COLLABORATION MEETING
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Introduction

Measurement of the electromagnetic form factors with Rosenbluth method

Measurement of the differencial cross section

$$\frac{d\sigma}{d\,Omega}=\frac{\alpha^2\,\rho(s)}{4s}[|G_M|^2(1+\cos^2\theta)+\frac{1}{\tau}|G_E|^2(1-\cos^2\theta)]\ \ with\ \ \tau=\frac{s}{4M_p}$$

Two problems / challenges:

10^6 times higher Background

$$\frac{\sigma(\pi^+\pi^-)}{\sigma(e^+e^-)}\approx 10^6$$

$$2\,\mu b/8pb\ \ at\ \ q^2=9(GeV/c)^2$$

Analysed events $\rightarrow$ Extraction of G_E and G_M

Introduction

Method

Analysis and reconstruction of the simulated events

List of variables

$$E_1, E_2, \cos\theta_{CM}, \ldots$$

Measurement of G_E and G_M based on ntuples

Analysed events $\rightarrow$ Extraction of G_E and G_M

Simulated events

$\bar{p}\,p \rightarrow e^+ e^-$

	$\vec{p}=5.8637\,GeV/c$	$\vec{p}=10\,GeV/c$
$G_E=0$	203 (20.000 events)	207(20.000 events)
$G_E=G_M \rightarrow \dfrac{G_E}{G_M}=1$	204(20.000 events)	208(20.000 events)
Phase space isotrop	205 (20.000 events)	171(95.000 events)

$\bar{p}\,p \rightarrow \pi^+ \pi^-$

	$\vec{p}=5.8637\,GeV/c$	$\vec{p}=10\,GeV/c$
Phase space isotrop	206	172

$\bar{p}\,p \rightarrow e^+\,e^-$

$G_E=0$ $\vec{p}=5.8637\,GeV$

$G_E=0$

$E=5.9383\,GeV$

$s=2m_p^2+2\,Em_p$
$\sqrt{s}=3.5922\,GeV$

$E_{lab}=E+m_p$
$E_{lab}=6.8766\,GeV$
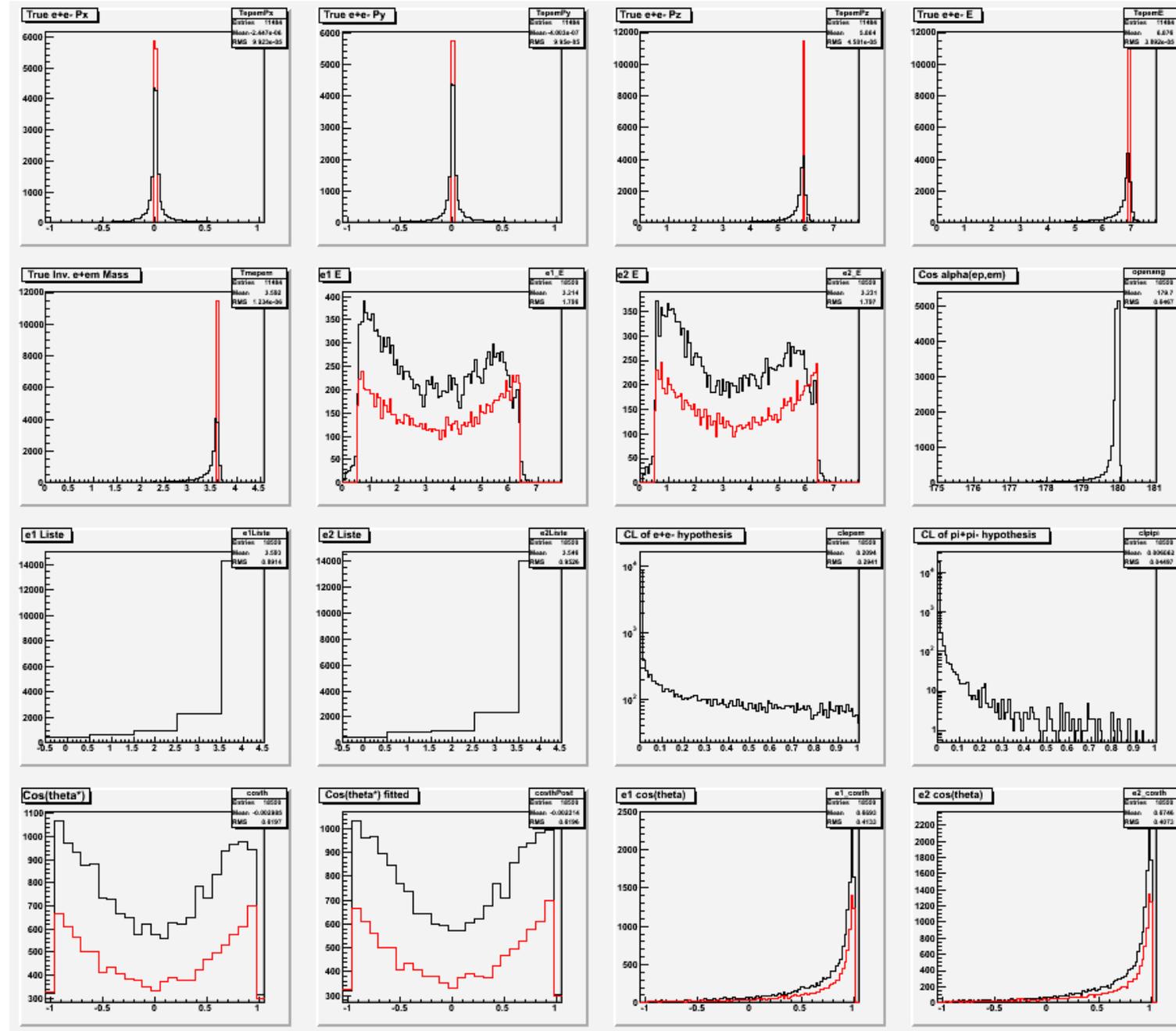
0 = Charged
1 = very loose
2 = loose
3 = tight
4 = very tight
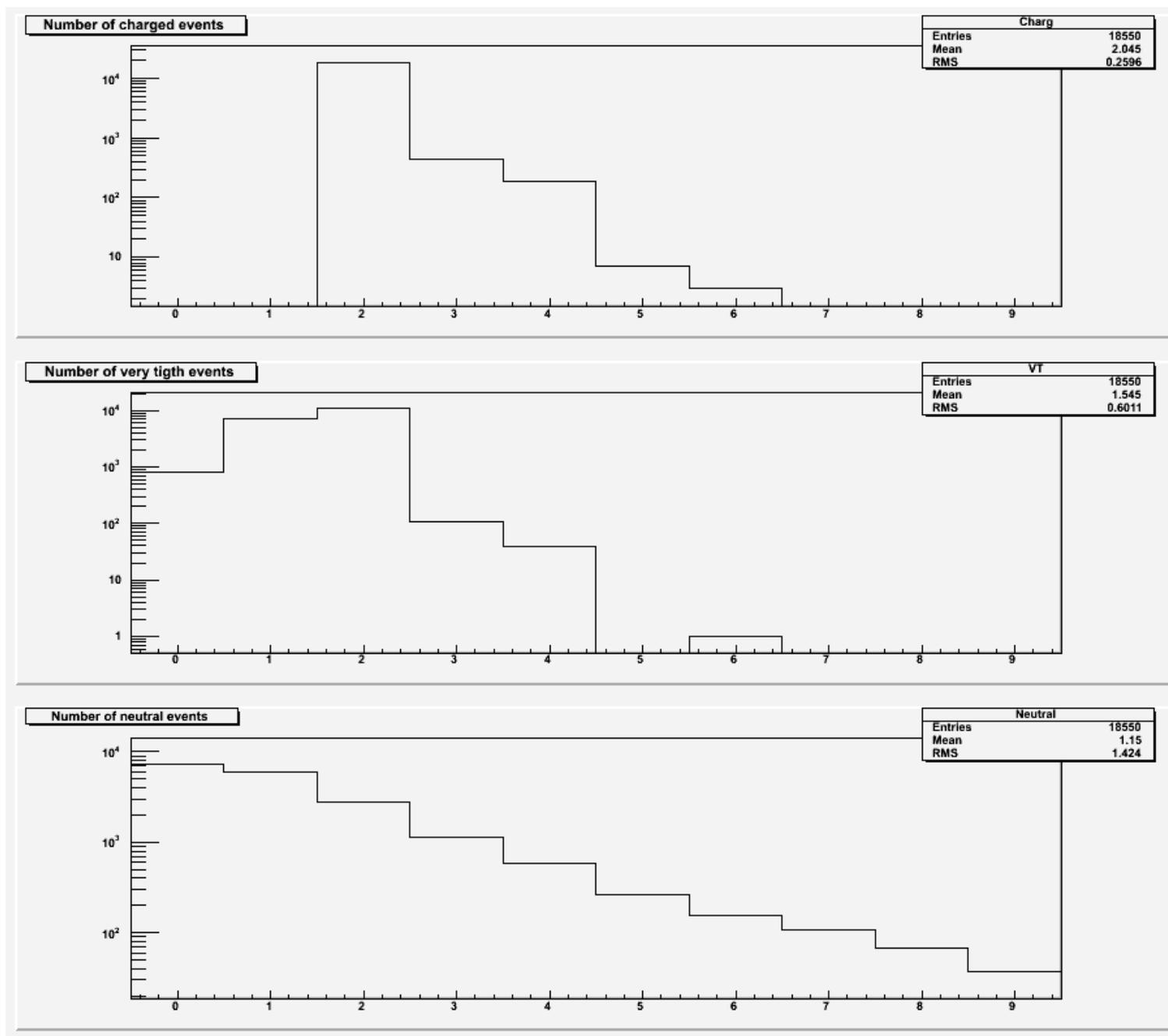
$\bar{p}\,p \rightarrow e^+ e^-$ $G_E = 0$ $\vec{p} = 5.8637\,GeV$

0 = Charged
1 = very loose
2 = loose
3 = tight
4 = very tight

$\bar{p}\,p \rightarrow e^{+}\,e^{-}$ $G_E = 0$ $\vec{p} = 5.8637\,GeV$

CUTS

CL_epem>0.01
e1_Liste>3
e2_Liste>3
CL_epem>10*CL_pippim

0 = Charged
1 = very loose
2 = loose
3 = tight
4 = very tight

Number of charged events — Charg, Entries 5334, Mean 2.011, RMS 0.1132

Number of very tigth events — VT, Entries 5334, Mean 2, RMS 0.01369

Number of neutral events — Neutral, Entries 5334, Mean 0.5714, RMS 0.9087

$\bar{p}\,p\to e^+\,e^-$

$G_E=0$ $\vec{p}=5.8637\,GeV$
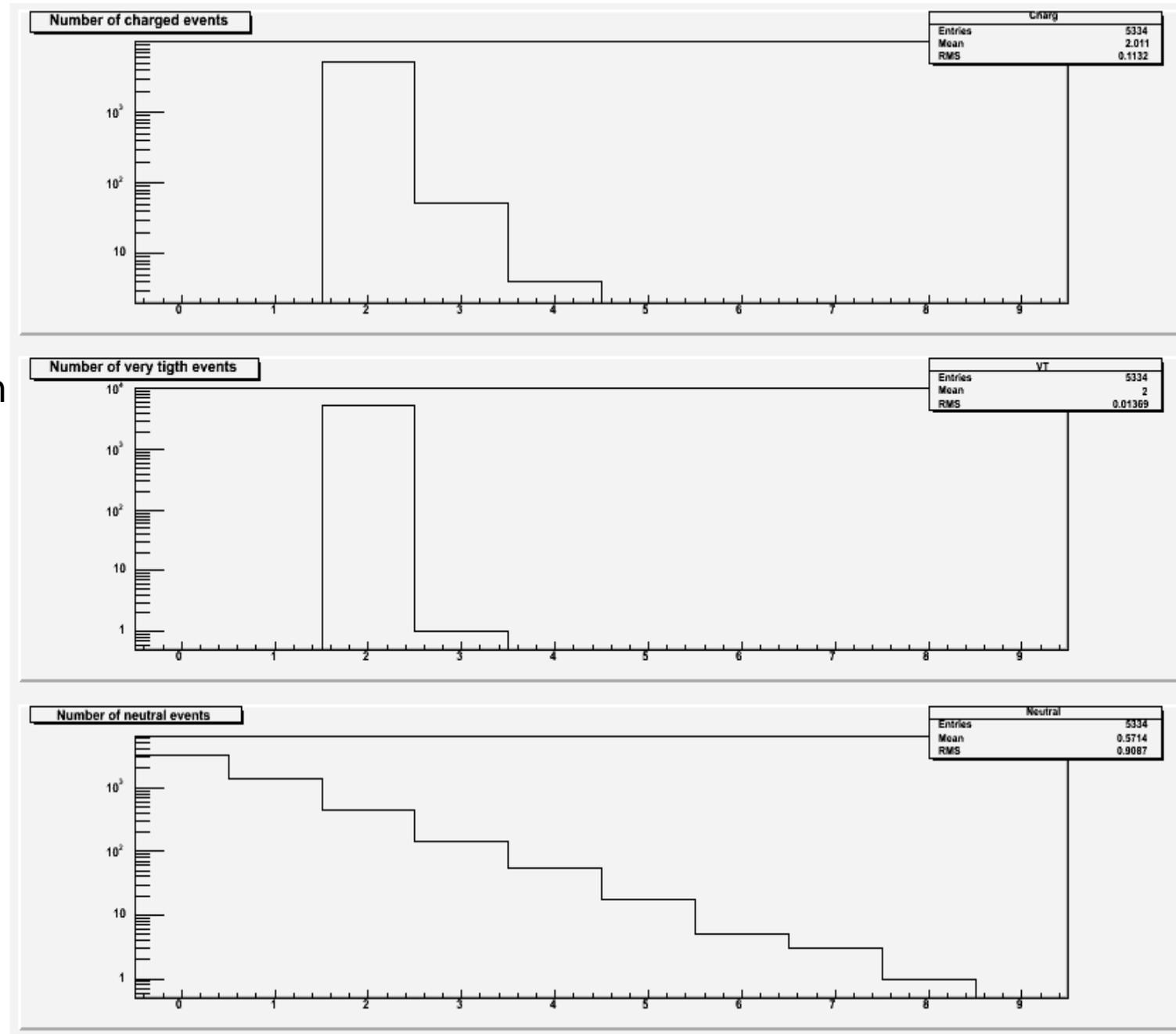
CUTS

CL_epem>0.01
e1_Liste>3
e2_Liste>3
CL_epem>10*CL_pippim

0 = Charged
1 = very loose
2 = loose
3 = tight
4 = very tight

Phase space isotrop

Acceptance correction= Measured/True

$\bar{p}\,p \rightarrow e^+\,e^-$ $G_E = 0$ $\vec{p} = 5.8637\,GeV$

$$\frac{d\sigma}{d\cos\theta} = A\left[G_M^2(1+\cos^2\theta) + \frac{4m_p^2}{s}G_E^2(1-\cos^2\theta)\right]$$

h2	
Entries	18550
Mean	-0.005942
RMS	0.6351

True events from MC

Events after the analysis
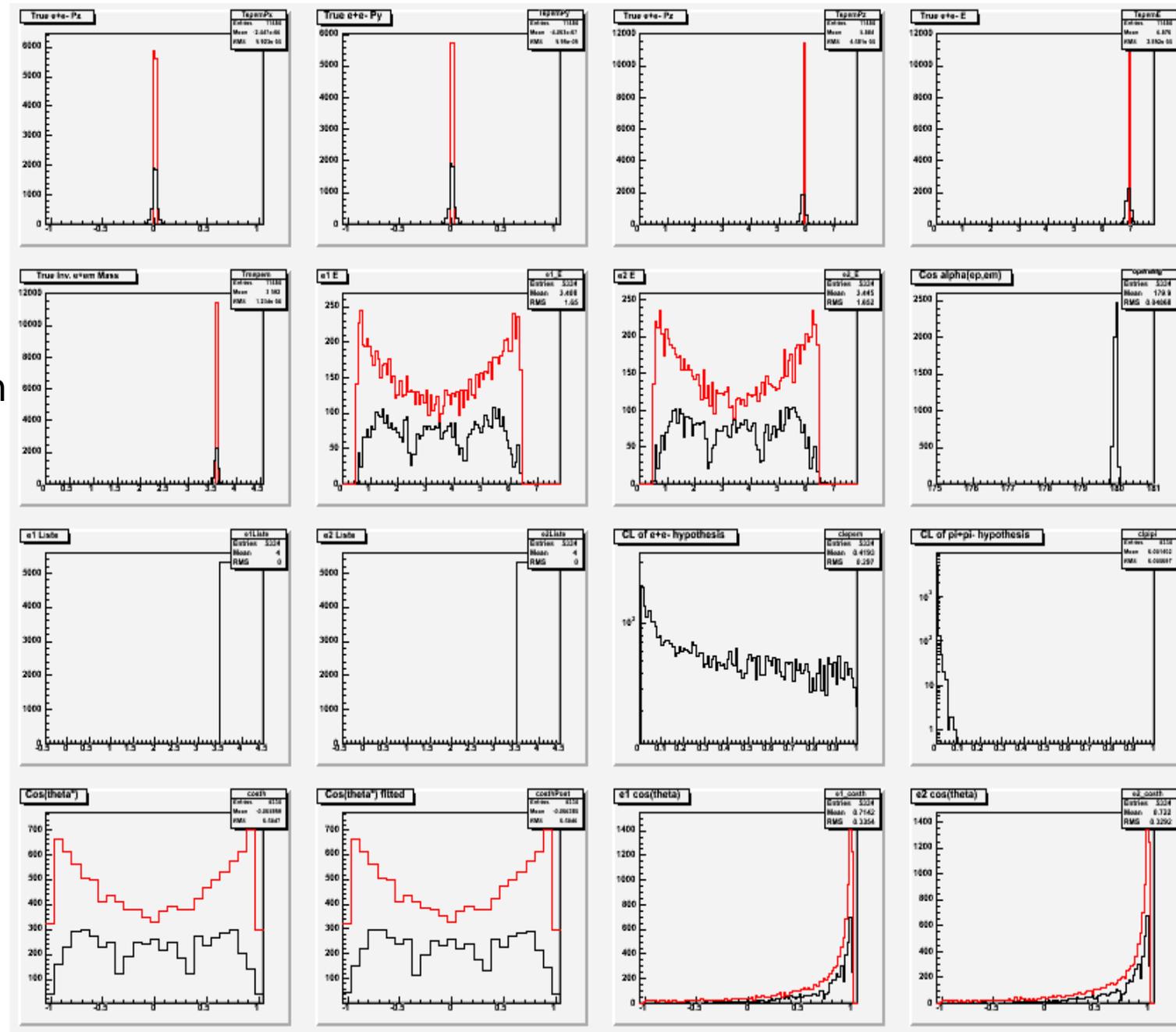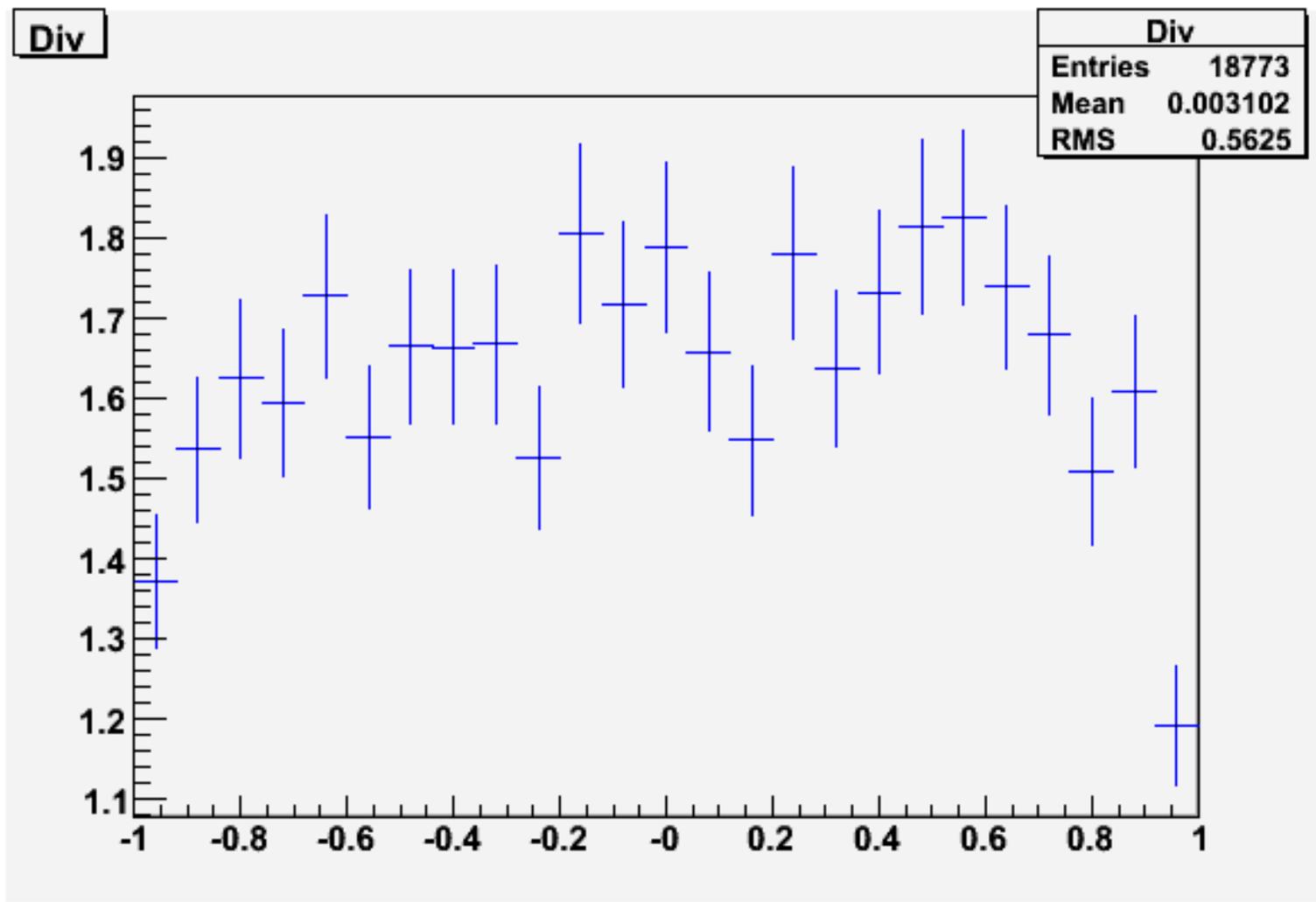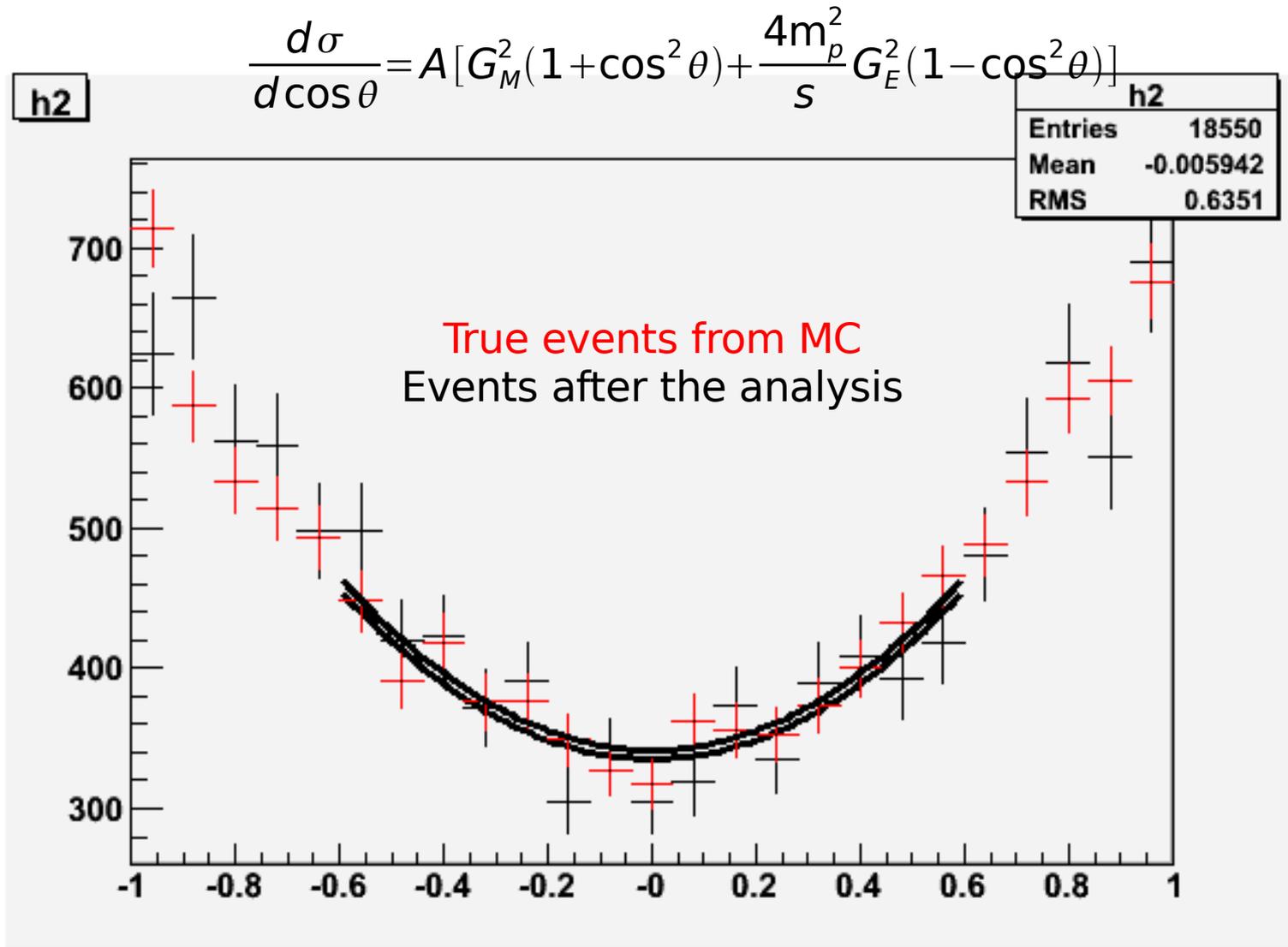
True:

$G_M = 1.57479 \pm 1.64431 \cdot 10^{-1}$

$G_E = 1.83044 \cdot 10^{-4} \pm 7.87346 \cdot 10^{-1}$

$A = 1.37785 \cdot 10^2 \pm 2.87736 \cdot 1$

Analysis:

$G_M = 1.56749 \pm 2.28769 \cdot 10^{-1}$

$G_E = 7.25080 \cdot 10^{-5} \pm 6.36081 \cdot 10^1$

$A = 1.36496 \cdot 10^2 \pm 3.98421 \cdot 10^1$

$$\frac{d\sigma}{d\cos\theta} = A\left[G_M^2(1+\cos^2\theta) + \frac{4m_p^2}{s}G_E^2(1-\cos^2\theta)\right]$$

h2

h2	
Entries	18697
Mean	-0.009026
RMS	0.6151

True events from MC
Events after the analysis
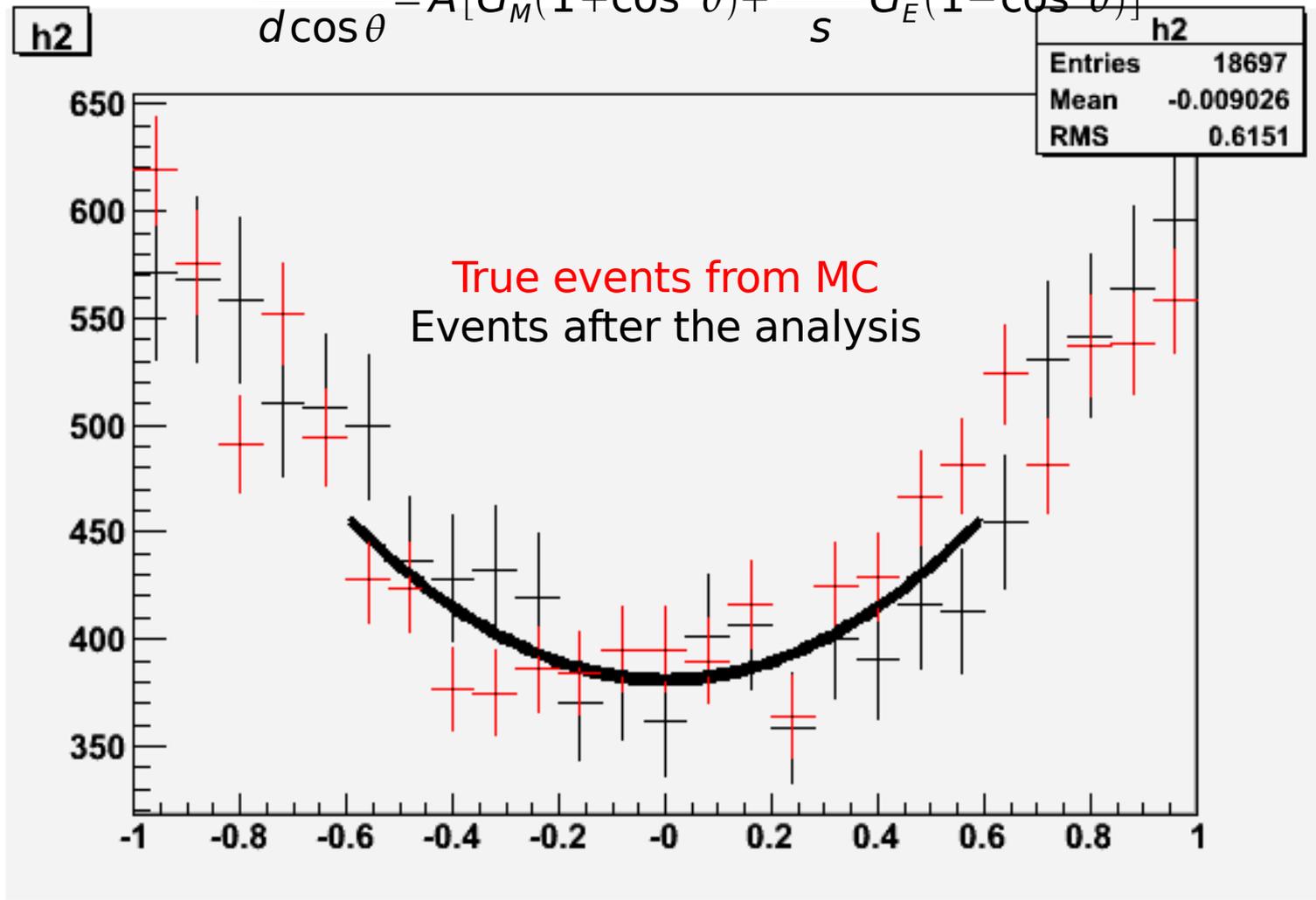
True:

$G_M = 9.86409 \cdot 10^{-1} \pm 9.19267 \cdot 10^{-2}$

$G_E = 1.00348 \pm 1.89084 \cdot 10^{-1}$

$A = 3.05042 \cdot 10^{+2} \pm 5.52543 \cdot 10^{+1}$

Analysis:

$G_M = 9.87167 \cdot 10^{-1} \pm 1.30735 \cdot 10^{-1}$

$G_E = 9.83544 \cdot 10^{-1} \pm 2.70540 \cdot 10^{-1}$

$A = 3.04918 \cdot 10^{+2} \pm 7.85726 \cdot 10^{+1}$

Phase space isotrop

Acceptance correction= Measured/True

$\bar{p}\,p \to e^+\,e^-$ $\qquad G_E = 0 \qquad \vec{p} = 10\,GeV$

$$\frac{d\sigma}{d\cos\theta} = A\left[G_M^2(1+\cos^2\theta) + \frac{4m_p^2}{s}G_E^2(1-\cos^2\theta)\right]$$

h2

h2	
Entries	18615
Mean	0.002895
RMS	0.6306

True events from MC
Events after the analysis
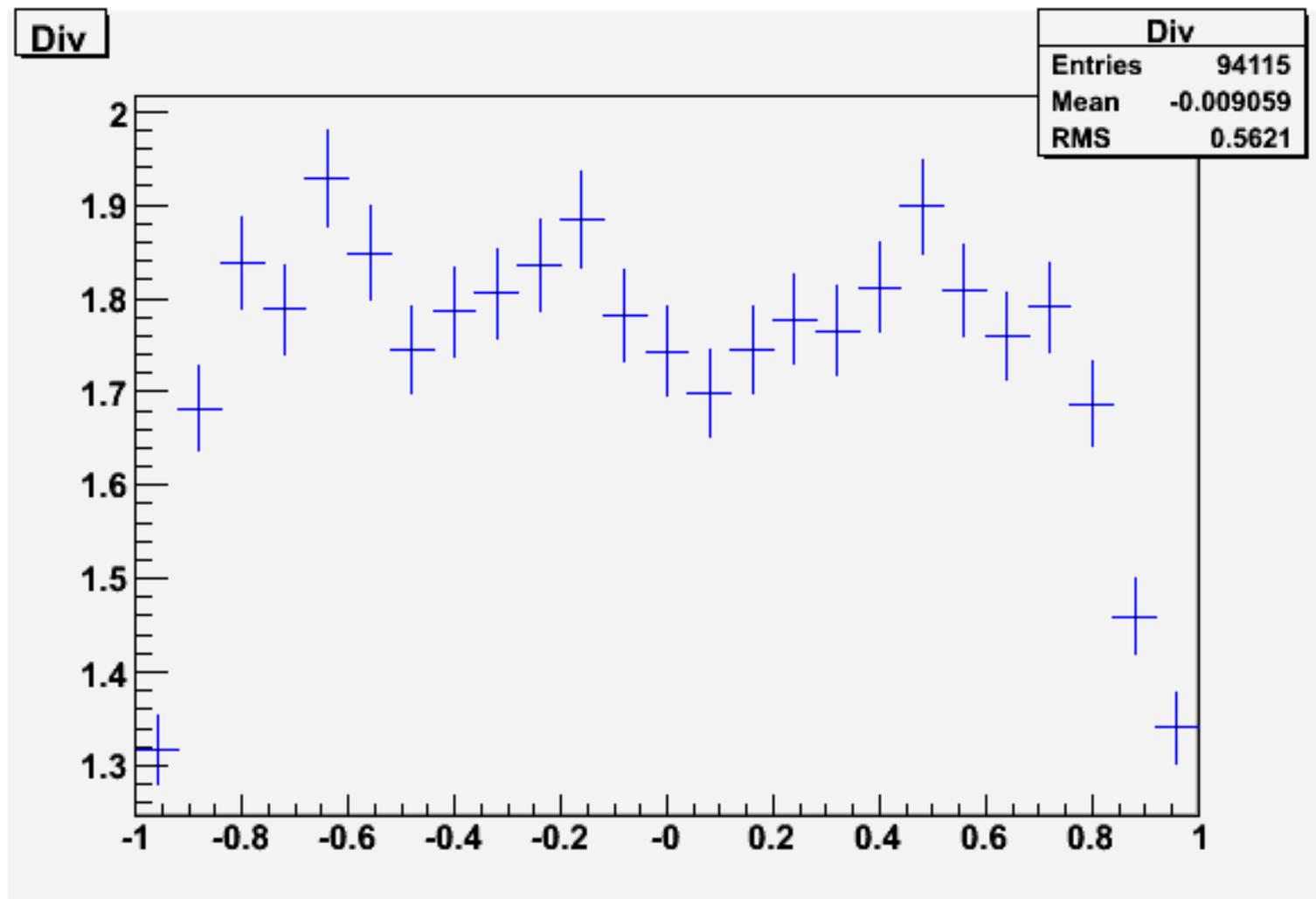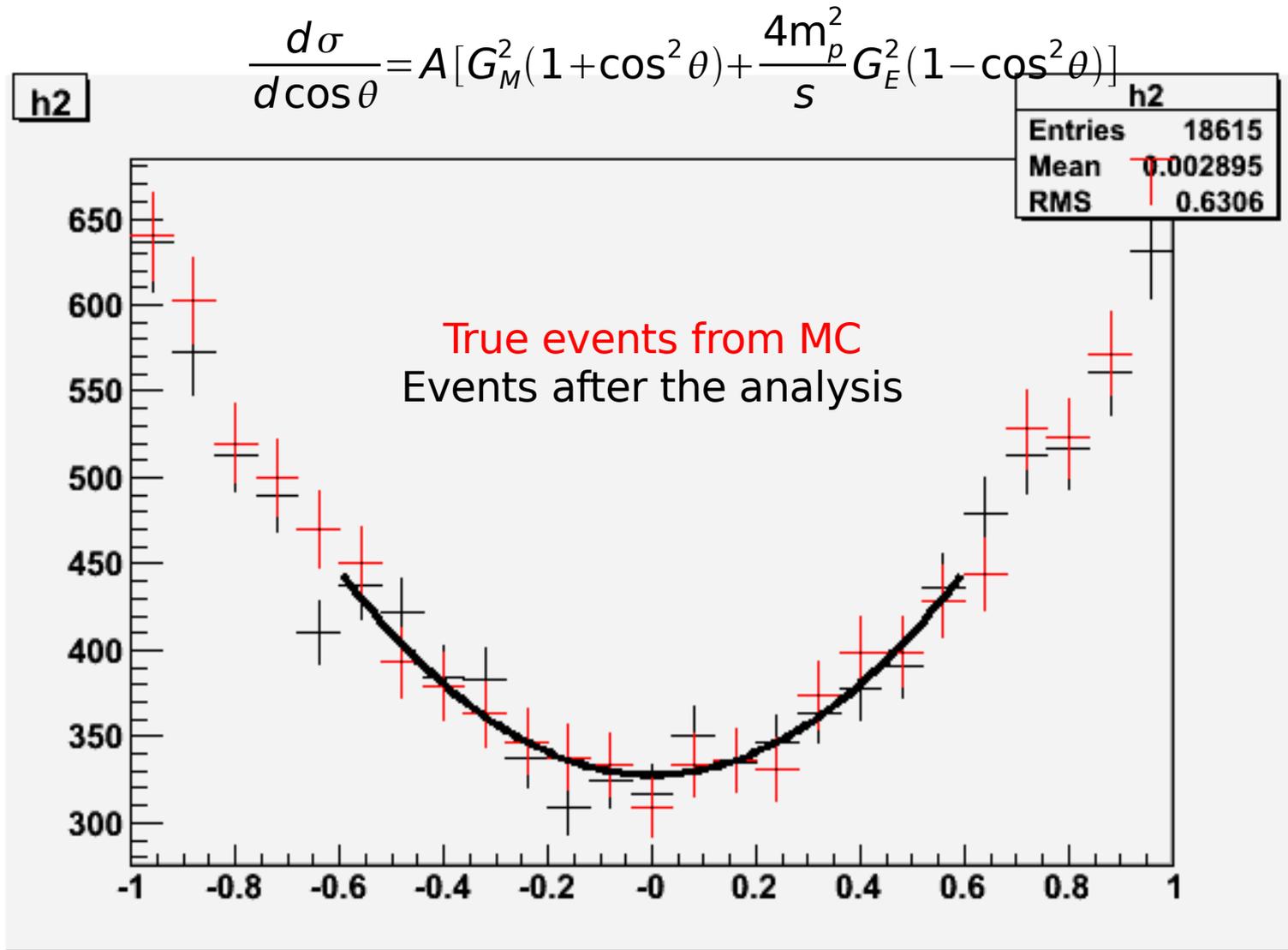
True:

$G_M = 1.39215 \pm 1.48359 \cdot 10^{-1}$

$G_E = 7.79309 \cdot 10^{-5} \pm 8.84406 \cdot 10^{-1}$

$A = 1.69263 \cdot 10^{+2} \pm 3.60760 \cdot 10^{+1}$

Analysis:

$G_M = 1.39170 \pm 1.34712 \cdot 10^{-1}$

$G_E = 3.89178 \cdot 10^{-5} \pm 7.08750 \cdot 10^{-1}$

$A = 1.69152 \cdot 10 + 2 \pm 3.27466 \cdot 10^{+1}$

$$\frac{d\sigma}{d\cos\theta} = A\left[G_M^2(1+\cos^2\theta) + \frac{4m_p^2}{s}G_E^2(1-\cos^2\theta)\right]$$

h2	
Entries	18646
Mean	-0.006344
RMS	0.6246

True events from MC
Events after the analysis
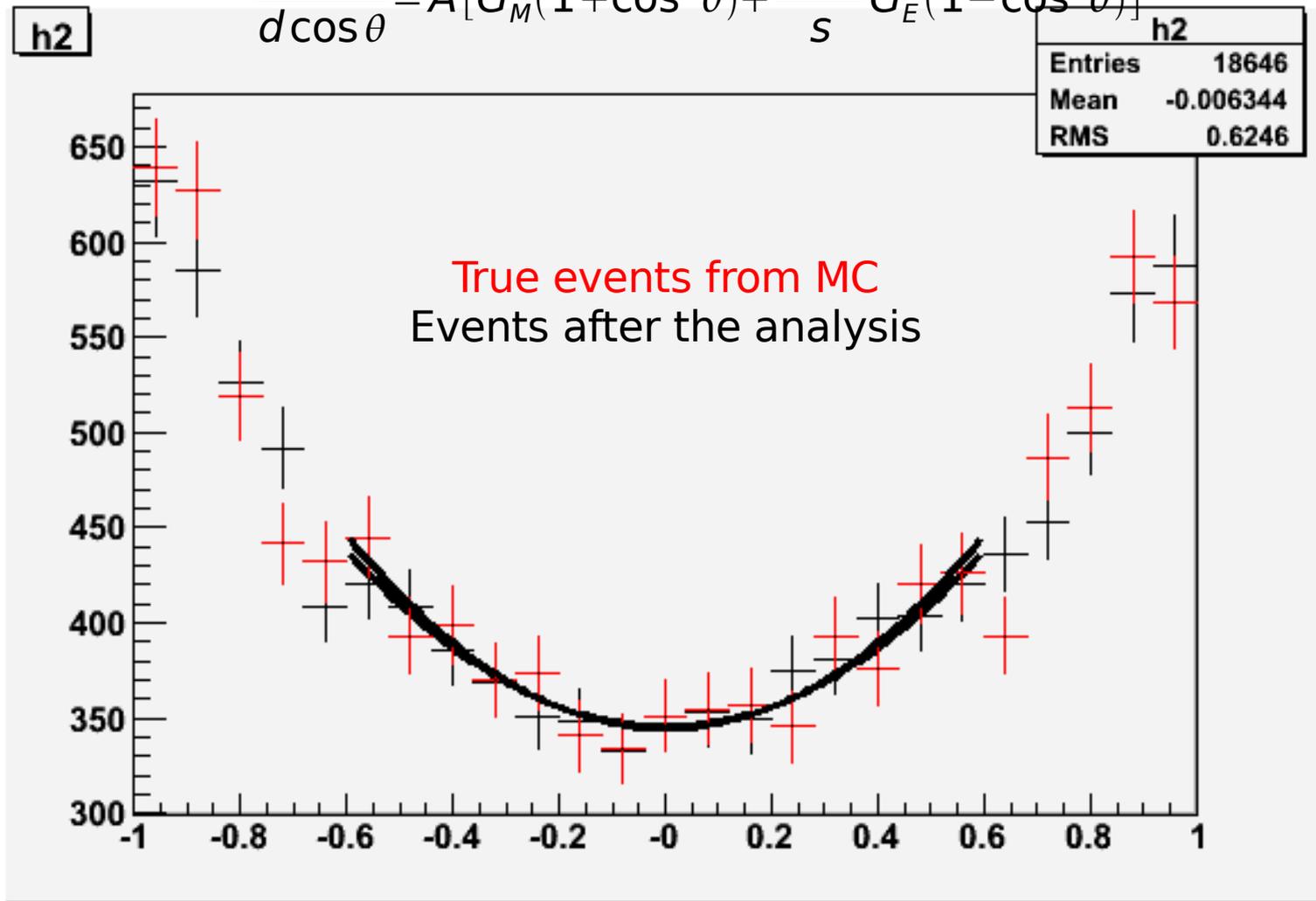
True:

$G_M = 1.11060 \pm 1.01097 \cdot 10^{-1}$

$G_E = 8.41182 \cdot 10^{-1} \pm 3.67232 \cdot 10^{-1}$

$A = 2.54221 \cdot 10^{+2} \pm 4.58687 \cdot 10^{+1}$

Analysis:

$G_M = 1.09818 \pm 9.29390 \cdot 10^{-2}$

$G_E = 1.01559 \pm 2.90146 \cdot 10^{-1}$

$A = 2.49876 \cdot 10^{+2} \pm 4.16992 \cdot 10^{1}$

Conclusions

DONE:

Starting point : preliminary results for GE and GM form factors

Preliminary but promising

TO DO:
Much more...

- More energies,

- Search for the best cuts

- Analysis of the background

- Improve the errors

- ...