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Simulations of $\bar{\mathrm{p}}\mathrm{p} \to \bar{\Lambda}\Lambda$

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Outline

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Simulations at 1.64 GeV

Differences from the December meeting:

- Release 0.15.2 instead of 0.13.1
- Polarisation given by $\sin 2\Theta_{\bar{\Lambda}}$ instead of 100%

Same:

- Events produced by modified generator, originally used at the PS185 experiment
- Angular distribution of $\bar{\Lambda}$ from PS185 experiment

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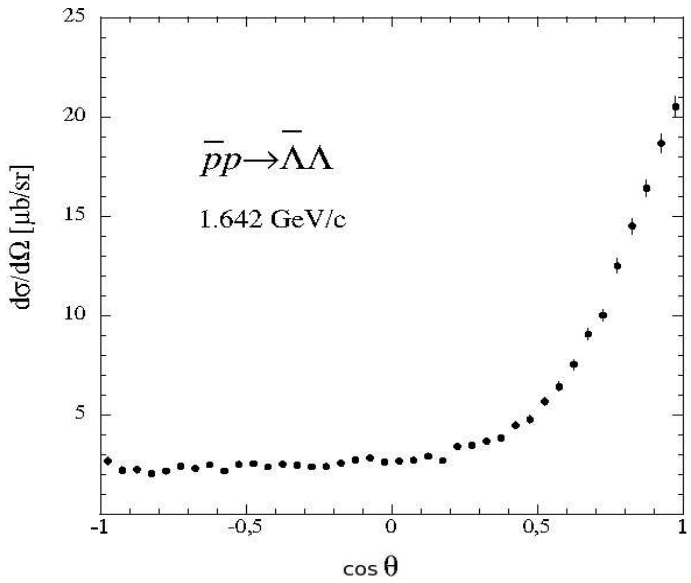
Simulations at 1.64 GeV

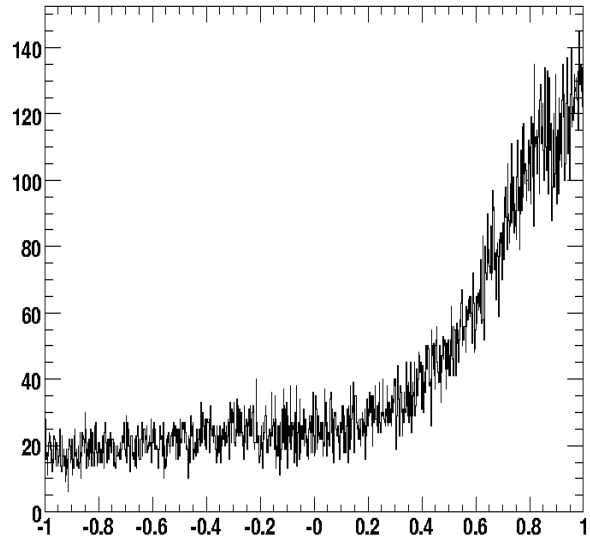
- $1.10 < m_{\Lambda} < 1.13$, $P(\chi^2) > 0.001$
- Efficiency drops from 35% to 20%
- Still very few background events 0.5%
- Angles, momenta and vertices are still well reconstructed

Probable reason for drop in efficiency:

- For release 0.15.2 the material budget of the MVD has been increased
- In release 0.15.2 the minimum number of hits necessary for a track has been increased

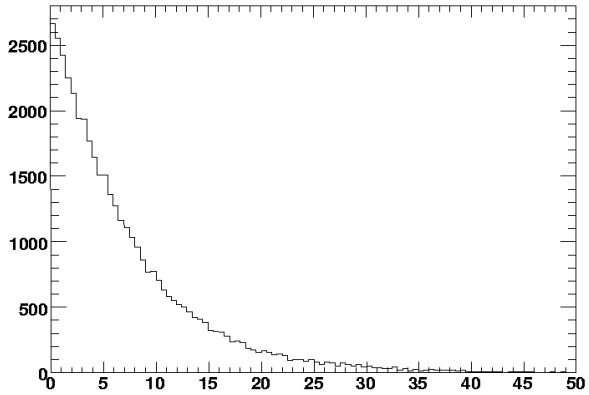
$\bar{\Lambda}$ angular distribution



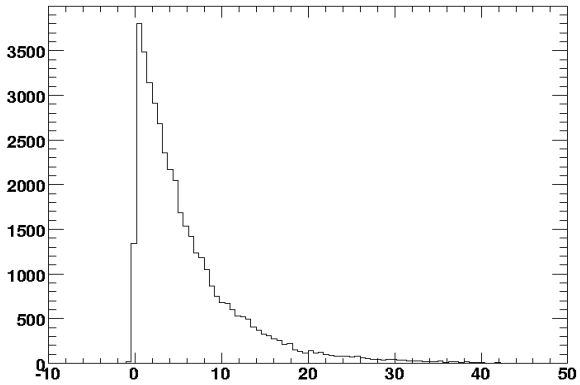


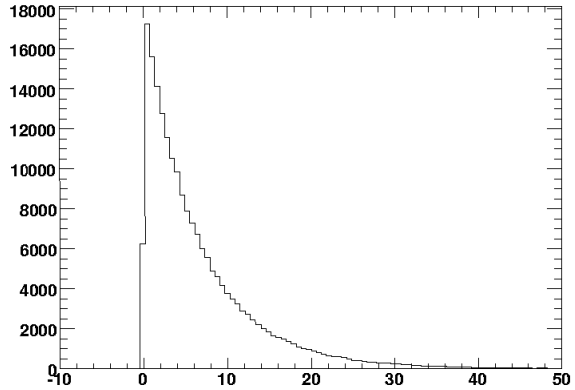
Angular distribution of $\bar{\Lambda}$ from the PS185 experiment and from the simulation.

Reconstruction of the $\bar{\Lambda}$ lifetime



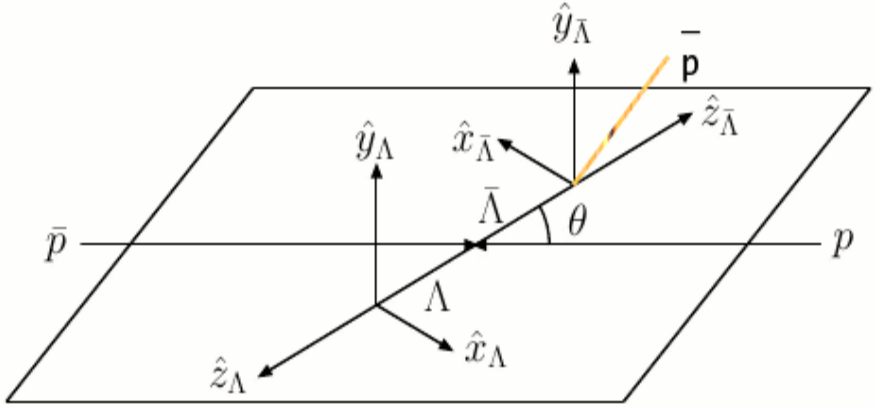
Reconstructed $c\tau = 7.06 \pm 0.03$ cm. The measured experimental value is 7.89 cm.





Vertex of $\bar{\Lambda}$ in z direction for the reconstructed events and for all generated events.

Reconstruction of $\bar{\Lambda}$ polarisation

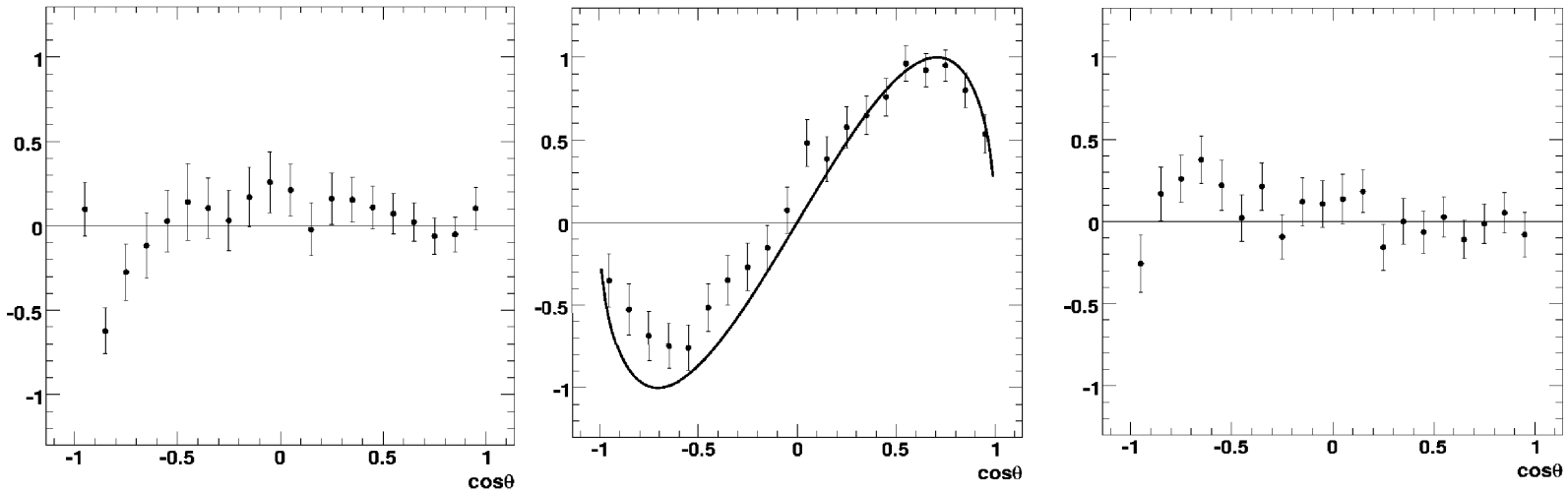


Angular distribution of decay $\bar{\mathrm{p}}$ in $\bar{\Lambda}$ rest system given by

$$I(\theta_{\bar{\mathrm{p}}}) = \frac{1}{4\pi}\left(1 + \alpha P \cos\theta_{\bar{\mathrm{p}}}\right) \tag{1}$$

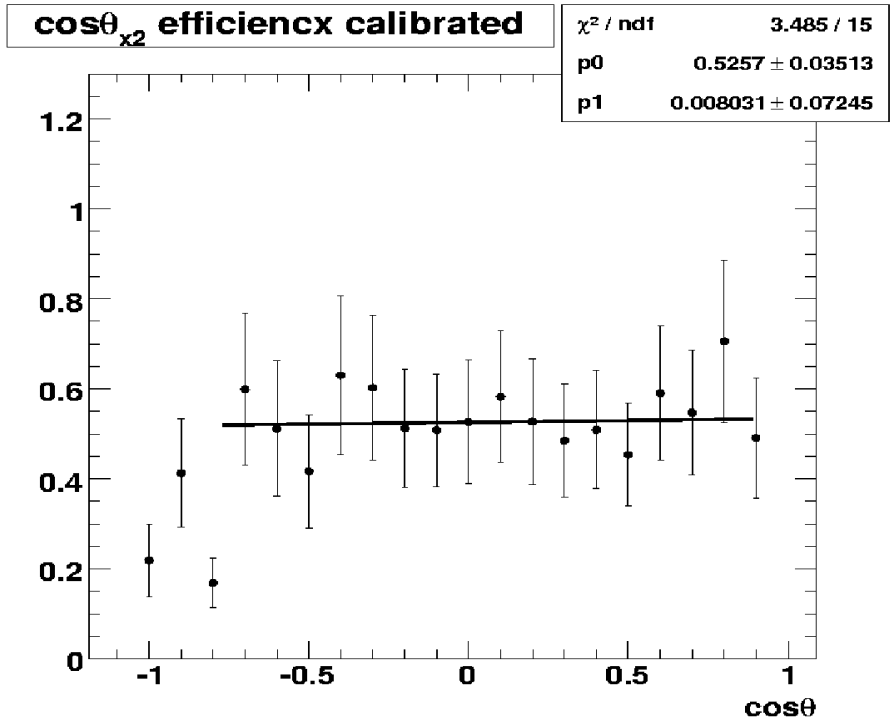
To compensate for different detector efficiency at different angles, non-polarised data is used. Since the polarisation now depends on the production angle of $\bar{\Lambda}$ this correction is done for 20 different intervals of $\cos\theta_{\bar{\Lambda}}$.

Reconstructed $\bar{\Lambda}$ polarisation as a function of $\bar{\Lambda}$ production angle



Too small polarisation in y-direction for negative $\cos\Theta_{\bar{\Lambda}}$.

$\cos\Theta_{\bar{p}}$ distribution for the polarisation point most different from zero



When the points close to -1 are neglected the polarisation becomes -0.03 instead of -0.63.

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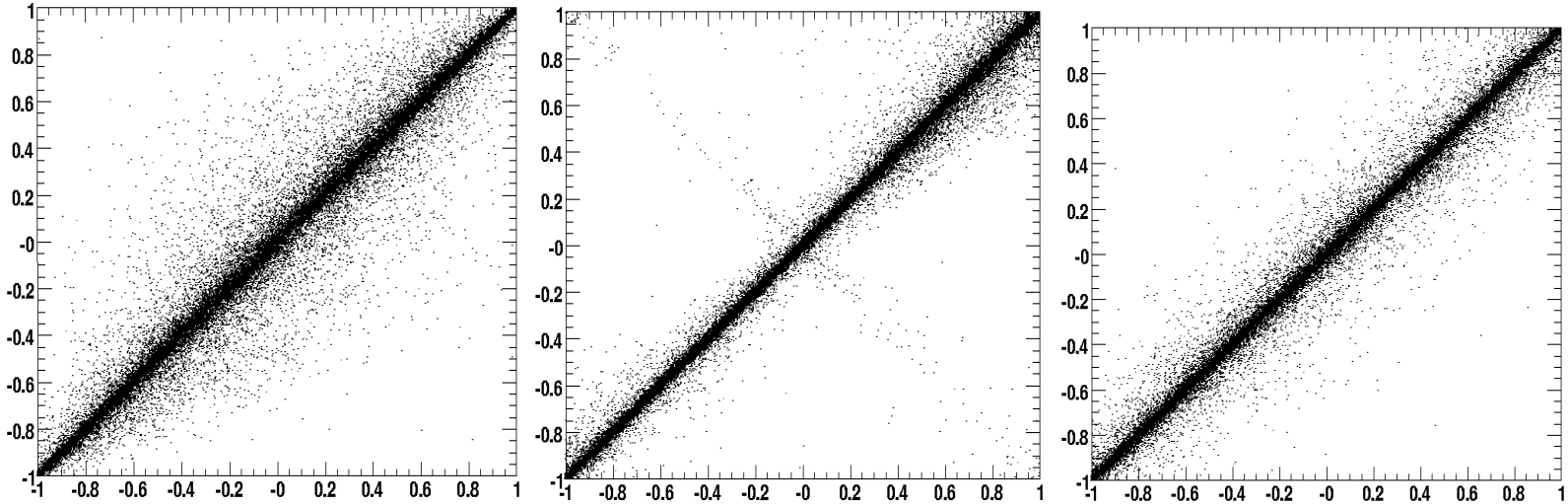
Simulations at 15 GeV

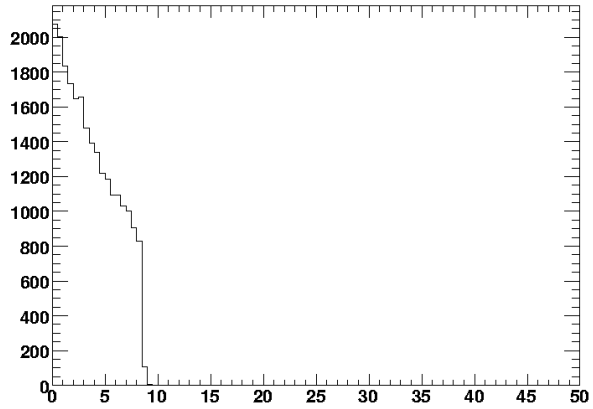
- Polarisation given by $\sin 2\Theta_{\bar{\Lambda}}$
- Angular distribution of $\bar{\Lambda}$ obtained from data at $p_{\bar{p}} = 6$ GeV
- The non-polarised data used for efficiency calibration generated with flat angular distribution of $\bar{\Lambda}$.
- Efficiency 12% for polarised data, 20% for non-polarised data

Reconstruction of $\cos\Theta_{\bar{p}}$ in $\bar{\Lambda}$ rest system

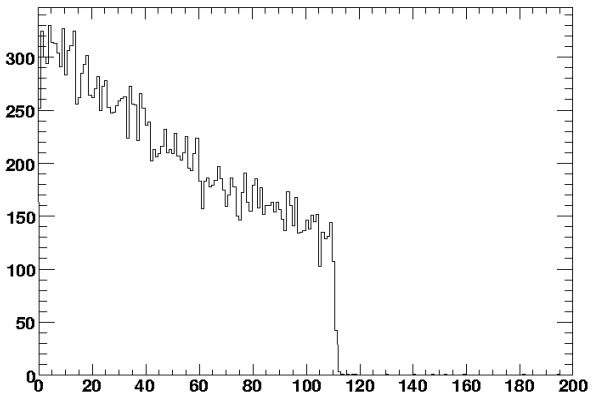


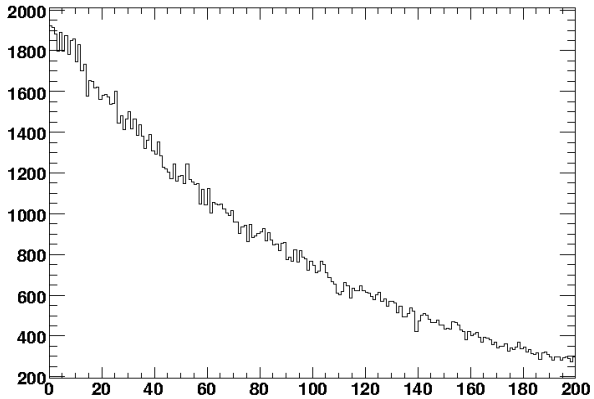
Reconstructed $\cos\theta_{\bar{p}}$ in $\bar{\Lambda}$ rest system versus MC information. The faint line in the y-direction is a sign of misidentification of $\bar{\Lambda}$ and Λ.

Reconstruction of the $\bar{\Lambda}$ lifetime



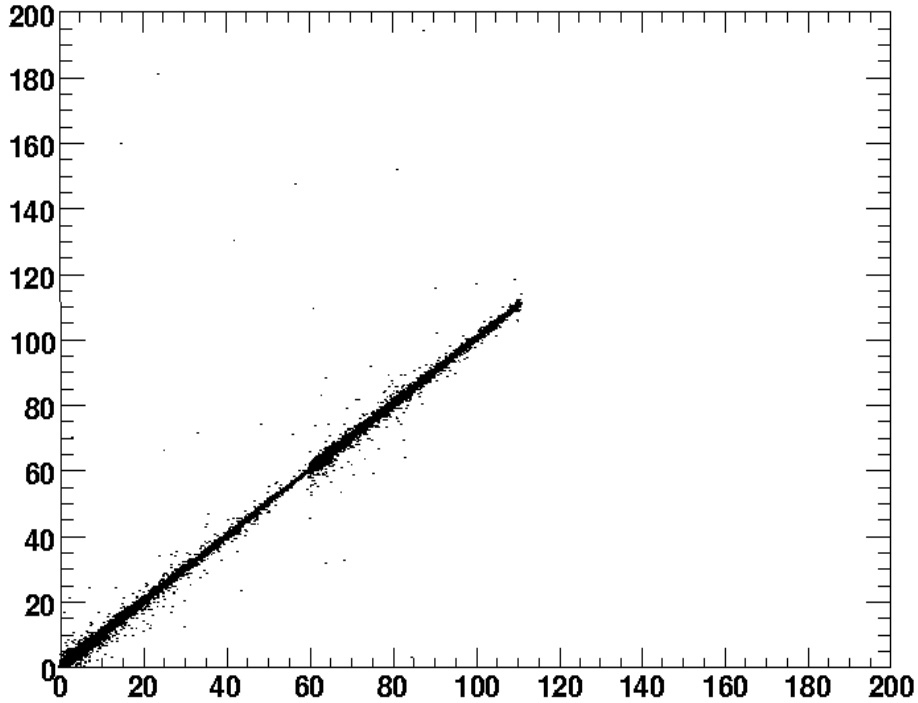
Reconstructed $c\tau$ of $\bar{\Lambda}$.





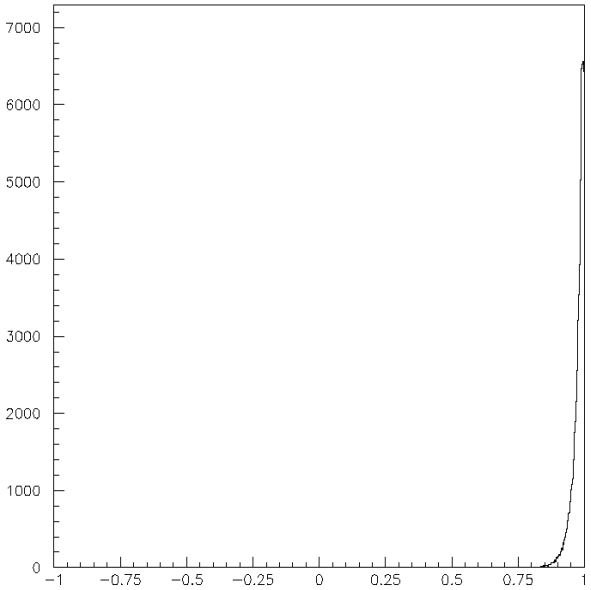
Vertex of $\bar{\Lambda}$ in z direction for the reconstructed events and for all generated events. No events are reconstructed over 110 cm.

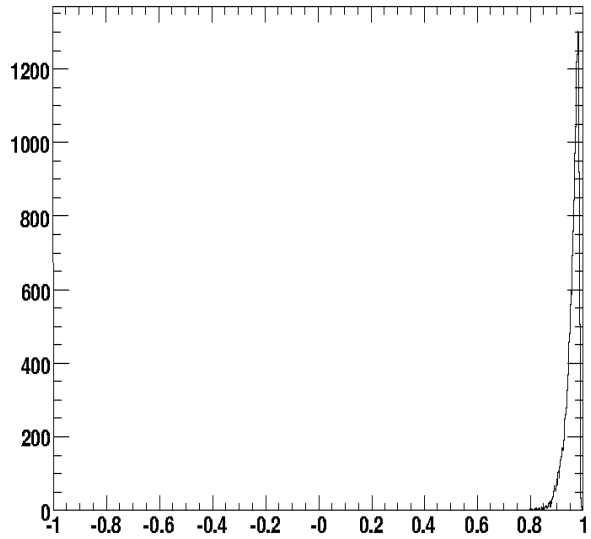
Reconstruction of $\bar{\Lambda}$ decay vertex in z-direction



Reconstructed $\bar{\Lambda}$ decay vertex in z-direction versus MC information.
The reconstruction becomes worse for decay vertices outside the MVD and no events are reconstructed over 110 cm.

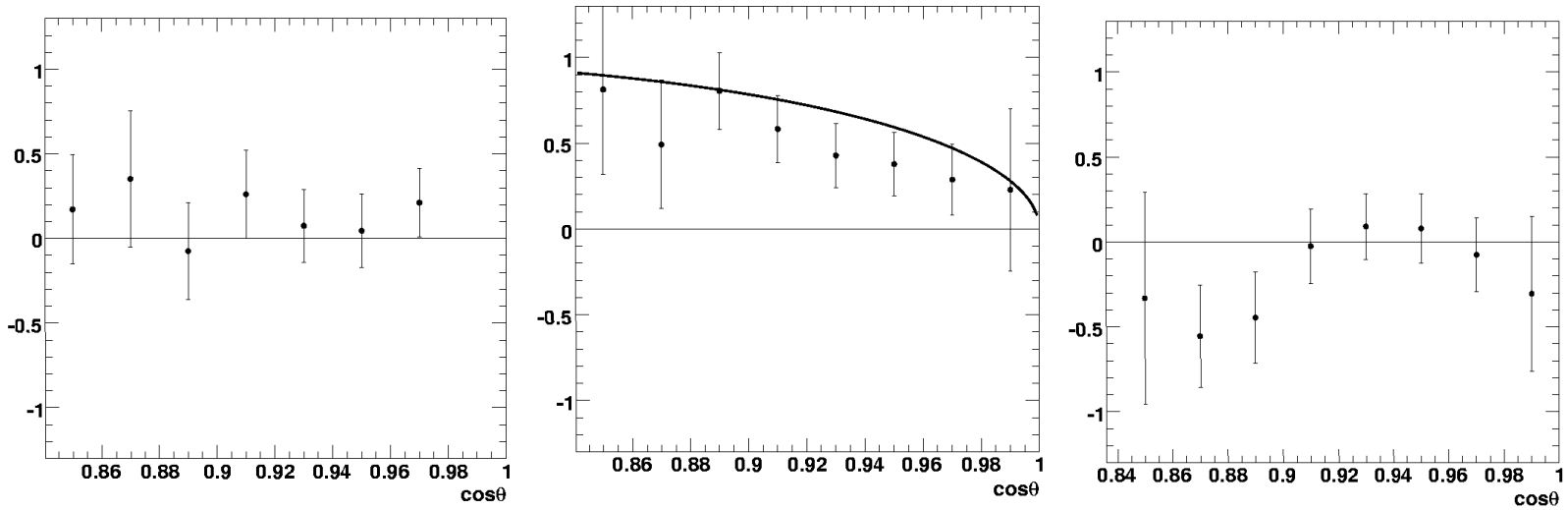
$\bar{\Lambda}$ angular distribution





Angular distribution of $\bar{\Lambda}$ from the event generator and from the simulation.

Reconstructed $\bar{\Lambda}$ polarisation as a function of $\bar{\Lambda}$ production angle



Polarised events generated with very forward peaked angular distribution $\Rightarrow$ only a few points close to 1.
We need data with a flat angular distribution of $\bar{\Lambda}$.

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Conclusions

Simulations at 1.64 GeV

- Efficiency drop from 35% to 20%
- Reasonably good reconstruction of polarisation as a function of $\bar{\Lambda}$ angle
- Slight problem with too low reconstructed polarisation for $\cos\theta_{\bar{\Lambda}} < 0$

Simulations at 15 GeV

- Efficiency 12% for forward peaked angular distribution of $\bar{\Lambda}$, 20% for flat distribution
- Polarised data with flat angular distribution of $\bar{\Lambda}$ needed to reconstruct polarisation as a function of $\bar{\Lambda}$ angle
- Problem with reconstruction of $\bar{\Lambda}$ decay vertex

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Outlook

- Experimental polarisation data for 1.64 GeV
- Reconstruction of polarisation as a function of $\bar{\Lambda}$ angle at 15 GeV, using polarised data with flat angular distribution
- Other hyperons (Ξ^+, Ξ^-, ...)