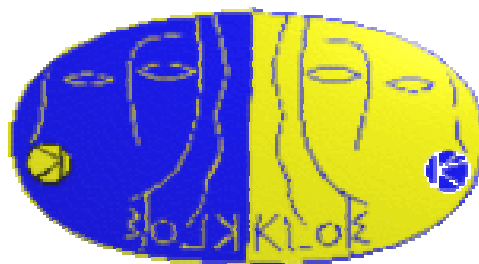# Status report on dynamics of the decay $\eta \rightarrow \pi^+ \pi^- \pi^0$

- Resolution
- Fit strategy
- Fit results MC
- Preliminary results on 2000 data
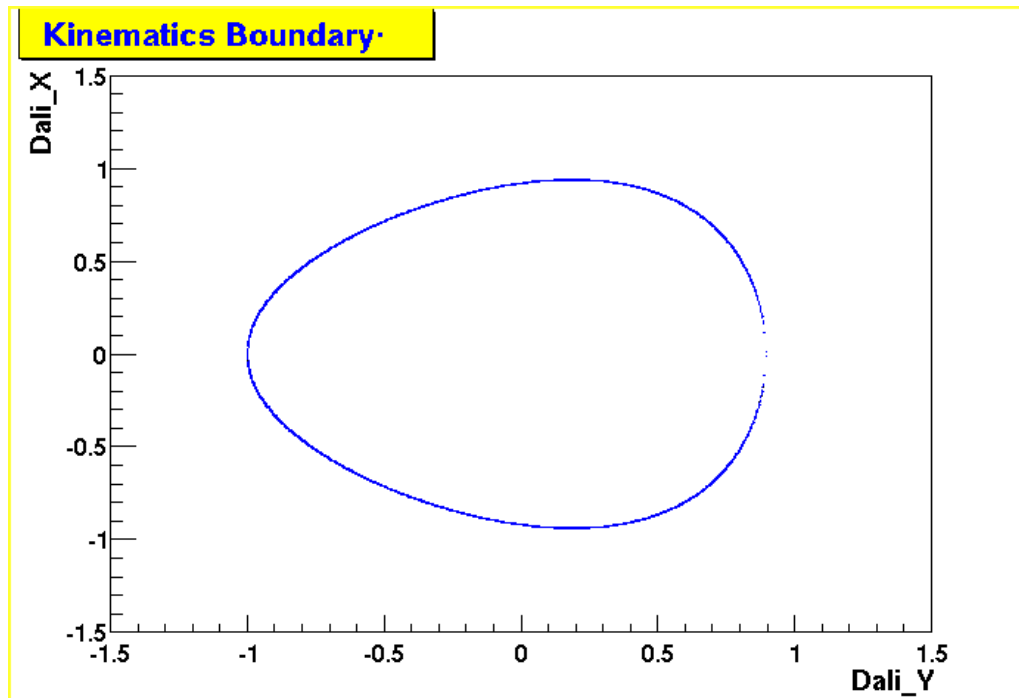- Conclusions and outlook

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Dalitz-Plot Parameters

$$X = \sqrt{3}\,\frac{T_+ - T_-}{Q} \qquad X \in [-1;1]$$

$$Y = \frac{3T_0}{Q} - 1 \qquad Y \in [-1;0.895[$$

Contour of the phase-space allowed region on the <u>X-Y</u> plane
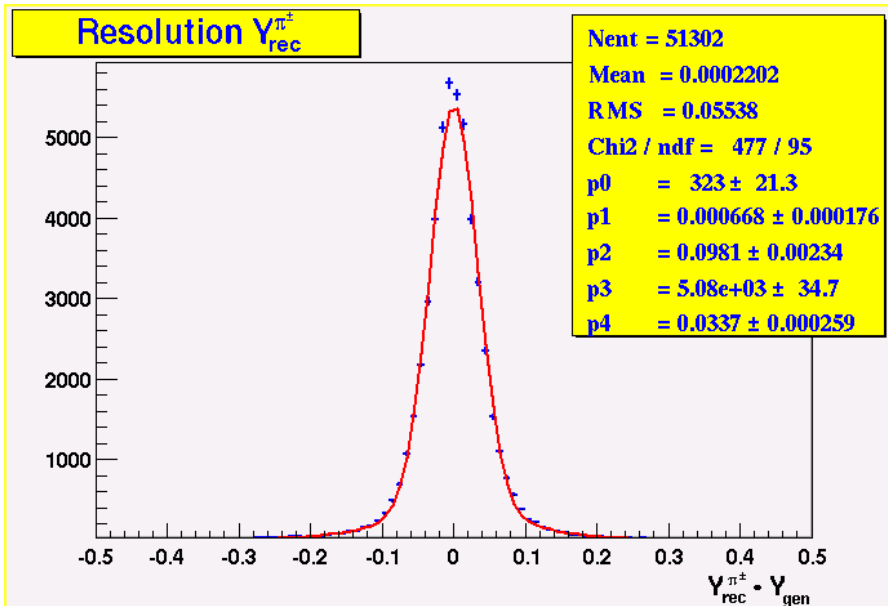

Kinematics Boundary·

Y resolution on MC
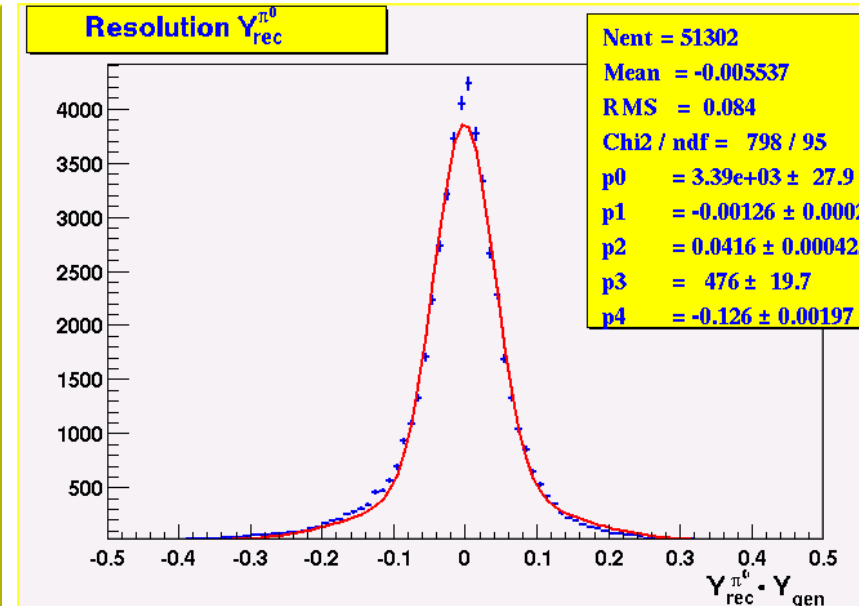
On a sample of 130000 MC events.

$$T_{0\_ch} = M_\eta - E_{\pi^+} - E_{\pi^-} - M_{\pi^0}$$
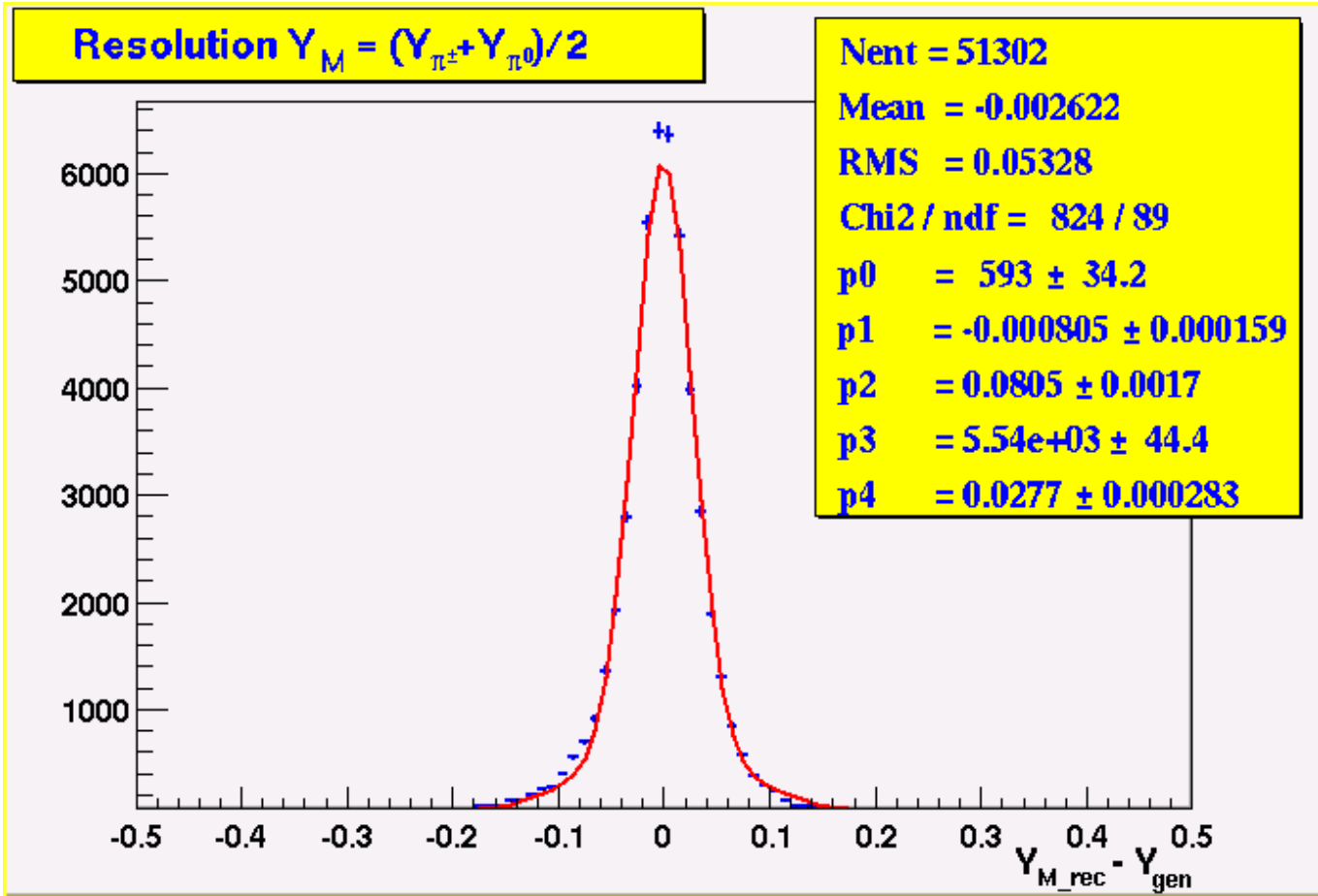
$$T_0 = E_{\gamma\gamma} - M_{\pi^0}$$

Resolution $Y_{rec}^{\pi^\pm}$

Nent	= 51302
Mean	= 0.0002202
RMS	= 0.05538
Chi2 / ndf	= 477 / 95
p0	= 323 ± 21.3
p1	= 0.000668 ± 0.000176
p2	= 0.0981 ± 0.00234
p3	= 5.08e+03 ± 34.7
p4	= 0.0337 ± 0.000259

$Y_{rec}^{\pi^\pm} - Y_{gen}$

Resolution $Y_{rec}^{\pi^0}$

Nent	= 51302
Mean	= -0.005537
RMS	= 0.084
Chi2 / ndf	= 798 / 95
p0	= 3.39e+03 ± 27.9
p1	= -0.00126 ± 0.000?
p2	= 0.0416 ± 0.00042
p3	= 476 ± 19.7
p4	= -0.126 ± 0.00197

$Y_{rec}^{\pi^0} - Y_{gen}$

"Core" res=0.034

"Core" res=0.042

$$Y_M = \frac{(Y_{\pi^{\pm}} + Y_{\pi^0})}{2}$$

Resolution $Y_M = (Y_{\pi^{\pm}} + Y_{\pi^0})/2$

Nent = 51302
Mean = -0.002622
RMS = 0.05328
Chi2 / ndf = 824 / 89
p0 = 593 ± 34.2
p1 = -0.000805 ± 0.000159
p2 = 0.0805 ± 0.0017
p3 = 5.54e+03 ± 44.4
p4 = 0.0277 ± 0.000283

$Y_{M\_rec} - Y_{gen}$

"Core" res=0.028

Event density in the XY plane may be parametrized by:
$$|M(X,Y)|^2 = 1 + aY + bY^2 + cX^2$$

In first approximation we neglect "b" and "c"
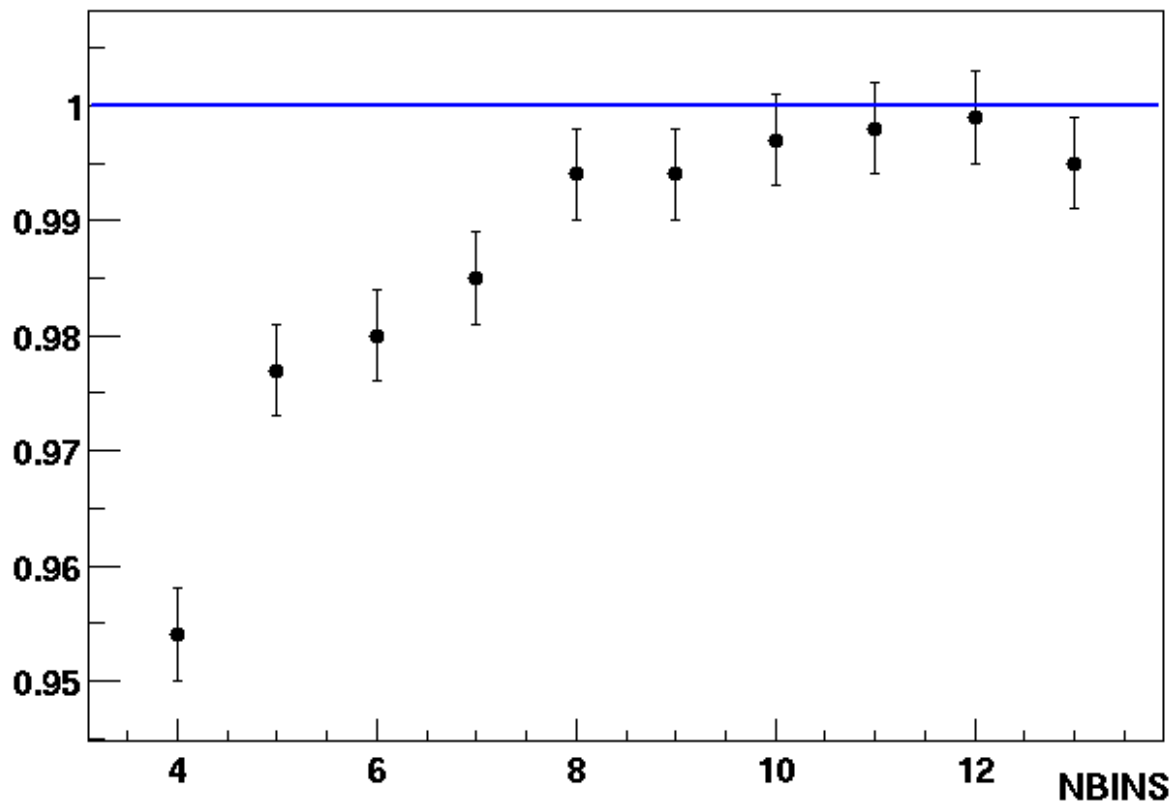$$|M(Y)|^2 = 1 + aY$$

$$|M(Y)|^2 = \frac{\displaystyle\sum_X \frac{N(X,Y)}{\varepsilon(X,Y)}}{\displaystyle\int dx}$$

Phase space

- N(X,Y) is for each bin: the number of events of Dalitz-plot.
- ε(X,Y) is for each bin: the efficiency as a function of Dalitz-plot.
- Phase space correction is applied when summig over X bins.
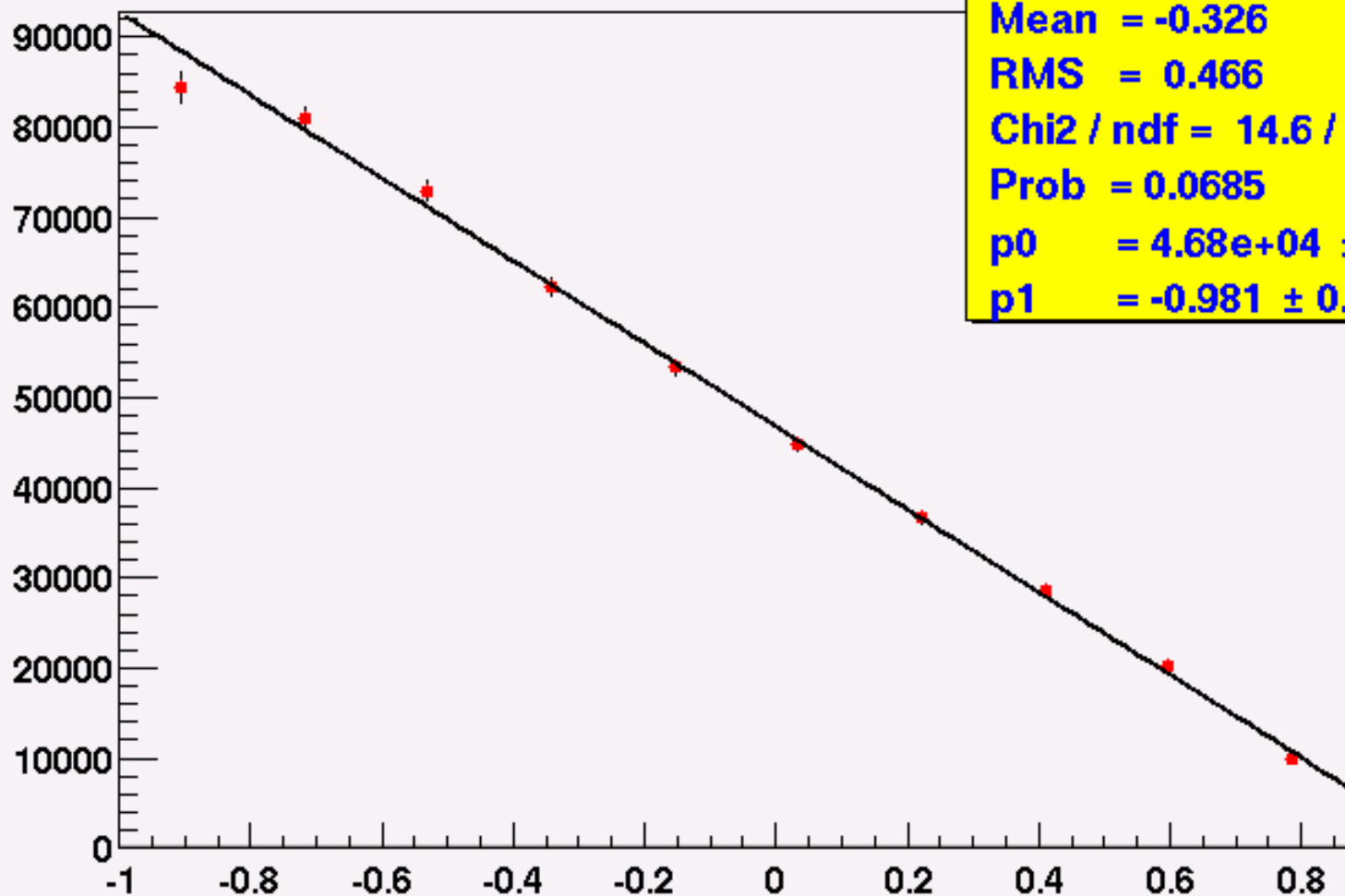- Efficiency obtained on an independent MC sample.

Results of fit

Fitted Slope (MC) / Generator Slope

dN/dY (phase space normalized)

Nent = 0
Mean = -0.326
RMS = 0.466
Chi2 / ndf = 14.6 / 8
Prob = 0.0685
p0 = 4.68e+04 ± 283
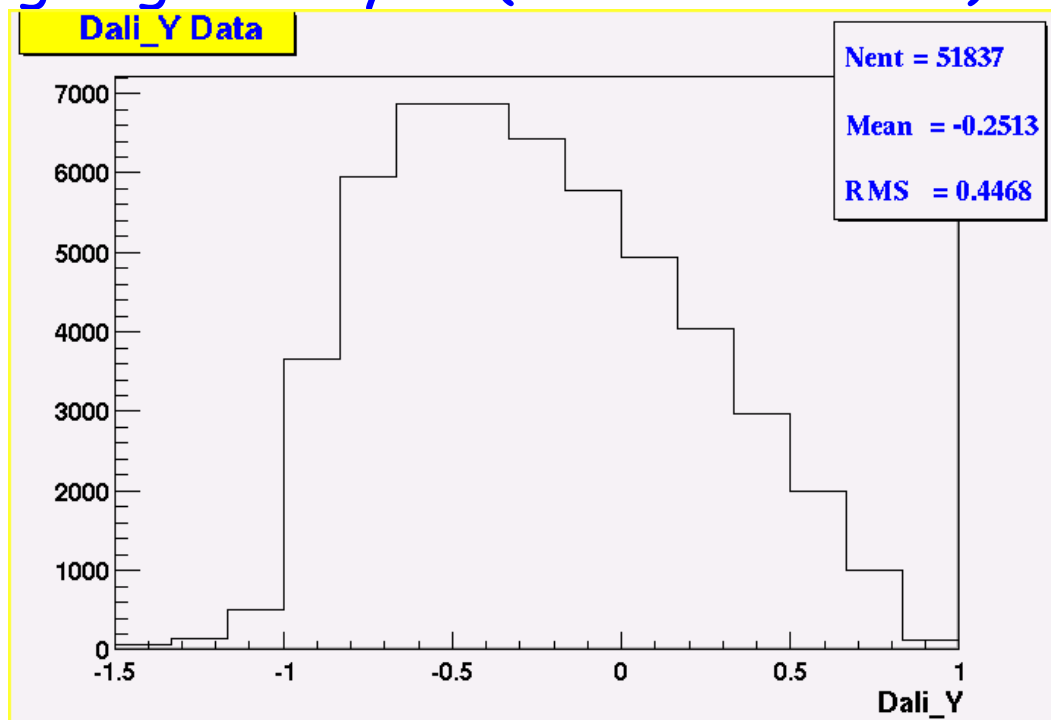p1 = -0.981 ± 0.00997

Analysis on Data

The analysis has been applied on 16 pb^{-1} from 2000.
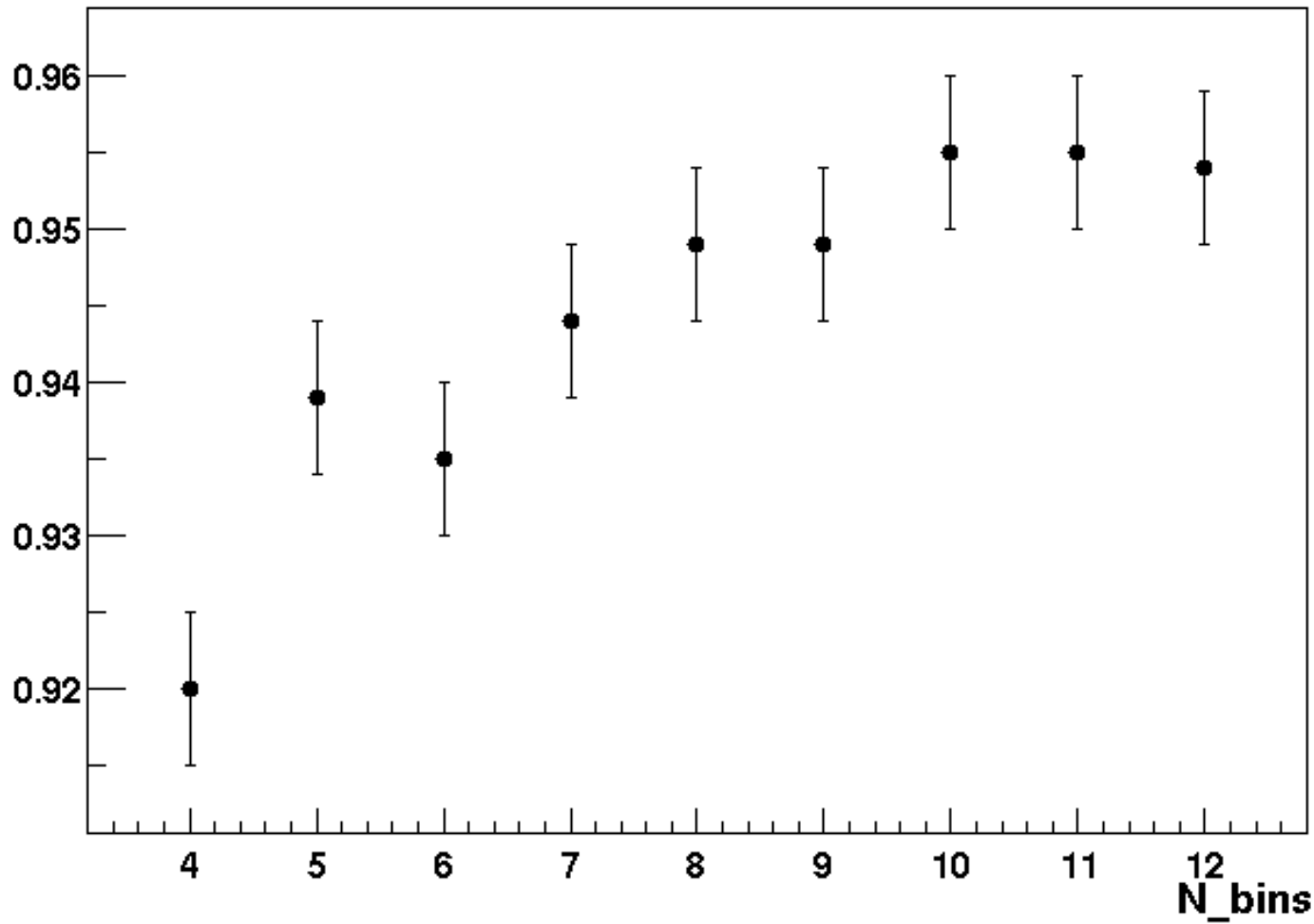
The cuts used to select: $\eta \rightarrow \pi^+ \pi^- \pi^0$ are the ones used fo
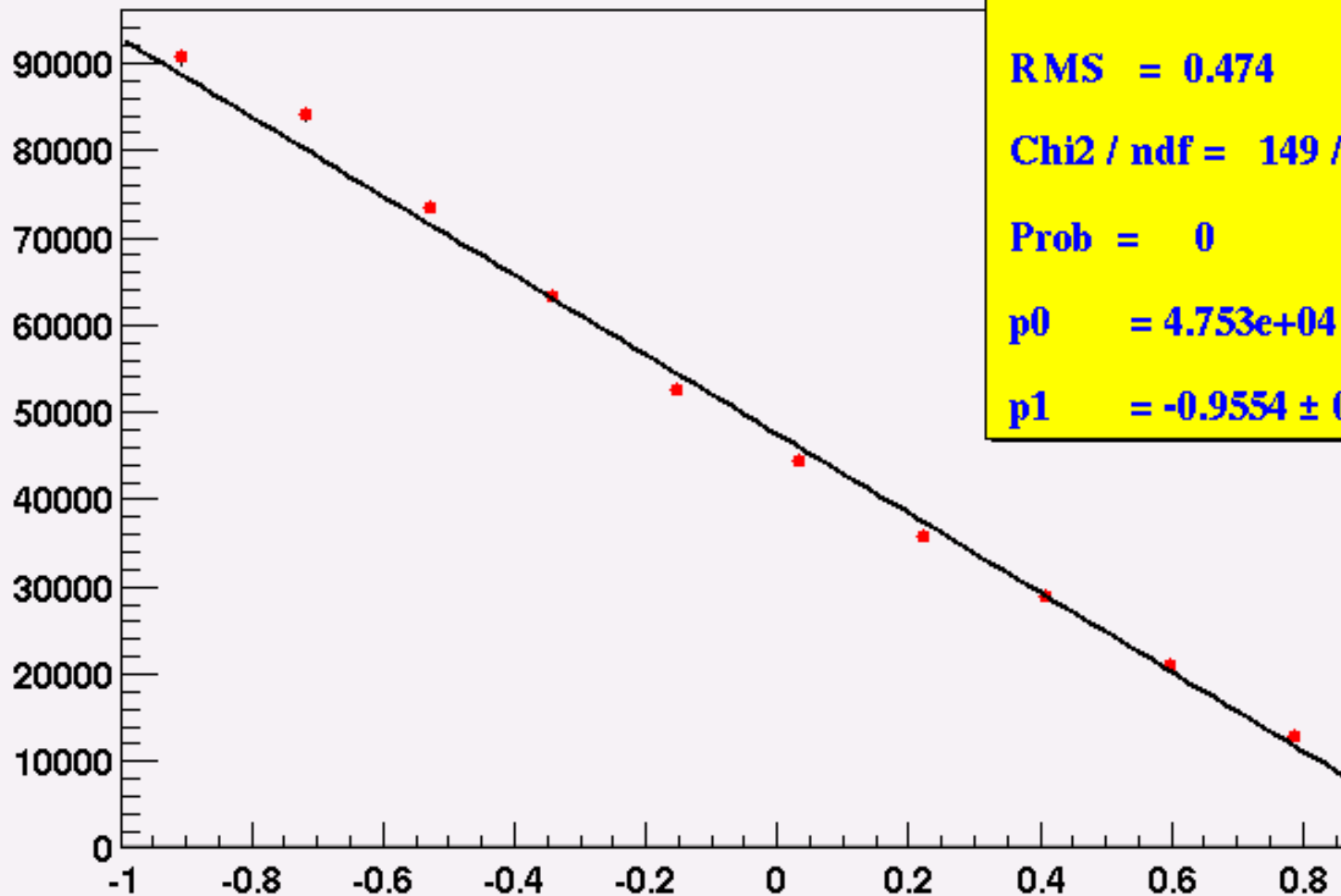the mixing angle analysis (Kloe memo 266).

Fit on Data

abs(Fitted slope)

dN / dY (phase space normalized)
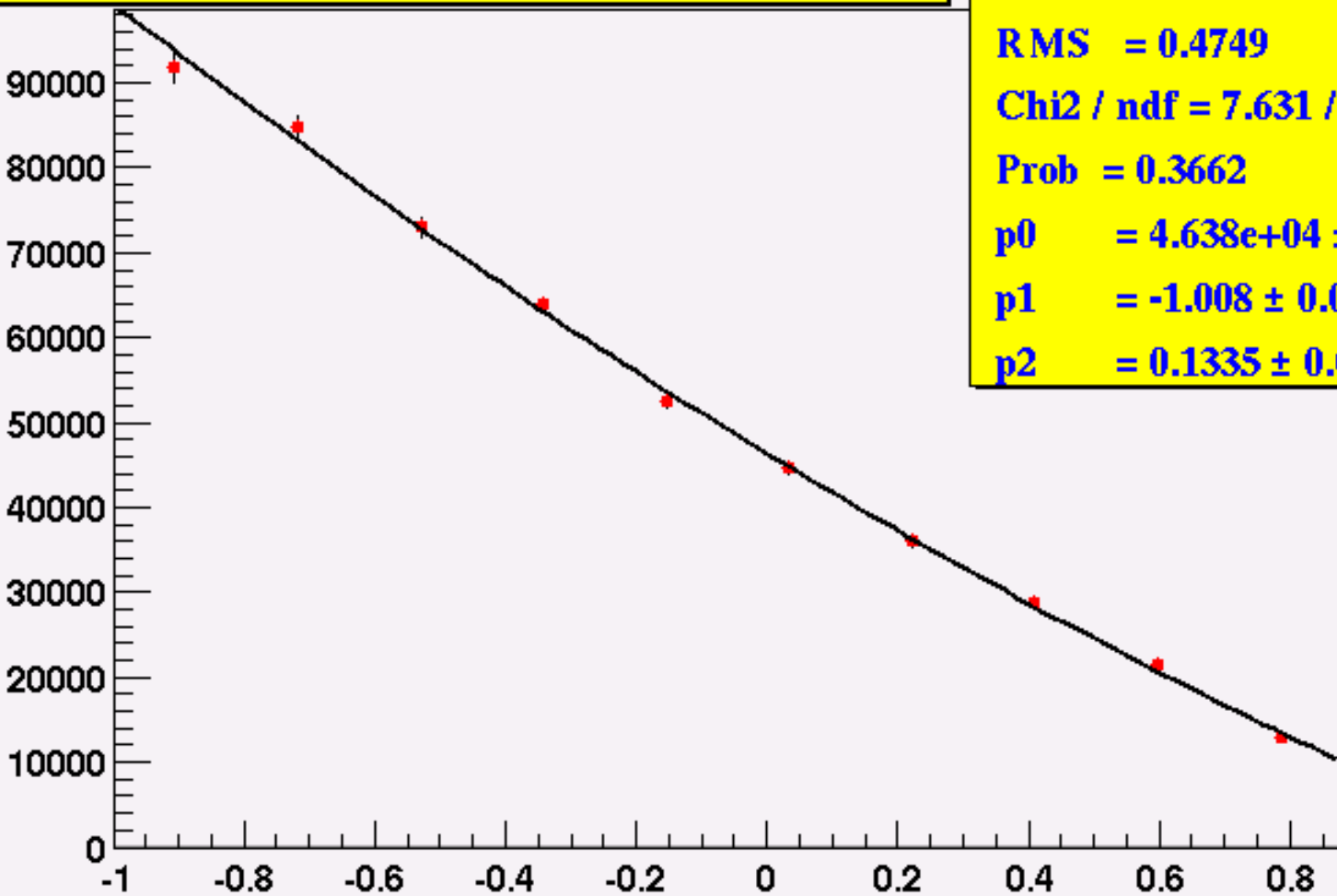
Mean = -0.3303

RMS = 0.474

Chi2 / ndf = 149 / 8

Prob = 0

p0 = 4.753e+04 ± 131.8

p1 = -0.9554 ± 0.00463

dN/dY Data (Phase space normalized)

Mean = -0.3306
RMS = 0.4749
Chi2 / ndf = 7.631 / 7
Prob = 0.3662
p0 = 4.638e+04 ± 394.2
p1 = -1.008 ± 0.01528
p2 = 0.1335 ± 0.02695

Conclusions and outlook

- The fit procedure has been tested on MC and reproduces input parameter

- Some work on optimization of resolution has been carried on

- First glance at data is encouraging, signalling sensitivity to quadratic slope(s)

- Still a lot of work ahead: systematic corrections, genuine 2D fit (to determine c), run on 2001-2002 data, possibly resolution unfolding…

Resolution X

Nent = 51302
Mean = 7.657e-06
RMS = 0.03142
Chi2 / ndf = 459 / 89
p0 = 5.14e+03 ± 39.6
p1 = 2.17e-07 ± 9.89e-05
p2 = 0.0182 ± 0.000175
p3 = 567 ± 31.9
p4 = 0.0497 ± 0.000961

$X_{rec} - X_{gen}$