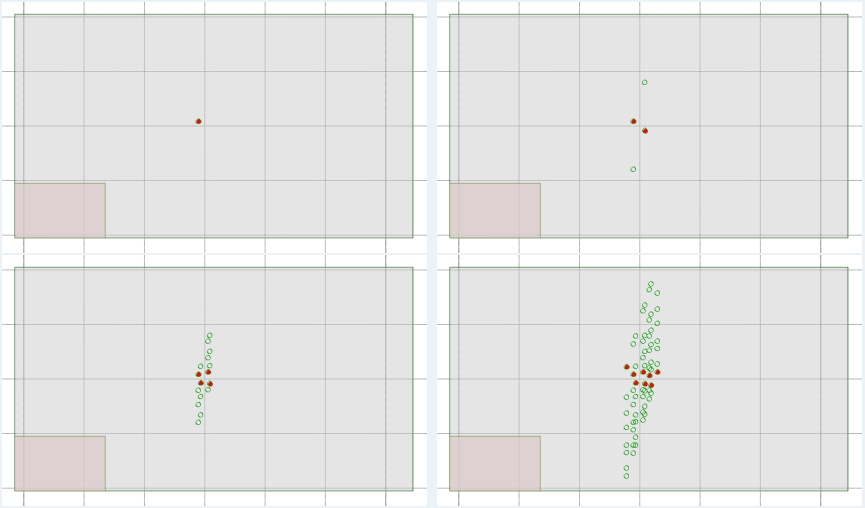
Common reconstruction chain



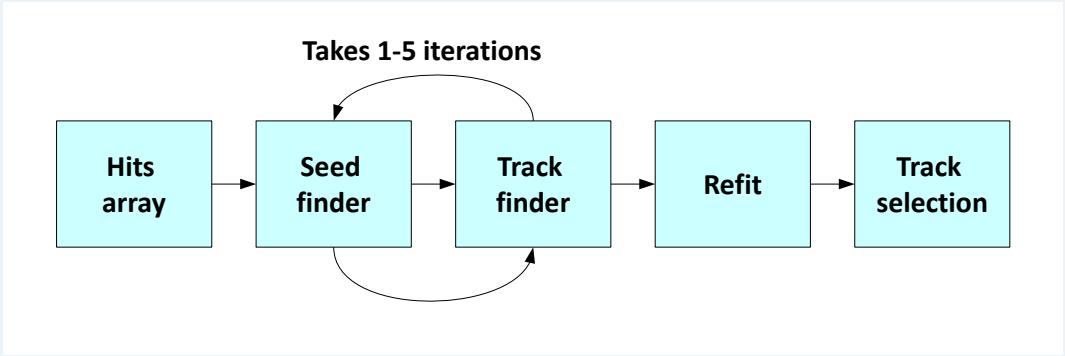
Hit reconstruction



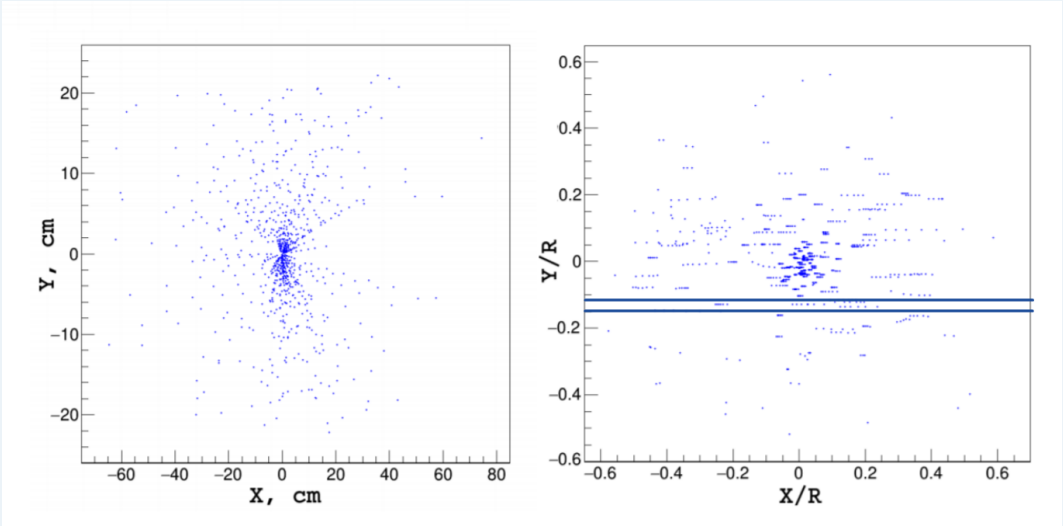
Hit reconstruction



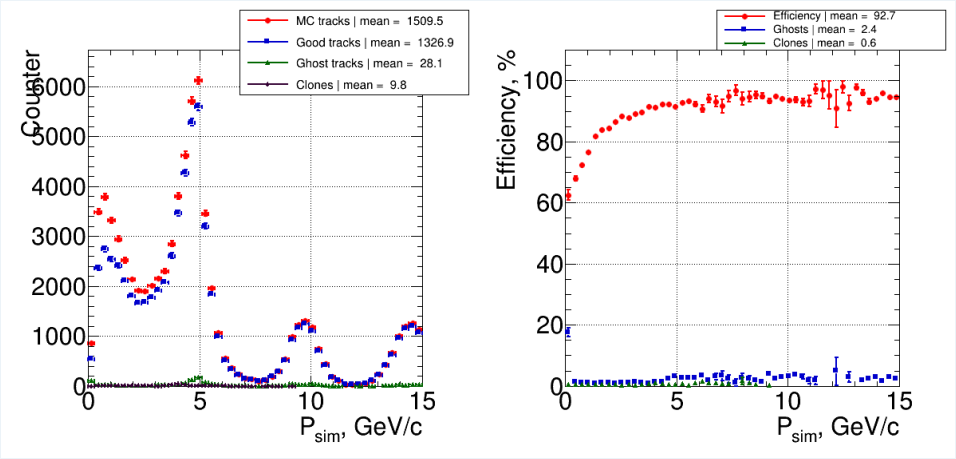
Tracking


Takes 1-5 iterations
Hits array
Seed finder
Track finder
Refit
Track selection

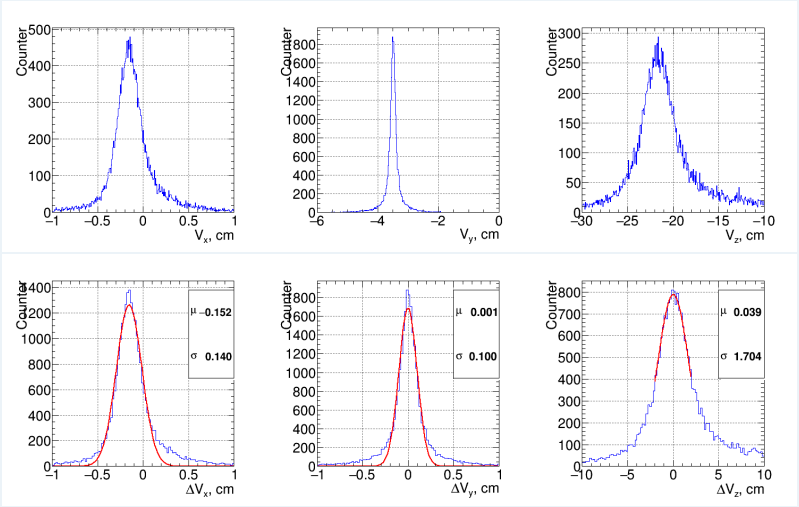
Tracking



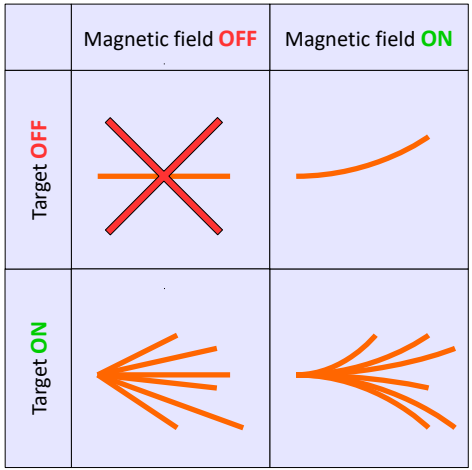
Tracking quality checking



Tracking quality checking



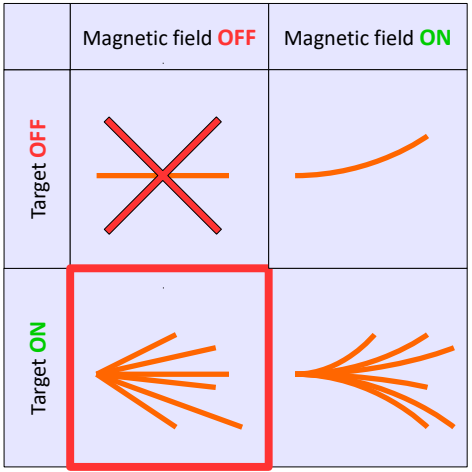
Results for experimental data



Possible classification of events

- Field-; Target- - not interested events
- Field-; Target+ - events for alignment
- Field+; Target- - events to estimate momentum resolution and test tracking
- Field+; Target+ - physics events

Results for experimental data. Alignment



Results for experimental data. Alignment

The package based on formalism of Millepede II with all its features and allows one to include / exclude different subdetectors from alignment (GEM, SI, MWPC, ...).

Gneralized straight-line model of track:

$u_i^j = x_0^j \cos\alpha_i + t_x^j z \cos\alpha_i + y_0^j \sin\alpha_i + t_y^j z \sin\alpha_i + \Delta u_i + (t_x \cos\alpha_i + t_y \sin\alpha_i)\Delta z$

Chosen weights:

$w_i^1 = \cos\alpha_i$ – shifts (x_0)

$w_i^2 = z_i \cos\alpha_i$ – shearings (t_x)

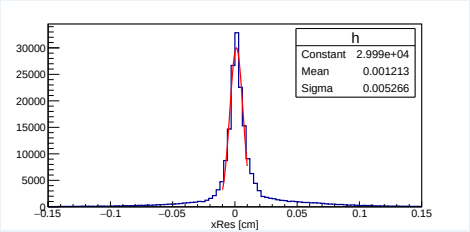
$w_i^3 = \sin\alpha_i$ – shifts (y_0)

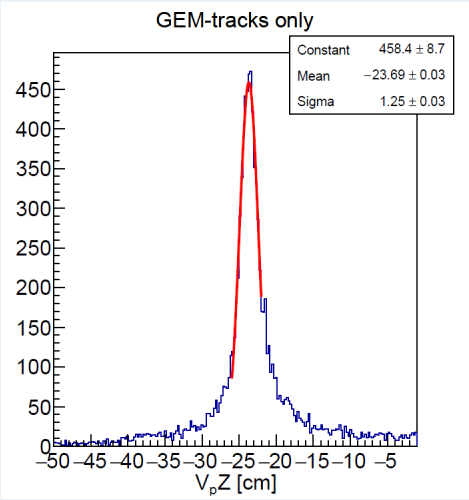
$w_i^4 = z_i \sin\alpha_i$ – shearings (t_y)

$w_i^5 = 1$ – overall shift in Z

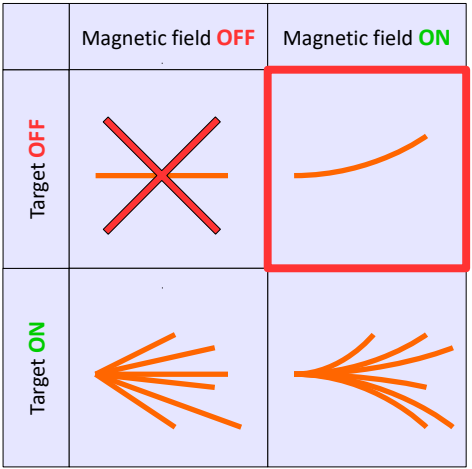
$w_i^6 = z_i$ – scaling in Z

Quality of alignment

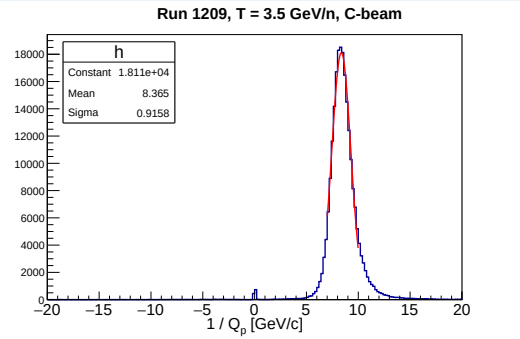


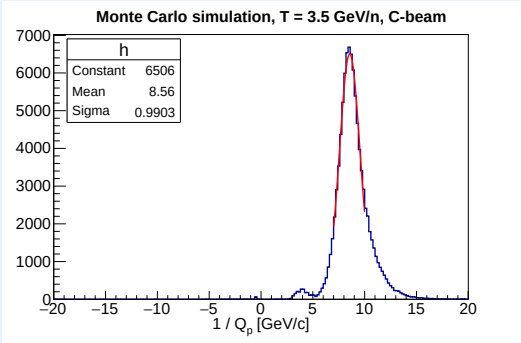


Results for experimental data

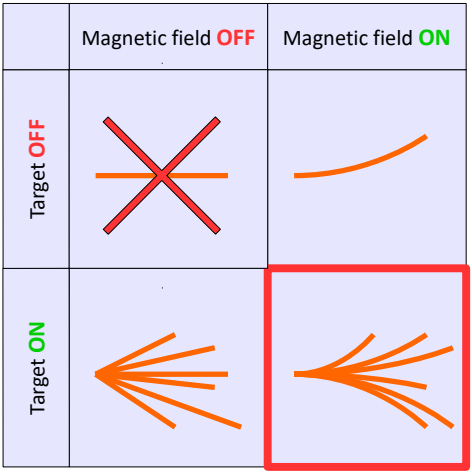


Results. MagField+, Target-

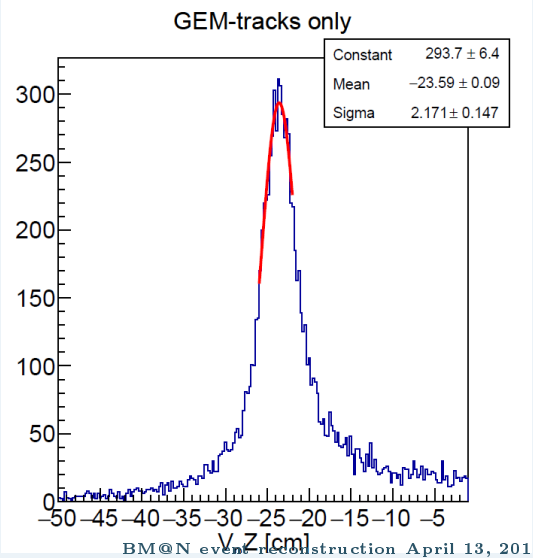




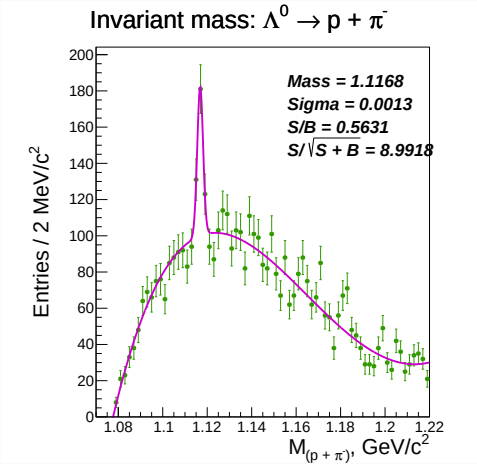
Results for experimental data



Primary vertex reconstruction, with mag. field



$\Lambda^0 \to \pi^- + p$, C-Cu @ 4GeV/n



Thank you!