



BM@N Analysis and Software Meeting
JINR, Dubna, Russia, March 12–13, 2024

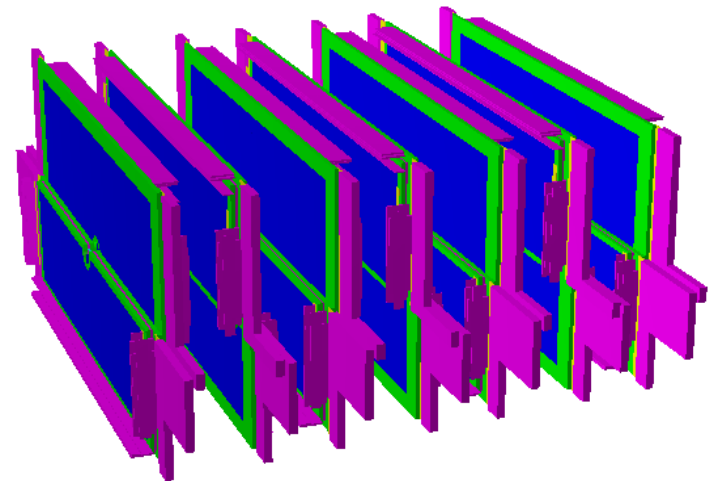
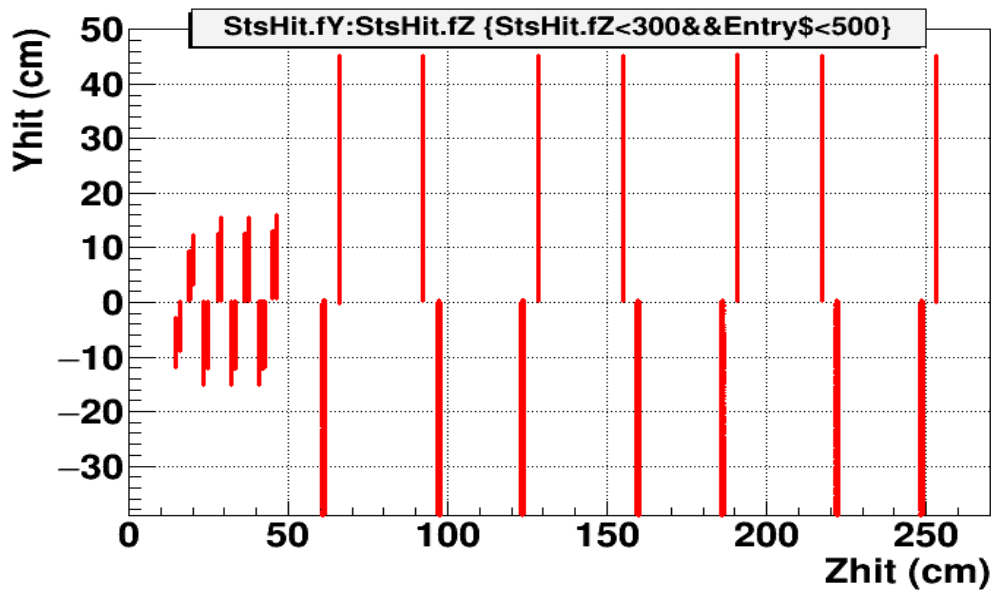
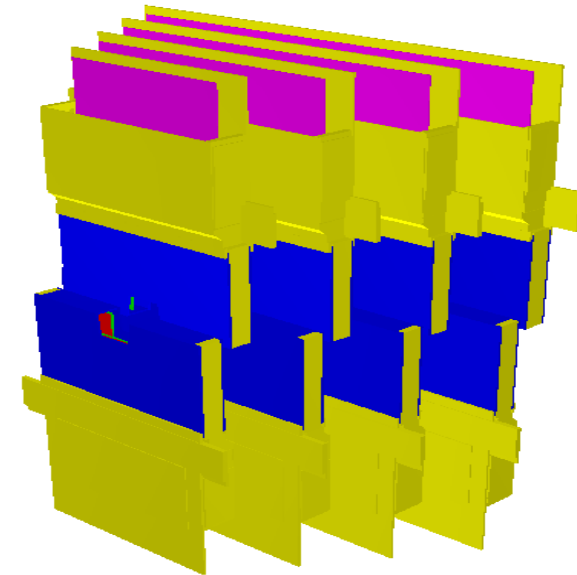
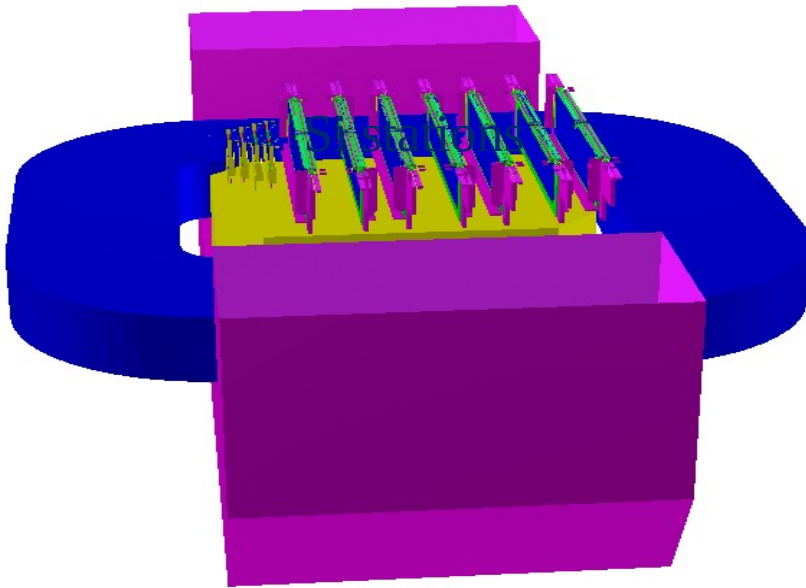
Reconstruction and analysis of the data from the central tracker in Run 8

J. Drnoyan, I. Rufanov, V. Vasendina, A. Zinchenko,
D. Zinchenko, R. Zinchenko

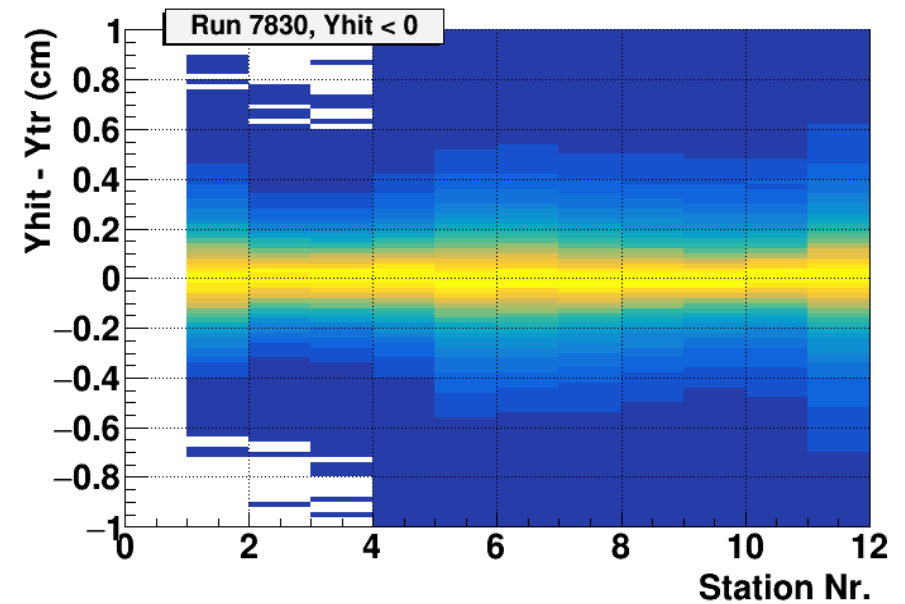
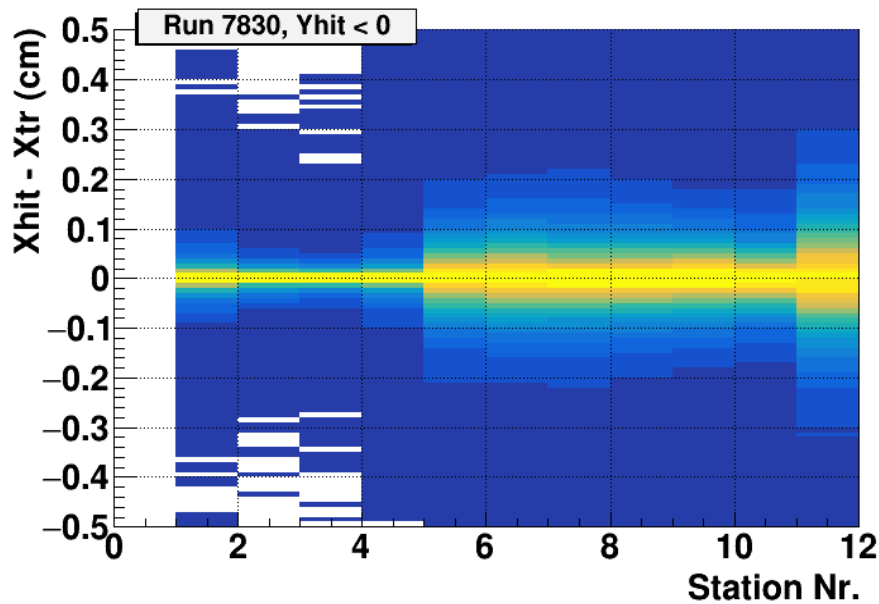
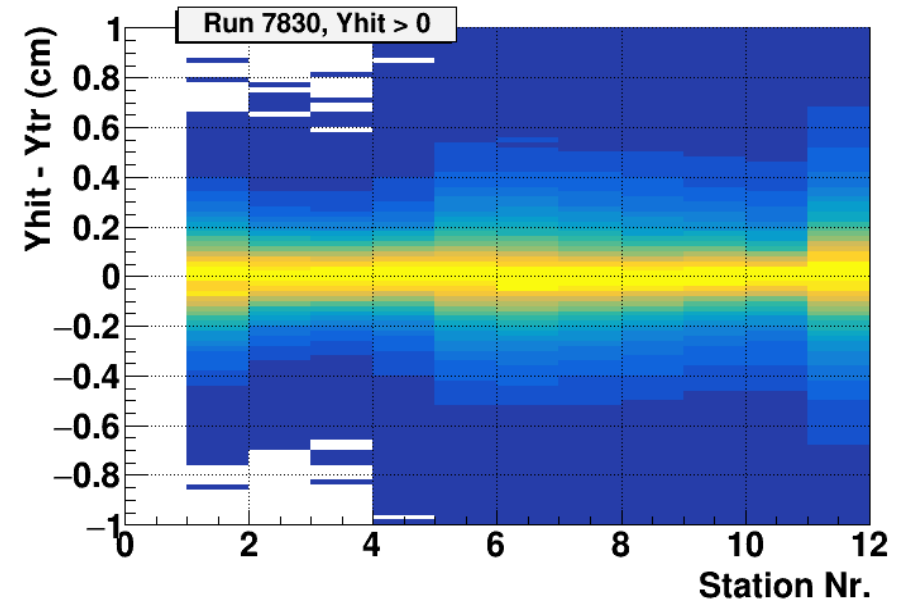
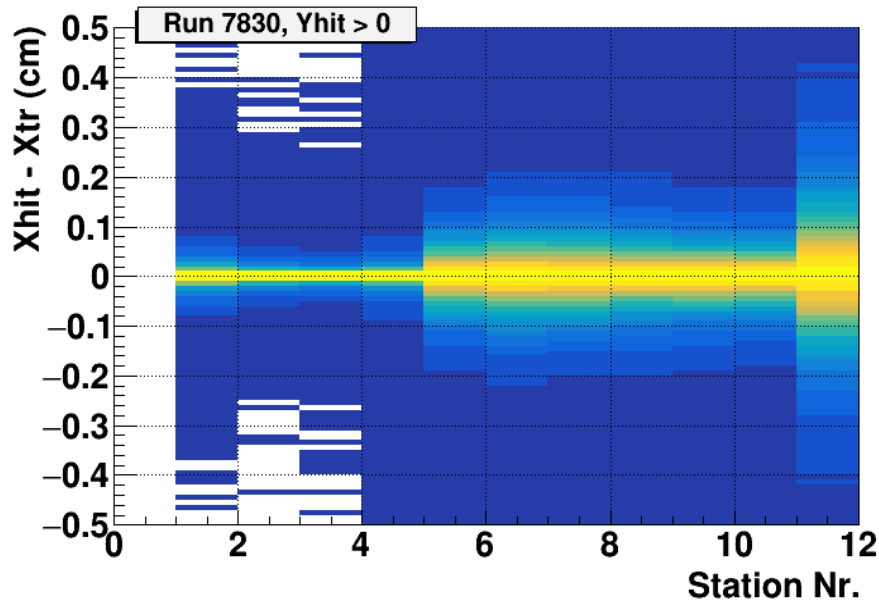
VBLHEP, JINR, Dubna, Russia

- ✓ BM@N configuration
- ✓ Alignment
- ✓ MC-to-data comparison
- ✓ Data quality checking
- ✓ Steps toward physics analysis
- ✓ Summary and next steps

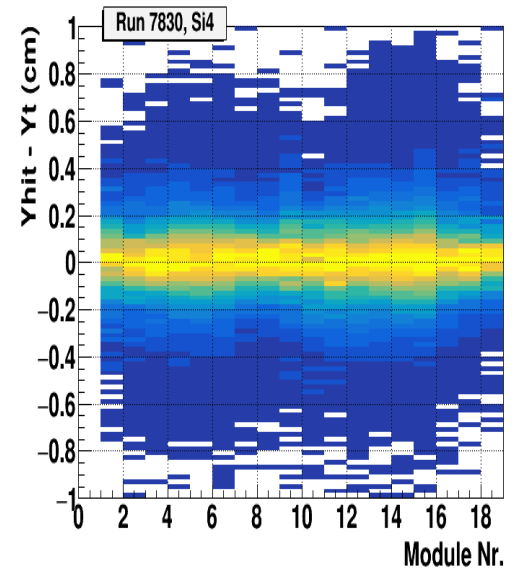
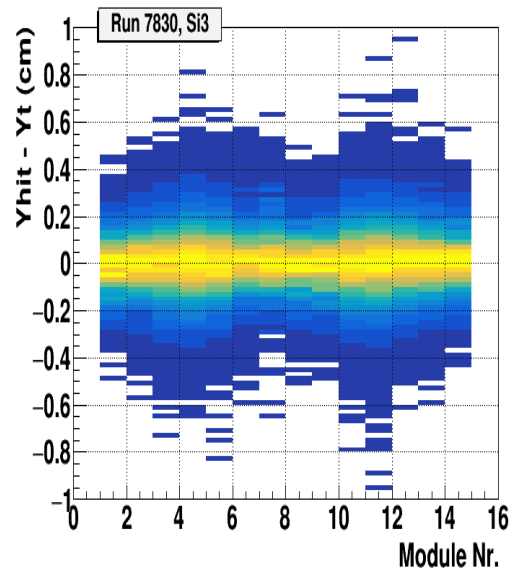
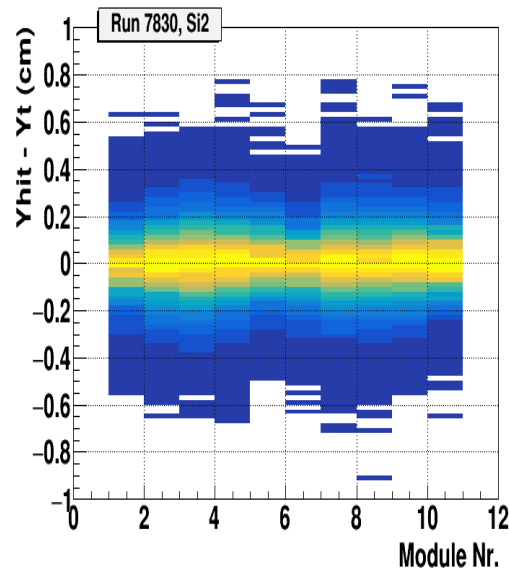
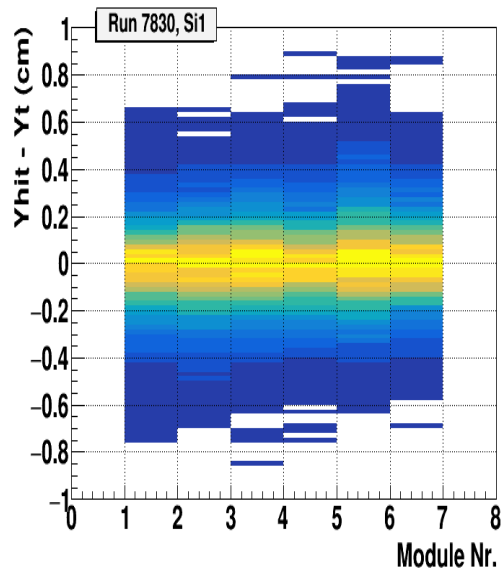
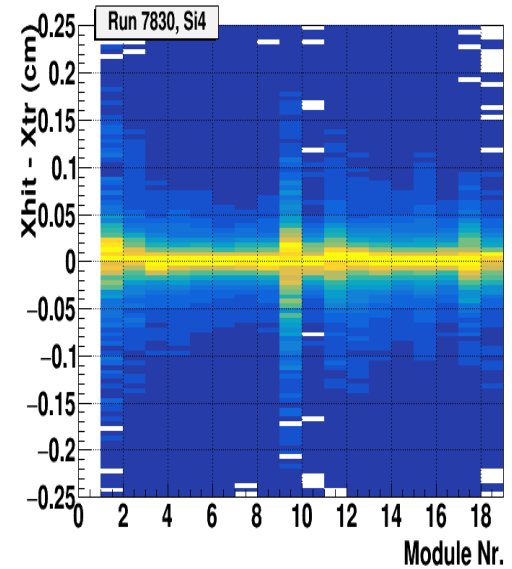
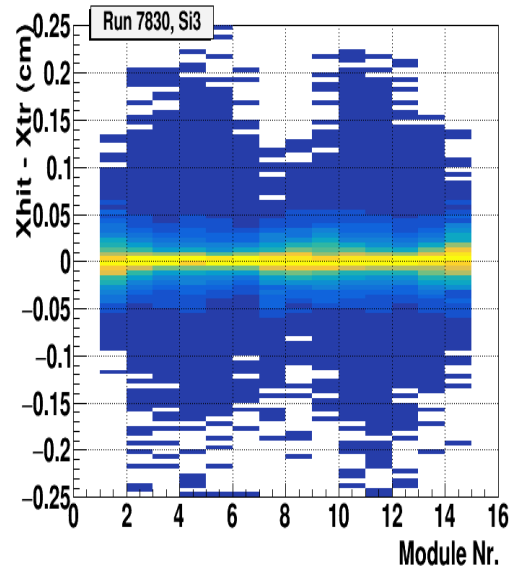
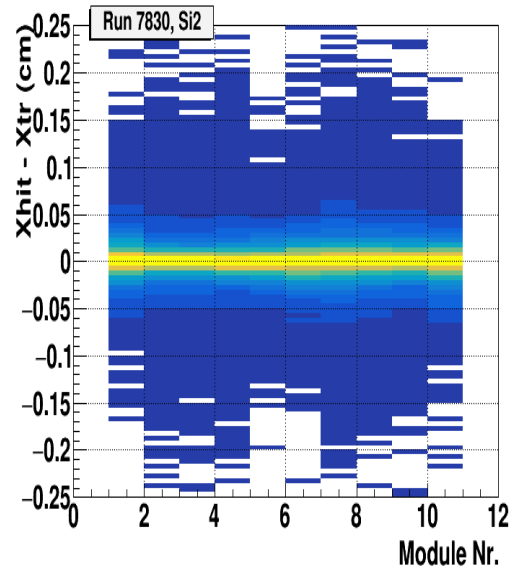
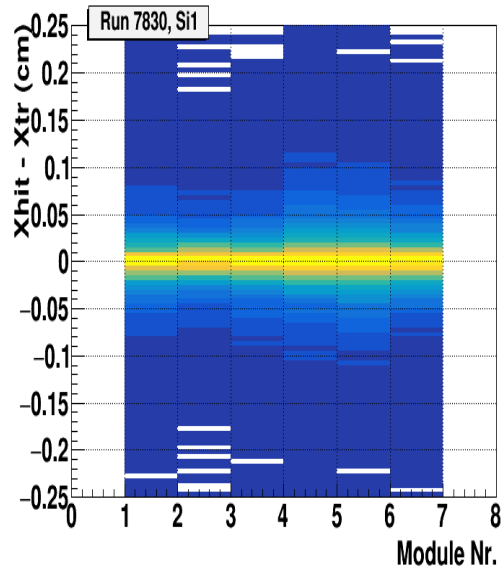
Detector geometry in Run 8



Residuals vs station Nr. (run 7830)



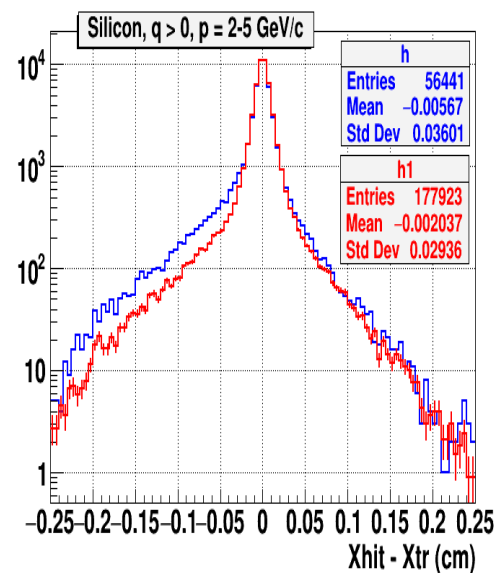
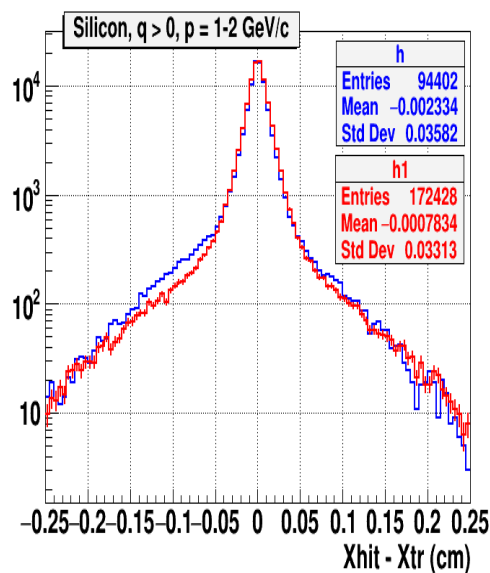
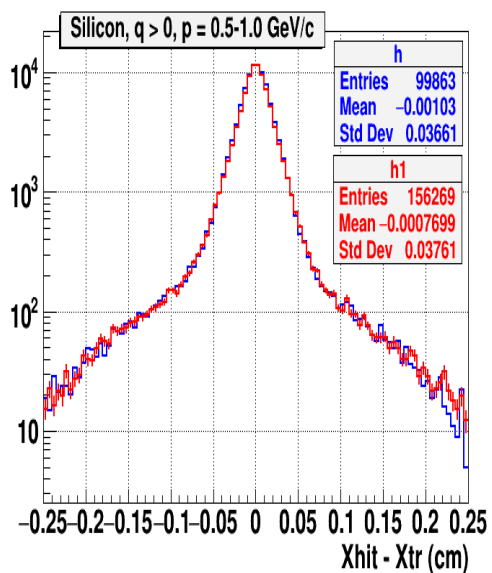
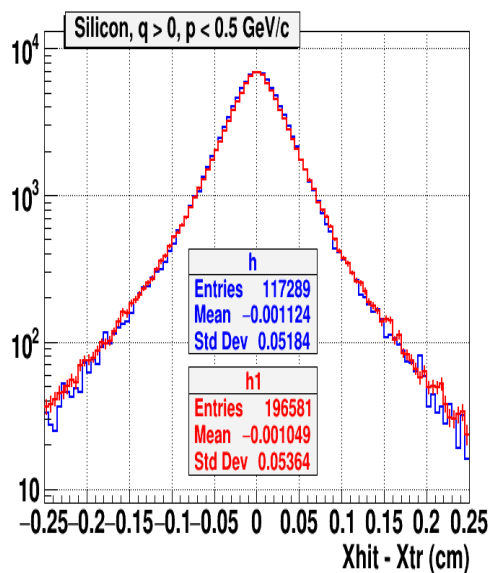
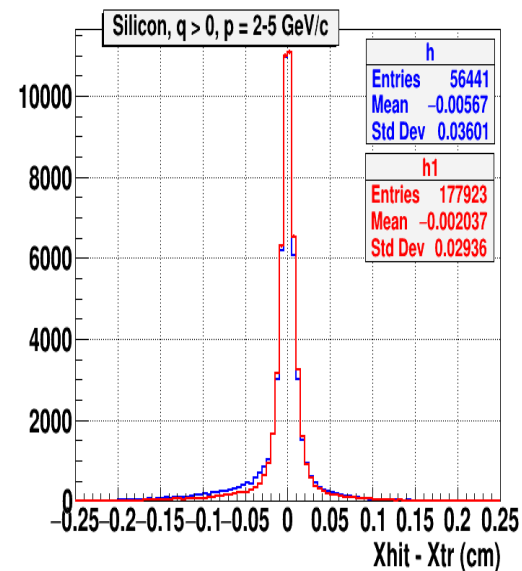
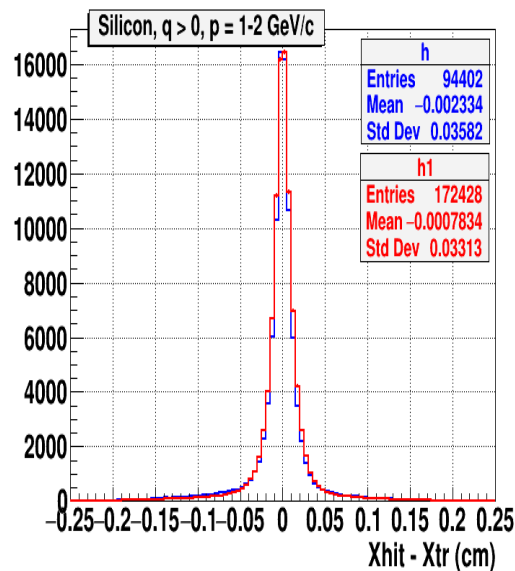
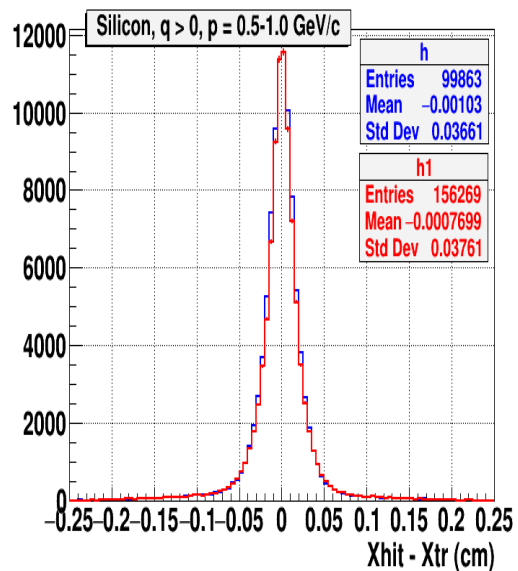
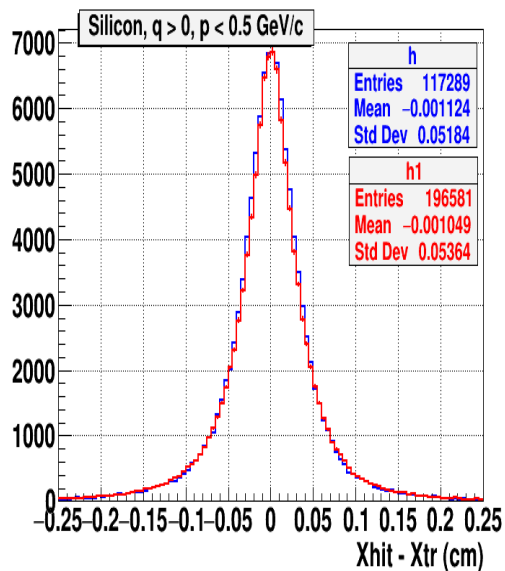
Residuals in Si vs module Nr.



Residuals in X vs momentum in Si ($q > 0$)



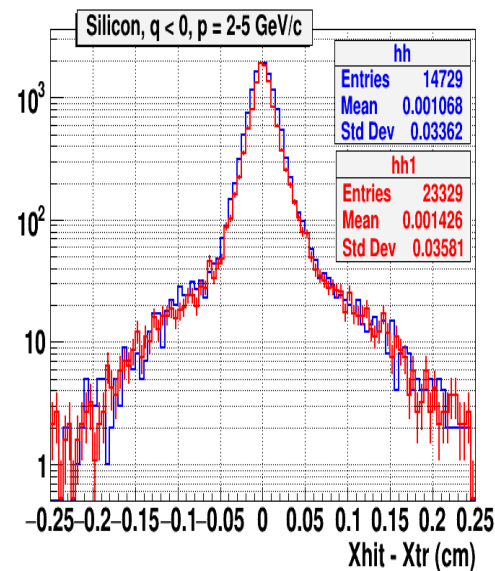
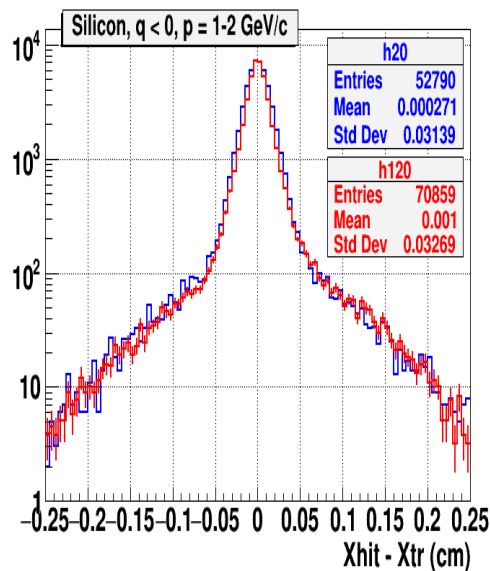
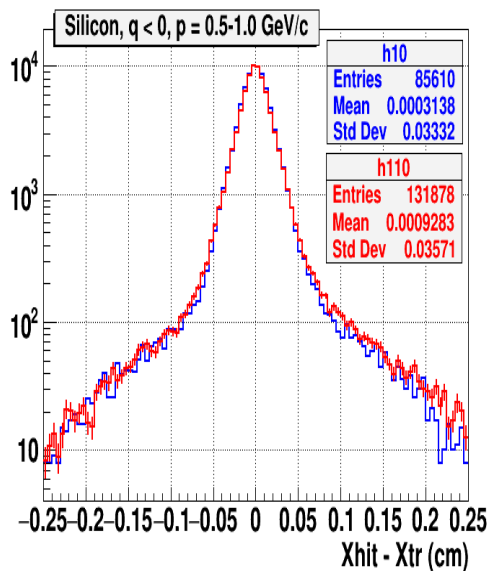
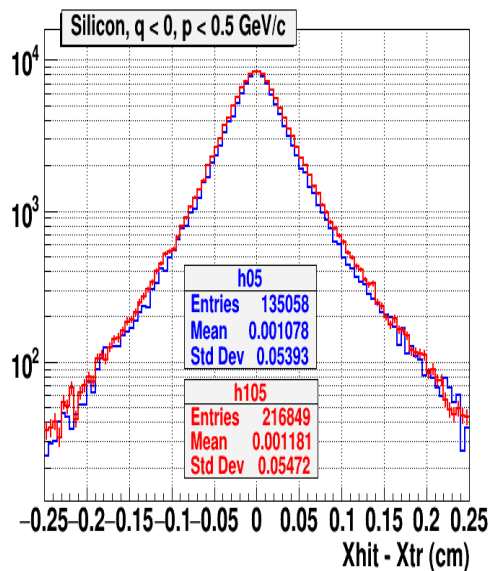
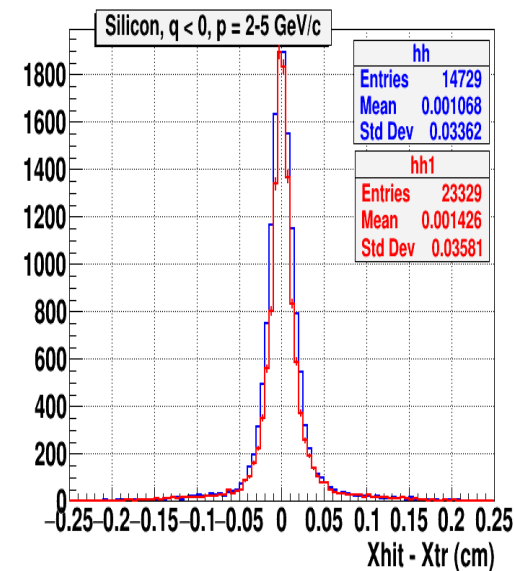
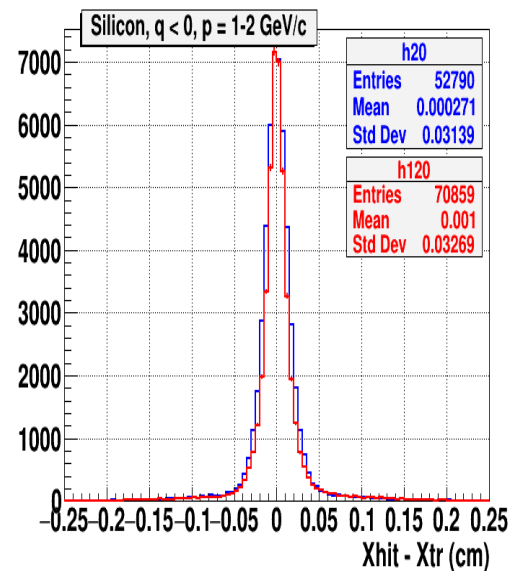
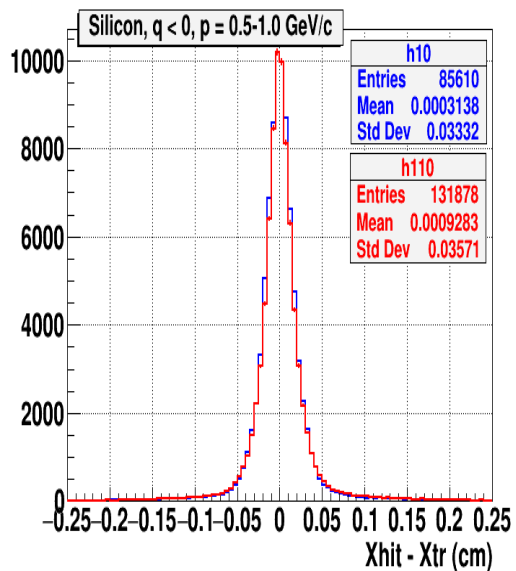
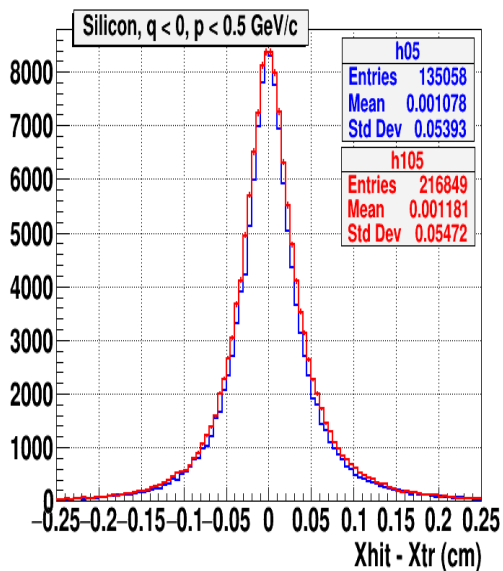
Data vs MC



Residuals in X vs momentum in Si ($q < 0$)



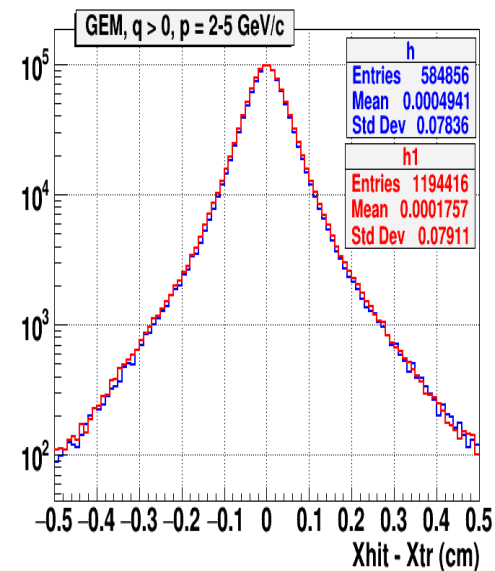
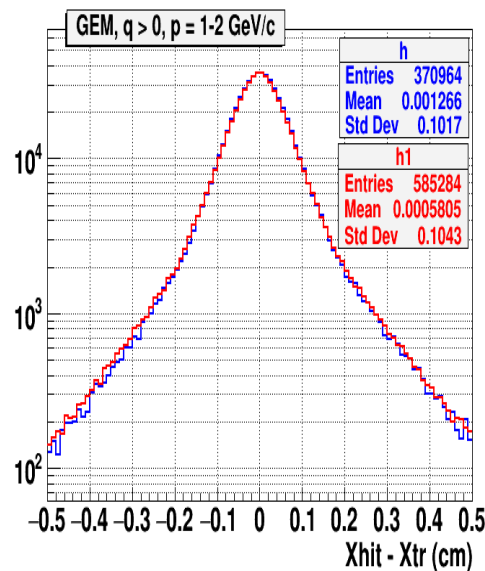
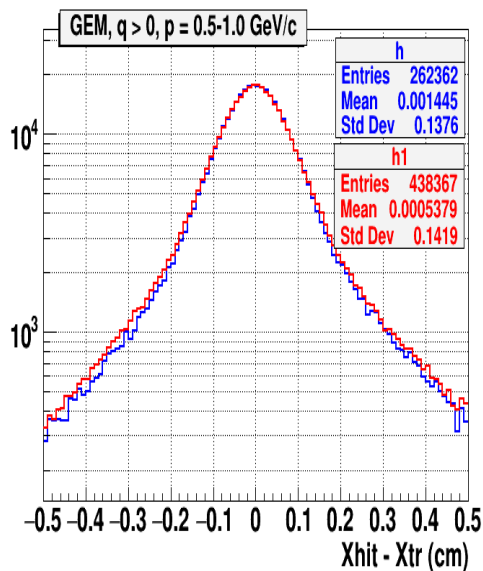
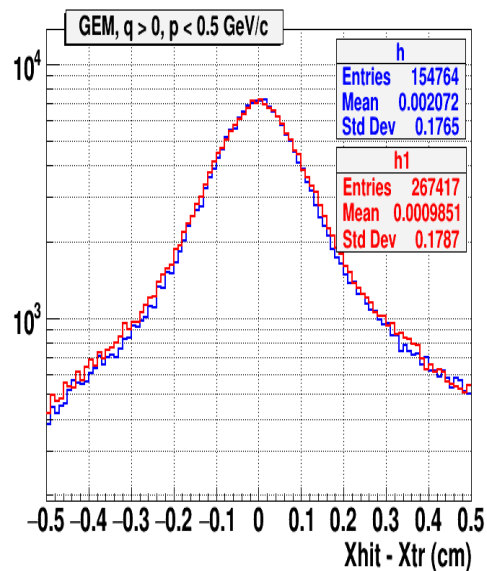
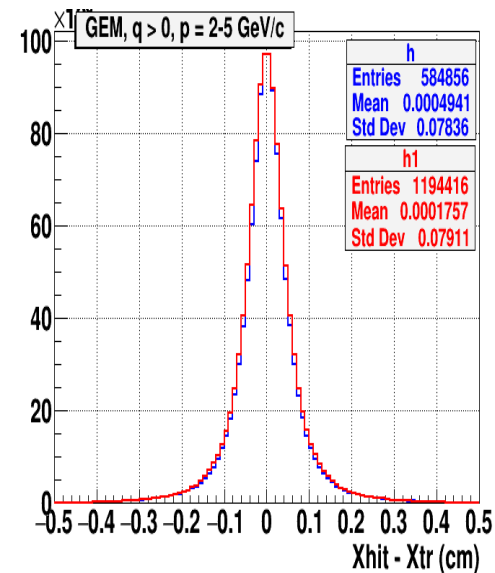
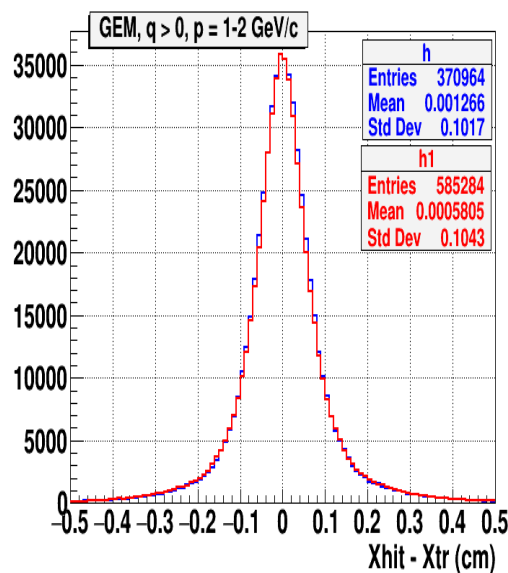
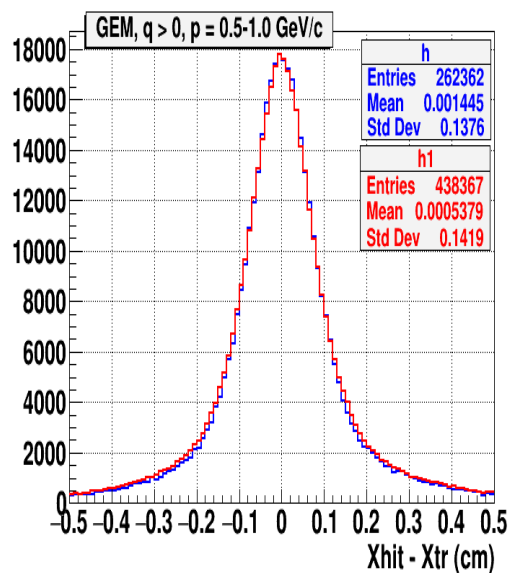
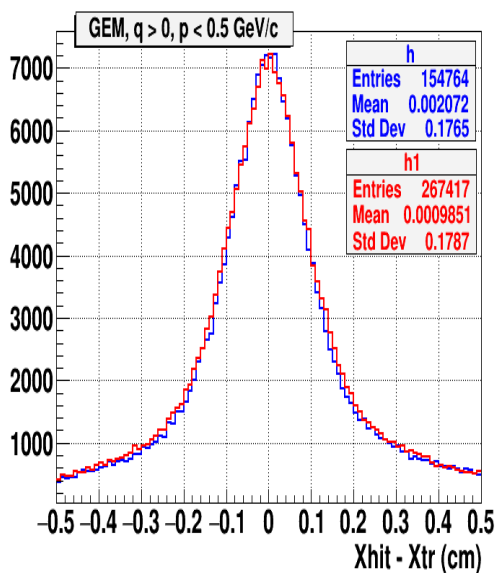
Data vs MC



Residuals in X vs momentum in GEM ($q > 0$)



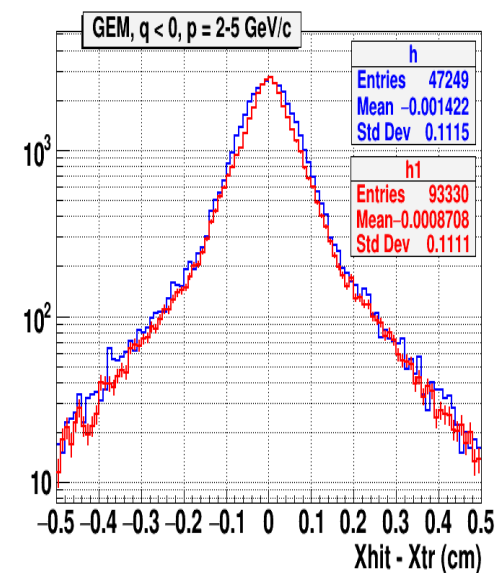
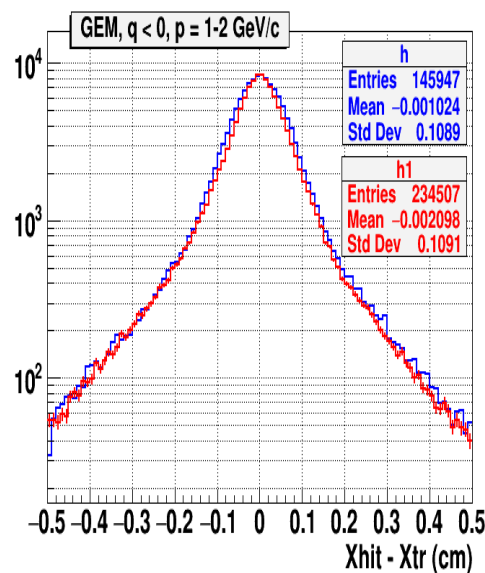
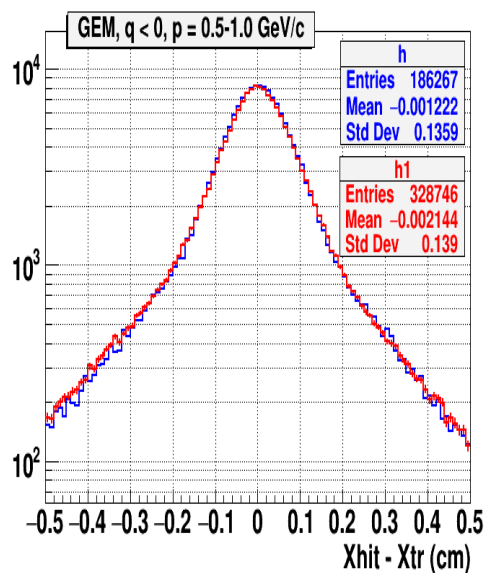
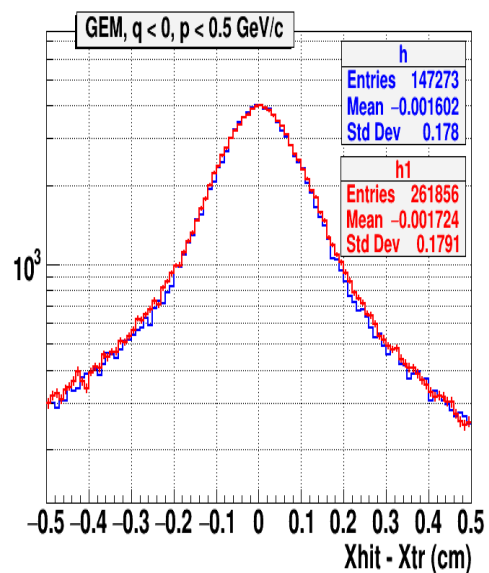
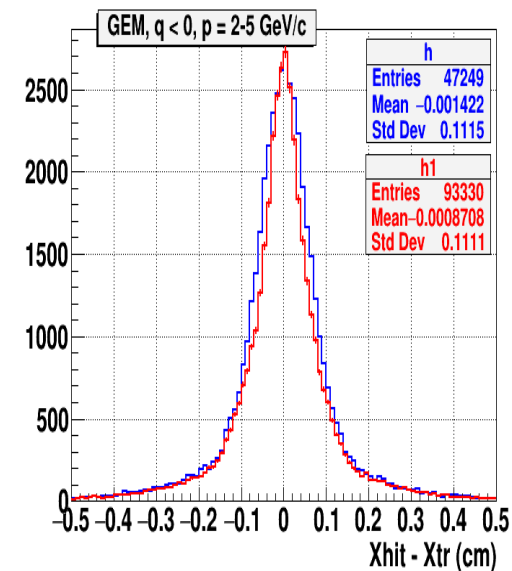
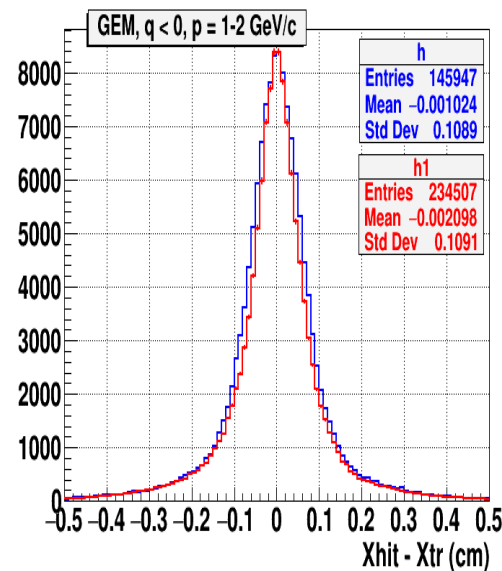
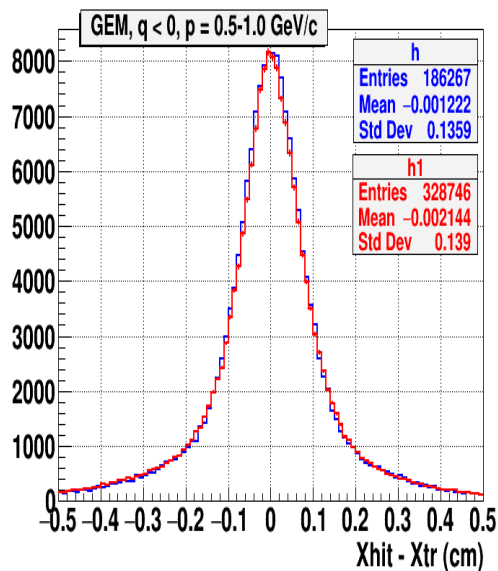
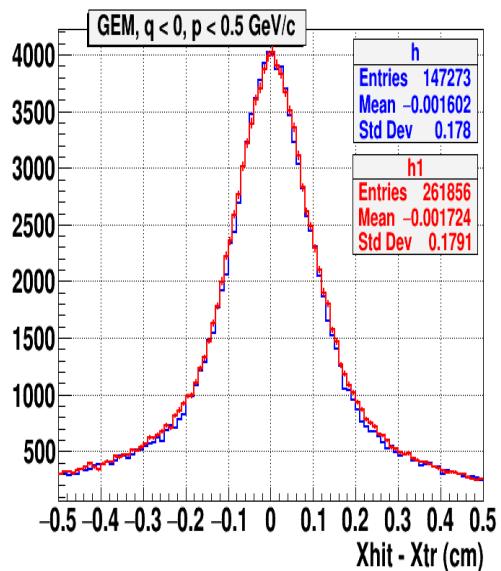
Data vs MC



Residuals in X vs momentum in GEM ($q < 0$)



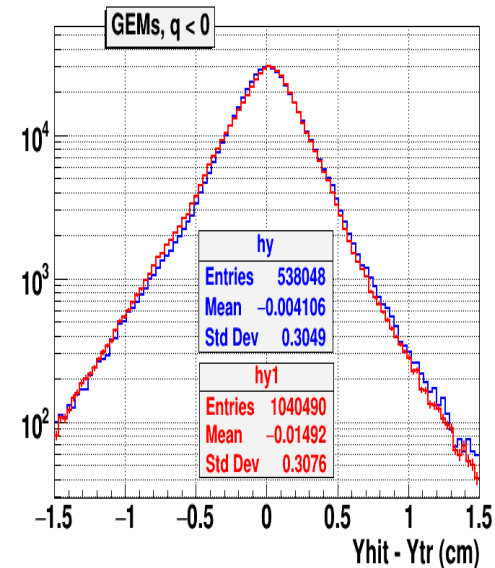
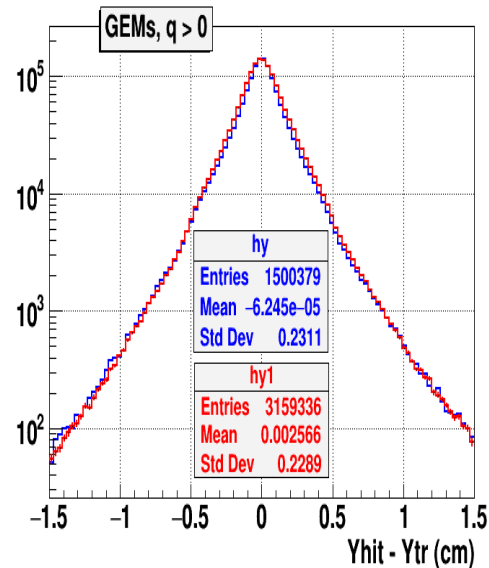
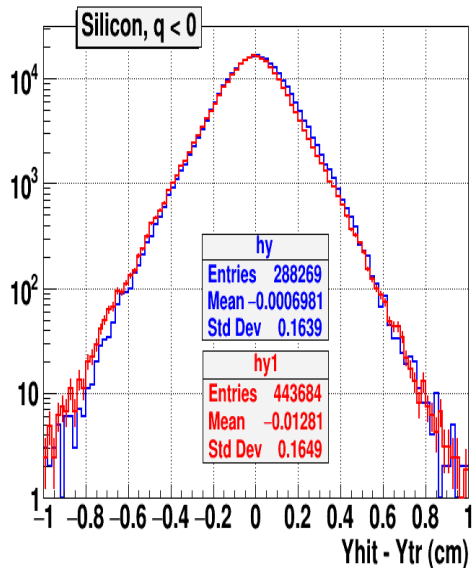
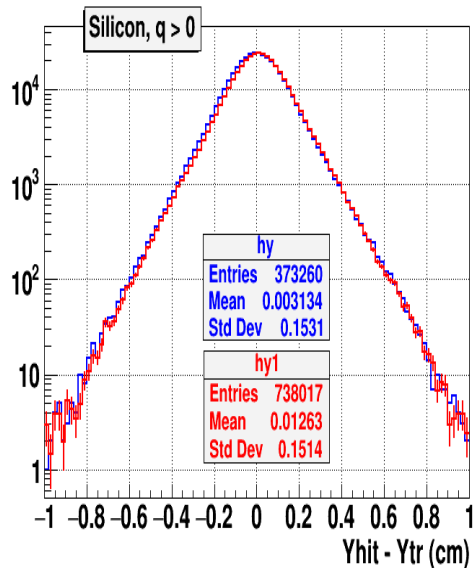
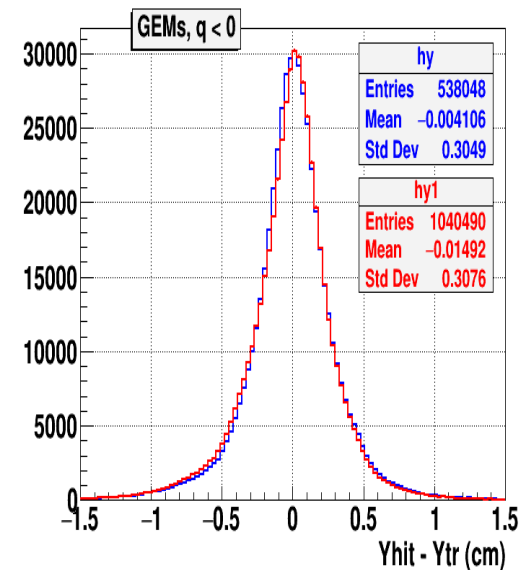
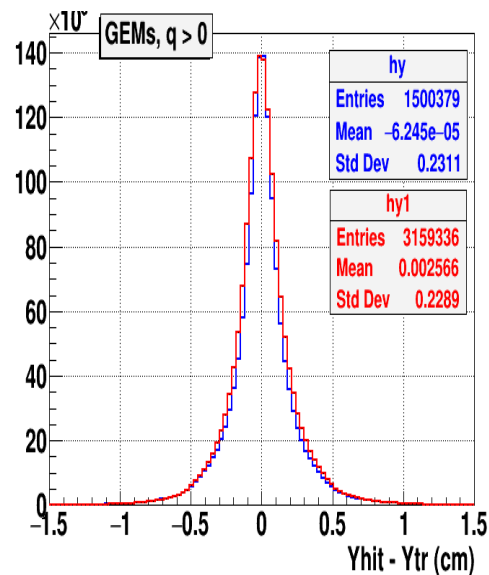
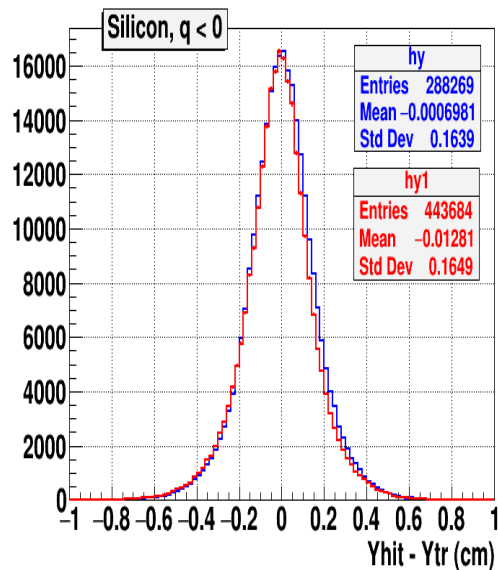
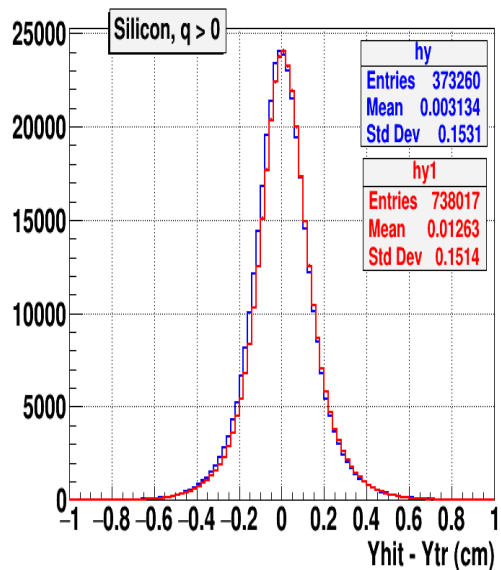
Data vs MC



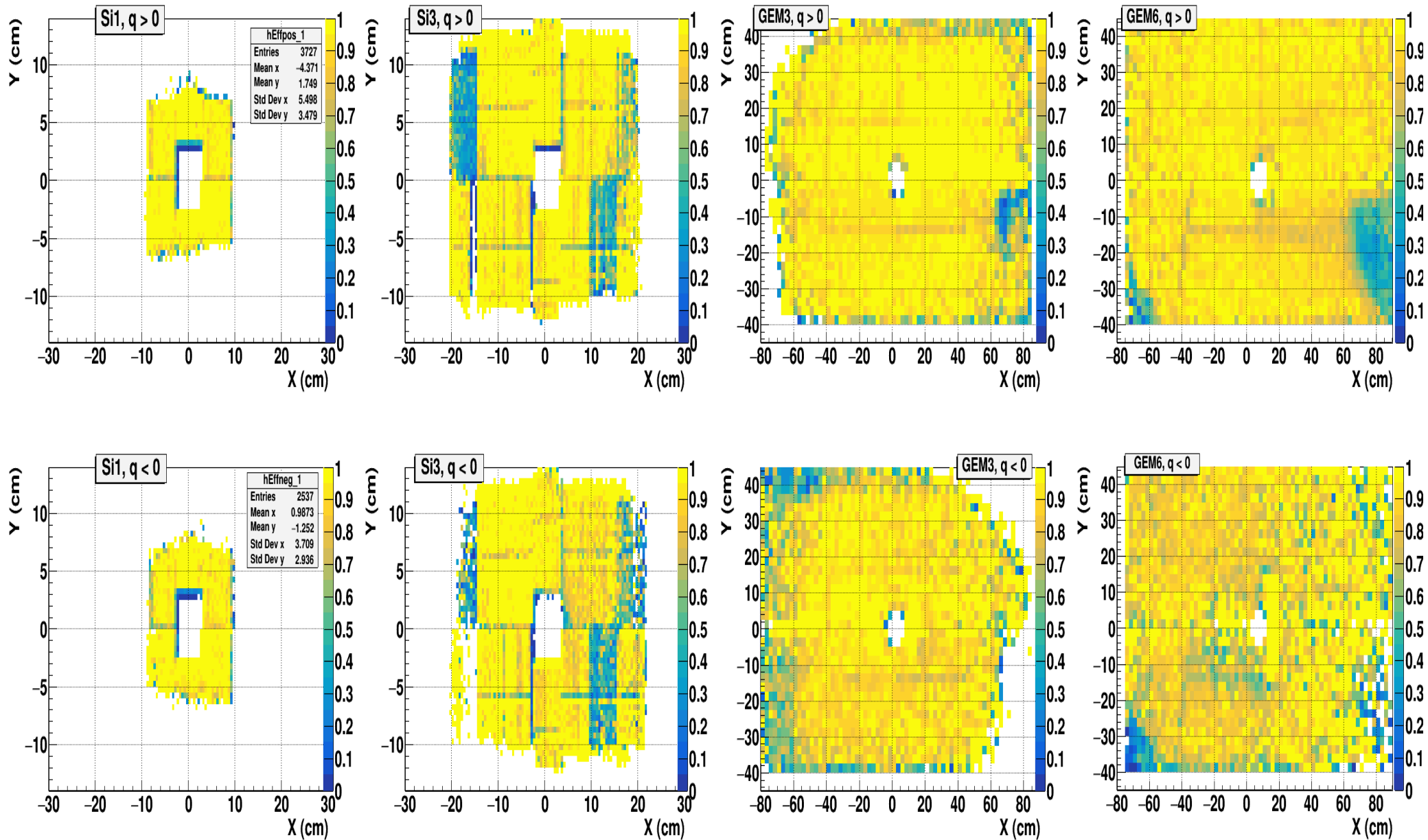
Residuals in Y



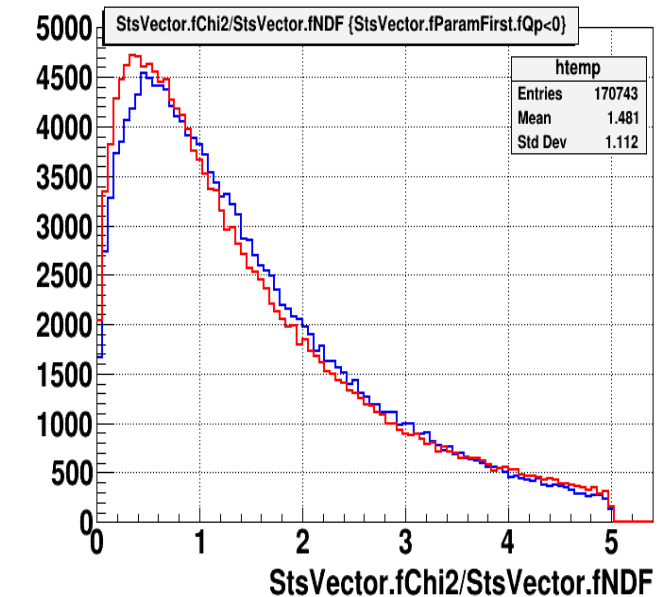
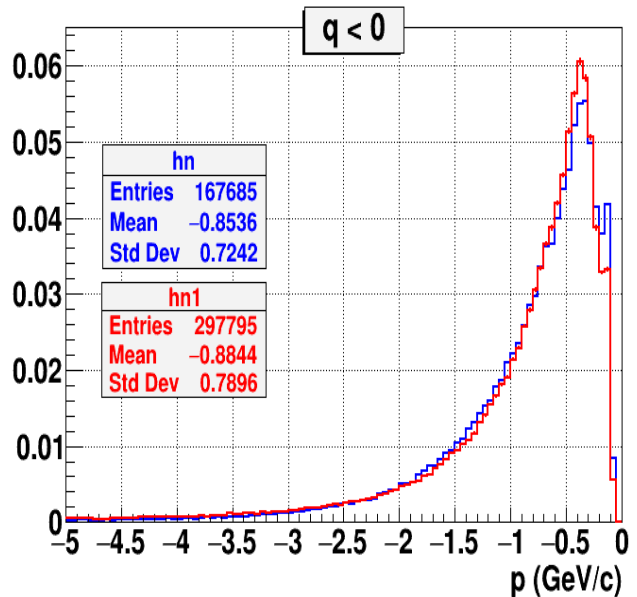
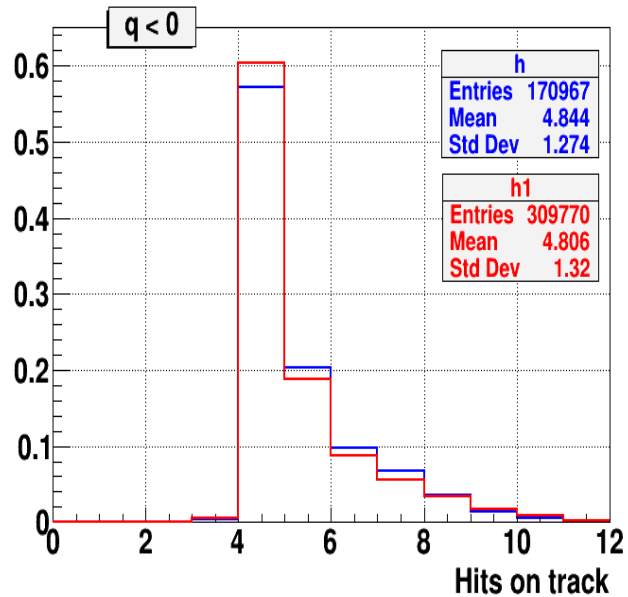
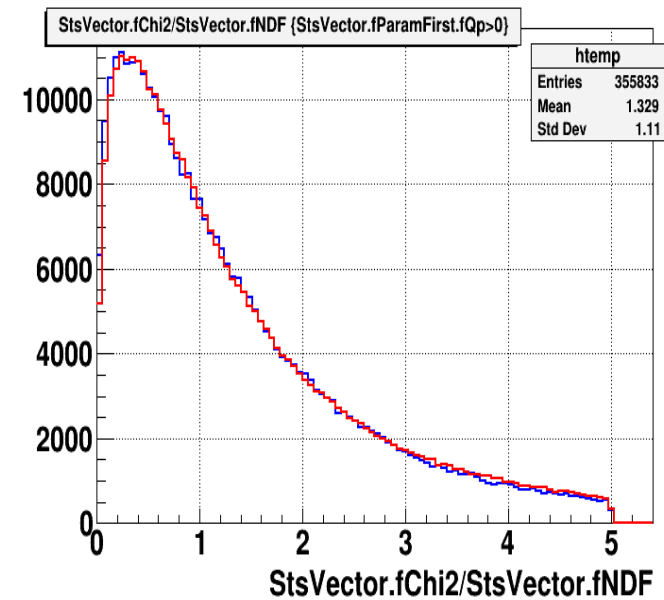
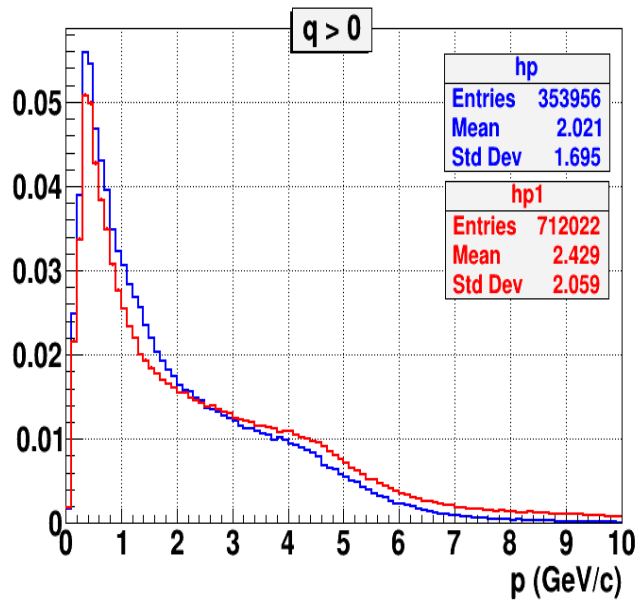
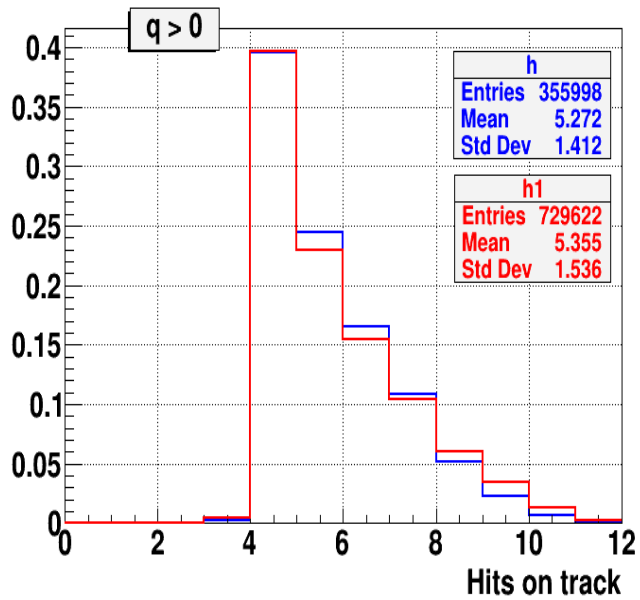
Data vs MC



Efficiency of detectors (Si and GEM)



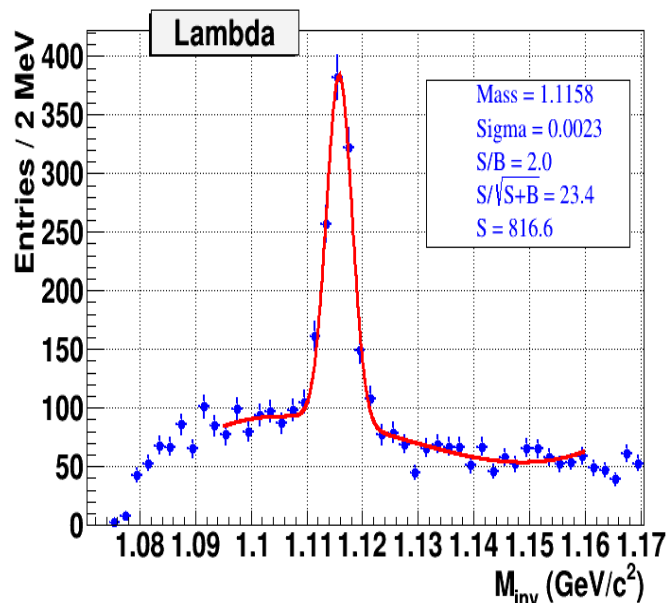
Geant4 tracks: Data vs MC



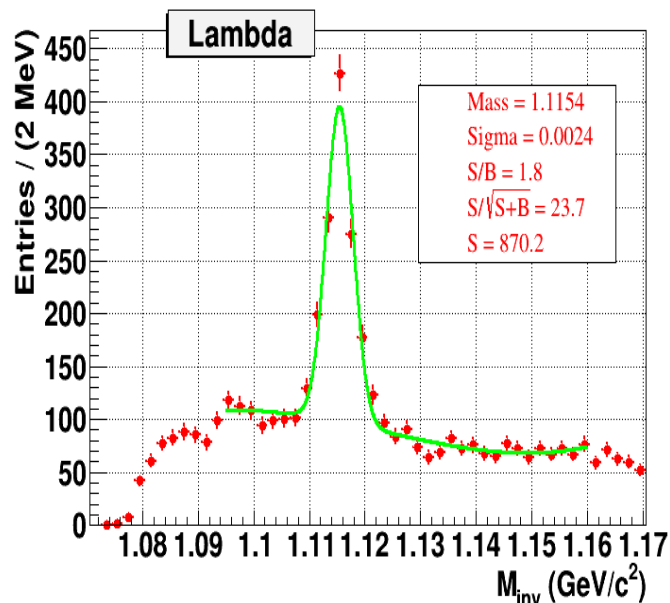
V0: Data vs MC



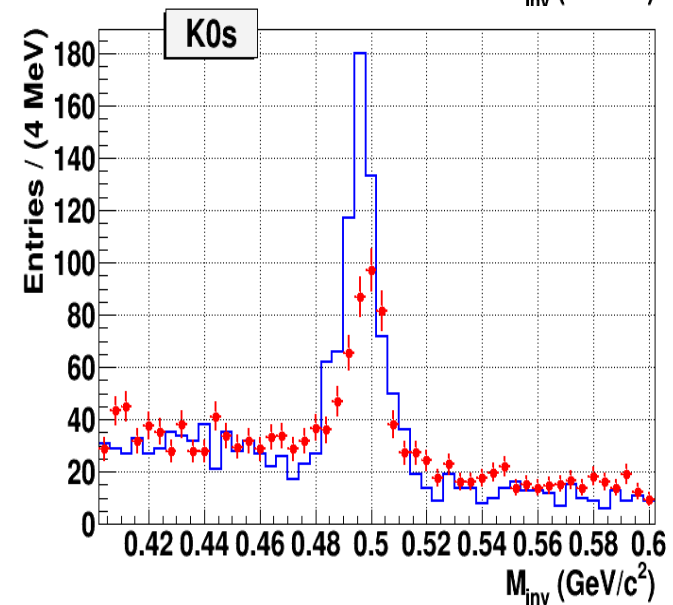
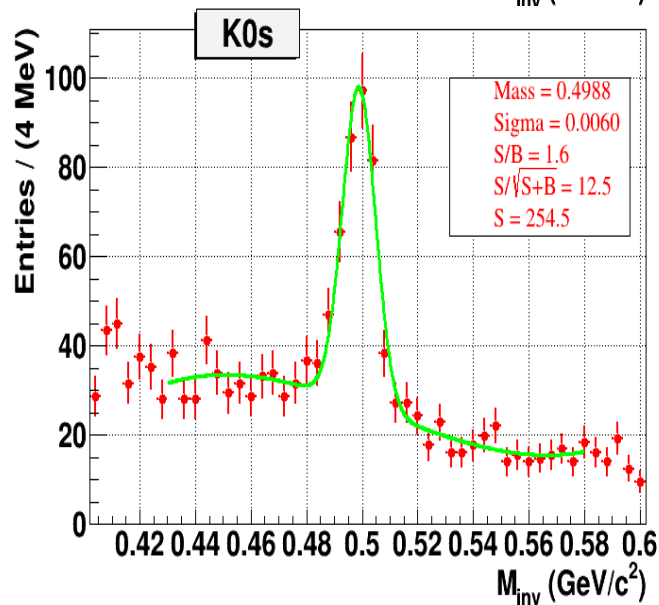
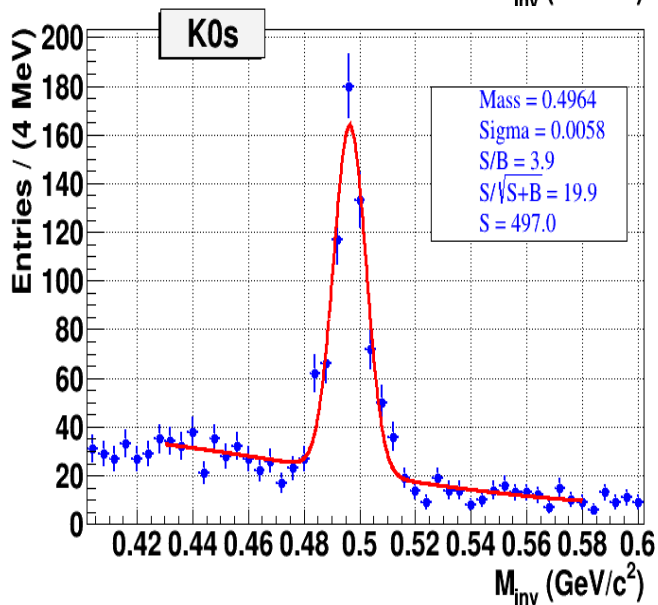
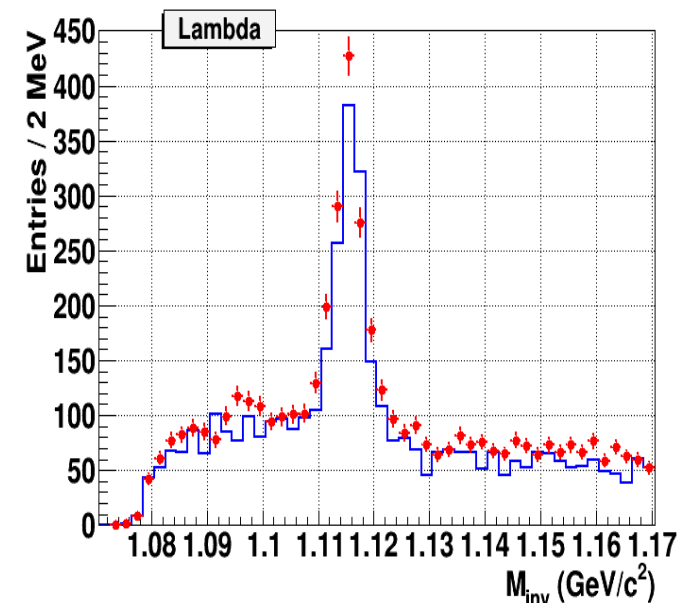
MC



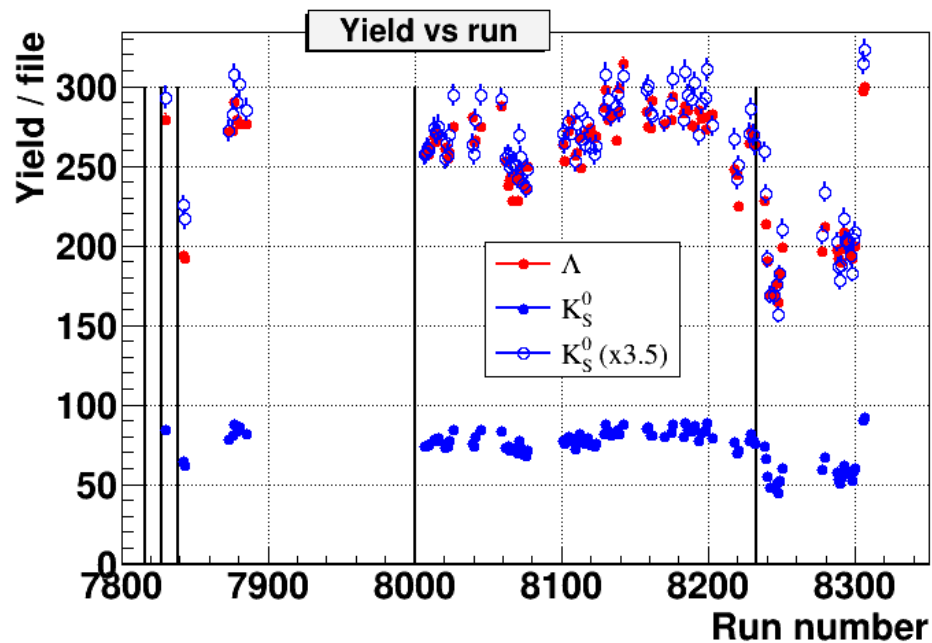
Data



Data vs MC

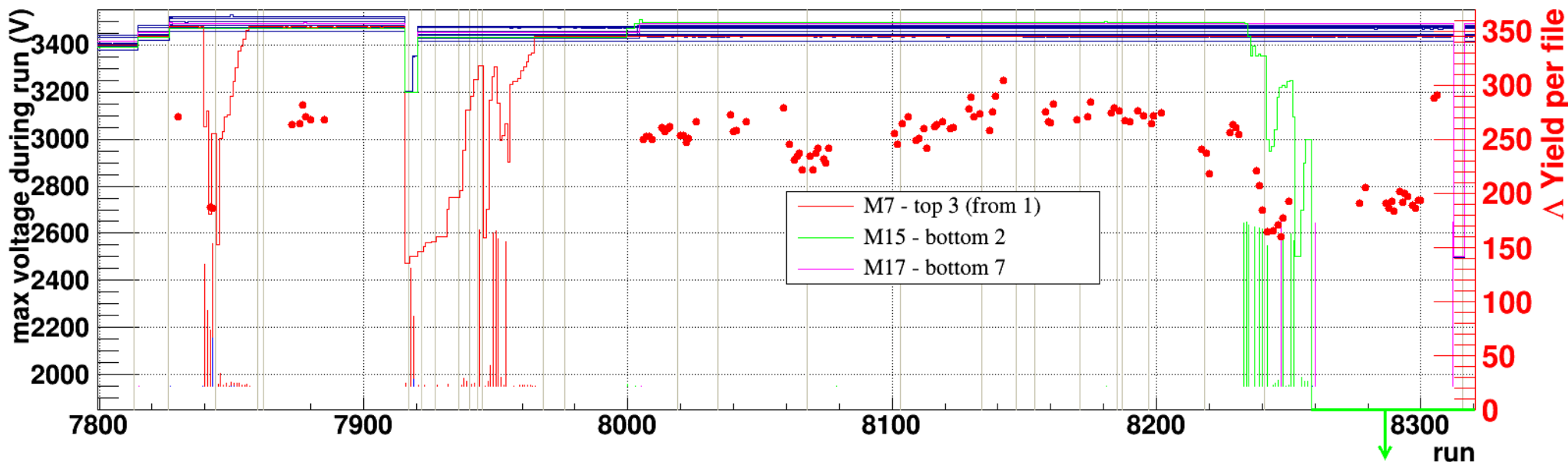


Run quality checking

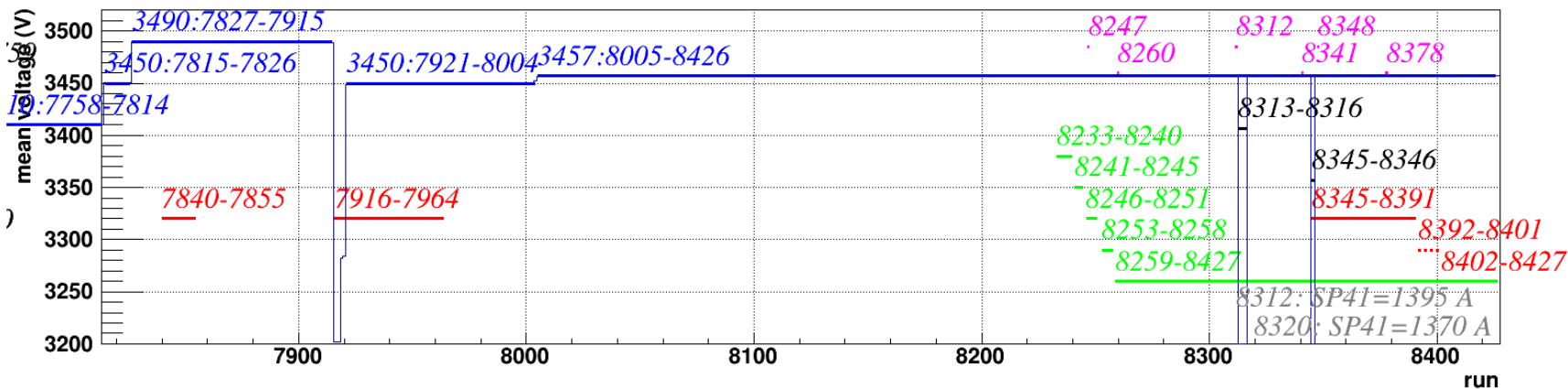
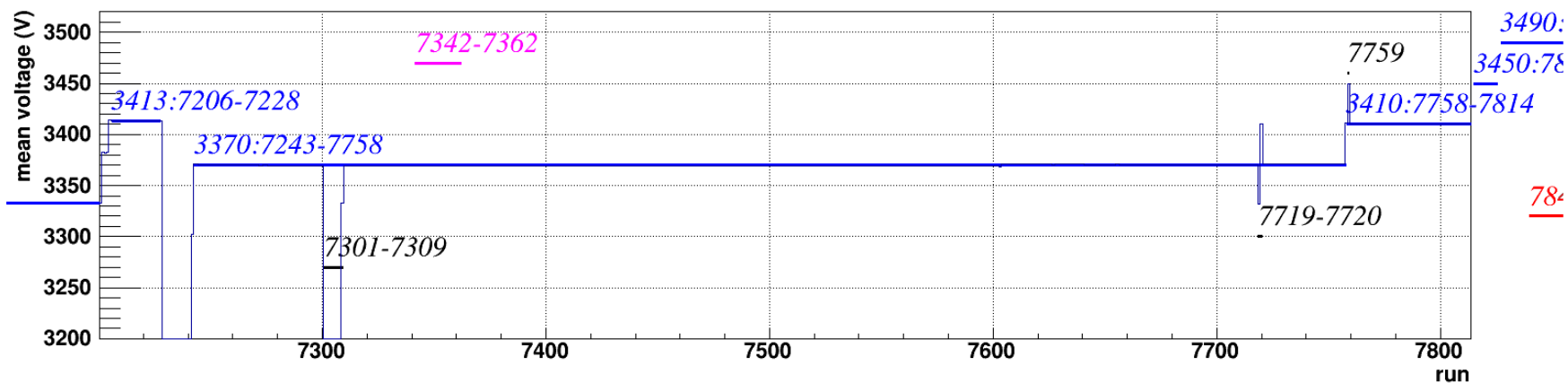
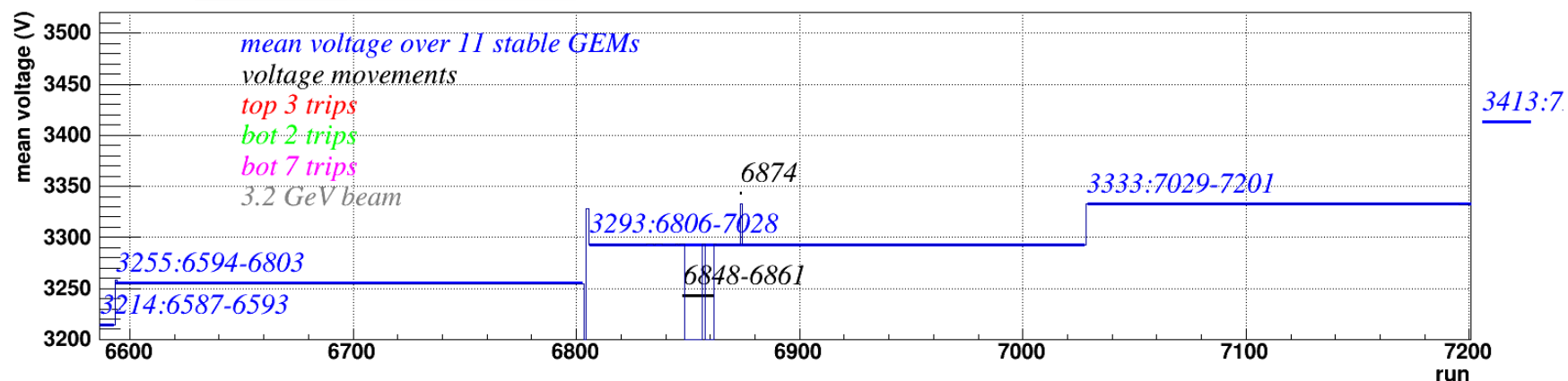


Physical runs:

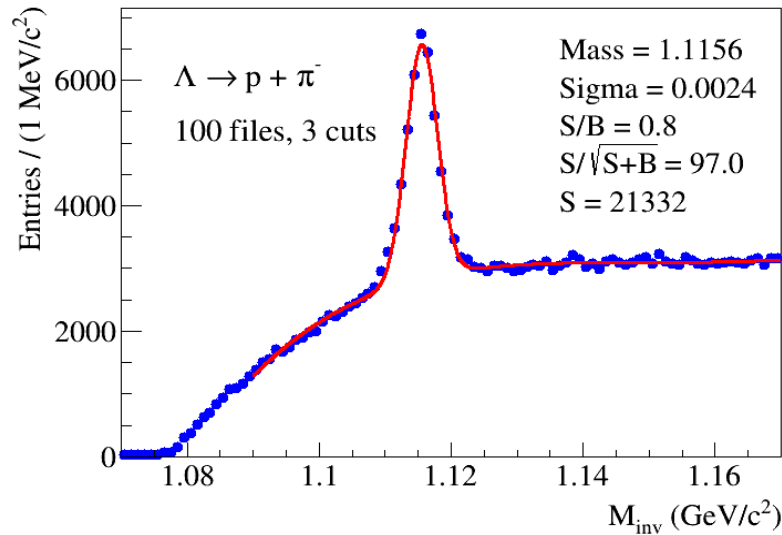
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Run quality checking

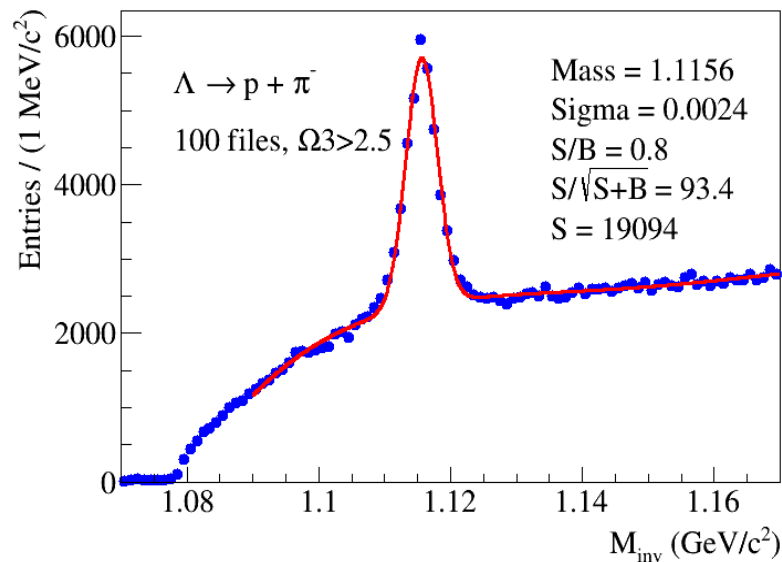


Λ selection (3 topological cuts vs Ω_3)



Topological cuts selection:

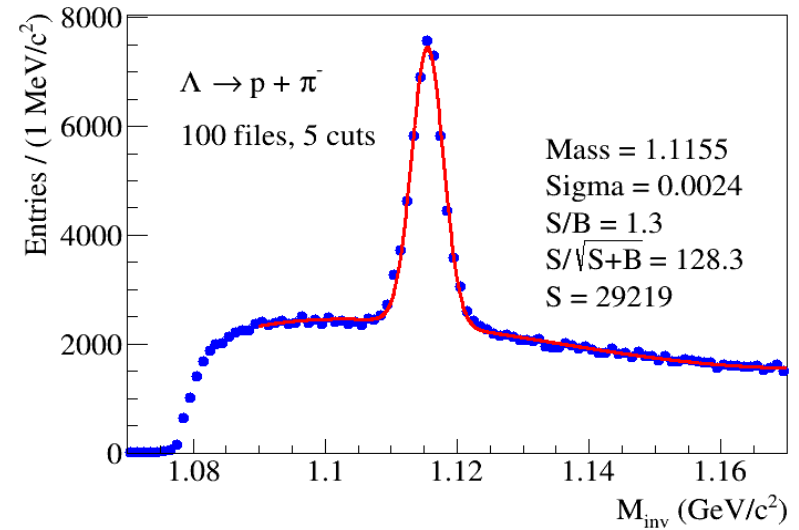
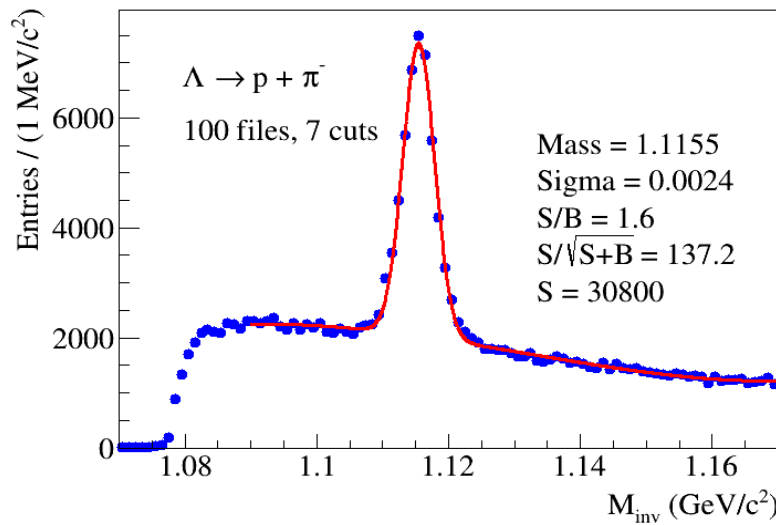
$$|0.c2s[[0]>7\&\&|0.chi2s[[1]>5\&\&|0.c2pv<5$$



Omega factor selection:

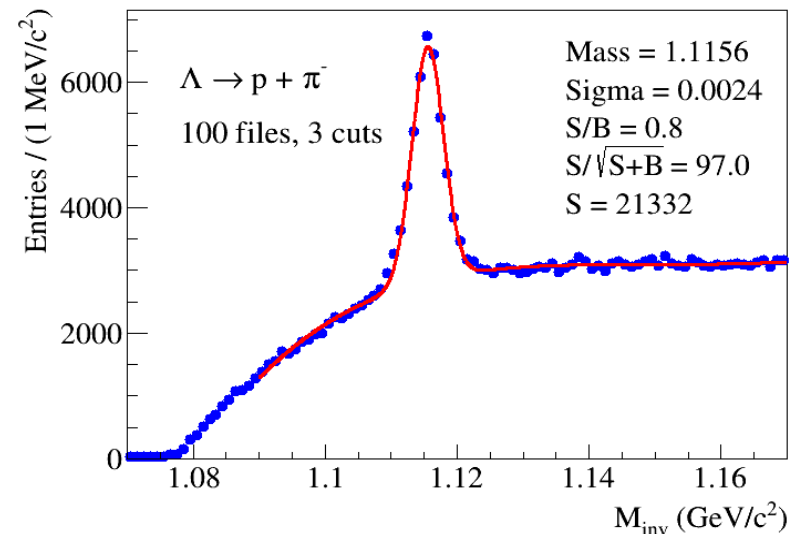
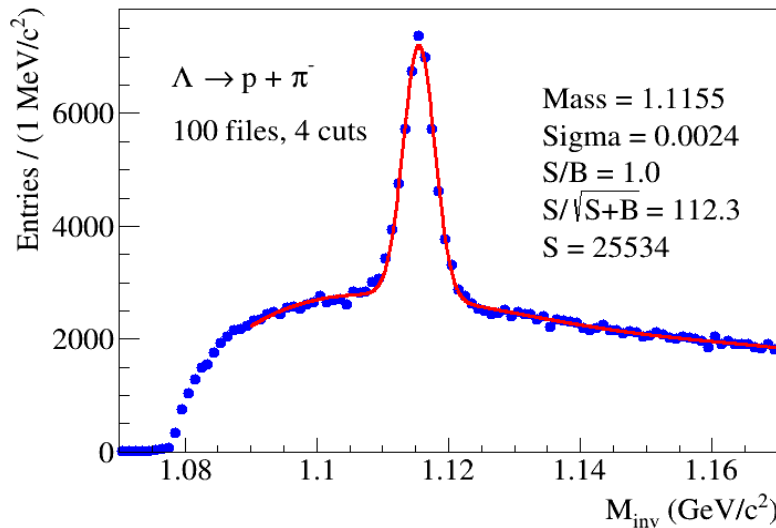
$$\Omega_3 = \log((\chi^2_{\pi} * \chi^2_p) / (\chi^2_{\Lambda} + 4 * \chi^2_{V_0} + 30 * \text{angle}))$$

Λ selection (3, 4, 5, 7 topological cuts)



$5 < \chi^2_{s[0]} < 10$, $10 < \chi^2_{s[1]} < 3$, $0.6 < \text{dsth} < 1$, $4 < \text{c2pv} < 8$, $0.02 < \text{angle} < 0.2$, $0.2 < \text{dcas}[1] < 0.4$

$7 < \chi^2_{s[0]} < 10$, $10 < \chi^2_{s[1]} < 3$, $0.6 < \text{dsth} < 1$, $6 < \text{c2pv} < 8$, $0.02 < \text{angle} < 0.2$



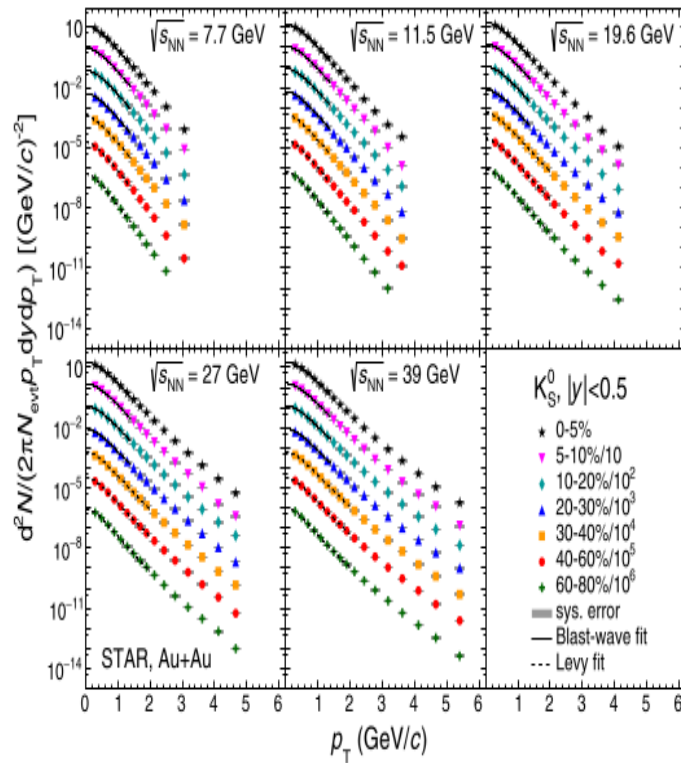
$5 < \chi^2_{s[0]} < 10$, $4 < \chi^2_{s[1]} < 10$, $5 < \text{c2pv} < 8$, $0.02 < \text{angle} < 0.2$

$7 < \chi^2_{s[0]} < 10$, $5 < \chi^2_{s[1]} < 10$, $5 < \text{c2pv} < 8$

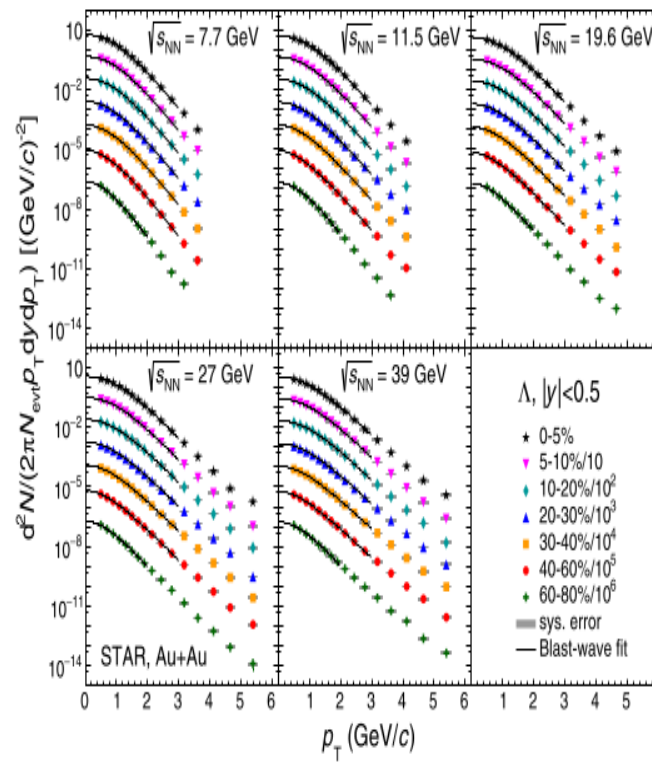
STAR strangeness production studies



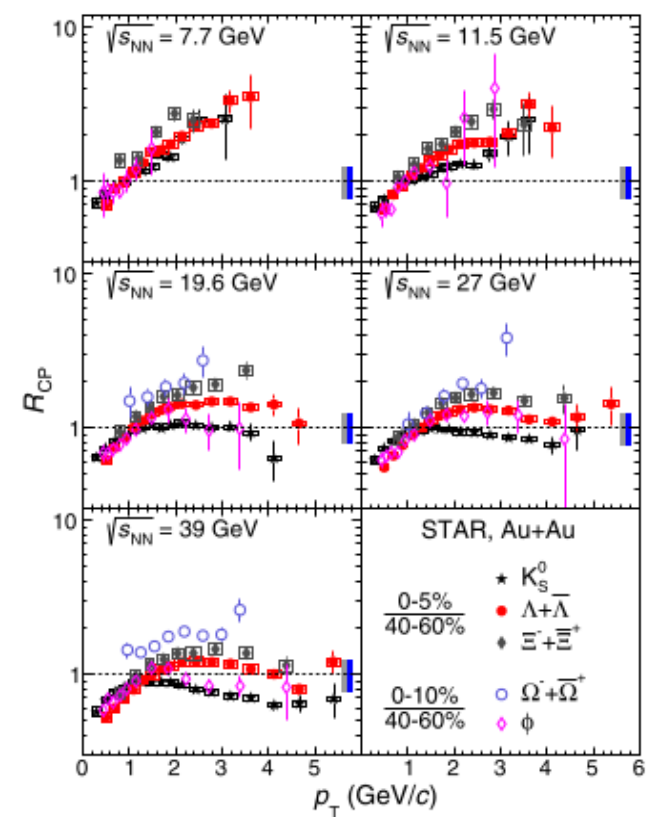
“Strange hadron production in Au + Au collisions at $\sqrt{s_{NN}} = 7.7, 11.5, 19.6, 27,$ and 39 GeV”



K_s^0 p_T -spectra



Λ p_T -spectra

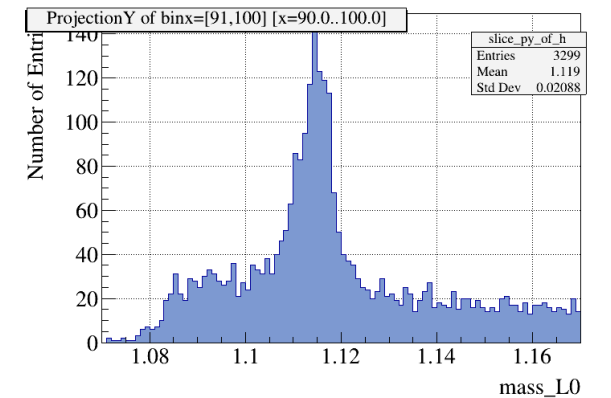
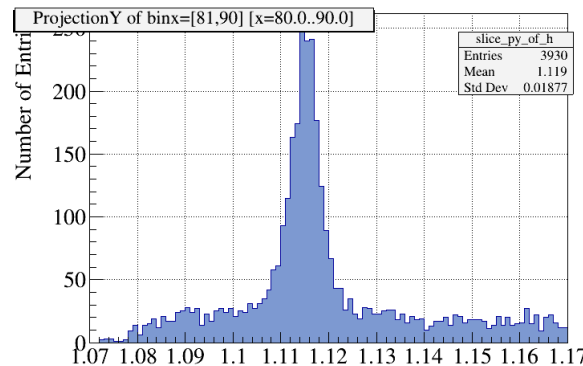
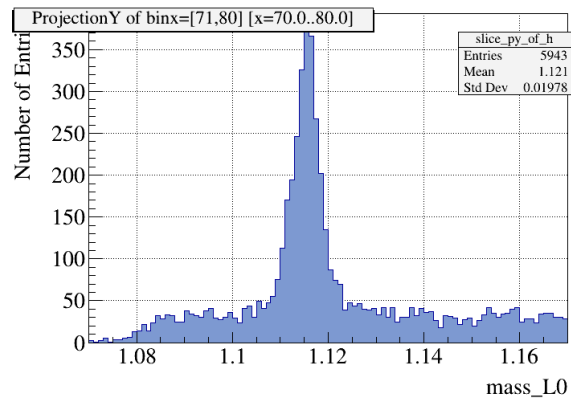
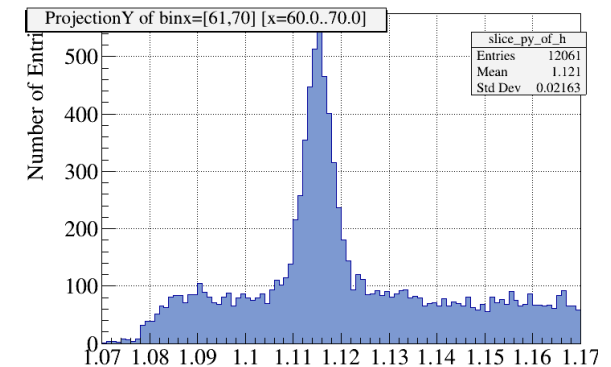
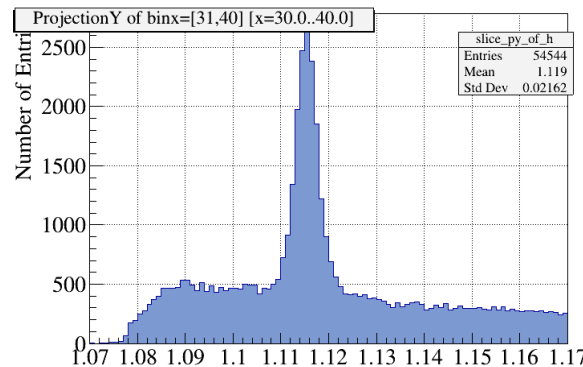
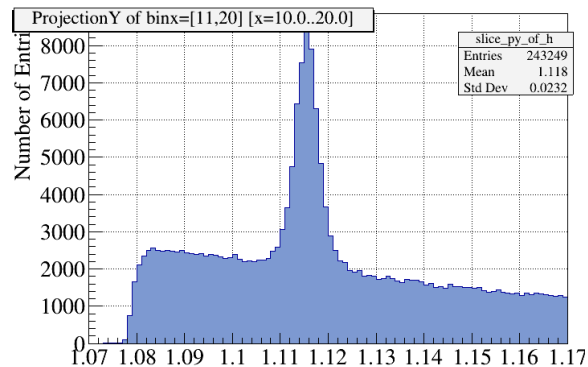
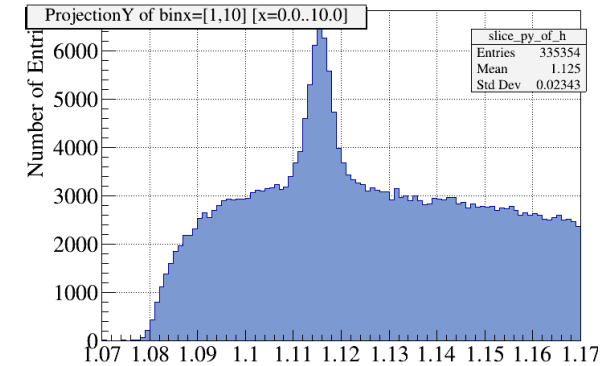
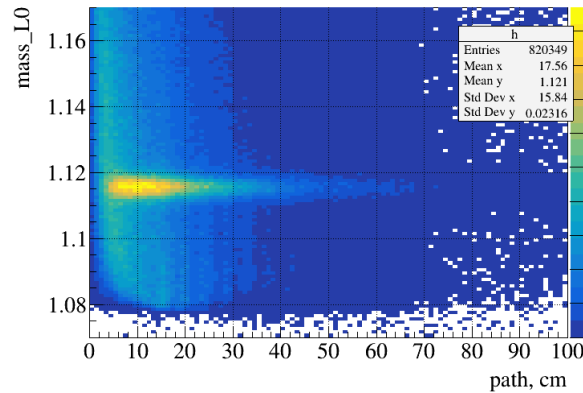


$$R_{CP} = \frac{[(dN/dp_T) / \langle N_{coll} \rangle]_{\text{central}}}{[(dN/dp_T) / \langle N_{coll} \rangle]_{\text{peripheral}}}$$

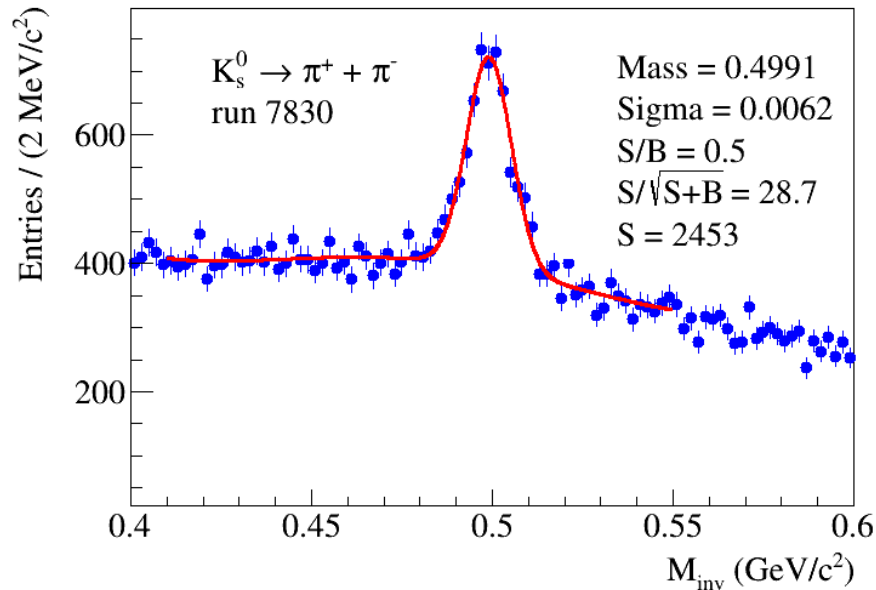
Λ selection: path



$10 \cdot \chi^2_{s[0]} > 7$ & $10 \cdot \chi^2_{s[1]} > 3$
& $10 \cdot \text{dsth} < 0.6$ & $10 \cdot \text{c2pv} < 6$
& $10 \cdot \text{angle} < 0.02$

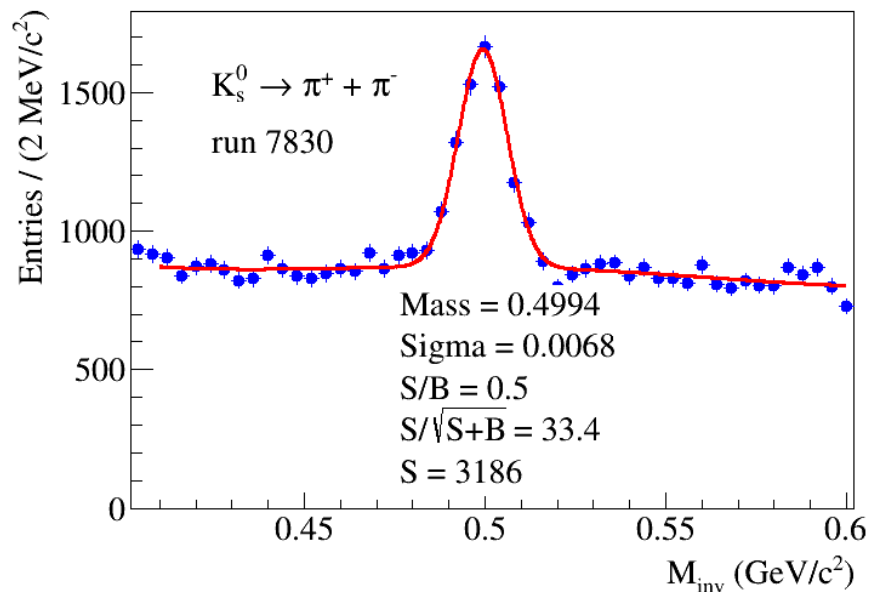


K_s^0 selection (3 topological cuts vs Ω_3)



Topological cuts selection:

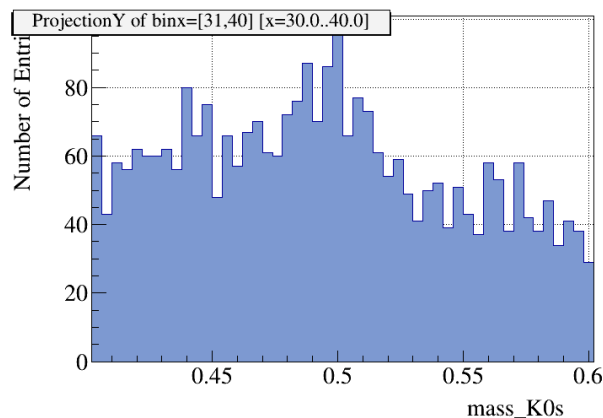
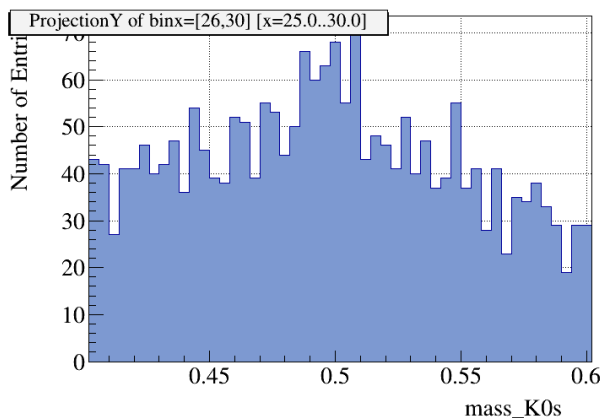
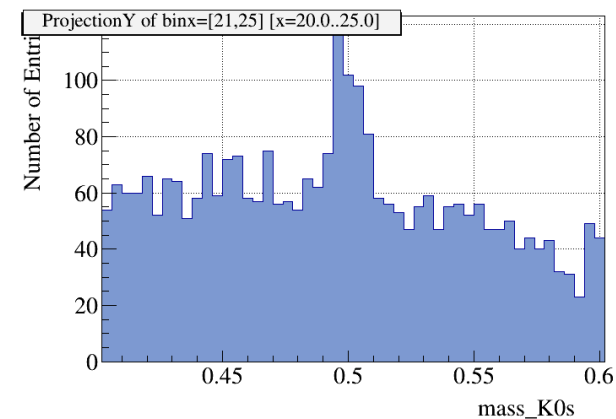
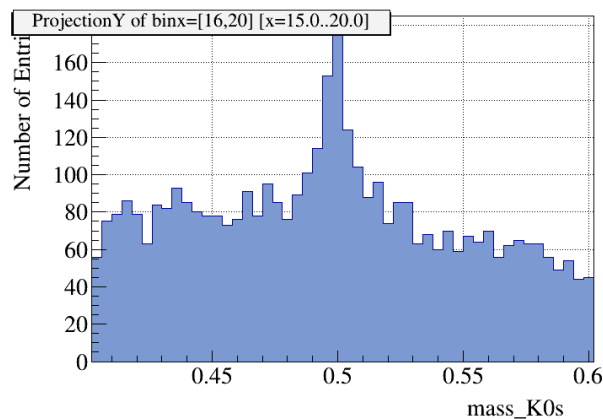
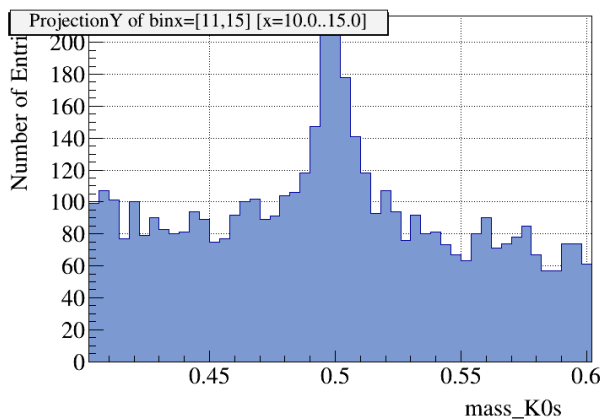
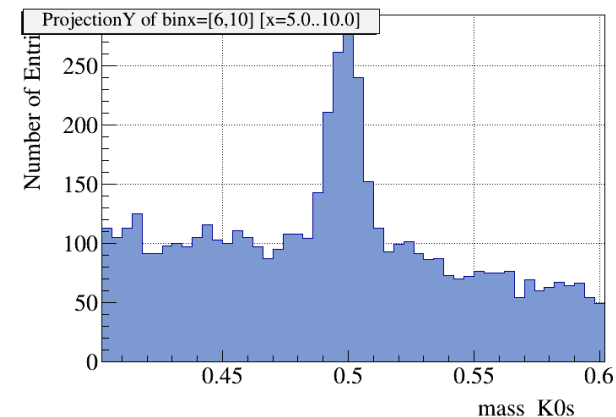
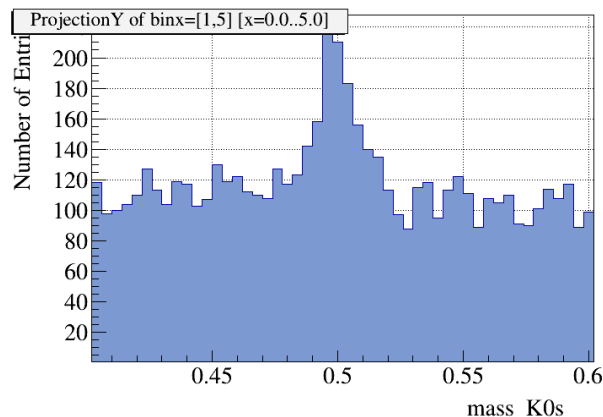
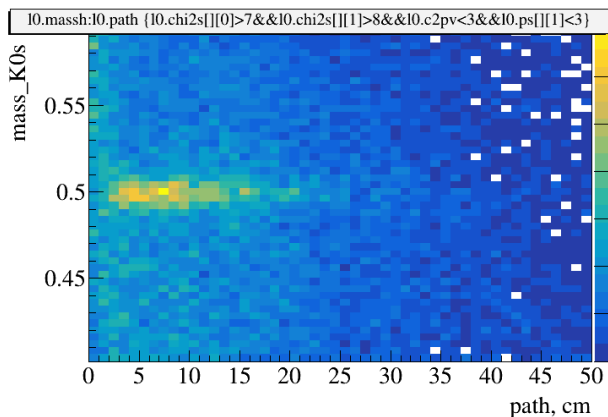
$$\begin{aligned} &|0.\chi^2s|[0]>7 \ \&\& \ |0.\chi^2s|[1]>7 \\ &|0.c^2pv<3 \ \&\& \ |0.ps|[1]<3 \end{aligned}$$



Omega factor selection:

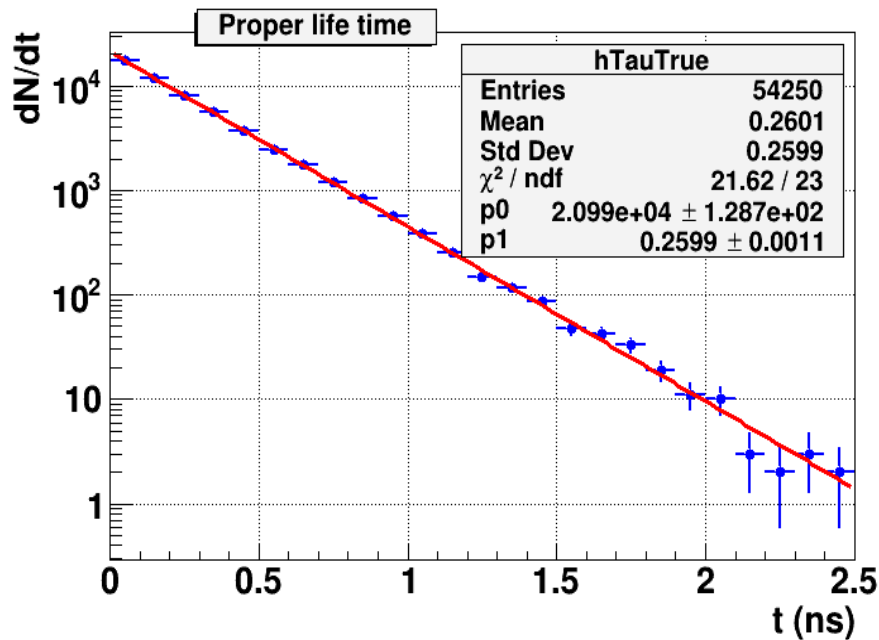
$$\begin{aligned} &\Omega_3>2.5 \ \&\& \ nvtx>1 \ \&\& \ |0.pts|[0]>0.1 \ \&\& \ |0.pts|[1]>0.1 \\ &|0.c^2s|[0]<3 \ \&\& \ |0.c^2s|[1]<3 \ \&\& \ |0.ps|[1]<3 \end{aligned}$$

K_s^0 selection: path



$l0.chi2s[[0]]>7 \& \& l0.chi2s[[1]]>7$
 $\& \& l0.c2pv<3 \& \& l0.ps[[1]]<3$

Lifetime of Λ : MC



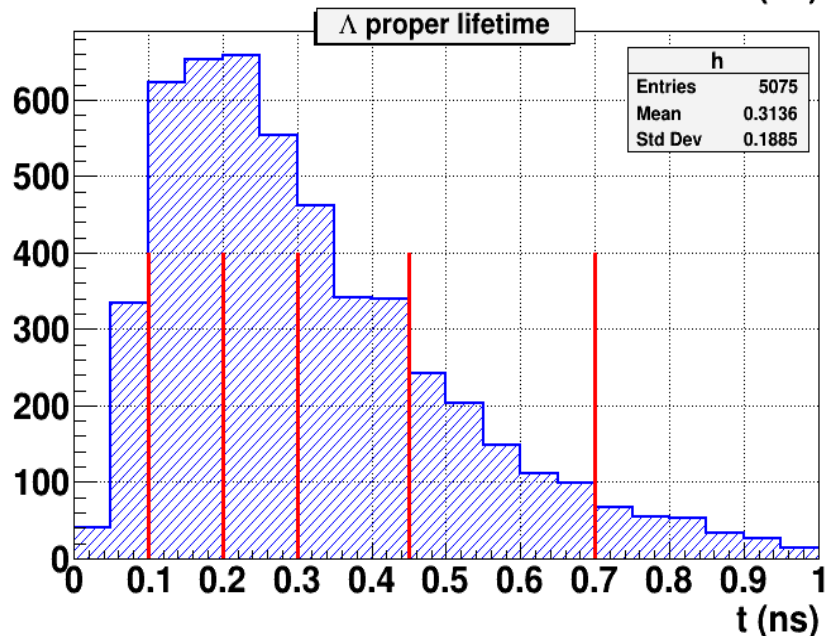
Decay formula:

$$dN / dt = N_0 / \tau * \exp(-t/\tau),$$

$$N_0 = p0 * p1 = 54574$$

Proper life time:

$$t = lm / pc$$



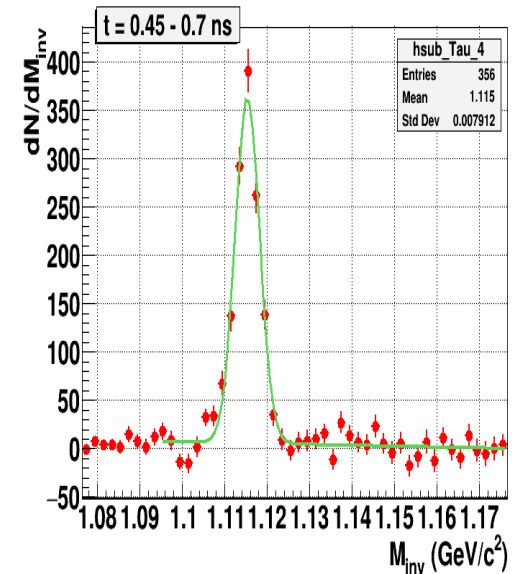
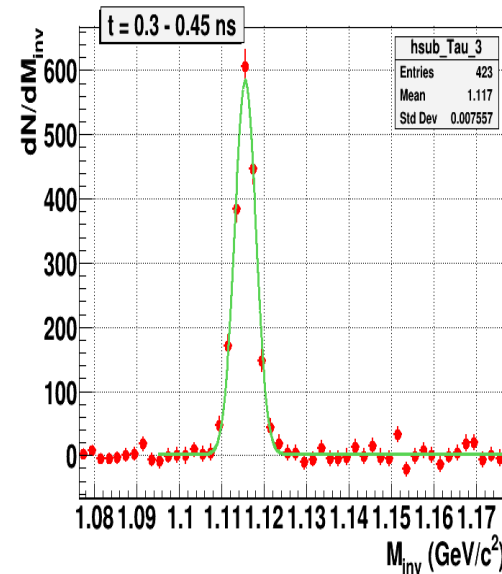
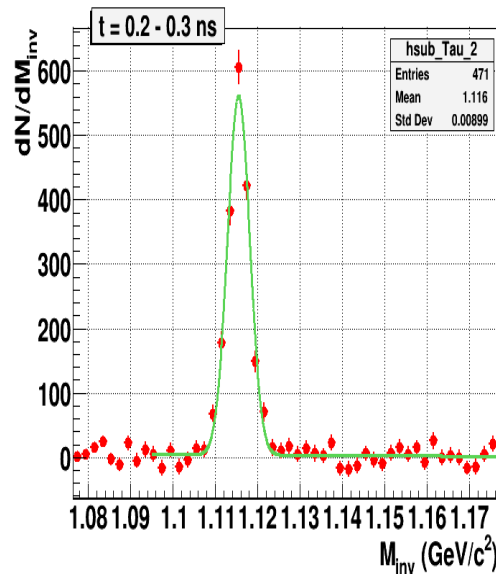
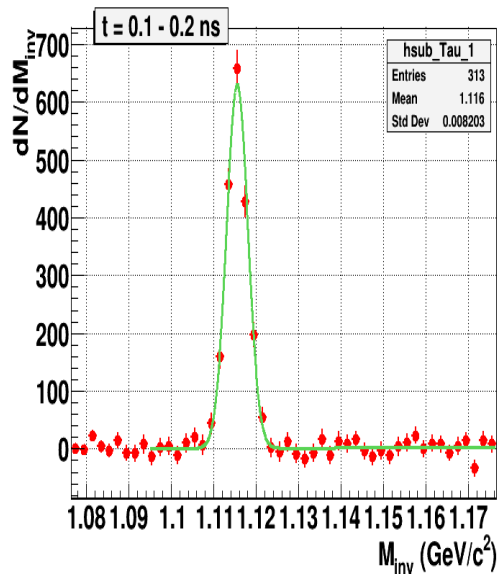
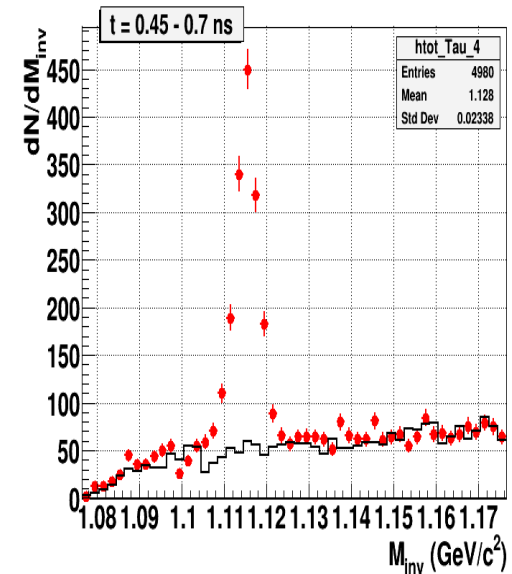
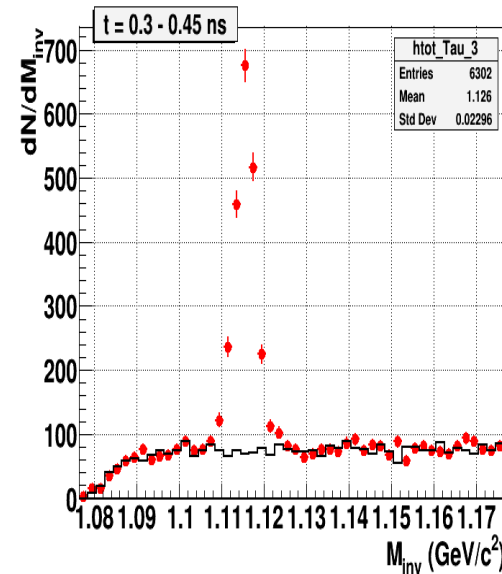
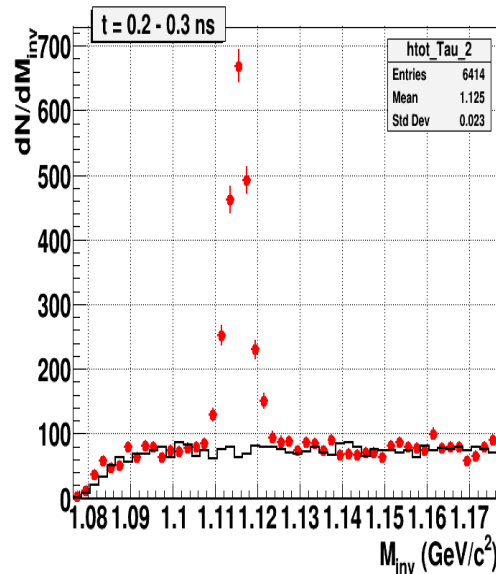
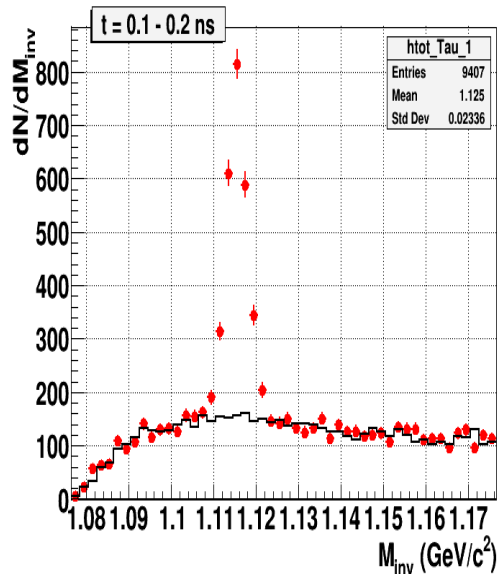
Used statistics:

500k MC events

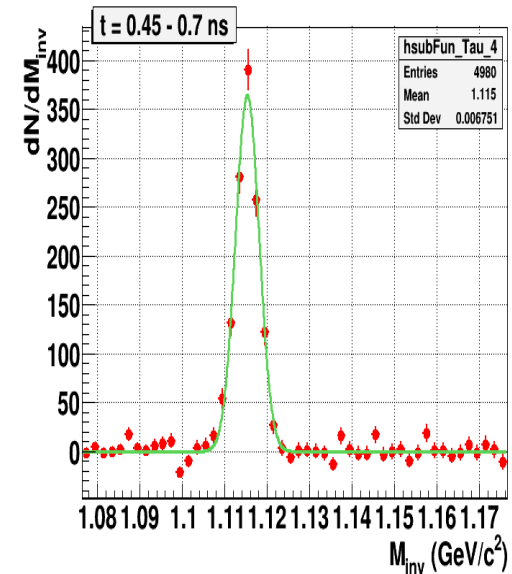
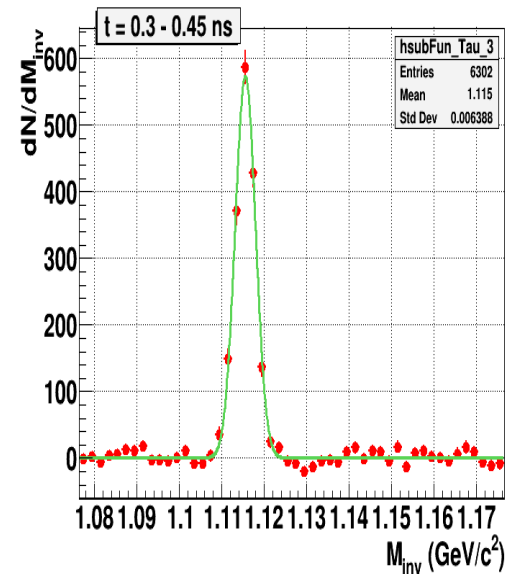
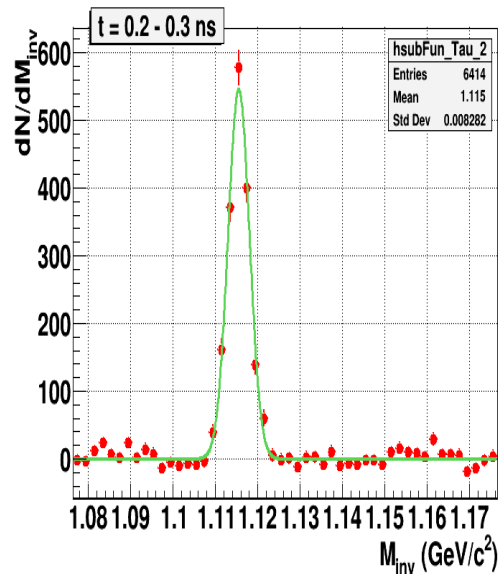
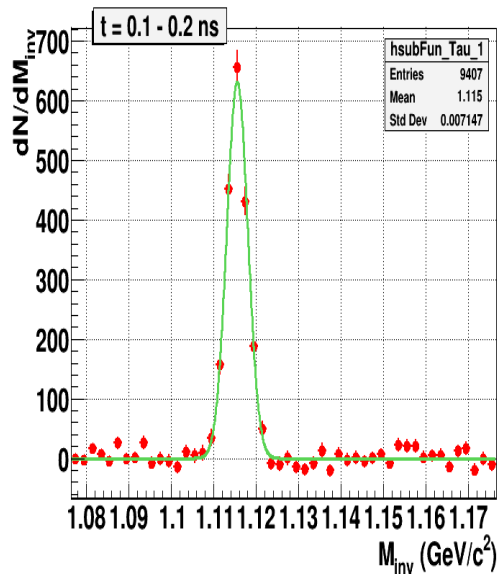
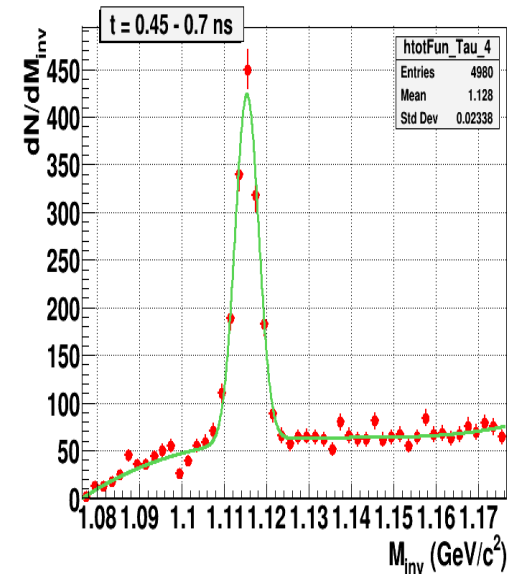
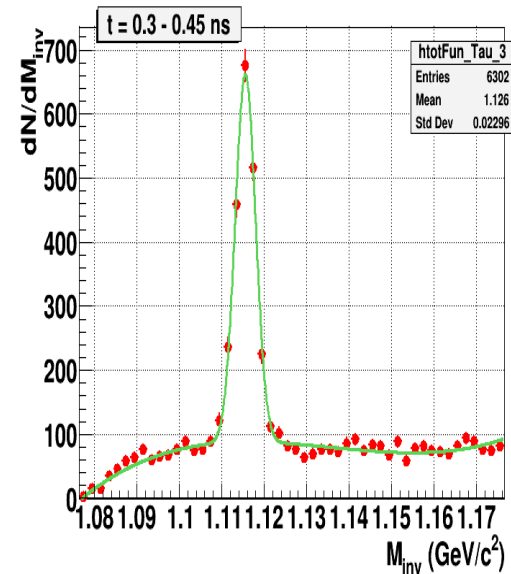
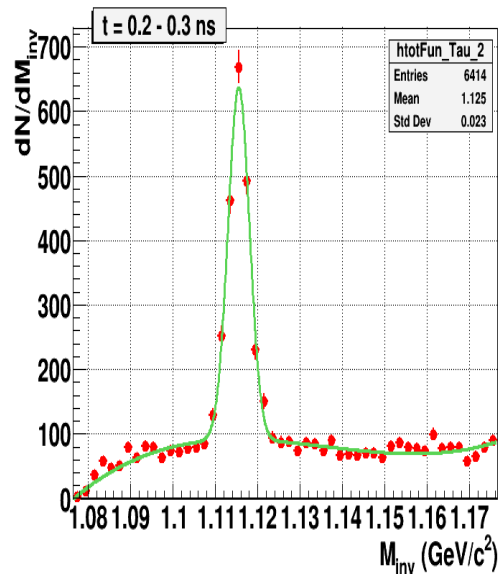
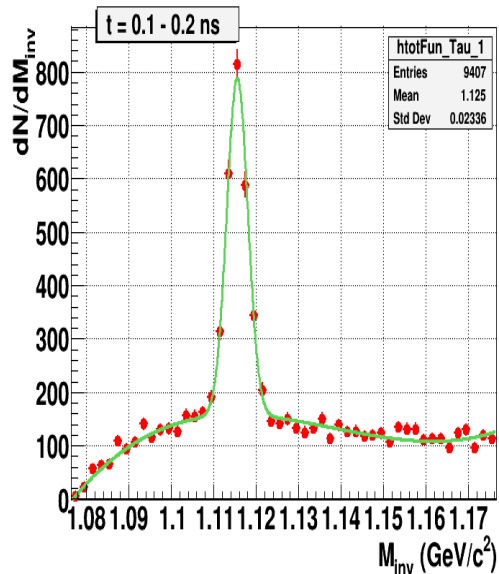
1M exp. data (run 7830)

The topic is being worked on by R.Zinchenko

Mixed background subtraction: Data



Fitted background subtraction: Data

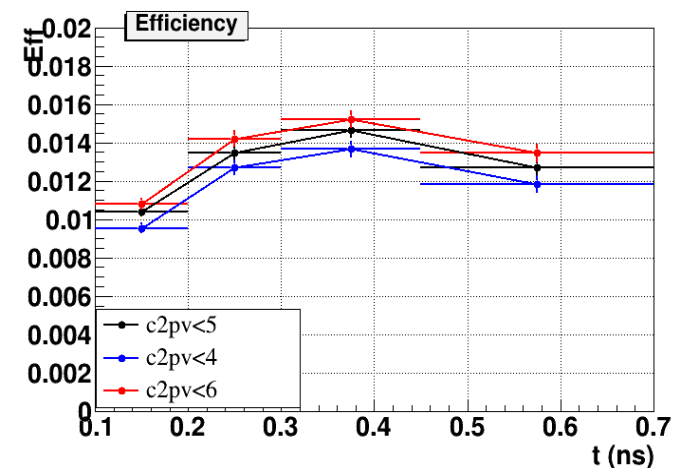
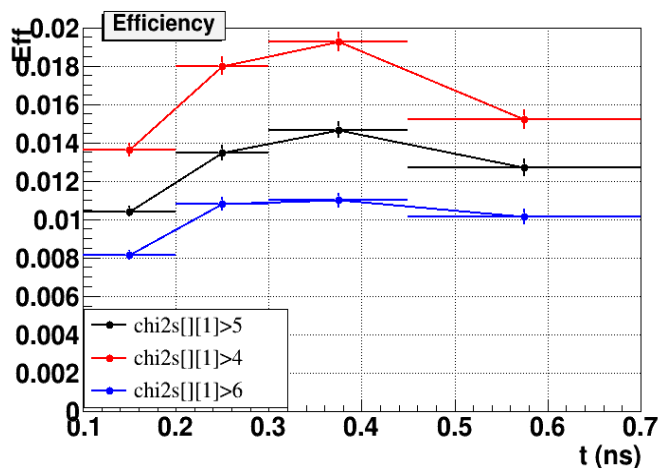
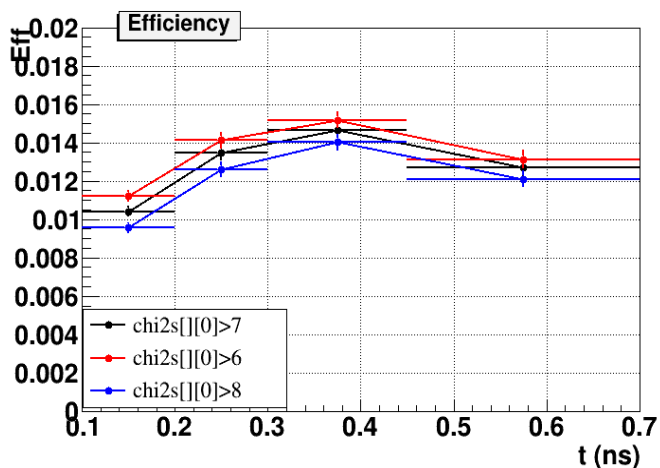


Lifetime of Λ

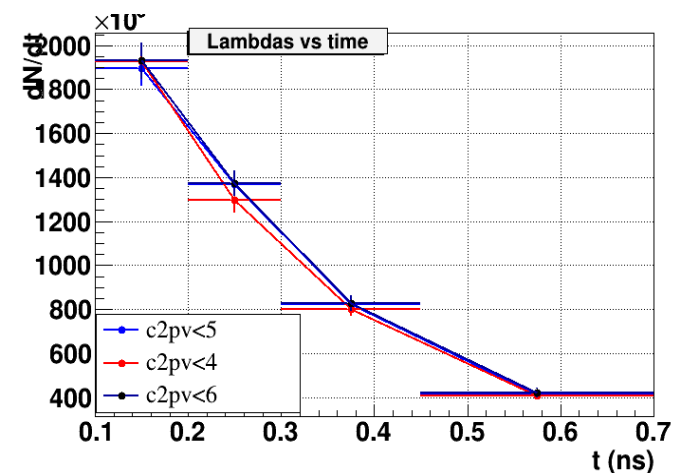
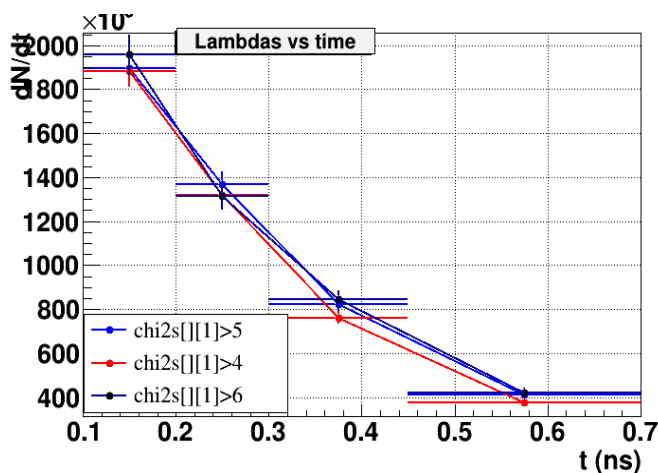
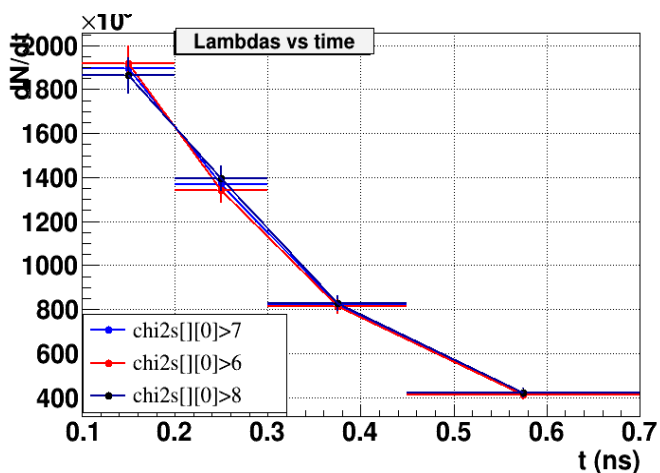


$10 \cdot \chi^2_{s[0]} > 7 \ \& \ 10 \cdot \chi^2_{s[1]} > 5 \ \& \ 10 \cdot c_{2pv} < 5 \ \& \ 10 \cdot pts[0] > 0.05 \ \& \ 10 \cdot pts[1] > 0.1$

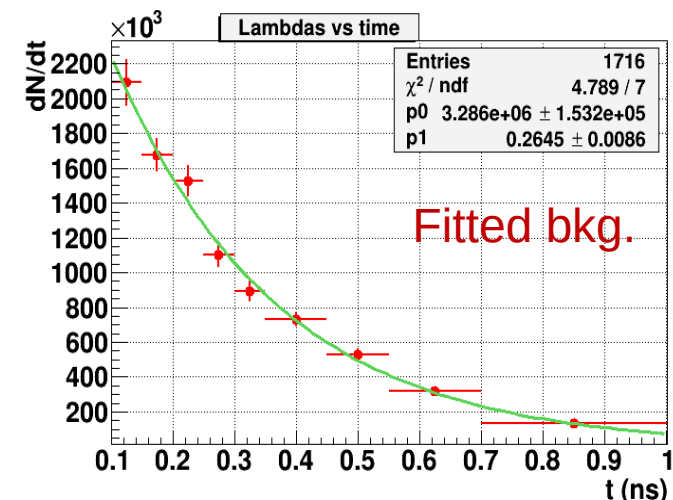
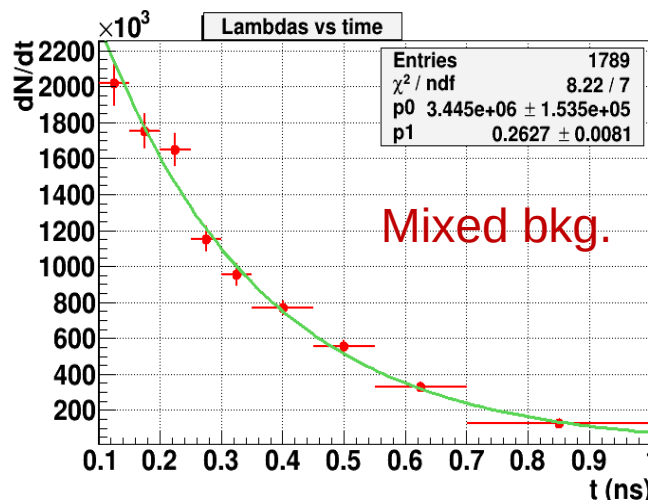
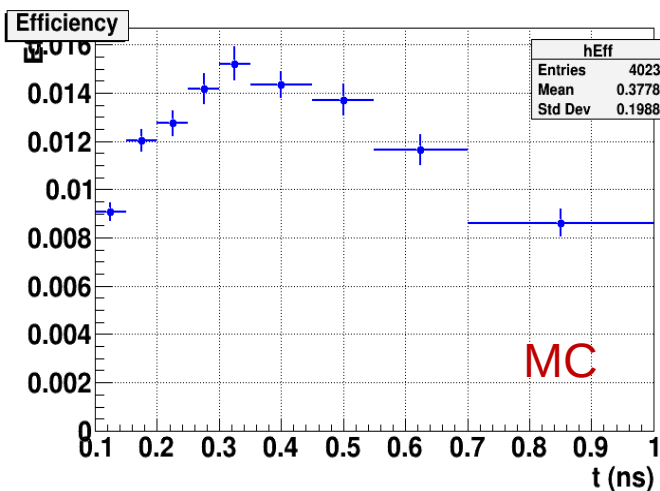
MC



Data corrected for efficiency



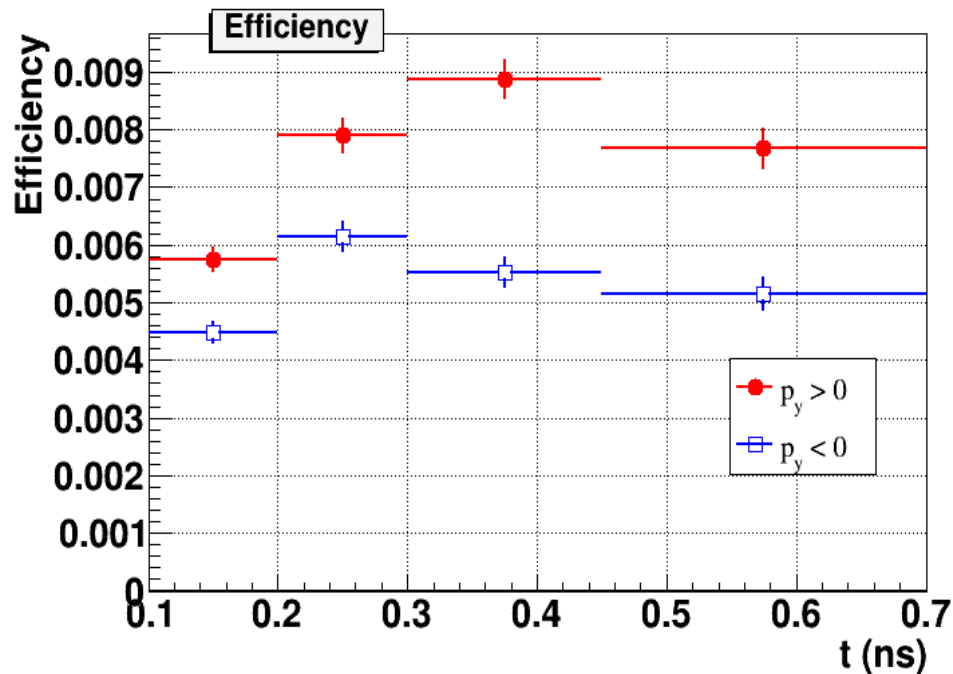
Lifetime of Λ



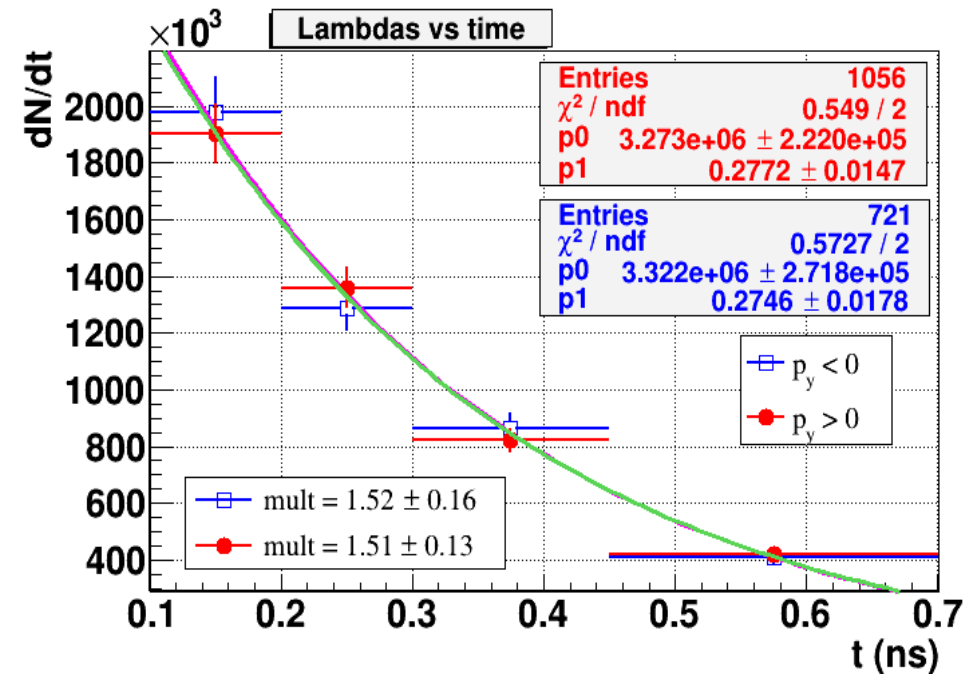
Selection:	$\Omega_3 > 2.3$	$\Omega_3 > 1$	3 cuts (4 bins)	5 cuts	3 cuts (9 bins)
τ , ns	0.301 ± 0.014	0.302 ± 0.016	0.270 ± 0.011	0.240 ± 0.008	0.262 ± 0.008
Multiplicity	1.168 ± 0.082	1.228 ± 0.097	1.499 ± 0.100	1.359 ± 0.075	1.510 ± 0.082
χ^2 / NDF	0.71 / 2	2.61 / 2	1.01 / 2	1.50 / 2	8.22 / 7

3 cuts:	centr. value	c2pv<4	c2pv<6	chi2s[1]>4	chi2s[1]>6	chi2s[0]>6	chi2s[0]>8
τ , ns	0.270 ± 0.011	0.262 ± 0.011	0.265 ± 0.011	0.254 ± 0.010	0.263 ± 0.012	0.266 ± 0.011	0.269 ± 0.012
Mult.	1.499 ± 0.100	1.430 ± 0.100	1.460 ± 0.100	1.360 ± 0.090	1.500 ± 0.110	1.420 ± 0.100	1.470 ± 0.100
χ^2 / NDF	1.01 / 2	1.00 / 2	0.63 / 2	2.23 / 2	1.49 / 2	0.88 / 2	1.10 / 2

Lifetime of Λ : upper and lower detectors



MC



Data corrected for efficiency

Summary and next steps



- ✓ Monte Carlo seems to be in reasonable agreement with the data
- ✓ Further checks of efficiencies are required: lifetime of $K_s^0 p_T$ -spectra in bins of proper time
- ✓ Centrality selection and trigger efficiency check are necessary

Thank you for your attention!

Any questions or comments?

