Study of $J/\psi \to p\bar{p}$

I. Introduction

For the baryons, the ratio of the electric form factor G_E^B to the magnetic one G_M^B is related to the angular distribution of the annihilation process $e^+e^- \to B\bar{B}$ through the general expressions:

$$\frac{dN}{dcos\theta_B} = N_0(1+\alpha cos^2\theta_B), \qquad \alpha = \frac{S-4x^2m_B^2}{S+4x^2m_B^2}$$

Where θ_B is the angle between the baryon direction and the beam; m_B is the baryon mass; and $x = |G_E^B/G_M^B|$.

Theoretical models in QCD framework (3 gluons coupling) predict the value of α at the J/ψ energy. The theretical expectation are shown in table 1.

Several experiments have already performed α measurements. Their results are given in table 1.

Table 1: Theoretical and experiment results of $J/\psi \to p\bar{p}$

	Events	α	Br.($\times 10^{-3}$)
Theoretical		0.70	
MARKII	1420±37	0.61±0.23	2.16±0.07±0.15
DM2		0.62±0.11	1.91±0.04±0.30
BESII	28926	$0.763 \pm 0.037 \pm 0.120$	$2.02 \pm 0.01 \pm 0.15$

II.Data analysis result of $J/\psi \to p\bar{p}$ at BESII

$J/\psi \to p\bar{p}$ **events selection.**

1. NCHRG=2. NTOTCH=0.
2. For charged tracks:

- mfit=2 or -19
- $|cos\theta| \leq 0.85$
- Vertex: $|x| \leq 1.5cm$, $|y| \leq 1.5cm$, $|z| \leq 15cm$
- P_{xy} >0.05GeV
- Accolinear angle $> 175^0$
- Particle identification by the weight information in TOF, we need 2 tracks are both identified as p,

  W_{tof}(p)>W_{tof}(K), W_{tof}(p)>$W_{tof}(\pi)$
- Telesis:

  $\chi^2_{p\bar{p}} < 50$

  $\chi^2_{p\bar{p}} < \chi^2_{\pi^+\pi^-}$, $\chi^2_{p\bar{p}} < \chi^2_{\mu^+\mu^-}$, $\chi^2_{p\bar{p}} < \chi^2_{e^+e^-}$

After above cuts, 28926 events have been got after $|cos\theta| \leq 0.7$ cut.

MC, Phase space generator, the efficiency is 67.2% after $|cos\theta| \leq 0.7$ cut.

The angular distribution fitted result is

$N_0 = 3824.9 \pm 26.032$, $\alpha = 0.76252 \pm 0.036895$

$\frac{dN}{d(cos\theta)} = 3824.9 \times (1 + 0.76252 \times cos^2\theta)$

The total evts number is

$\int_{-1}^{1} 3824.9 \times (1 + 0.76252 \times x^2)dx \times 10/2$=47970.9

The Br. is $47970.9/(23.8 \times 10^6) = 2.02 \times 10^{-3}$

Error analysis:

The statistical error of α is given by the fitting, which has included the error of each bin.

The systematical error of α is got by changing cuts (include TOF particle ID, telesis χ^2, accolinear angle, etc), as well as changing the width of each bin and the fitting scope, the total is about 0.120.

The statistical error of the braching ratio is given by $\sqrt{N}$, N is the total events number got.

The systematical error of the branching ratio is got by changing cuts and bins of fitting, which is 0.09×10^{-3}, as well as the total J/ψ number error 6%. Then the total systematical error is about 0.15×10^{-3}.

So the final results is:

$\frac{dN}{d(cos\theta)} = N_0 \times (1 + (0.763 \pm 0.037 \pm 0.120) \times cos^2\theta)$

Br.($J/\psi \to p\bar{p}$)=$(2.02 \pm 0.01 \pm 0.15) \times 10^{-3}$

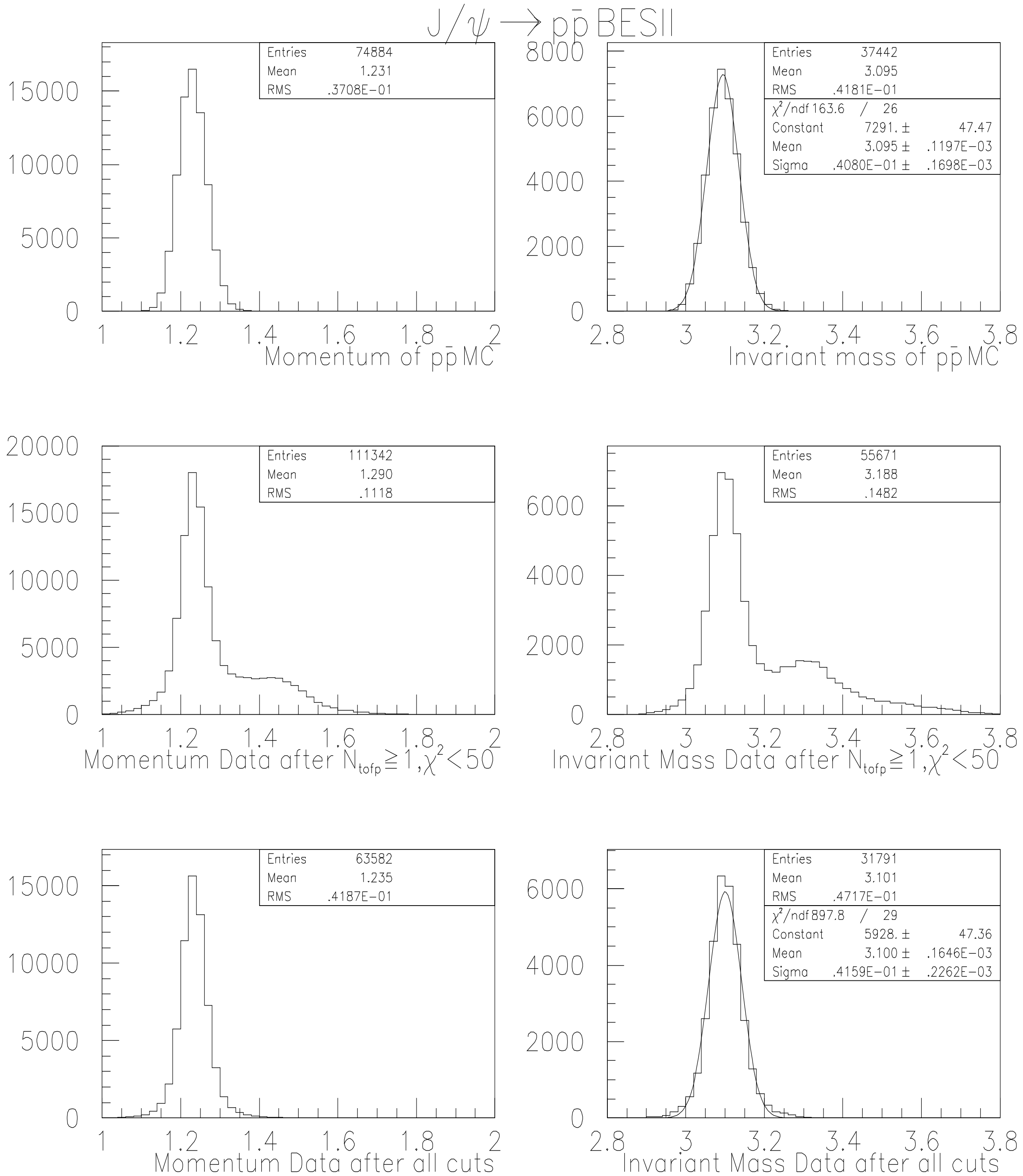

Figure 1: The momentum and invariant mass of $p\bar{p}$

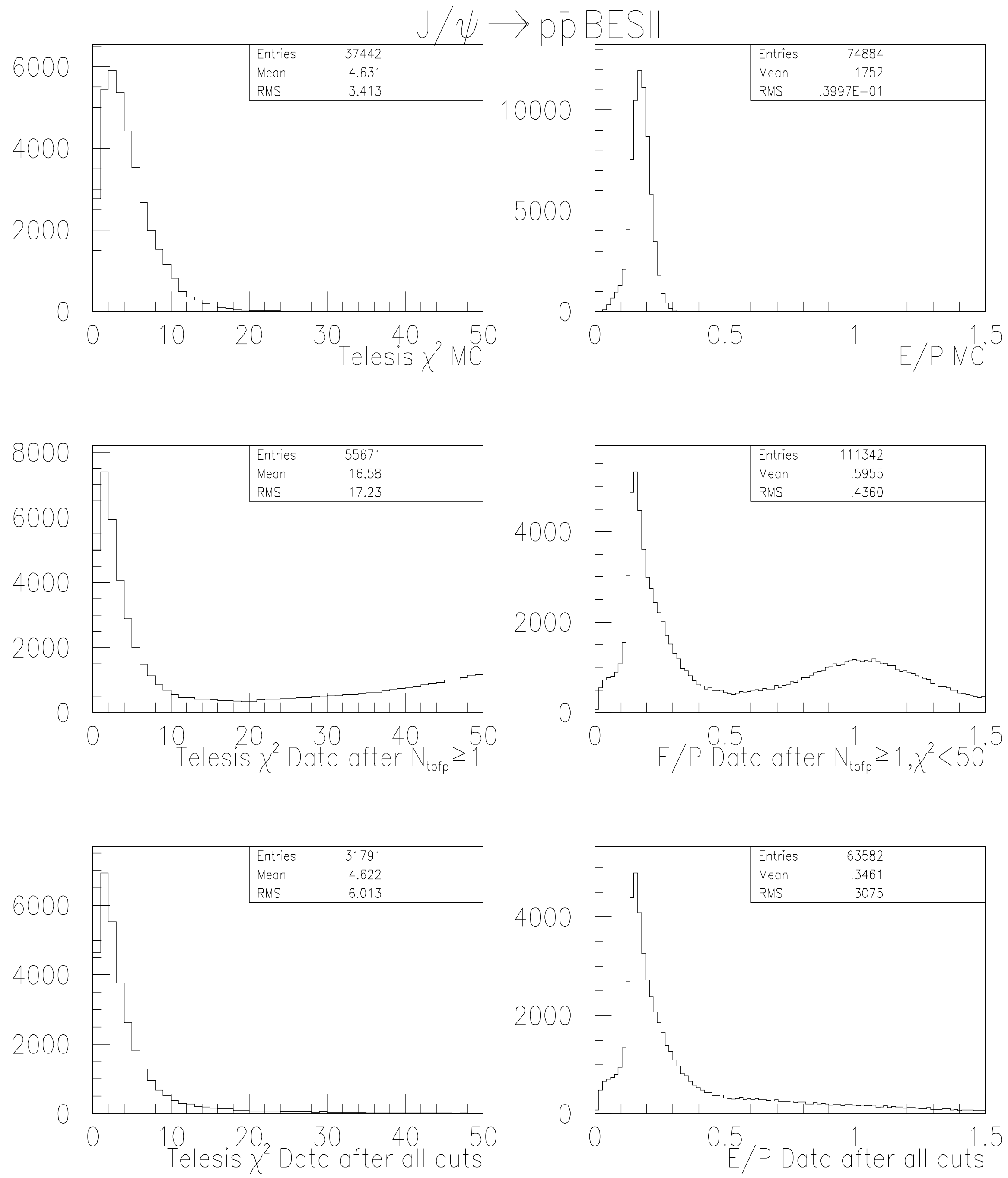

Figure 2: Telesis $\chi^2_{p\bar{p}}$ and E/P of $p\bar{p}$

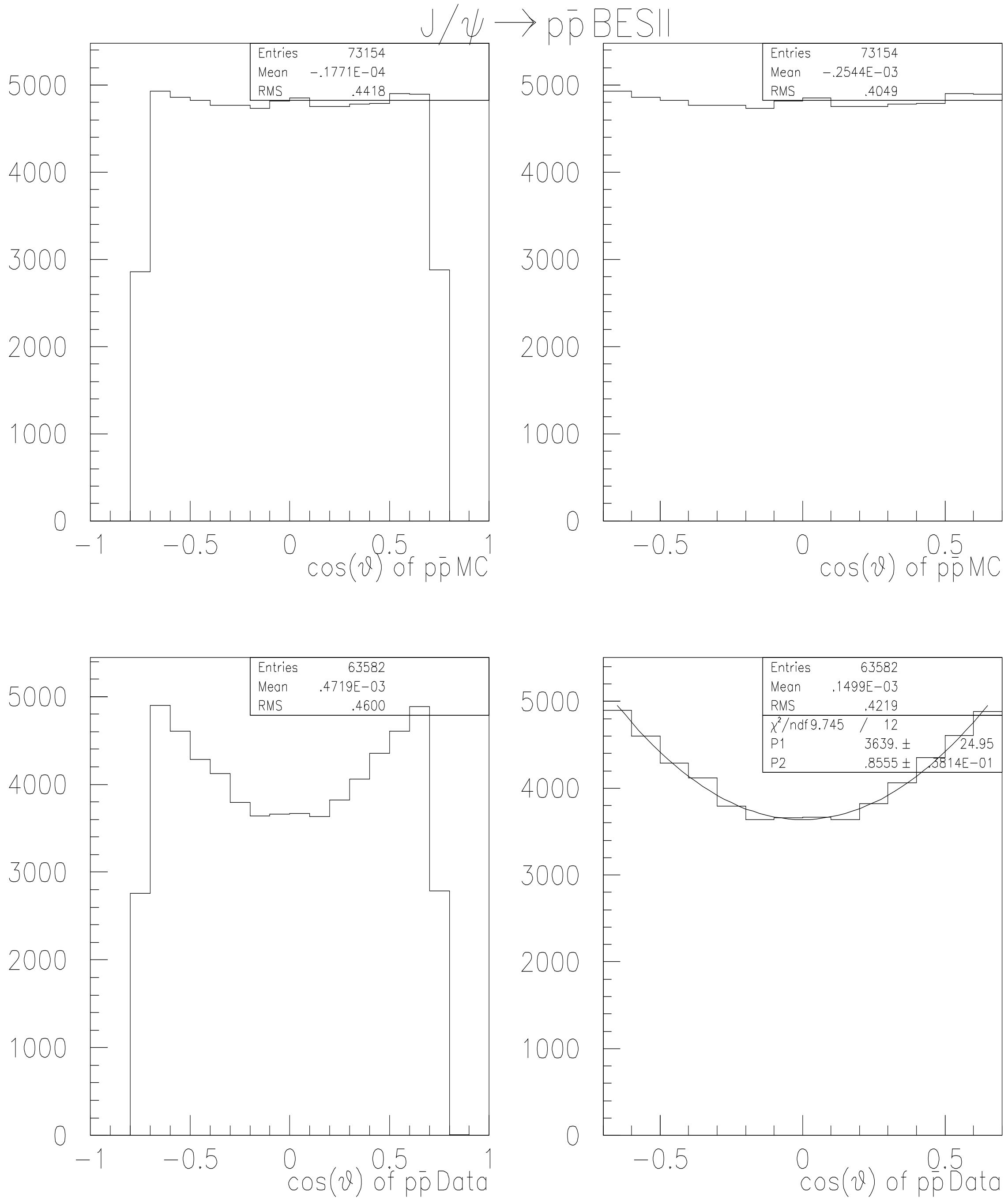

Figure 3: θ distribution of MC phase space and data

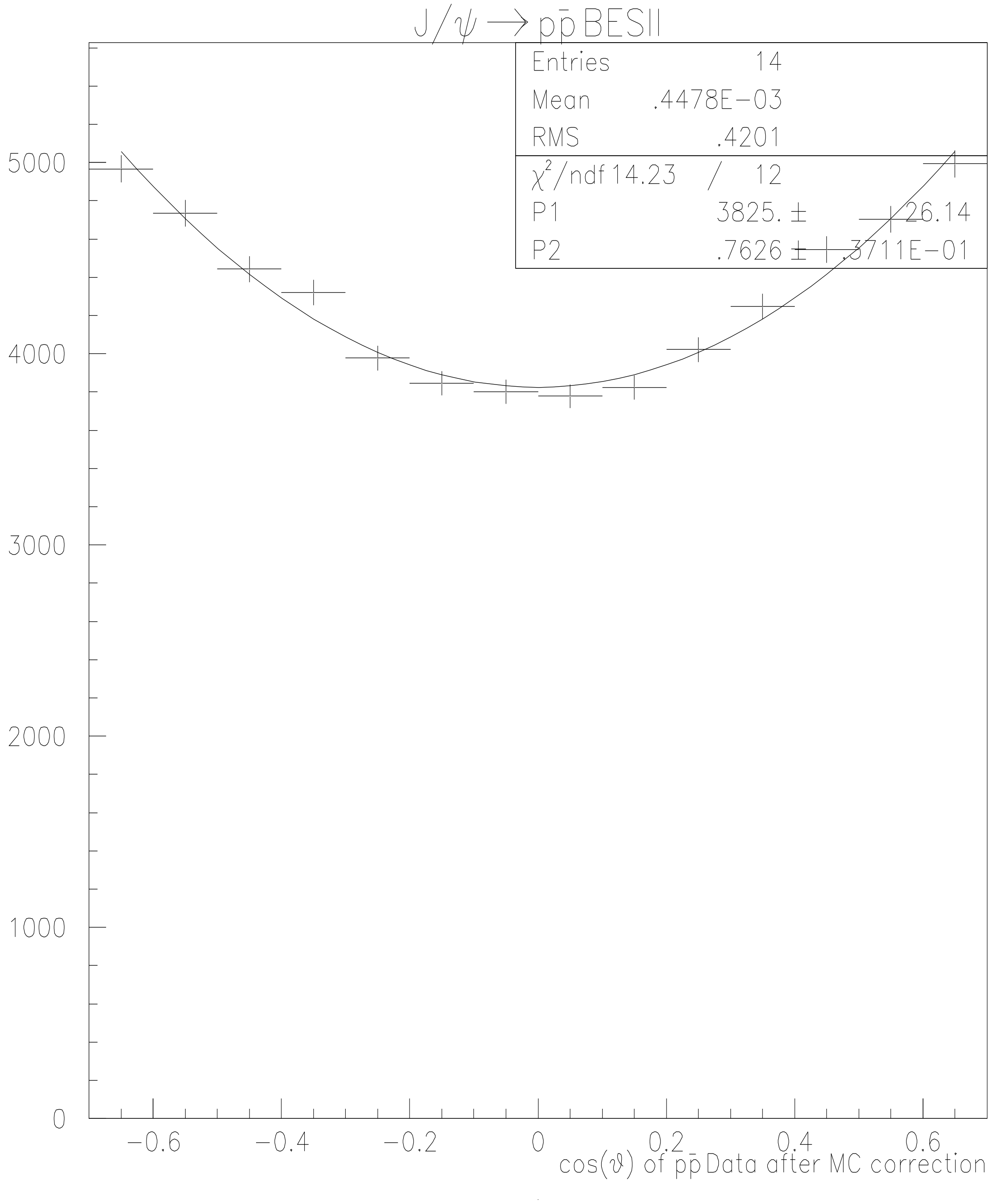

Figure 4: θ distribution after MC correction