MCS in LH2 (field-off)

Content

- PID ML method in field-off data
  - Approach
  - Features (explanatory variables)
    - KL
  - Linear Classifiers
- Data reconstructed with MAUS 3.3.2
  - Track discrepancy
  - Scattering distribution

MCS in LH2 (field-off)

Selection

TOF1 SP	US Track	TOF	Tracking region	Fiducial Selection	Diffuser cut
Requiring a TOF0& TOF1 hit	…one US track	±150ps around muon peak	Tracks associated with events appearing at > 150mm in trackers are removed	R<100mm at DS ref plane	R<90mm

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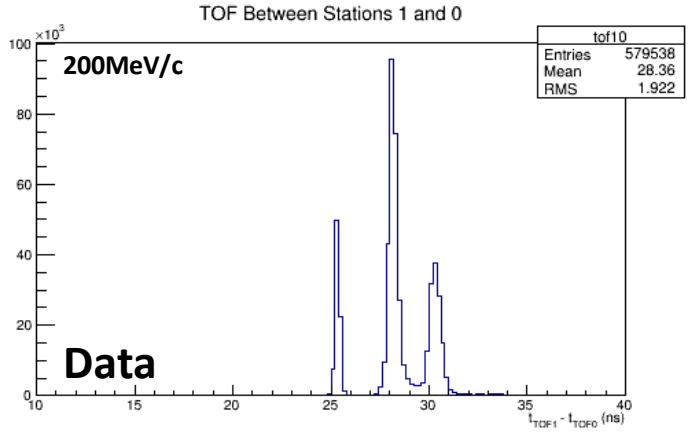
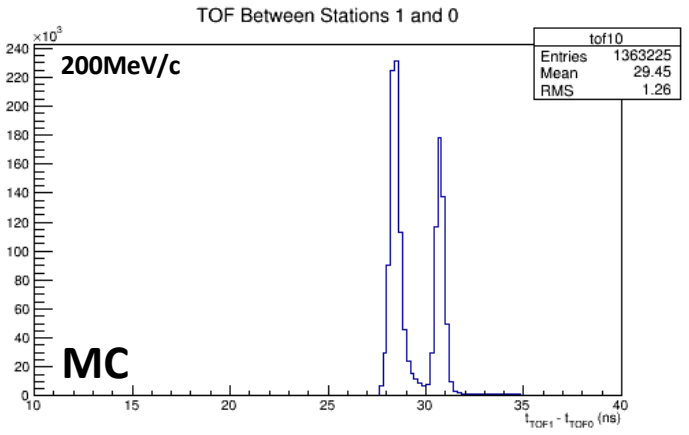
PID approach





Pionic beam

- π, e present in muon TOF peak
- Contamination increases with momentum
- MC shows some protons, photons
- MC contains significantly less electrons

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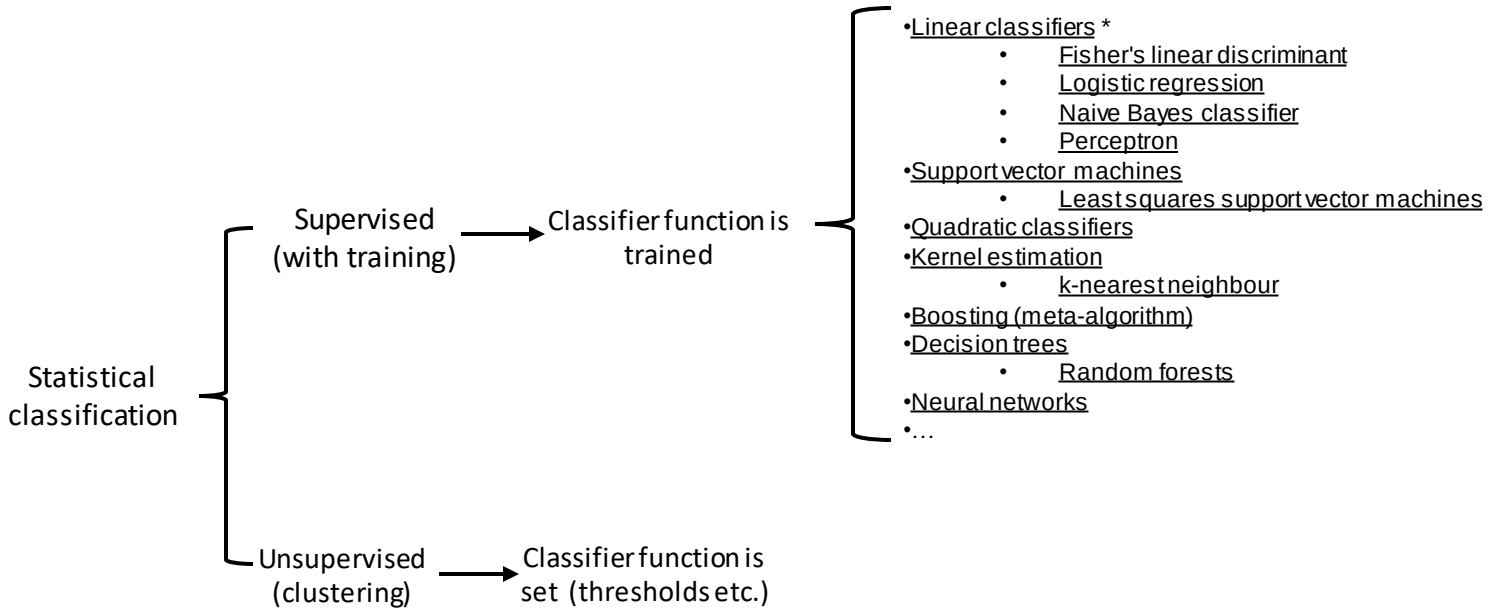
PID approach

Methods



*methods are mixed and functionalities have been inherited from previous algorithms, or borrowed from neighbouring methods.

Plan

- Extract discriminators
  - E-loss in KL,EMR,TOFs
  - Ckov NPE
- Choose the simplest method
- Find possible limitations
- move to a more fitting method

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Generic Linear Classifier

$$S^{ij} = F_k^{ij} \cdot w^k$$

i: event
j: PID
k: feature

Feature vector: (input)

$$F^{ij} = \left(\frac{dE^{ij}}{dx}\frac{1}{E_0^{ij}}\right)_{EMR} + \left(\frac{dE^{ij}}{dx}\frac{1}{E_0^{ij}}\right)_{KL} + \left(\frac{dE^{ij}}{dx}\frac{1}{E_0^{ij}}\right)_{TOFs} + X_{Ckov}$$

Weight vector (training derived)

$$w^k = w_{EMR} + w_{KL} + w_{TOF} + w_{Ckov}$$

- The feature vector is k dimensional (k number of discriminating variables available)
- The weight vector is determined from training, where the PID is known, and the **w** elements are tuned to maximise discrimination.
- A score (**S**) is formed for each event for each hypothesized PID
- Highest score **wins**
- Subclass of linear classification is chosen based on requirements.

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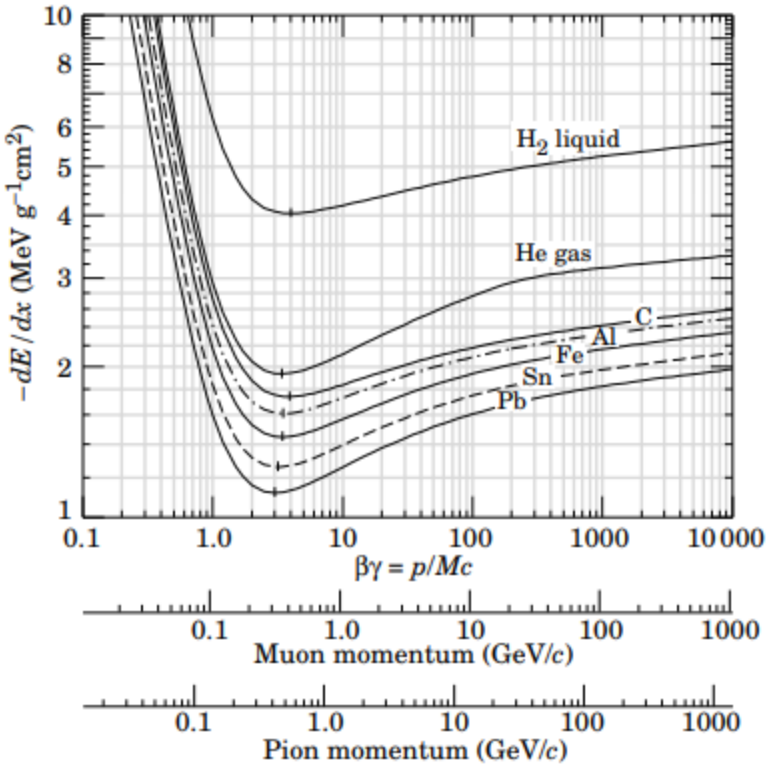
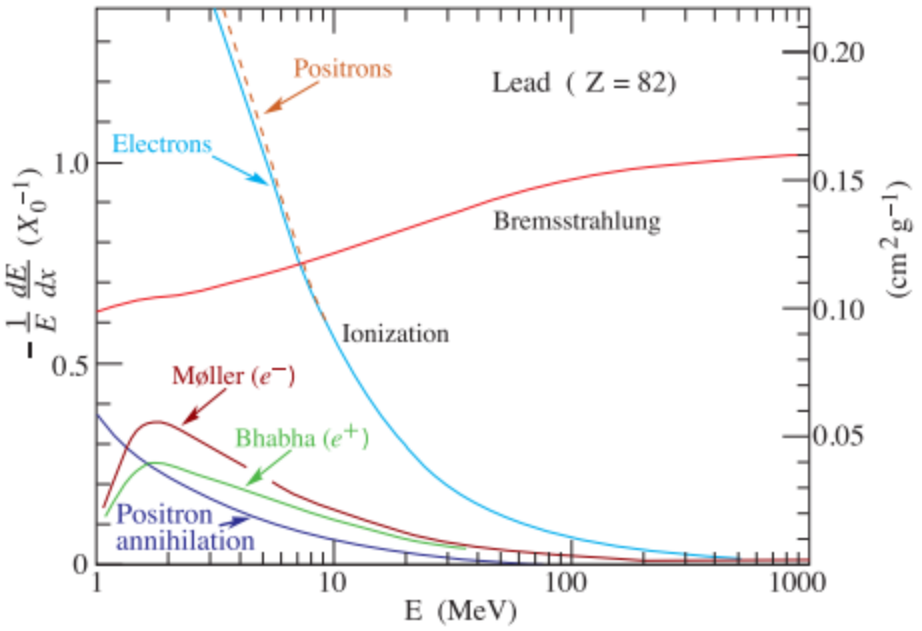
Energy loss

- Electronic energy loss (Bethe equation) predicts E-loss for muons/pions
- Bremsstrahlung dominates electronic E-loss for electrons
- Should work as discriminating quantity

Muons



Electrons



*PDG 2012

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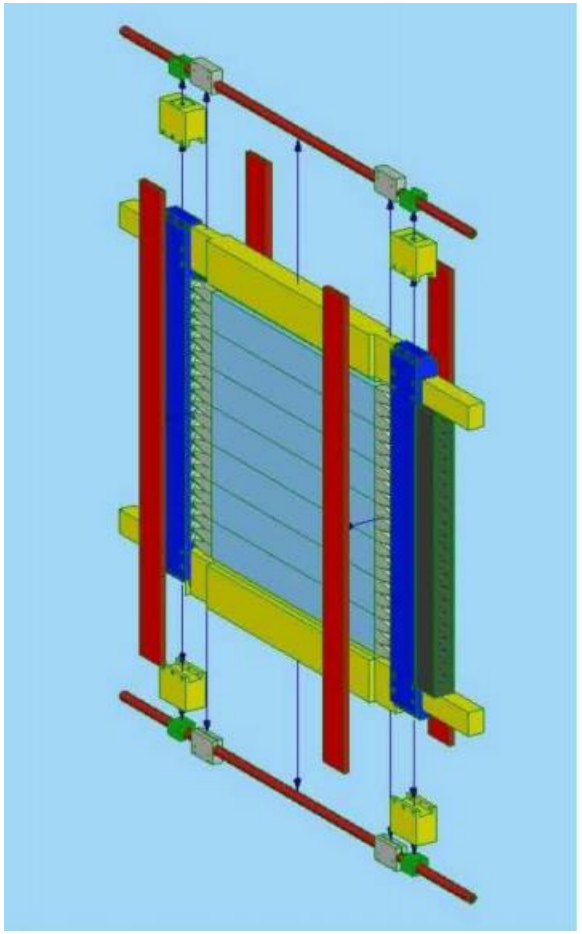
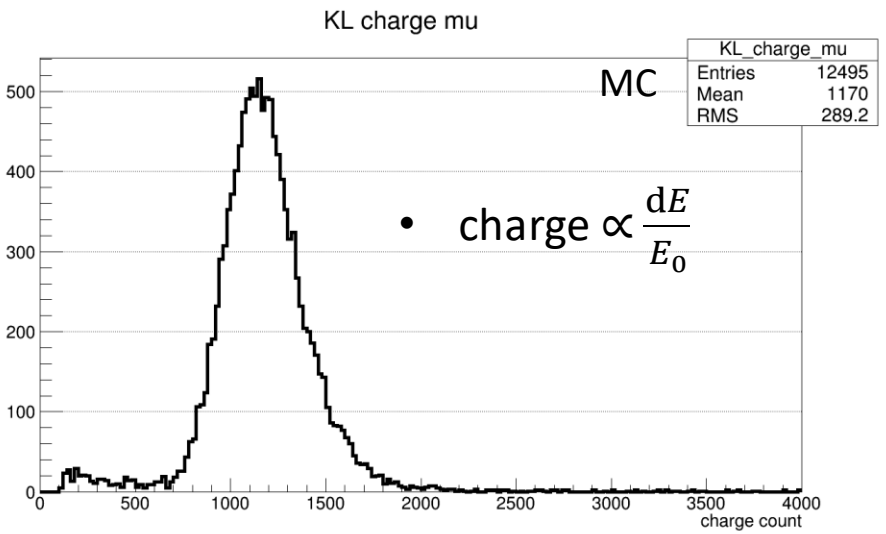


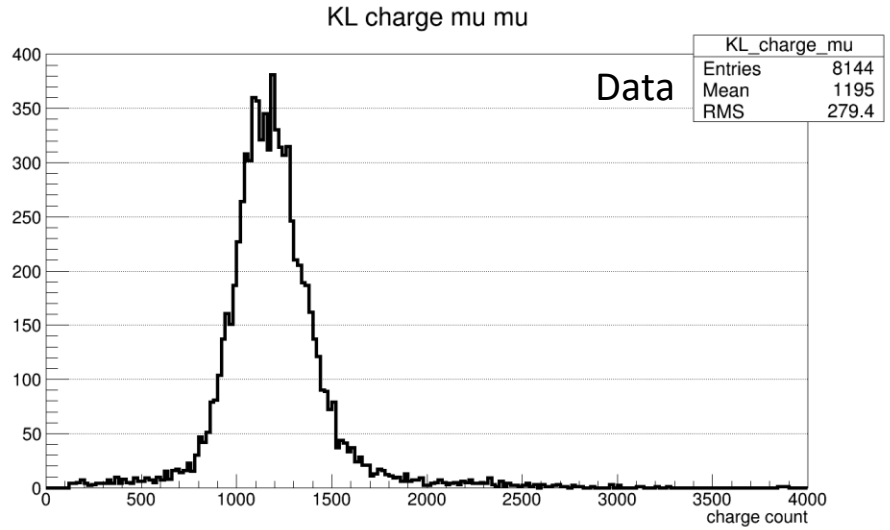
KLOE-light sampling calorimeter

- Pb/Sci 1:1 volume ratio
- 7 modules, 3 cells each.
- 2 PMTs per cell.
- **Dimensions:** 120(x) × 160(y) × 4(z) cm
- X_0 = 9.904 gcm^{-2} or 1.6cm

KL response to selected beam, MC/data



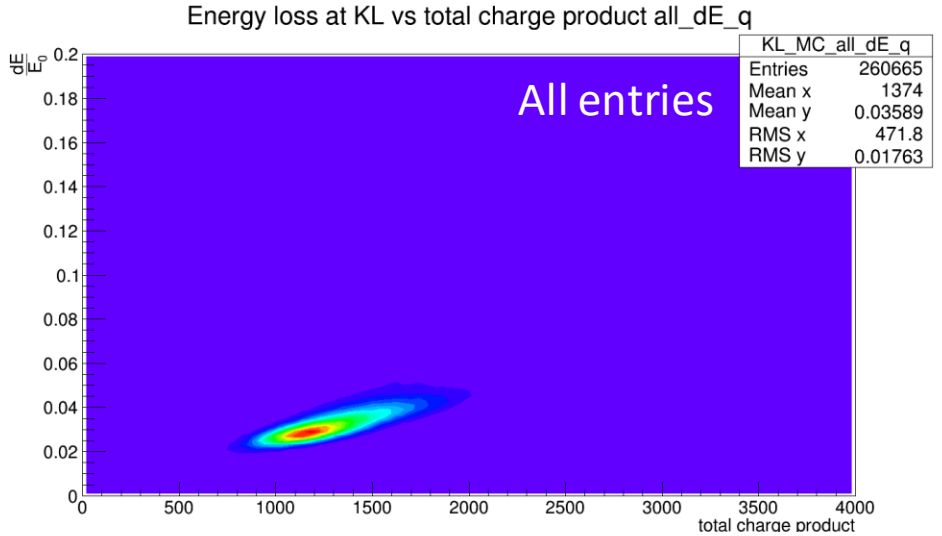
- charge $\propto \frac{dE}{E_0}$

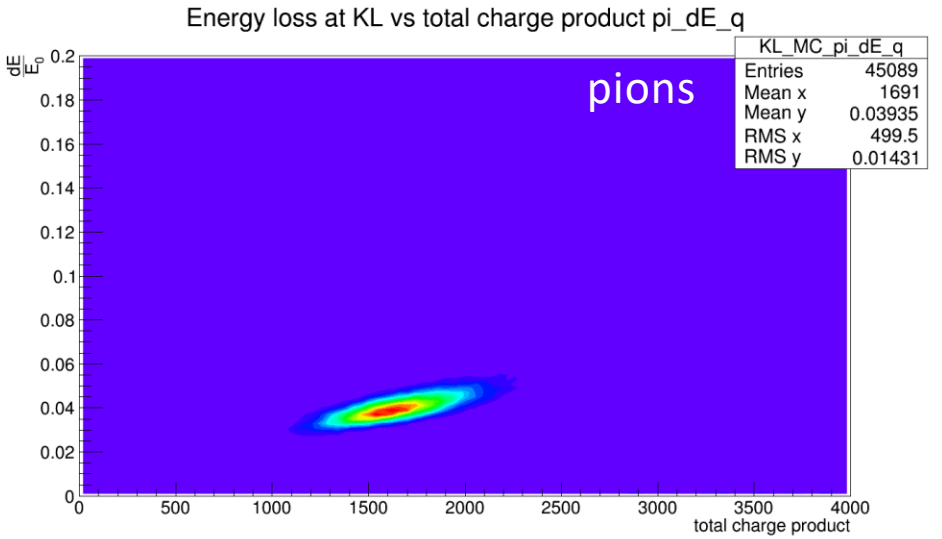


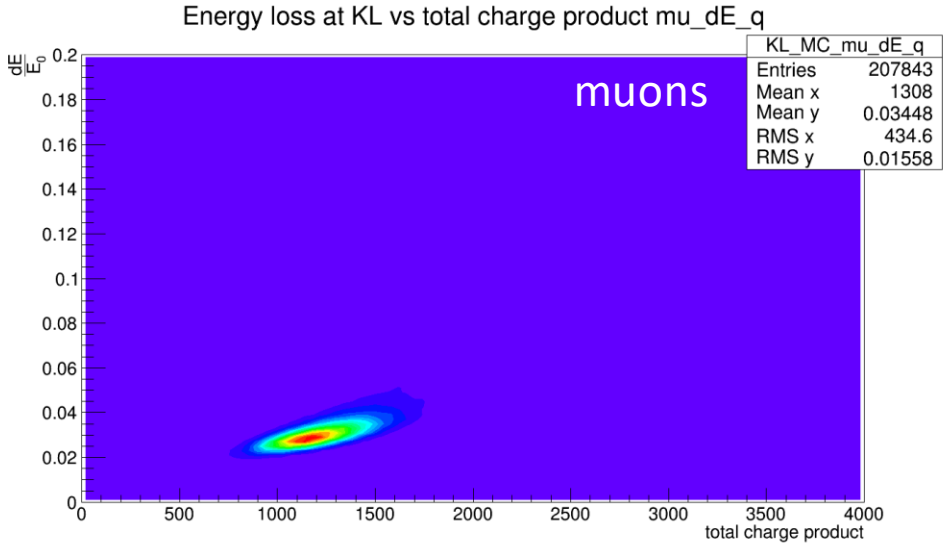
MCS in LH2 (field-off)

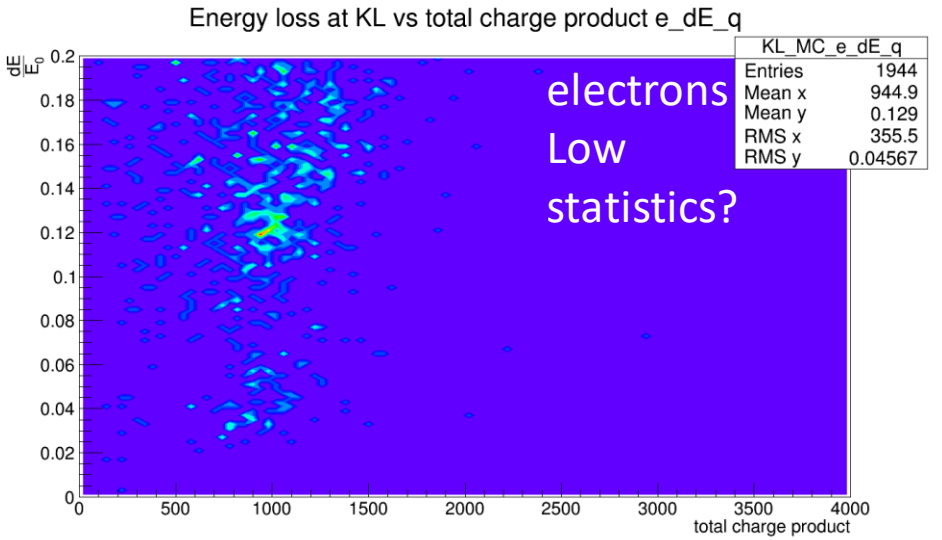
KLOE-light sampling calorimeter

- charge / $\frac{\mathrm{d}E}{E_0}$ Relationship can be obtained from MC, should be linear





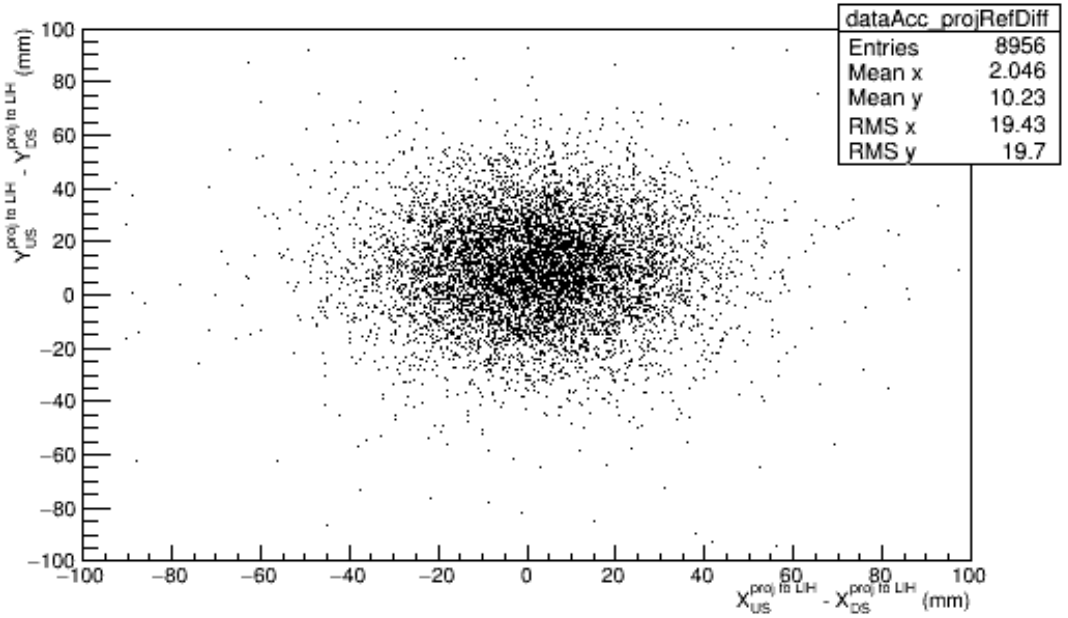


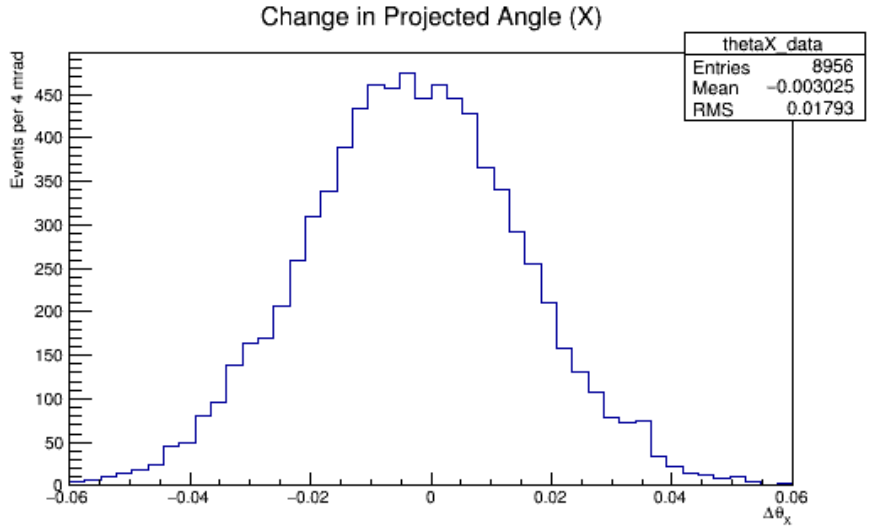


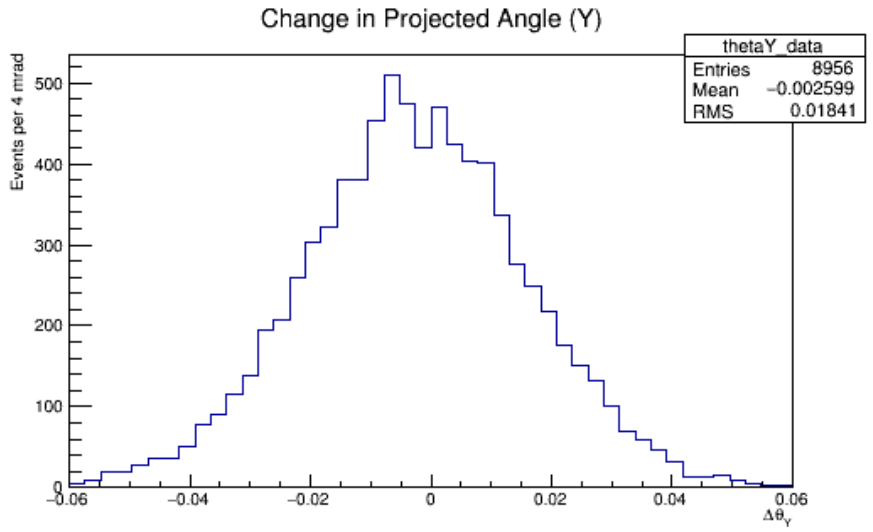
MCS in LH2 (field-off)

Tracker check in new version 3.3.2

Projection residuals US-DS



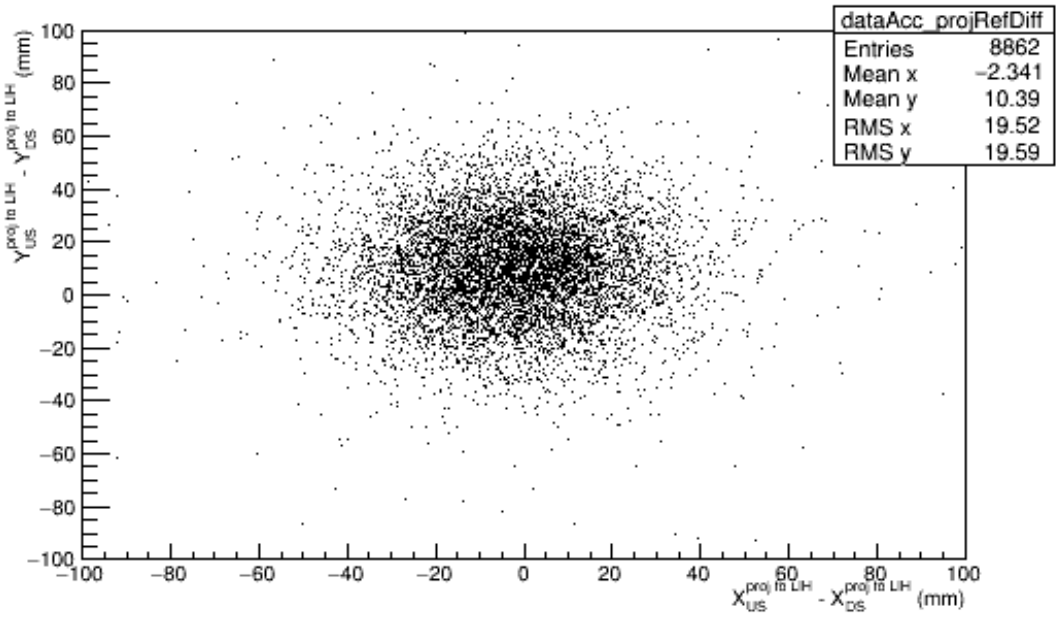




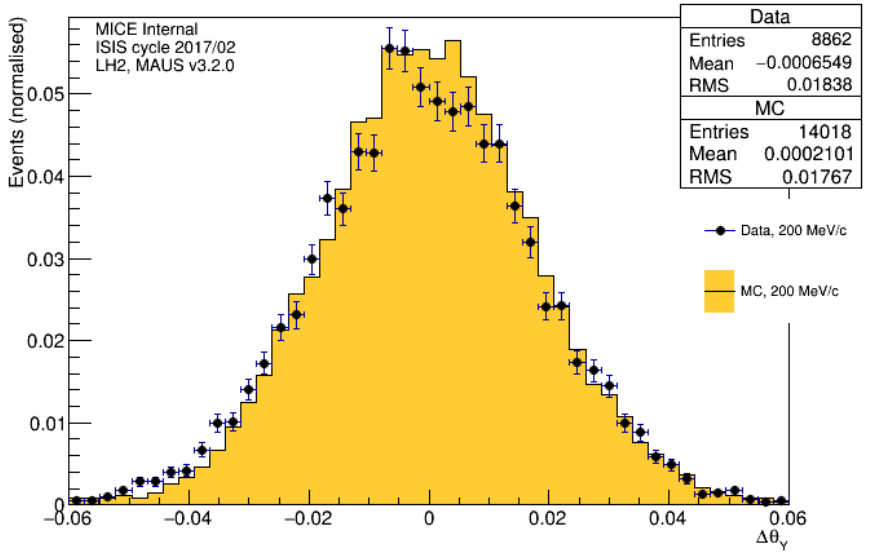
MCS in LH2 (field-off)

Old version 3.2.0

Projection residuals US-DS



Change in Projected Angle (Y)



Change in Projected Angle (X)