The Identification of $p(\bar{p})$ in BES II

Ji Xiaobin
Shandong University
Email:jixb@hpws6.ihep.ac.cn

November 9, 2000

- Motivation;
- Comparison of p and $\bar{p}$;
- Conclusion.

1 Motivaton

- **Many important decay channel include** $p(\bar{p})$**; eg.**

$$J/\psi \to p\bar{p}\pi^0 \textbf{ and}$$
$$J/\psi \to p\bar{p}\eta \textbf{ and}$$
$$J/\psi \to p\bar{p}\pi^+\pi^- ...$$

- **The momentum spectrum of** $p(\bar{p})$ **is asymmetry if we using TOF weight to identify them.[See Fig. 1 and Fig. 2]**

2 Comparison of p and $\bar{p}$

2.1 One track simulaton

Produce 10,000 proton and anti-proton.
$0.1 \leq P \leq 1.5$**,** $-0.8 \leq cos\theta \leq 0.8$**[See Fig. 3].**

Since $\bar{p}$ **is easy to annihilate with the matter in the detector, it can produce much more particles than proton.[See Fig. 5, 4, 6]**

2.2 Good charge tracks selection

- $Rxy < 0.02, Z < 0.2$**;**

- $Mfit = 2or - 19$;
- $|cos(\theta)| < 0.8$;
- $P_{xy} > 0.07Gev$;
- $P < 1.5Gev$;
- **charge equal 1 for proton and -1 for anti-proton.**

After the above event selection, most of the produced charge particle by anti-proton was cut off, only ten among 10,000 anti-proton events include two good charge tracks. [See Fig. 7]

2.3 Particle identification and comparison

♠ **If we use TOF weight to select the $p(\bar{p})$, the difference of p and $\bar{p}$ comes out. At the lower part($< 0.3Gev$) of the proton's momentum, almost no proton was selected out. This is because these part of protons can not hit the TOF. And as some anti-proton annihilated, TOF still can get signal for low momentum anti-proton.[See Fig. 8, 9, 10]**

♠ **If we use DEDX to identify $p(\bar{p})$, the result is good.[See Fig. 11]**

When the momentum less than 0.6Gev, DEDX can identify $p(\bar{p})$ very well; and when the momentum large than that, some pion mixed.[See Fig. 12, 17]

♠ Mass. **When $P < 0.3Gev$, the protons still cann't be selected out. Because**

$$m^2 = p^2 \cdot \frac{1-\beta^2}{\beta^2}$$

When $P < 0.3$, no β information for proton.[Fig. 13, 14]

2.4 False photos comparison

Energy,Angle between photo and charge tracks. [Fig. 15, 16]

Data: $J/\psi \to p\bar{p}\pi^0(\eta)$. The comparison of three kinds of cut: TOF weight, DEDX and Mass.

TOF $Wt_p > Wt_\pi$ **and** $Wt_p > Wt_K$**;**

DEDX $|XS_p| < |XS_\pi|$ **and** $|XS_p| < |XS_K|$**;**

Mass $|M_p - 0.97| < 0.2$**.[Fig. 18]**

♡ **Only one track is identified as** $p(\bar{p})$**.[Fig. 19]**

♡ **Both two tracks are considered as** $p(\bar{p})$**.[Fig. 20]**

♡ $J/\psi \to p\bar{p}\pi^+\pi^- + n\gamma$ **result.[Fig. 21]**

3 Conclusion

- **The identification efficiency of** $\bar{p}$ **is lower than** p**.**
- **Using TOF weight and Mass to identify** $p(\bar{p})$**, asymmetry exists at the low momentum part. Especially for** $P < 0.3Gev$**.**
- **DEDX can identify** $p(\bar{p})$ **very well when** $P < 0.6Gev$**.**

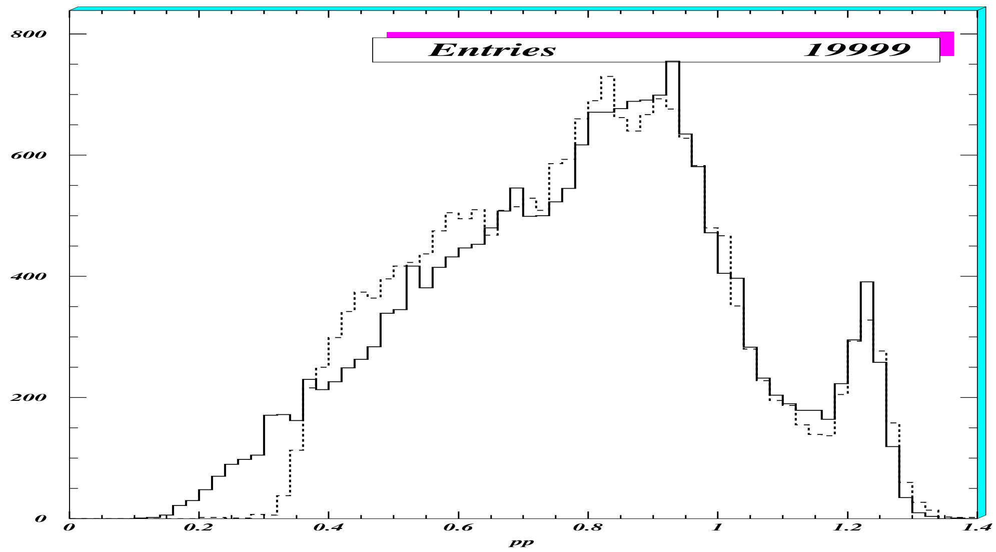

Figure 1: The momentum spectrum from $J/\psi \to p\bar{p}\gamma\gamma$. The solid line is $\bar{p}$, the dash line is p.

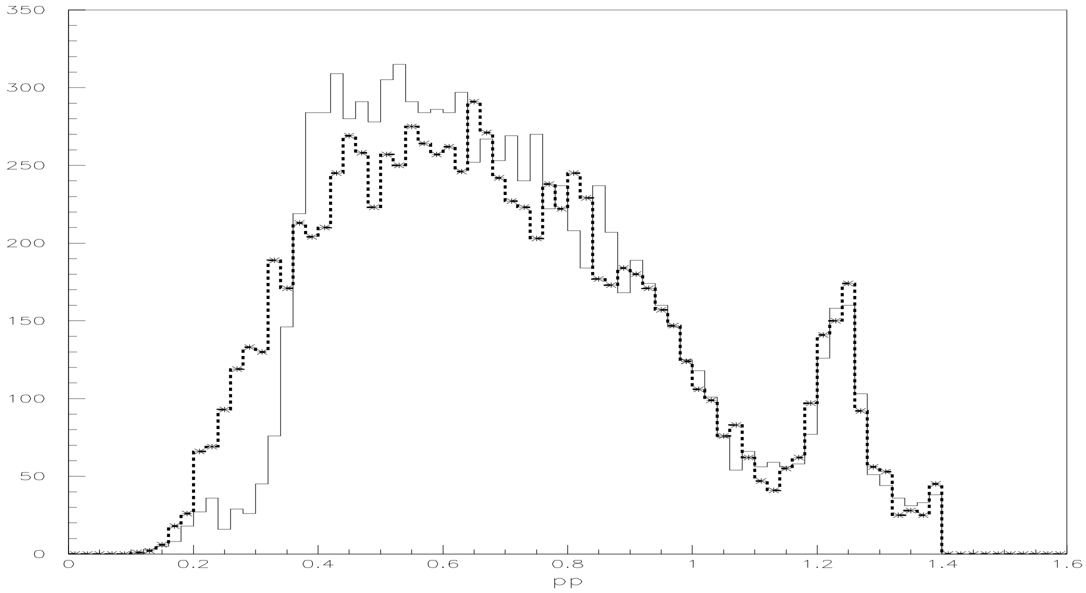

Figure 2: momentum of $p(\bar{p})$ form p and $\bar{p}$ inclusive decay. Solid histogram is come from p, and line with star is from $\bar{p}$

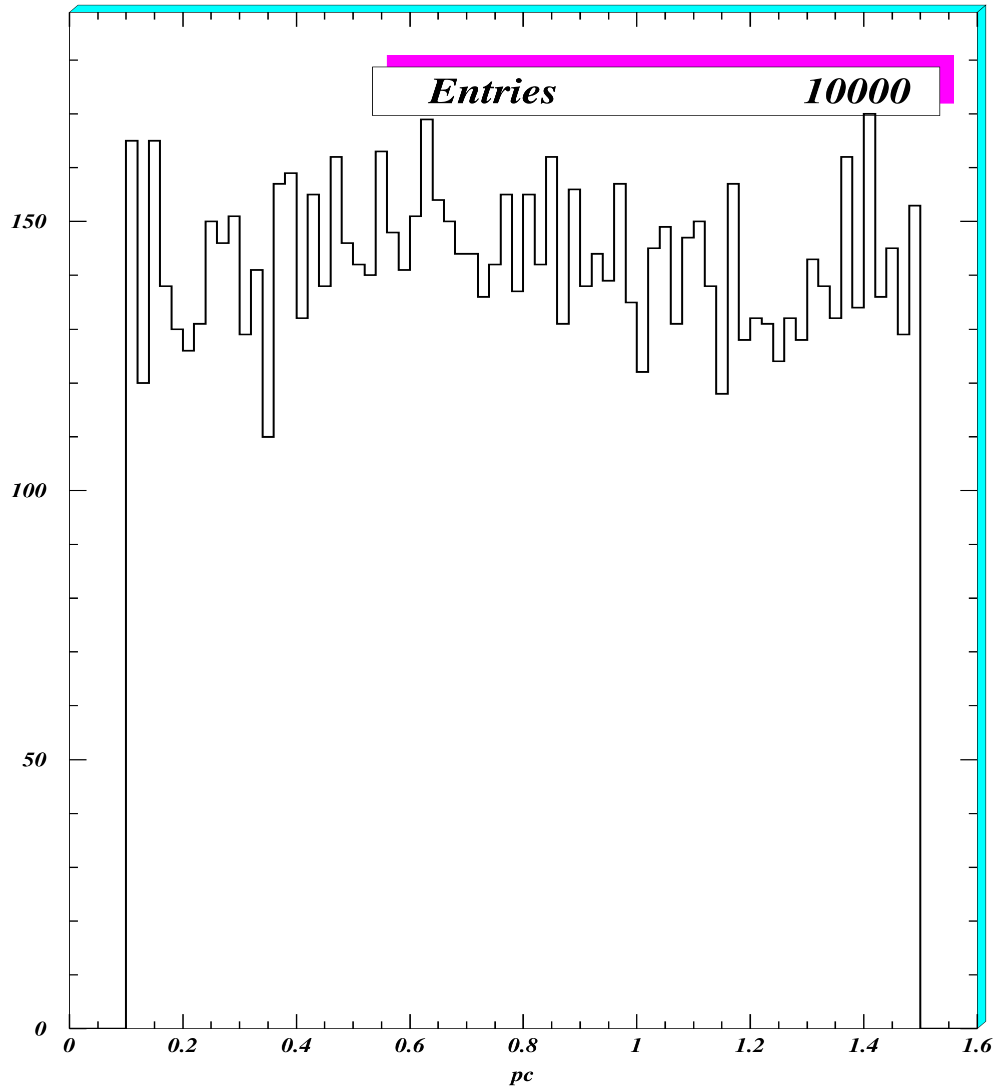

Figure 3: The momentum spectrum of generated $p(\bar{p})$.By Simbes

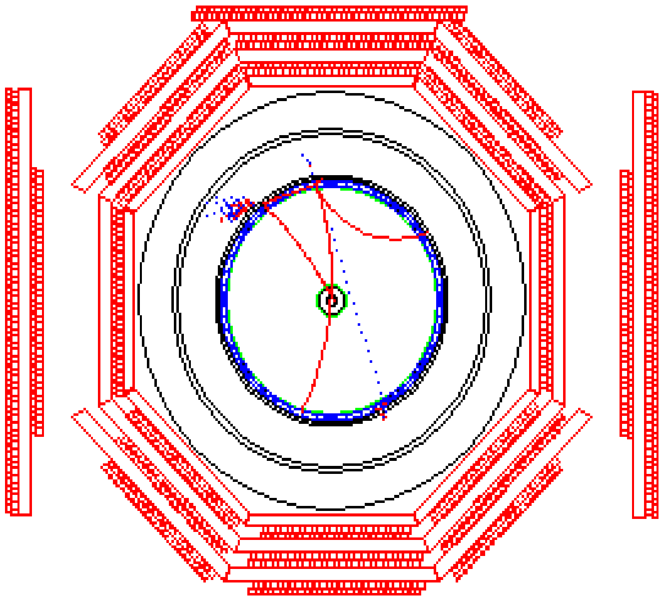

Figure 4: Anti-proton with momentum equal 0.5Gev. (Simbes)

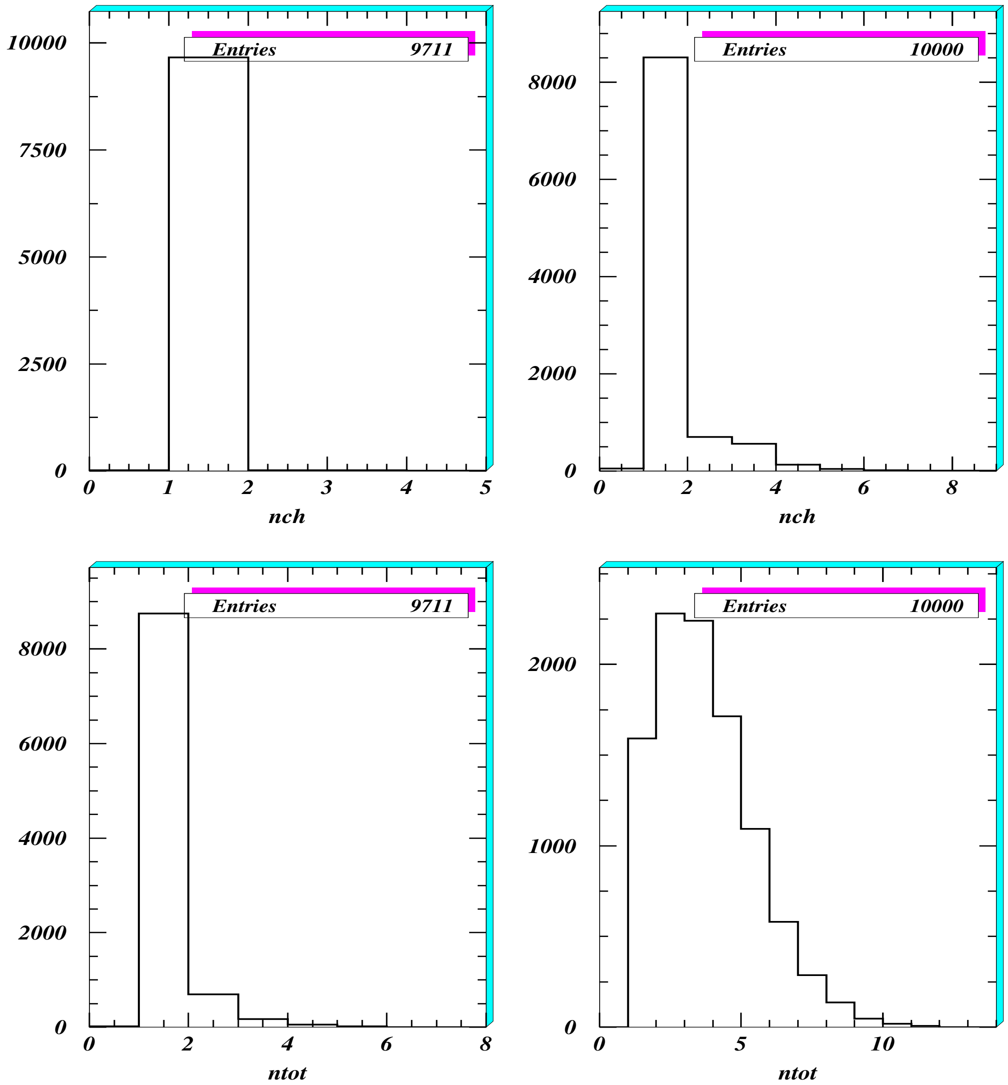

Figure 5: The comparasion of p and $\bar{p}$. The upper two is the no. of charge tracks; the lower is the total tracks' no. And the left is proton; the right is anti-proton.

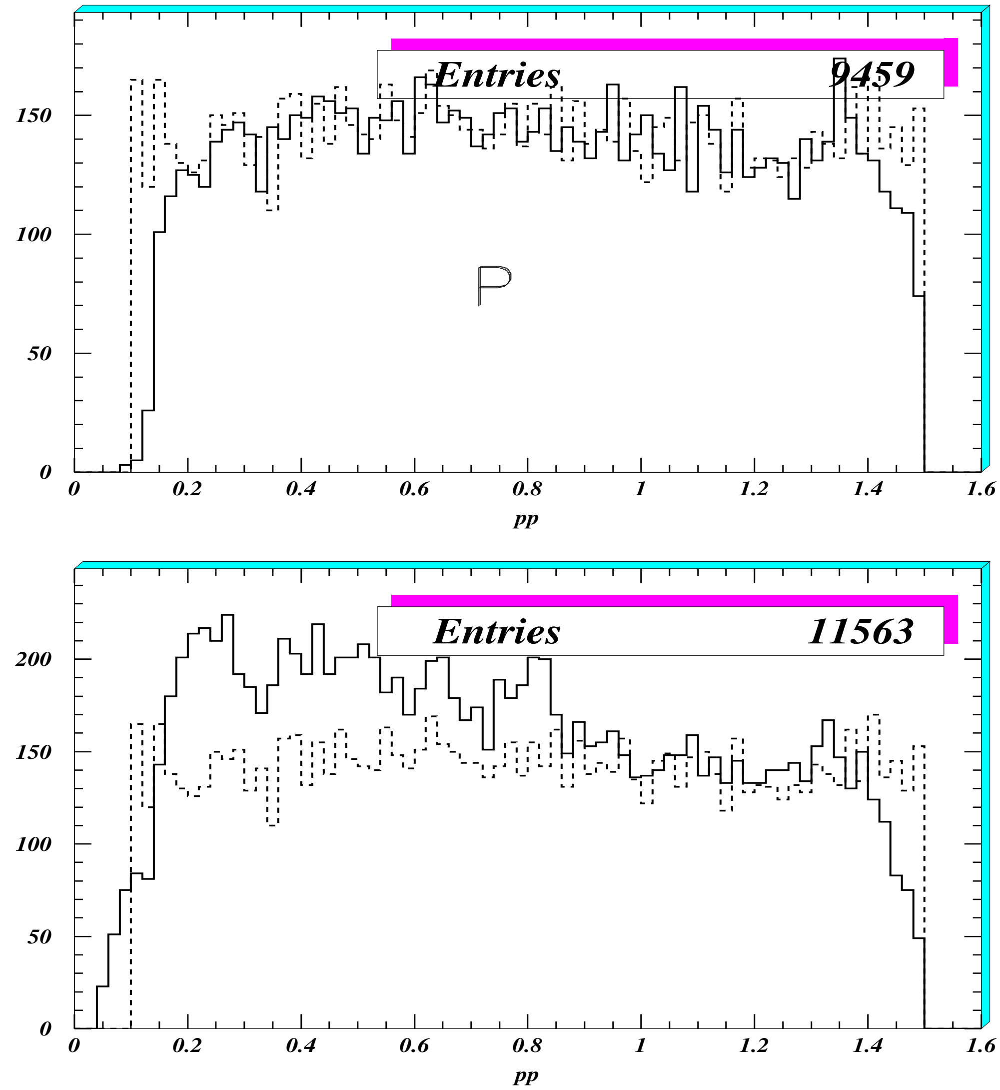

Figure 6: Before good charge selection

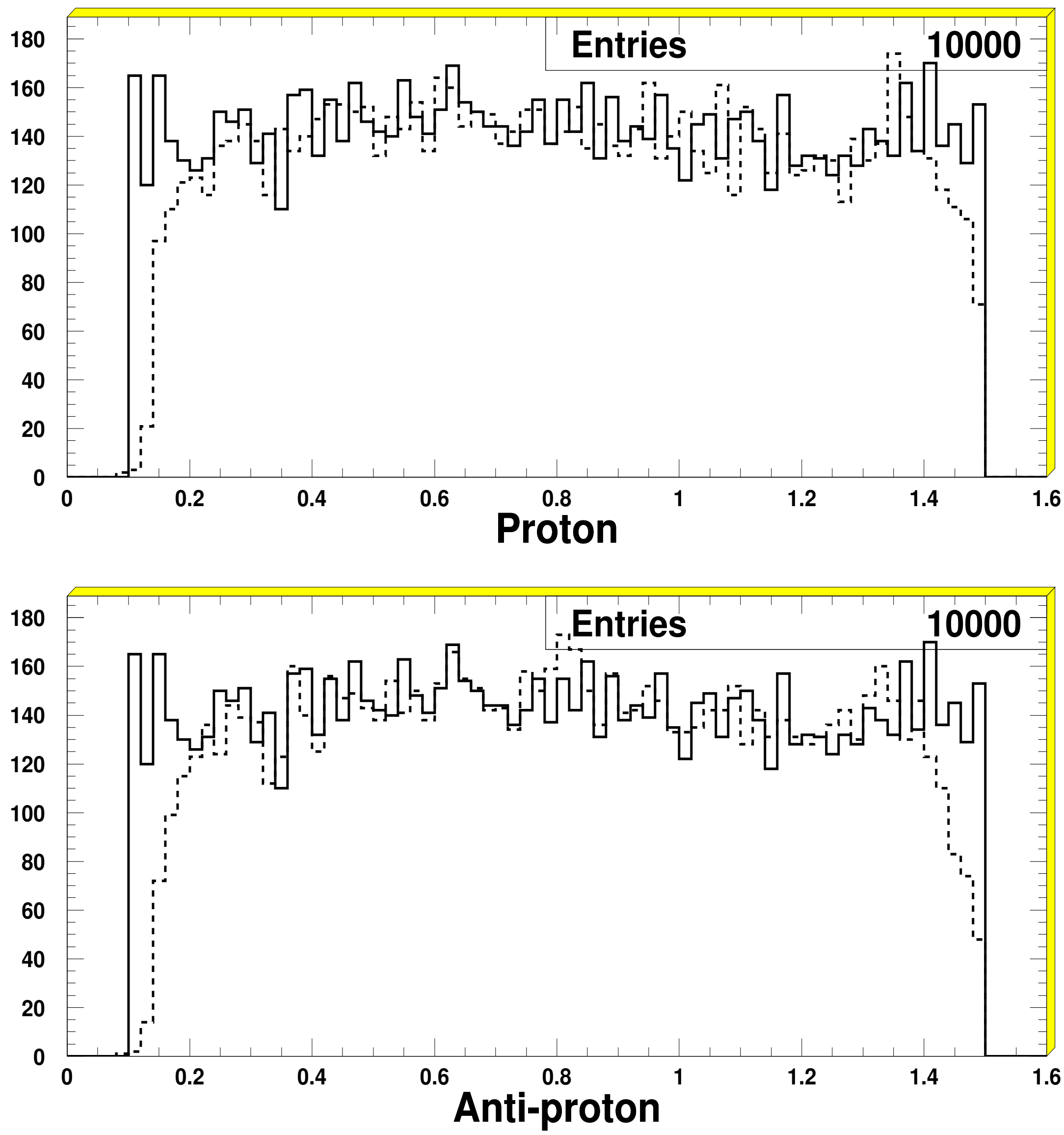

Figure 7: The momentum spectrum after good charge selection. The outer is the generated spectrum(from genbes); the medium is proton; the inner is anti-proton.

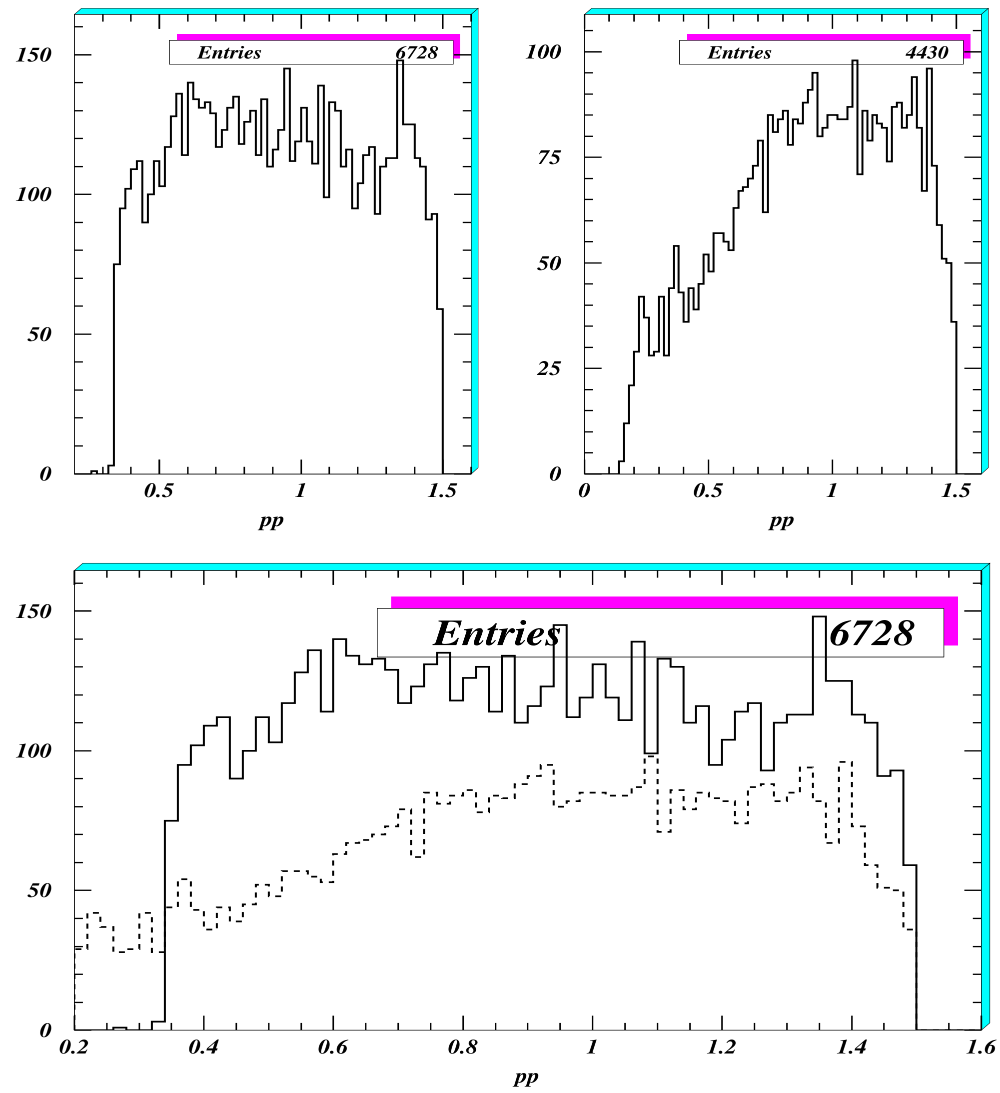

Figure 8: The momentum spectrum after using weight of TOF cut. The up-left is p; the up-right is $\bar{p}$; In the below, the two plot is added together.

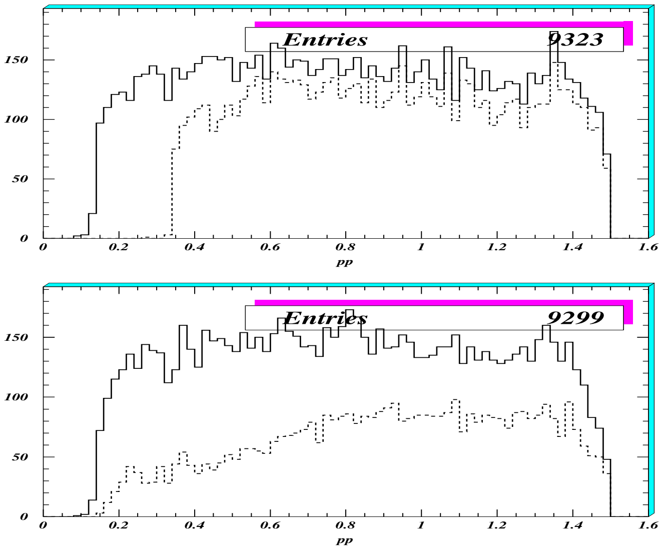

Figure 9: The momentum comparasion added the weight cut.The upper is p, the below is $\bar{p}$.

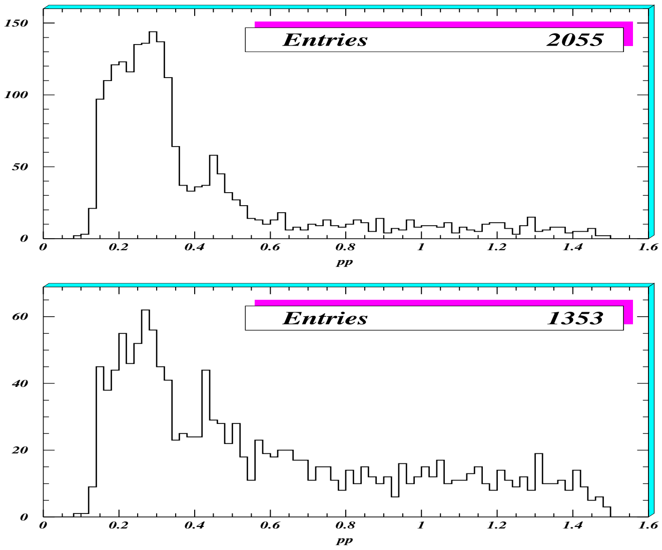

Figure 10: The momentum distribution When $tof < 1$. The upper is p, the below is $\bar{p}$.

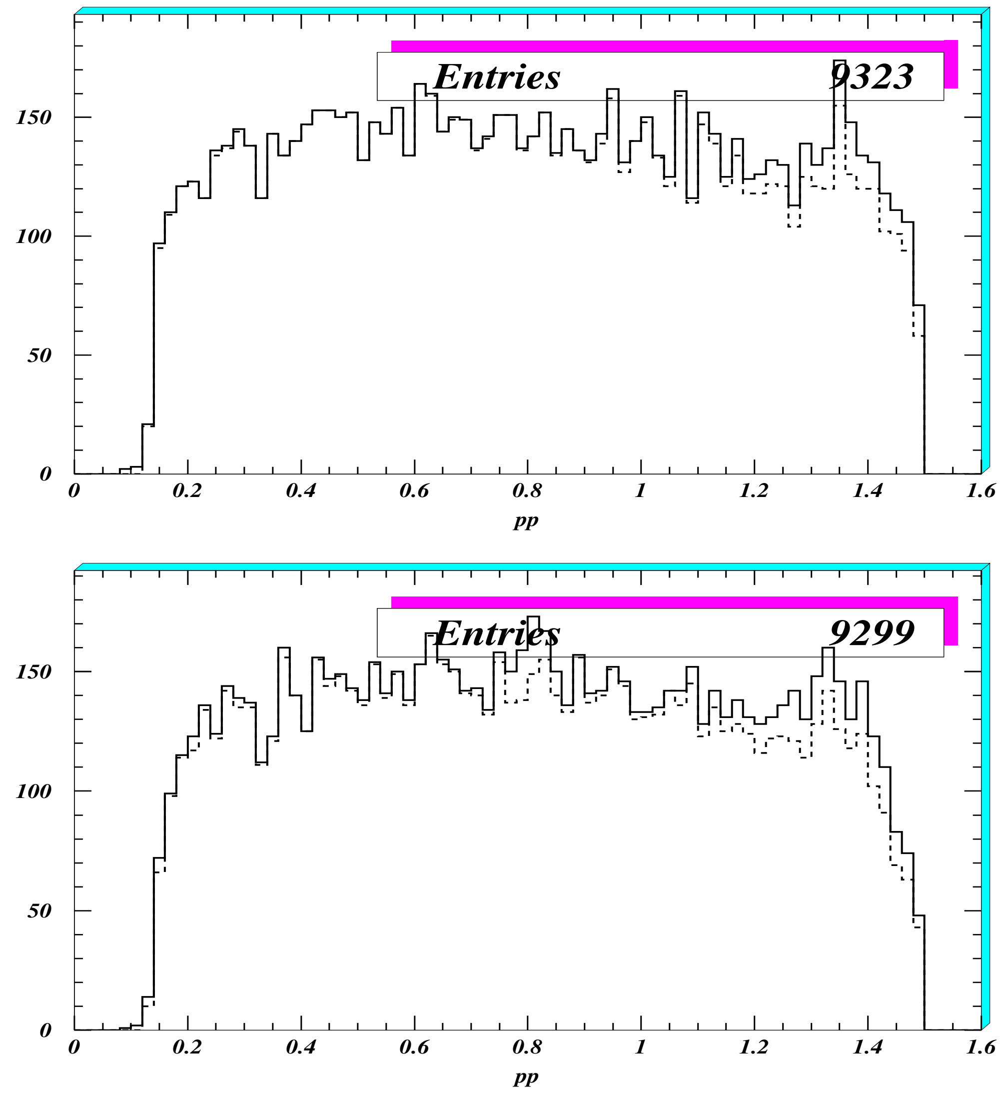

Figure 11: The momentum spectrum after using DEDX cut. The upper is p, the lower is $\bar{p}$. The solid line doesn't using DEDX cut, the dash line using the cut.

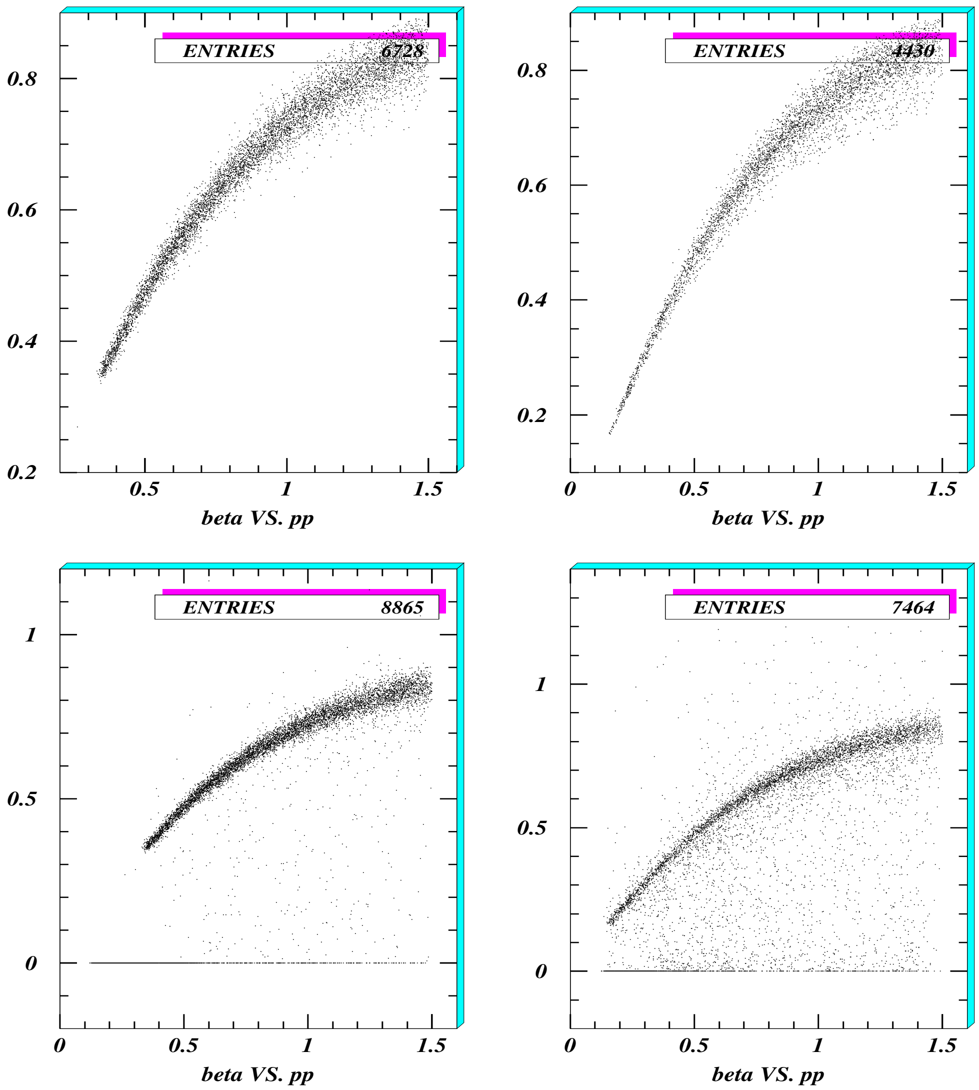

Figure 12: $\beta vs.p$. The upper two using the TOF weight; the lower using DEDX.

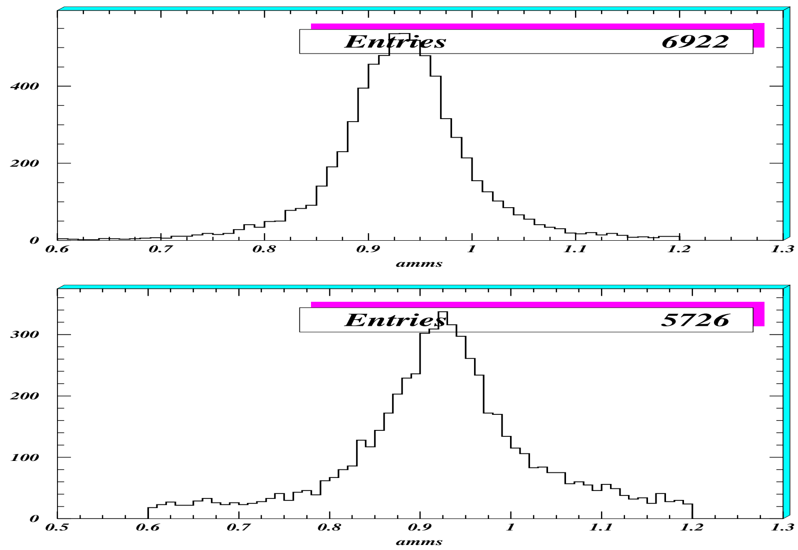

Figure 13: The mass distribution.The upper is p, the lower is $\bar{p}$.

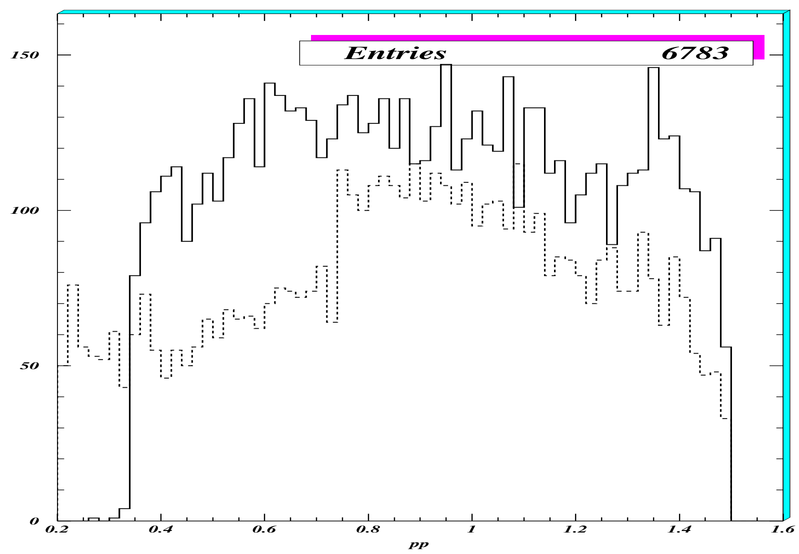

Figure 14: The comparion using Mass cut.Solid line is p, dash line is $\bar{p}$.

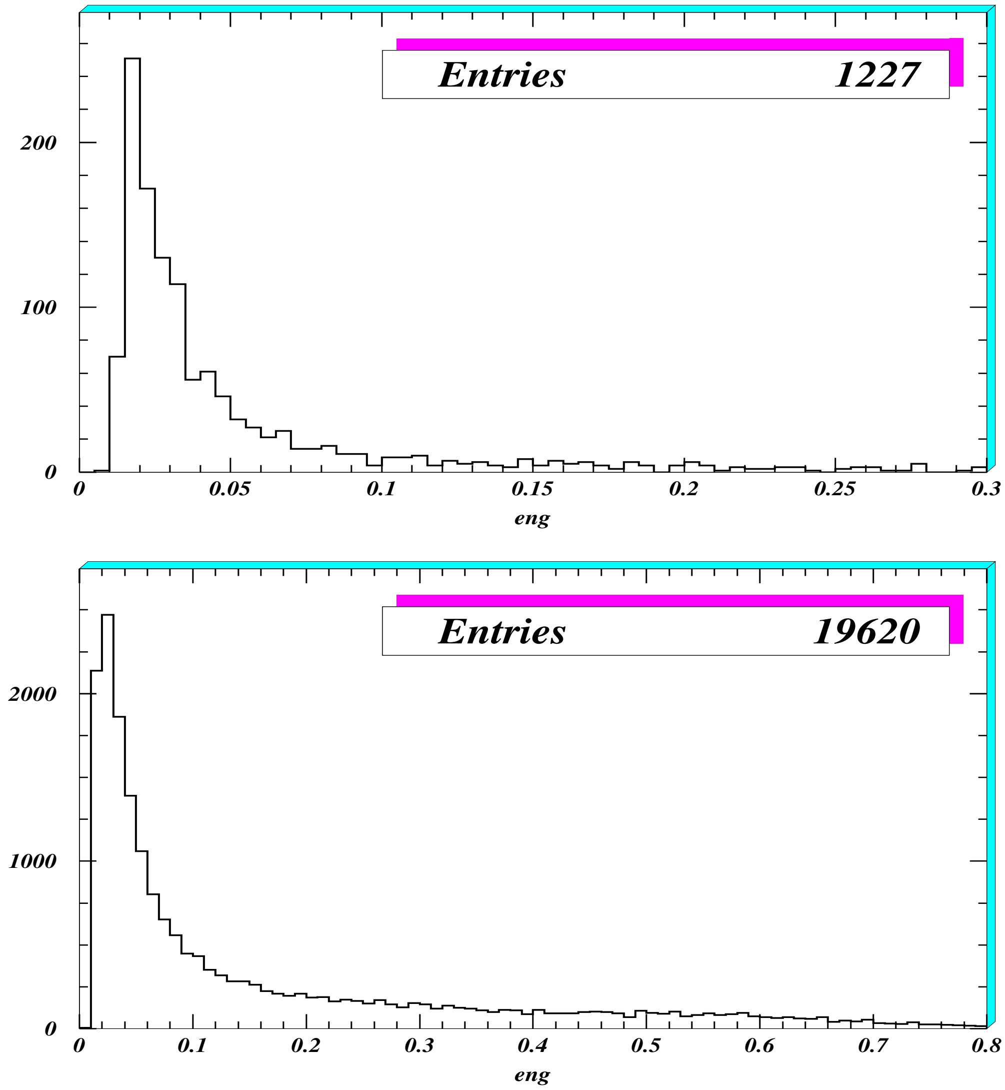

Figure 15: Photon energy.

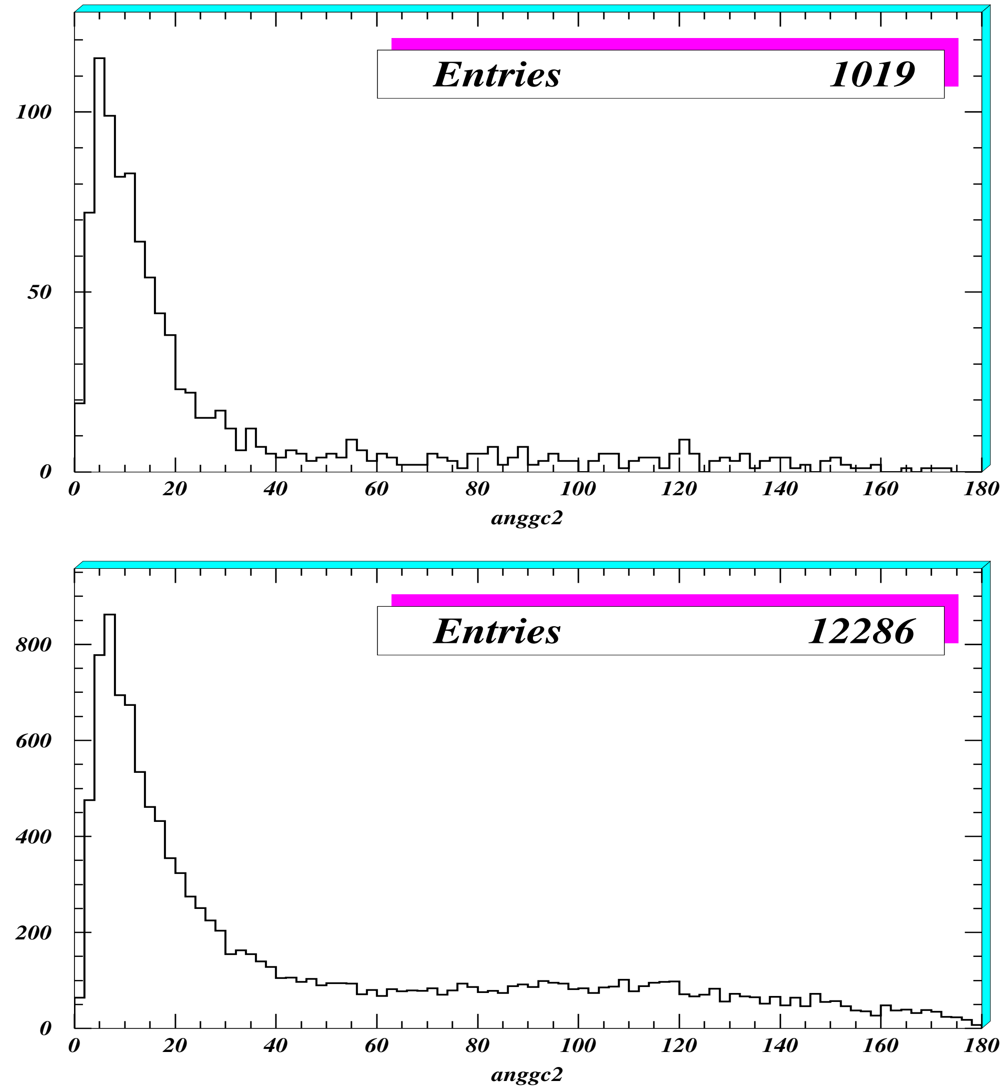

Figure 16: The angle between the photon and $p(\bar{p})$.

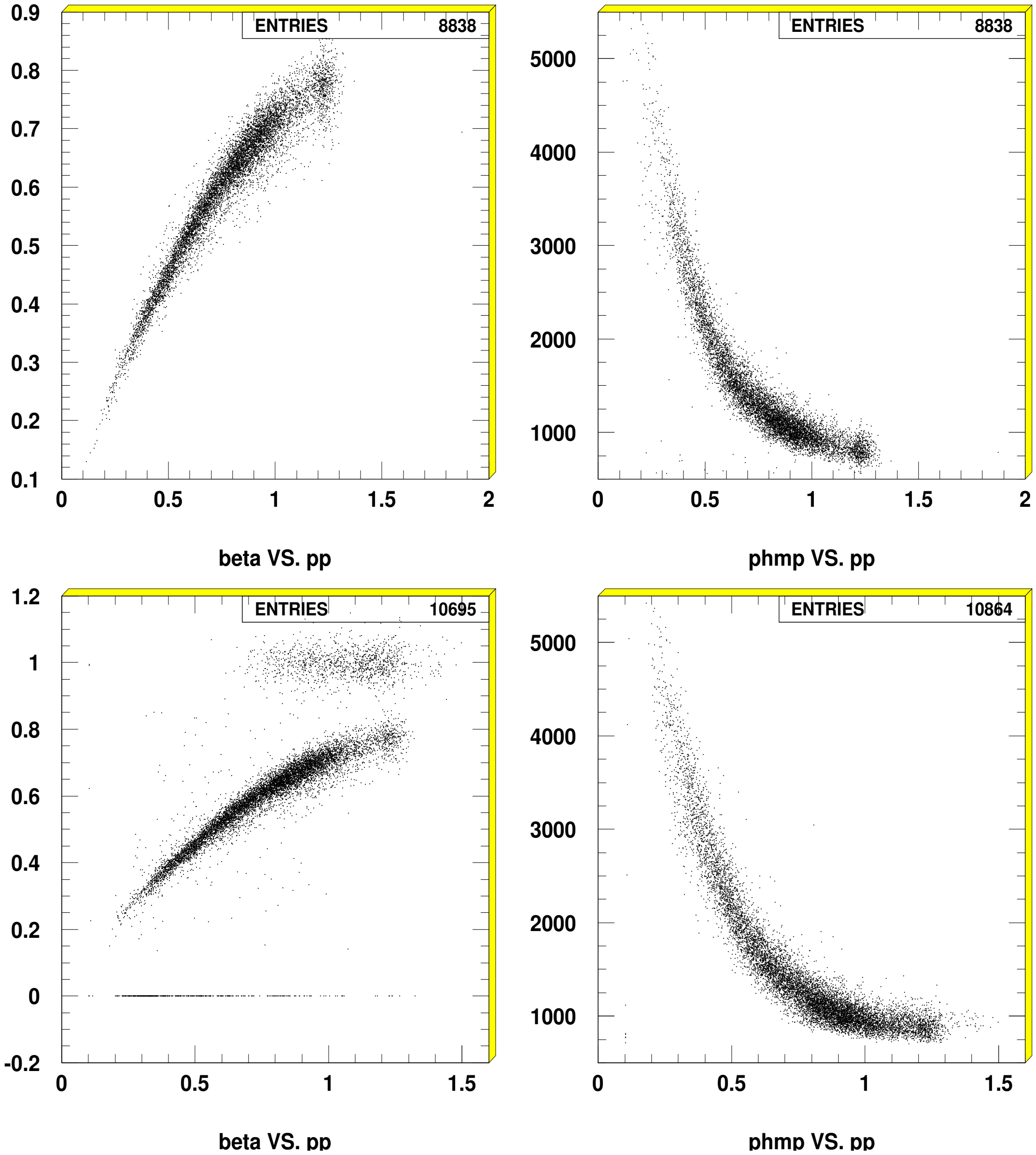

Figure 17: $J/\psi \to p\bar{p}\pi^0(\eta)$. The upper, two charge tracks are identified as $p(\bar{p})$ by weight, the lower are by DEDX.

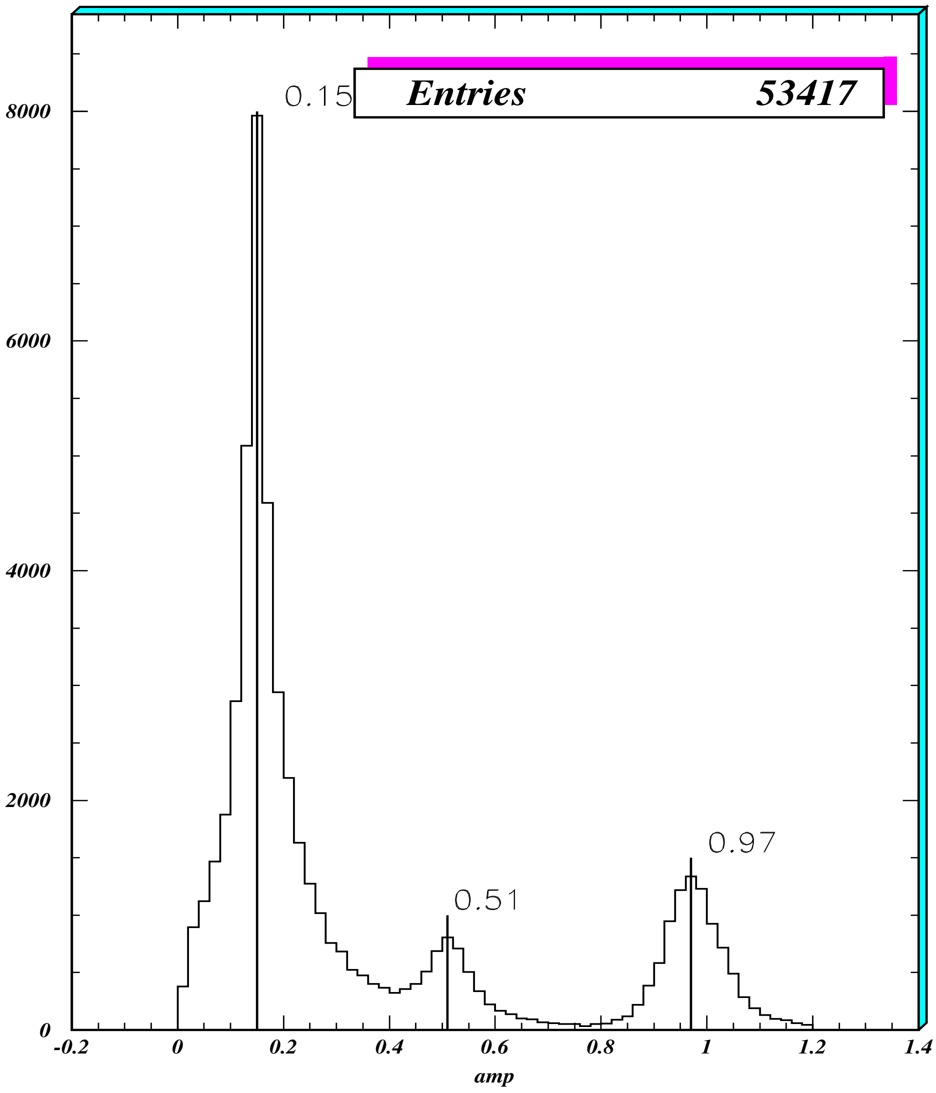

Figure 18: Mass distribution

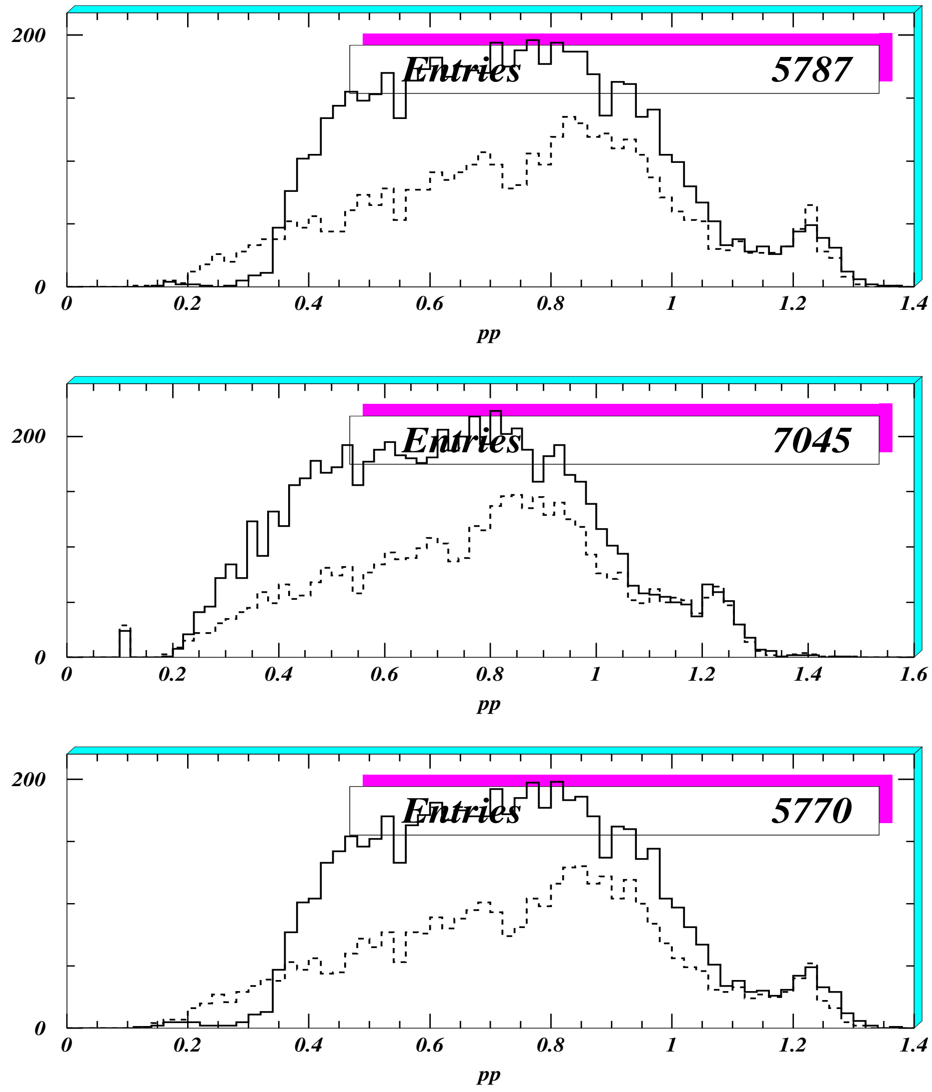

Figure 19: Only one track is identified as $p(\bar{p})$.The cut from top to end is Weight, DEDX and Mass.

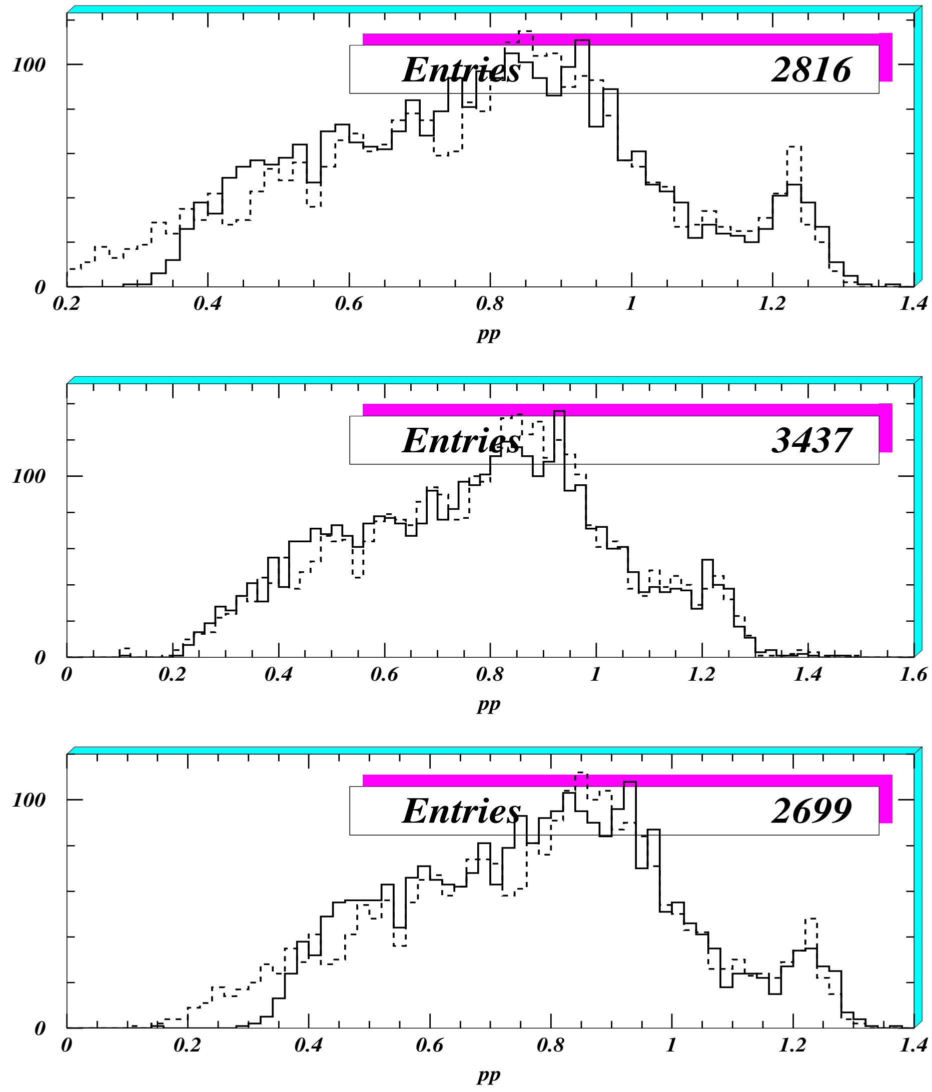

Figure 20: Two tarcks are identified as $p(\bar{p})$.The cut from top to end is Weight, DEDX and Mass.

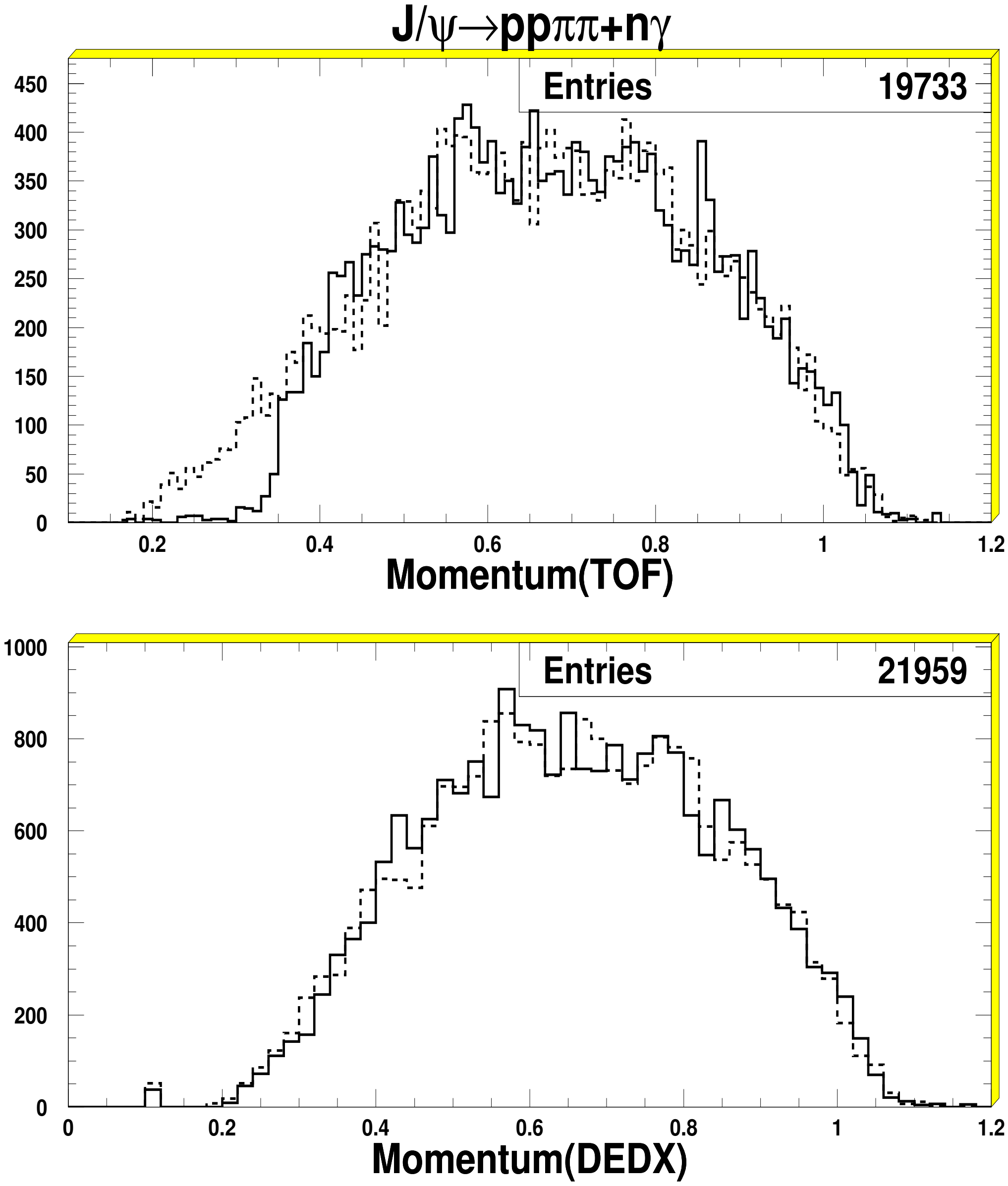

Figure 21: The momentum spectrum after good charge selection. Solid line is the generated spectrum(from genbes); the dish line is $p(\bar{p})$.