Multiple Scattering with Fields Off

John Nugent

University of Glasgow

j.nugent.1@research.gla.ac.uk

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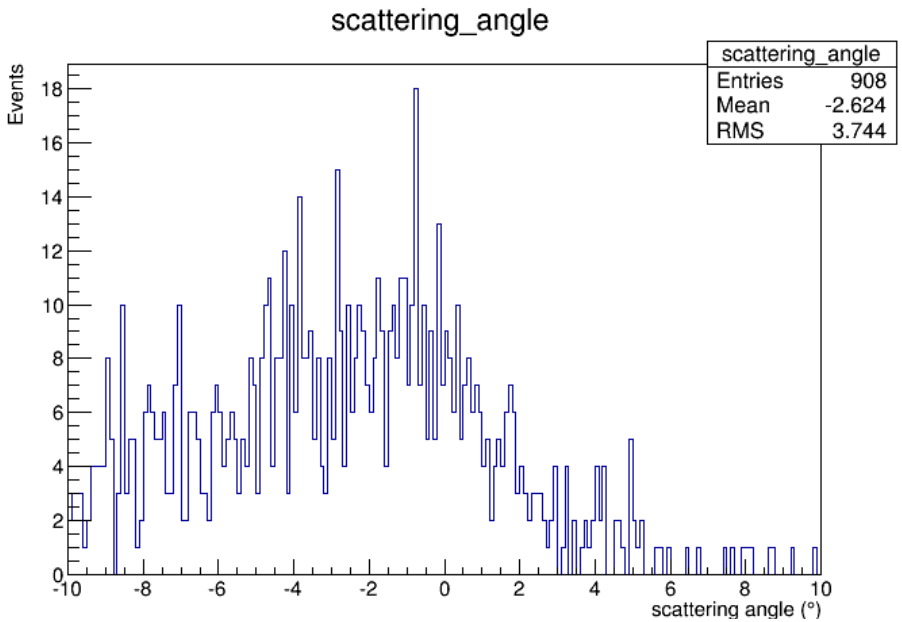
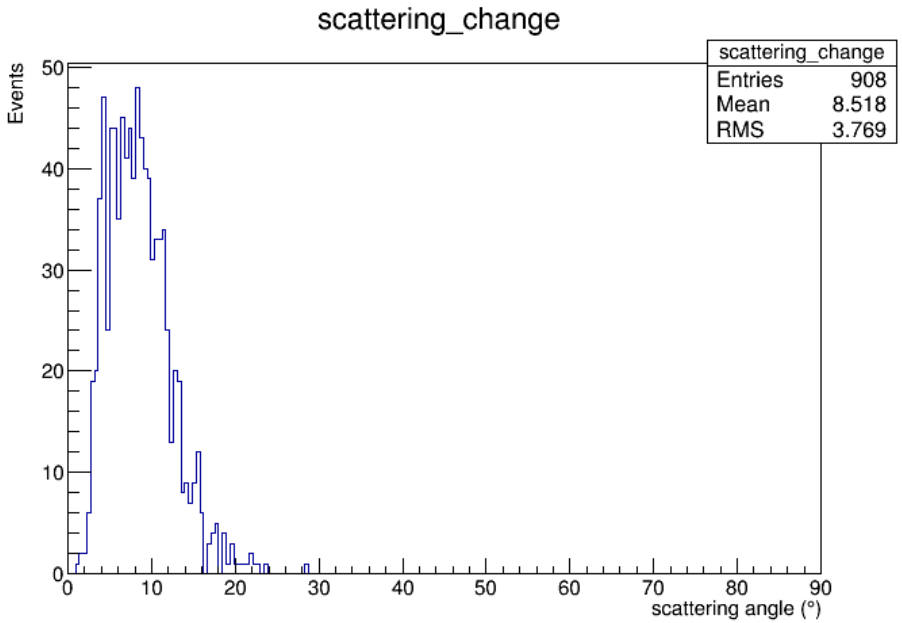
Multiple Scattering with Fields Off

- Particles follow straight tracks through the spectrometers, scattering off absorber material in AFC
- Use TOFs to measure momentum, KL, EMR & CKOVs for PID
- Measure multiple scattering as a function of momentum
- This activity can happen concurrently with the tracker alignment

Tracker Software





- Pattern recognition provides straight tracks & angles in each tracker
- Calculate the change in angle between US and DS trackers
- Project from tracker reference plane to centre of absorber material to determine distance between two tracks

Beam Settings

- To maximise the no. of particles reaching TOF2 emittance should be 3π, then scan across momentum range
- As much as possible will try to use settings that are being used for tracker alignment to make data collection as efficient as possible
- Matched beam line settings ideal to maximise data collection but focusing is not to important - only taking straight tracks

Number of triggers from batch simulation

- Ran 6π 200 MeV M0 beam line with the solenoid fields off
  - TOF1 44673
  - TOF2 2096
  - Corresponds to $\sim$1000 straight tracks
- Need $\sim 10^4$ straight tracks so require $\sim 45 \times 10^5$ TOF1 triggers

Systematic Errors

• Rotation between USS & DSS	→ Get Max. offset from surveys
• Windows	→ Run empty channel
• Field residuals from PRY	→ Run MC with no fields
• TOF calibration	→ Shift TOF selection $\pm$ 0.1 ns
• PID	→ MC run
• Resolution of tracker	→ Deconvolution calculation
• Distance between projected tracks cut	→ Increase/decrease by 50%
• Monochromatic P_z beam	→ Change selection

Unpacking Tracker Resolution

$$D_{\text{obs}} = R \cdot \epsilon \cdot \theta_{true}$$

http://arxiv.org/pdf/hep-ex/0512005v1.pdf

Unpacking Tracker Resolution

$$D_{\text{obs}} = R \cdot \epsilon \cdot \theta_{true}$$

$$\rightarrow \theta_{true} = \epsilon^{-1} \cdot R^{-1} \cdot D_{\text{obs}}$$

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Unpacking Tracker Resolution

$$D_{\text{obs}} = R \cdot \epsilon \cdot \theta_{true}$$

$$\rightarrow \theta_{true} = \epsilon^{-1} \cdot R^{-1} \cdot D_{\text{obs}}$$

$$\rightarrow \theta_{true} = \begin{pmatrix} \epsilon_{1,1} & 0 & \cdots & 0 \\ 0 & \epsilon_{1,1} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \epsilon_{m,n} \end{pmatrix} \cdot \begin{pmatrix} & R_{x,1} & \cdots & R_{x,m} \\ R_{\theta,1} & R_{x_1,\theta_1} & \cdots & R_{x_m,\theta_1} \\ \vdots & \vdots & \ddots & \vdots \\ R_{\theta,n} & R_{x_1,\theta_n} & \cdots & R_{x_m,\theta_n} \end{pmatrix}$$

$$\begin{pmatrix} & R_{y,1} & \cdots & R_{y,m} \\ R_{\theta,1} & R_{y_1,\theta_1} & \cdots & R_{y_m,\theta_1} \\ \vdots & \vdots & \ddots & \vdots \\ R_{\theta,n} & R_{y_1,\theta_n} & \cdots & R_{y_m,\theta_n} \end{pmatrix} \cdot \begin{pmatrix} D_{x1,1} & 0 & \cdots & 0 \\ 0 & D_{x2,2} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & D_{xm,n} \end{pmatrix}$$

$$\begin{pmatrix} D_{y1,1} & 0 & \cdots & 0 \\ 0 & D_{y2,2} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & D_{ym,n} \end{pmatrix}$$

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Wish List

- Run with no absorber
- Kalman residuals in MAUS
- Global PID in MAUS
- Runs at 3π 140, 200 & 240 MeV/c need X triggers at TOF1

Conclusions

- Preliminary look at multiple scattering study
- Step IV data is coming so hope to have first look at analysis at next CM