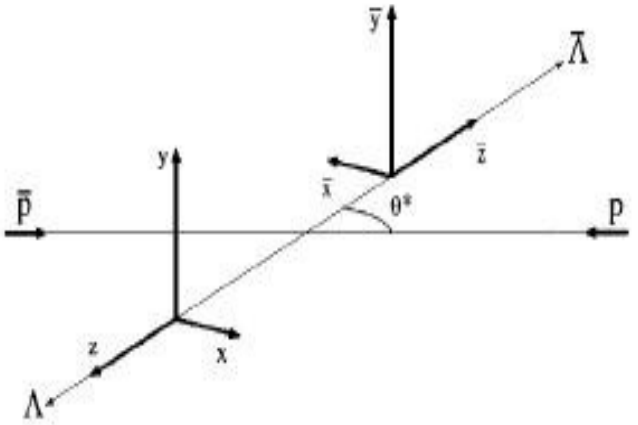
Simulations of $p\bar{p} \rightarrow \Lambda\bar{\Lambda} \rightarrow p\bar{p}\pi^+\pi^-$

Coordinate system:

The polarization is investigated in the lambda rest system, which is defined according to the figure below. The z-axis is defined by the direction of the decaying lambda, the y-axis is perpendicular to the production plane and the x-axis completes the right hand system.

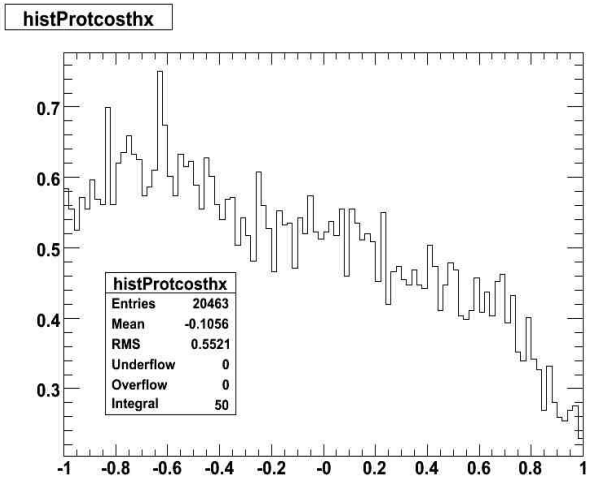


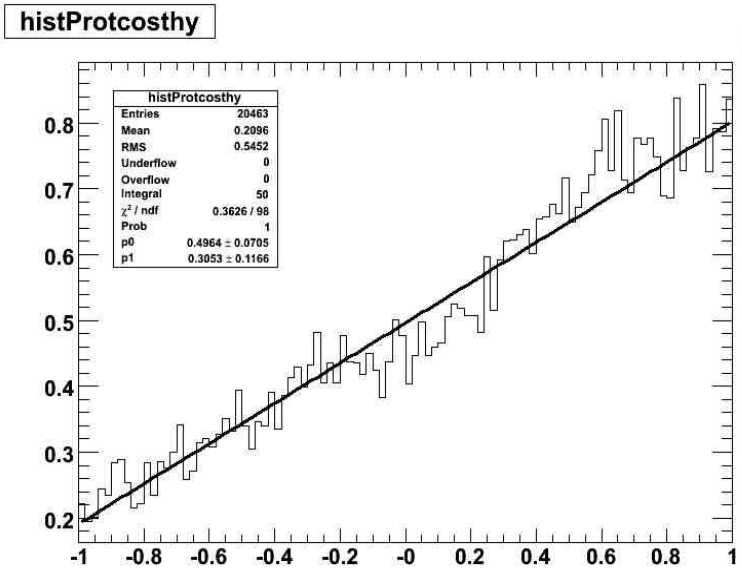
Since parity is conserved in the strong interaction, polarization is only allowed perpendicular to the production plane (along the y-axis).

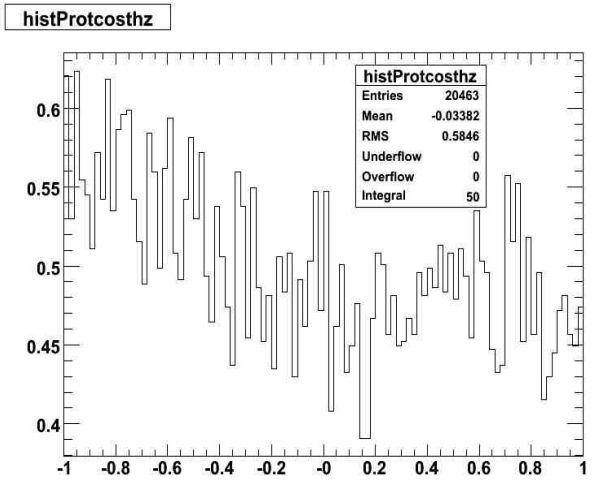
To test the reconstruction of polarization, we have set the polarization to 100% in y-direction. Simulations have been performed in the release 0.11.4.

Simulations at 1.64 GeV/c

Histograms of cosθ for the daughter proton from the Λ-decay in the lambda rest frame in the case of 100% polarization



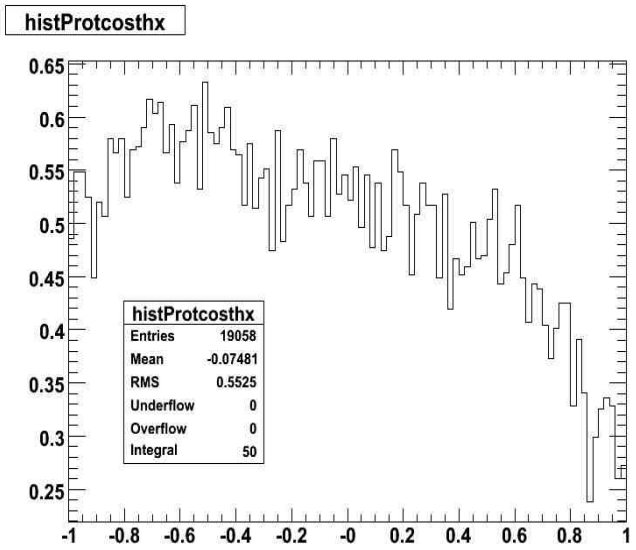


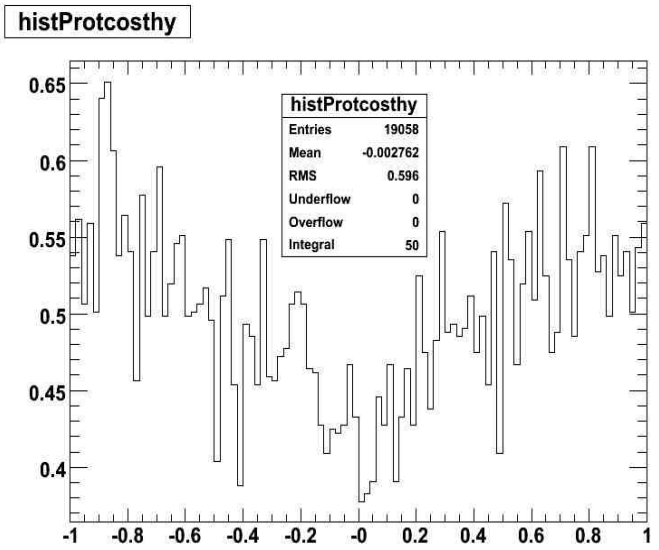


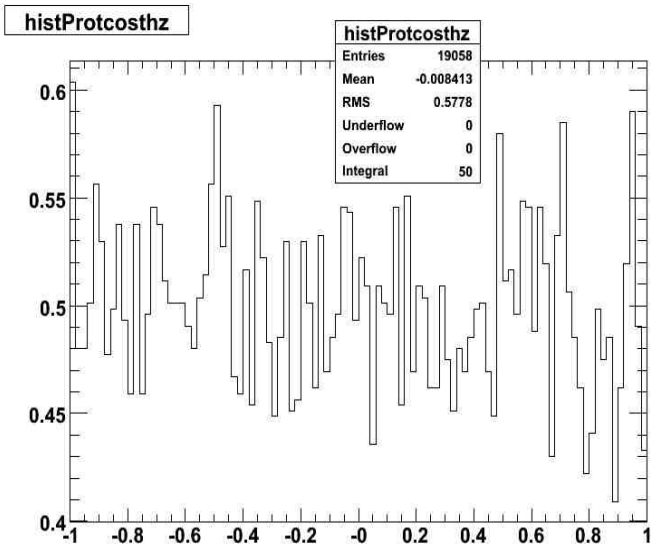
100 000 generated events.

Method of moments gives reconstructed polarization: -0.494±0.018, 0.979±0.019, -0.158±0.019.

Histograms of cosθ for the daughter proton from the Λ-decay in the lambda rest frame in the case of 0% polarization





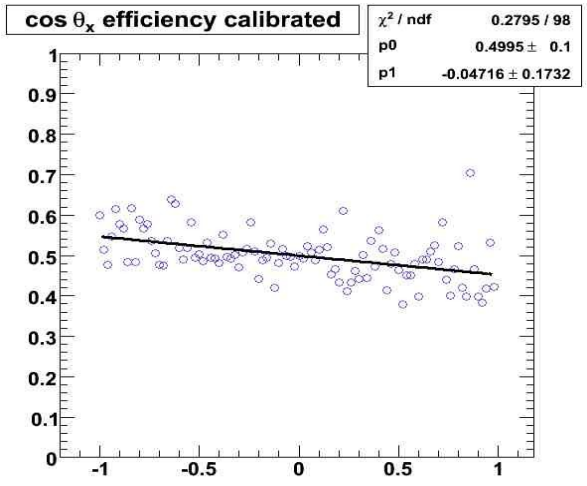


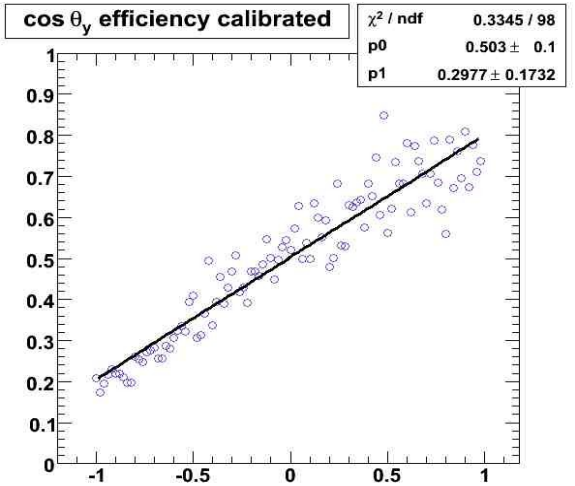
100 000 generated events.

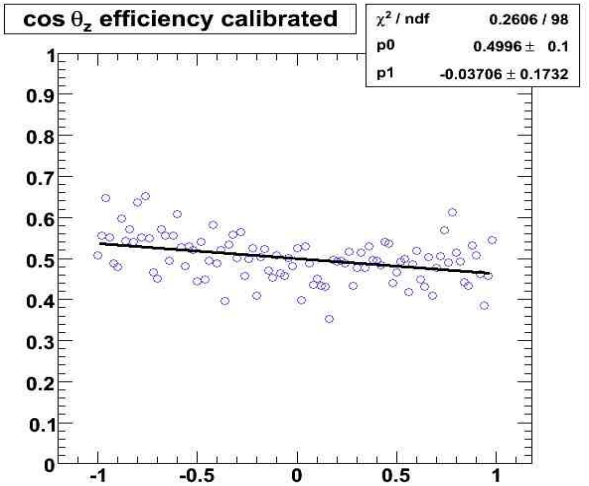
Method of Moments gives reconstructed polarization: -0.350±0.019, -0.012±0.020, -0.039±0.019.

Efficiency Calibration

Considering that the cosθ-distribution should be flat in all three directions in the case of 0% polarization, we can use these events to calibrate for the detector efficiency in the case of 100% polarization. Using this method instead of the Method of Moments gives the following results



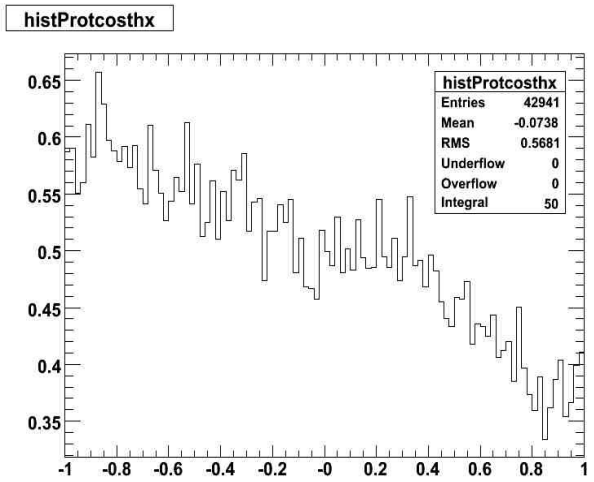


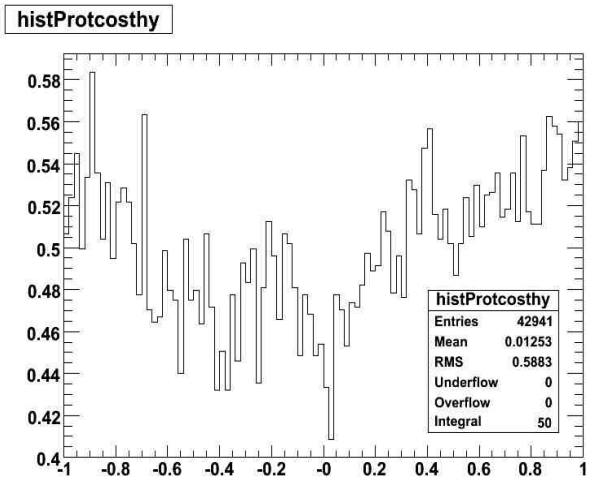


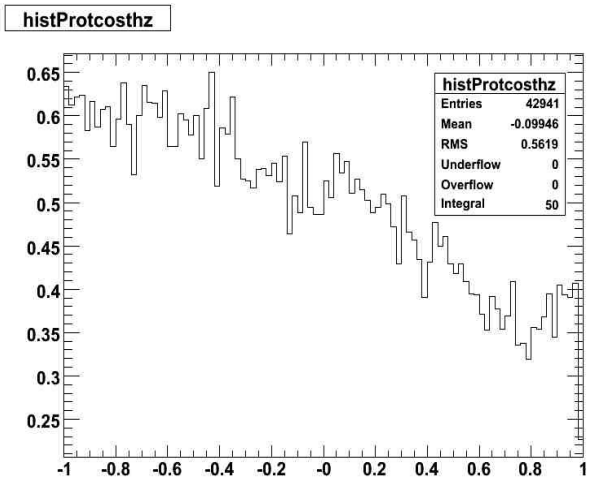
Polarization from slope (p1) divided by the asymmetry parameter $\alpha/2$: -0.14±0.54, 0.93±0.54, 0.12±0.54.

Simulations at 3 GeV/c

Polarization not possible yet at this energy. For 0% polarization we obtain







Note the large efficiency compared to the 1.64 GeV (twice!).

Summary

Simulations show that at 1.64 GeV the reconstructed polarization in y-direction is ok. It's not as good for the two other directions where there are dips or $\cos\theta$ close to 1, especially in the x-direction.

When calibrating for the detector efficiency, the x and z-directions look better and the y-direction looks about the same.

For 3 GeV/c the reconstruction efficiency is twice as good but the dip in x-direction for $\cos\theta$ close to 1 is still present, as is the dip in z-direction which is now even more pronounced.