

Field Off Scattering Studies: Current Status

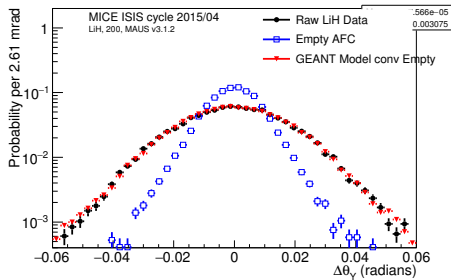
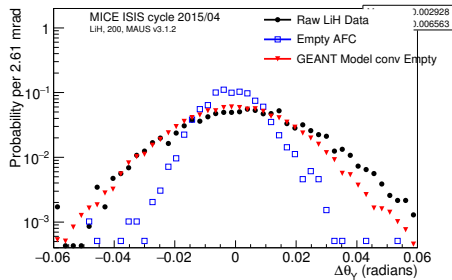
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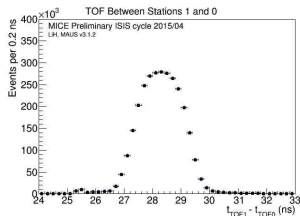
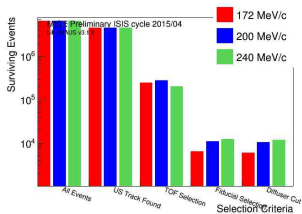
3/5/2018

Data vs. MC



- All plots shown use MC v3.0.1 - Righthand
 - ▶ There are known issues with geometry in this version
- All plots shown use data v3.1.2-V2 - Lefthand
 - ▶ Myself and Durga independently found bug in v3.1.2 field off data

Selection



Only minor changes to selection

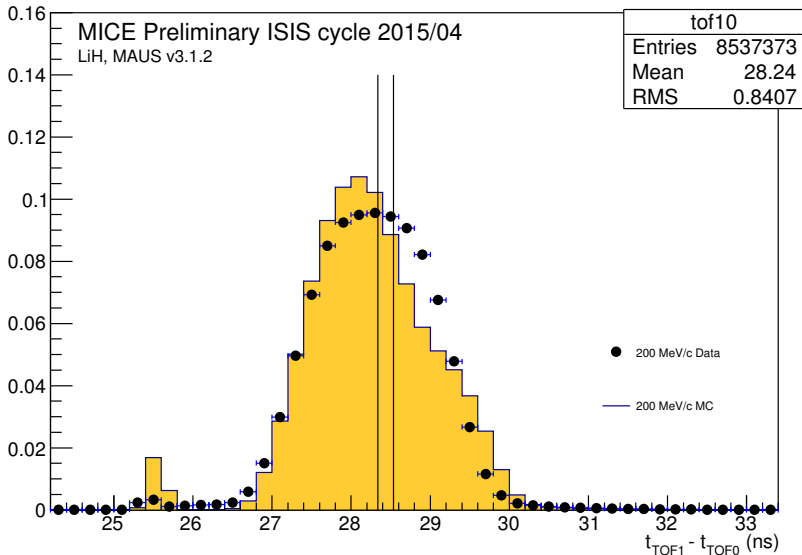
- Require a US track. If a DS track not extant, statistics are set to overflow values.
- Analysis done in 200 ps bins, as shown in TOF plot
- Require projection of US tracks to appear, when 12 mrad radial angle is added, within central 140 mm radius of DS trkr plane 5
- Tracks are projected to the upstream face of the diffuser, if track crosses the diffuser it is rejected

Selection

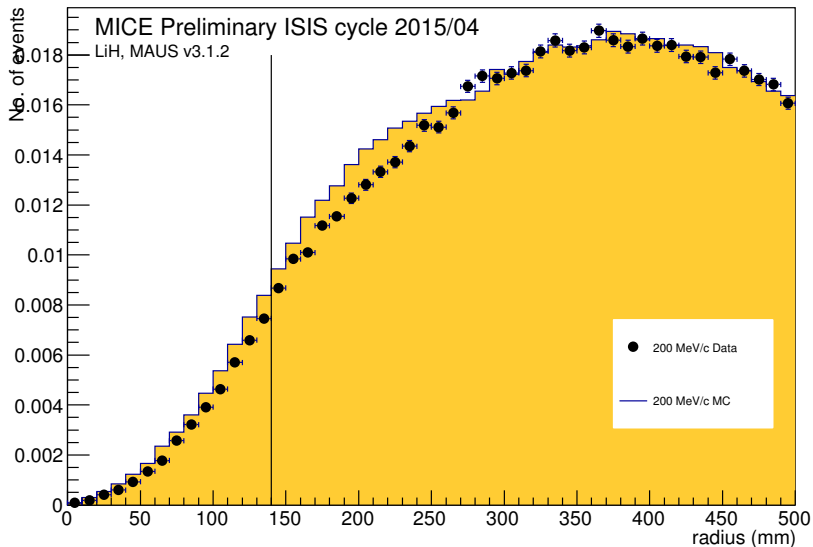
Selection	Description	μ Beams, LiH abs.		
		172	200	240
TOF1 trigger	At least two raw TOF slab hits exist and at least one in each TOF plane.	1.	1.	1.
Upstream track selection	There is one US track and at most one track in the DS tracker (If there is no DS track $\theta_X = \theta_Y = 45^\circ$).	66.84 %	68.05 %	74.15%
TOF timing selection	Select muons from run at the target momentum.	4.1 %	5.42 %	7.77 %
Fiducial selection	For projected US tracks $\sqrt{x^2 + y^2} < r_0$ at plane 5 of DS tracker, where $x = x_0 + (\frac{dx}{dz} + a_0 \cos \phi)\Delta z$, $y = y_0 + (\frac{dy}{dz} + a_0 \sin \phi)\Delta z$, and $\phi = \tan^{-1} \frac{dy/dz}{dx/dz}$. $r_0 = 150$ mm and $a_0 = 0.012$ assumed.	0.09 %	0.19 %	0.41 %
Diffuser cut	US tracks are projected to the diffuser position any track within the radius of the diffuser annulus is rejected	0.07 %	0.16 %	0.36 %

Cut plot

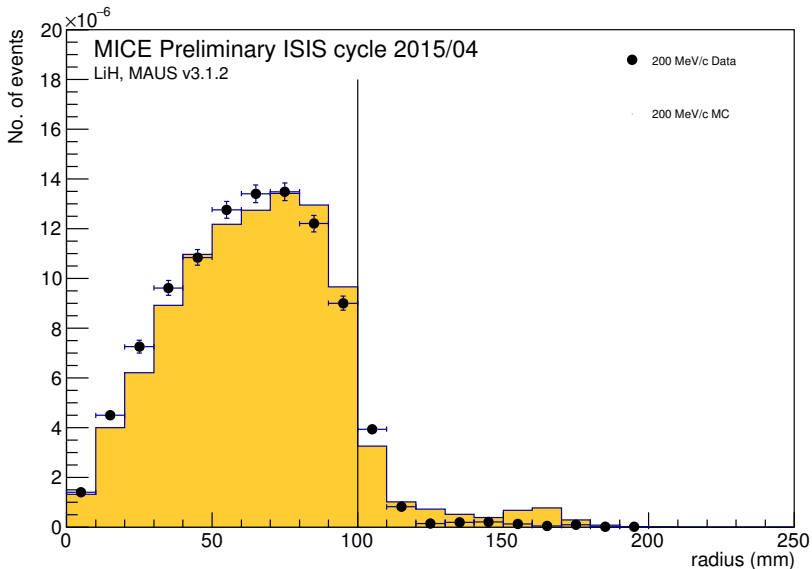
TOF Between Stations 1 and 0



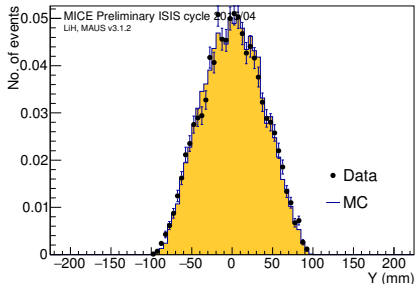
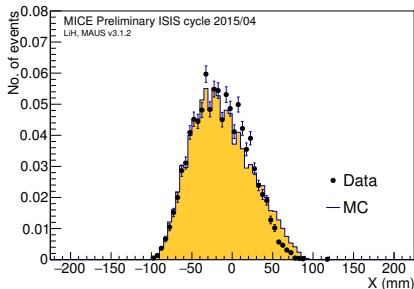
Cut plot



Cut plot

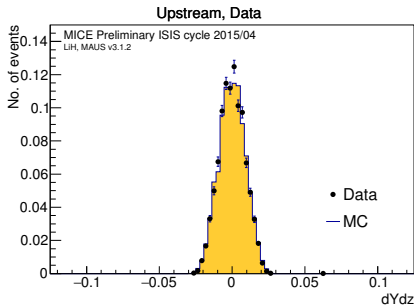
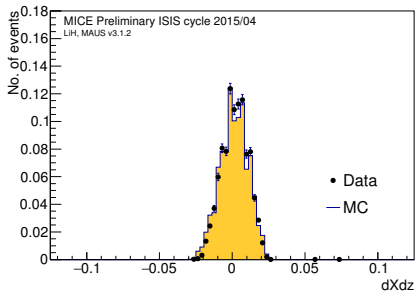


MC Data comparison



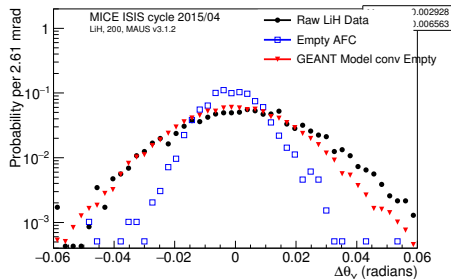
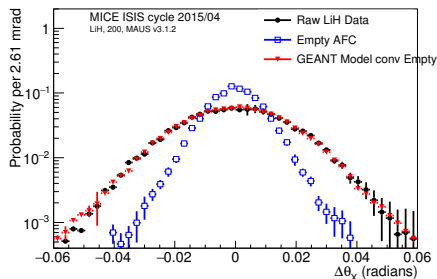
- 200 MeV/c case
- Compare MC recon and data

MC Data comparison



- 200 MeV/c case
- Compare MC recon and data

Forward convolution

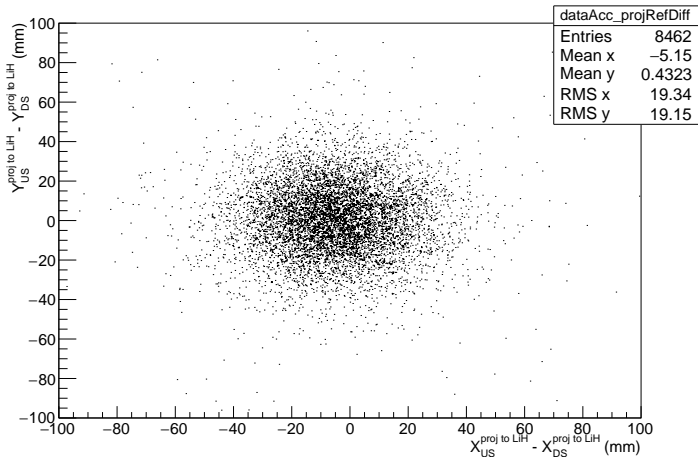


- Geometry fix gives much improved agreement
- Impact parameter plots on next slide
- Updated fiducial selection to account for known position of tracker

Transverse Distance at Absorber

Request to understand distance between projected tracks at absorber centre

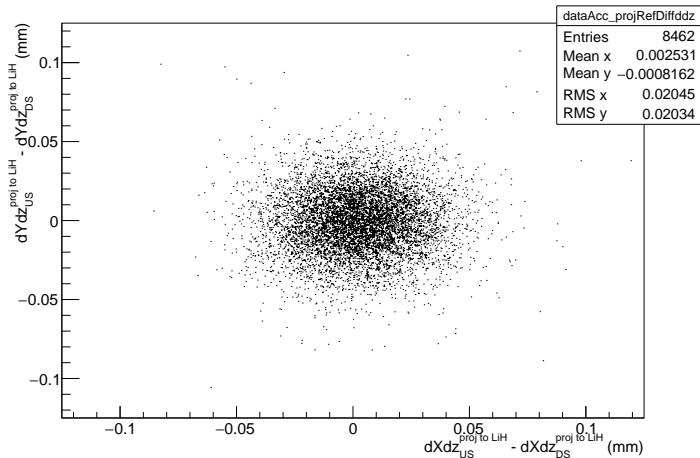
Project tracks to centre of absorber and calculate transverse distance



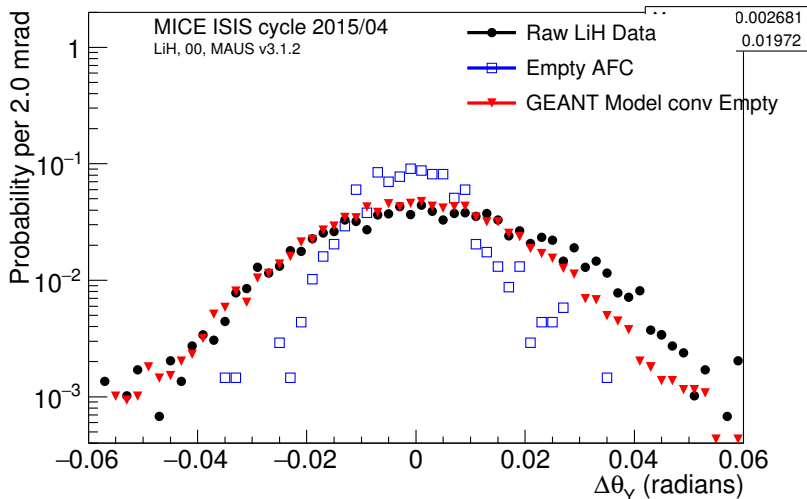
Transverse Distance at Absorber

Request to understand distance between projected tracks at absorber centre

Project tracks to centre of absorber and calculate angle difference

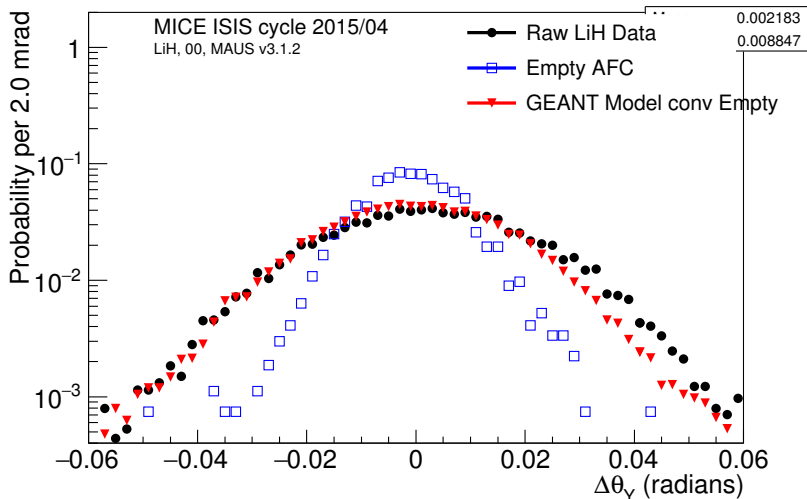


Fiducial cut



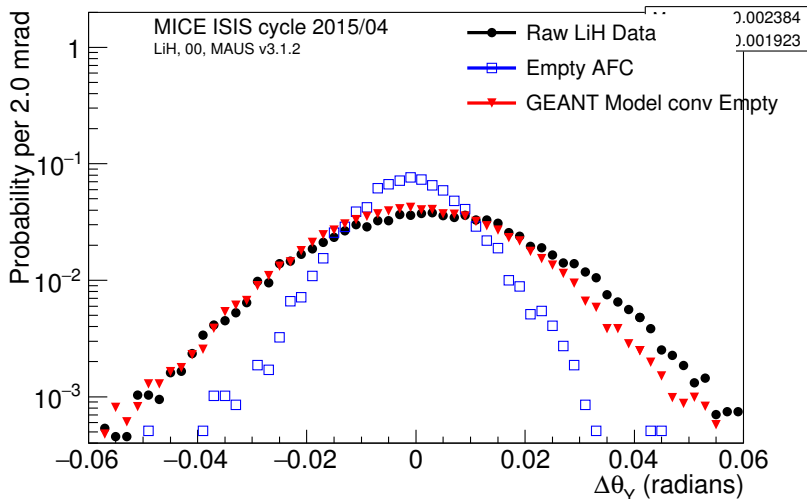
Projected track is within 50 mm of on z-axis track

Fiducial cut



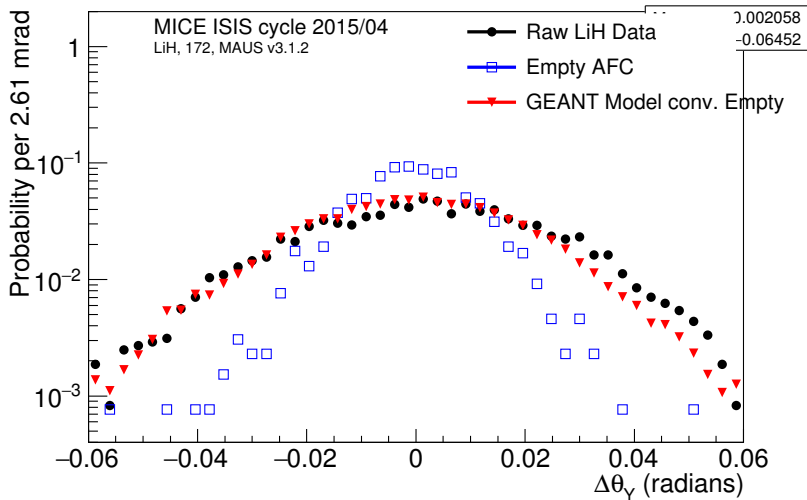
Projected track is within 100 mm of on z-axis track

Fiducial cut

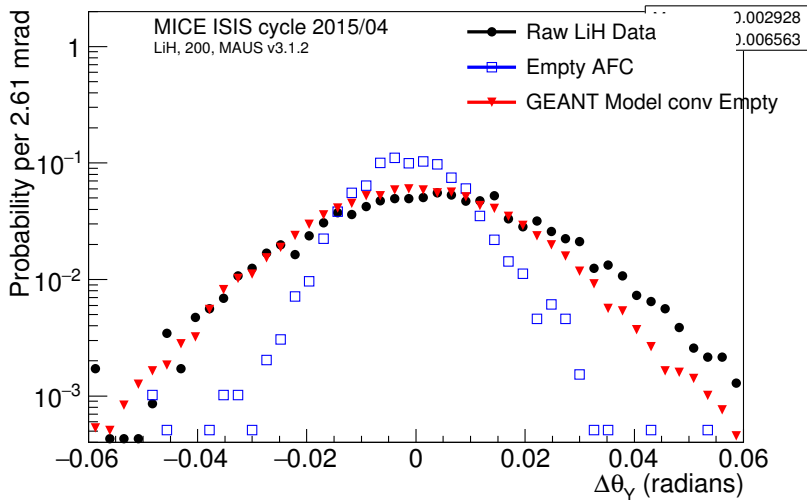


Projected track is within 150 mm of on z-axis track

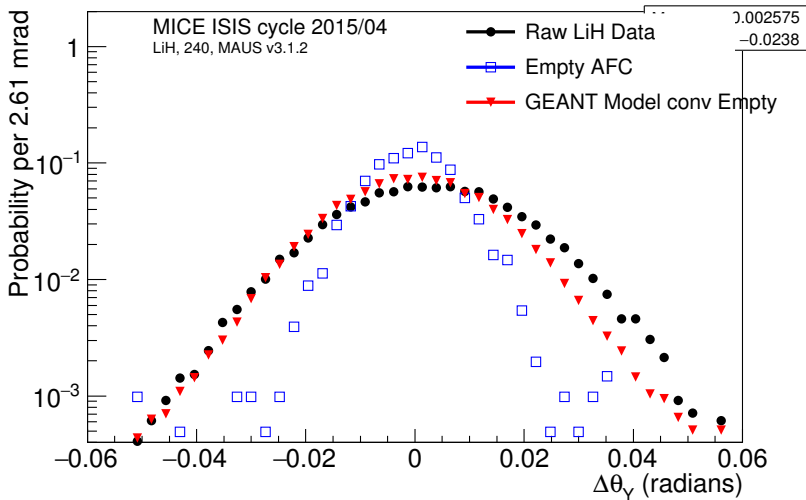
P scan



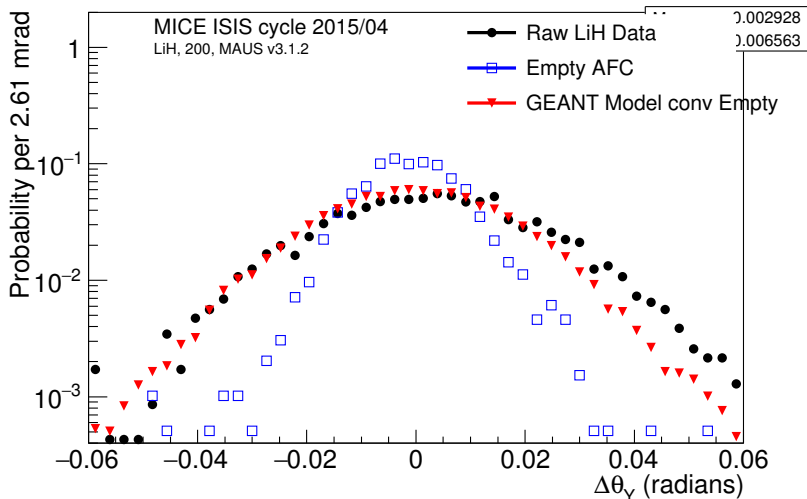
P scan



P scan

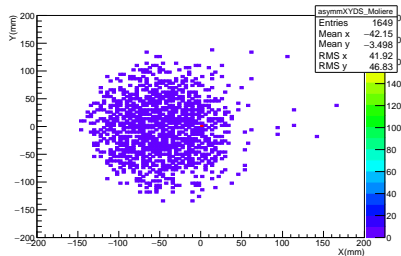
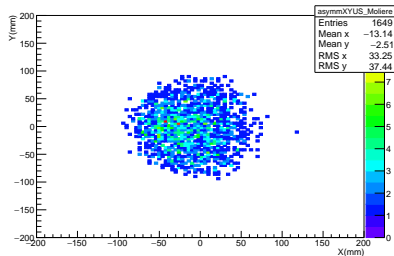


Core of beam



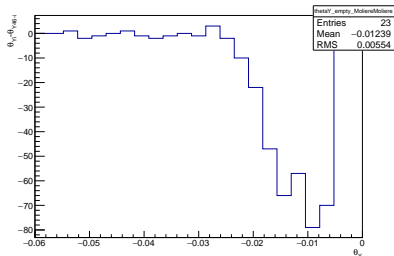
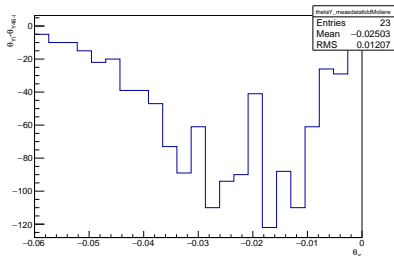
If XY position is < 30 mm or > -30 mm upstream ref plane

Asymmetric bump



Left: Upstream & Right: Downstream
If $\theta_Y > 0.02$ plot

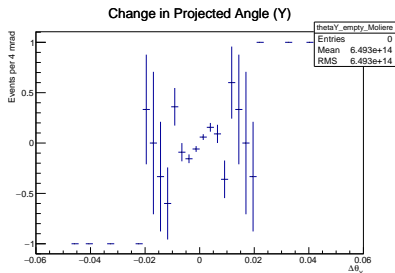
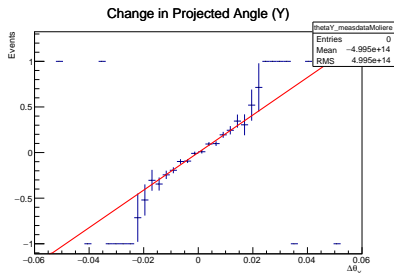
Left-Right Comparison



Left: LiH & Right: Empty channel
Left hand bin minus corresponding right hand bin

Asymmetry plot

$$A_i = \frac{h_1 - h_2}{h_1 + h_2} \quad (1)$$



Left: LiH & Right: Empty channel

Job List

- Scan in rotation angle

Rotate Angle Definitions

Definition of scattering angles comes from Cobb Note

$$\tan \theta_p = \frac{\vec{d} \cdot \vec{v}'}{\vec{d} \cdot \vec{u}} \quad (2)$$

where

$$\vec{v} = \vec{s} \times \vec{u} \quad (3)$$

where \vec{s} is arbitrary defined as $\vec{s} = (0, -1, 0)$

Test that this definition is arbitrary by rotating around the z-axis and plot RMS of scattering distribution

Scattering Data

Scattering Angle Definitions

- In the top diagram both the solid vectors are in the plane of the square i.e. the plain of the board. The y-axis is coming out of the board
- If both the up- and downstream vector were in the same plane then the subtraction of the simple projected angle would be sufficient
- The bottom figure is a side on view of the top figure. If the up- and downstream vectors are in two different planes then a more consider approach is required as detailed in <http://www.ppe.gla.ac.uk/~jnugent/Projected-angles.pdf> by John Cobb

