

Weekly work report

measure $\psi' \rightarrow N\bar{N}$ with BESIII detectors

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Motivation

- phase angle between strong and EM amplitudes
- from J/ψ results, it seems these two amplitudes are orthogonal to each other
- PDG: $Br(\psi' \rightarrow p\bar{p}) = (2.76 \pm 0.12) \times 10^{-4}$, no data for $n\bar{n}$.
- to extract the relative phase angle, $44pb^{-1}$ continuum data at 3.65 GeV and $2.9fb^{-1}$ $\psi(3770)$ data may be helpful also?

Event selection for $\psi' \rightarrow p\bar{p}$

Topology of this process is simple, the selection rules should be simple too.

- track level (definition of good track)
 - ▶ $V_r < 1.0\text{cm}$, $V_z < 10.0\text{cm}$
 - ▶ $|\mathbf{p}| < 2.0\text{GeV}/c$
 - ▶ $|\cos(\theta)| < 0.93$ (0.8 is used by Jianming)
- track level
 - ▶ two good charged tracks, the net charge is zero
 - ▶ $angle(b2b) > 177\text{deg}$ in CMS.
 - ▶ Only PID for proton, $prob(p) > 0.001$ (not used by Jianming),
 $prob(p) > prob(K)$, $prob(p) > prob(\pi)$

Now the efficiency is 65.7%. (Jianming's around 44%)

Scatter plot of momenta of p and \bar{p}

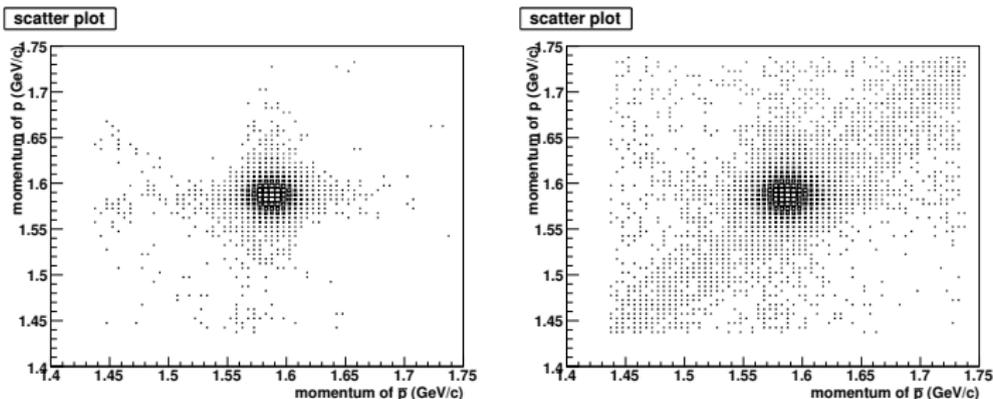


Figure: scatter plot of momenta of p and \bar{p} , left: inclusive MC, right: data.

- 1, Define $1.55 < p < 1.63$ GeV/c as the signal region, there is only two events from background in inclusive MC.
- 2, There are unknown background (the slope band) in data, need further study to understand. If it is flat, we may consider a background subtract.

momentum distributions

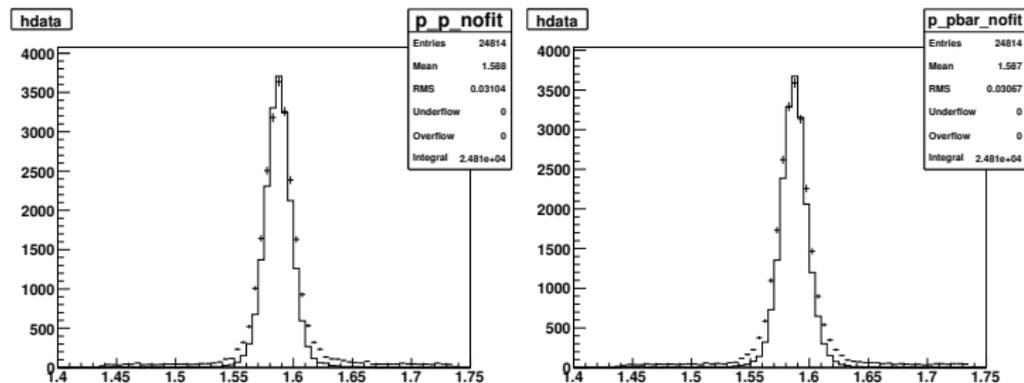


Figure: momenta of p and \bar{p} in ψ' CMS, histogram: inclusive MC, error bars: data.

The momentum from data takes obvious larger resolution, this also be observed in the back to back angle (bbangle) in next slide. Resolution from fit with GAUSS: data(14 MeV), MC(11 MeV).

bbangle and eveflag

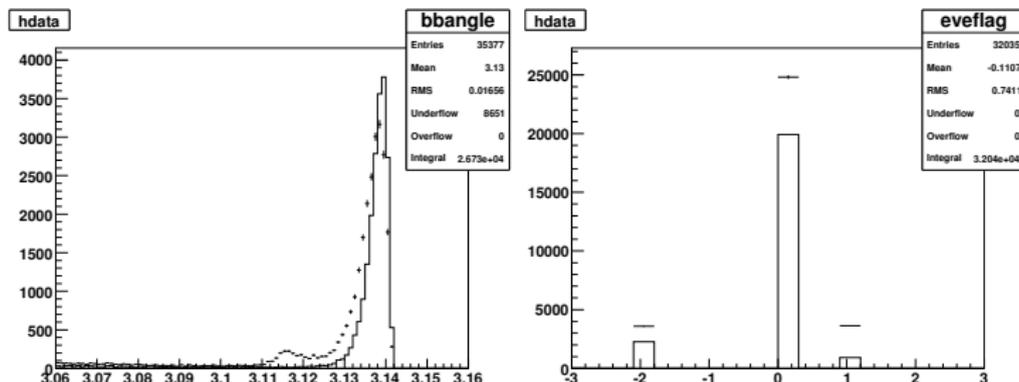


Figure: back to back angle of p and \bar{p} in ψ' CMS, histogram: inclusive MC, error bars: data. eveflag indicates the number of positive/negative charged tracks, 0 means one positive and one negative.

$\cos(\theta)$ plots of p and \bar{p}

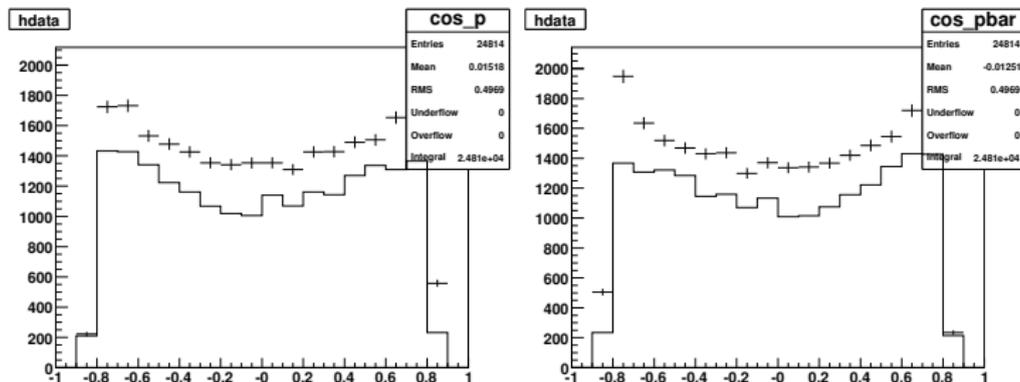


Figure: $\cos(\theta)$ of p and \bar{p} in ψ' CMS, histogram: inclusive MC, error bars: data. Jianming only use $\cos(\theta)$ of p , I will try a simultaneous fit with both of them.

No scale in these plots.

efficiency correction

Assuming the partial cross section is $d\sigma/d(\cos\theta) = 1 + \alpha\cos^2\theta$, to determine the α , a double-fold efficiency correction need to do, one is from the signal MC, the other is from the difference between data and MC.

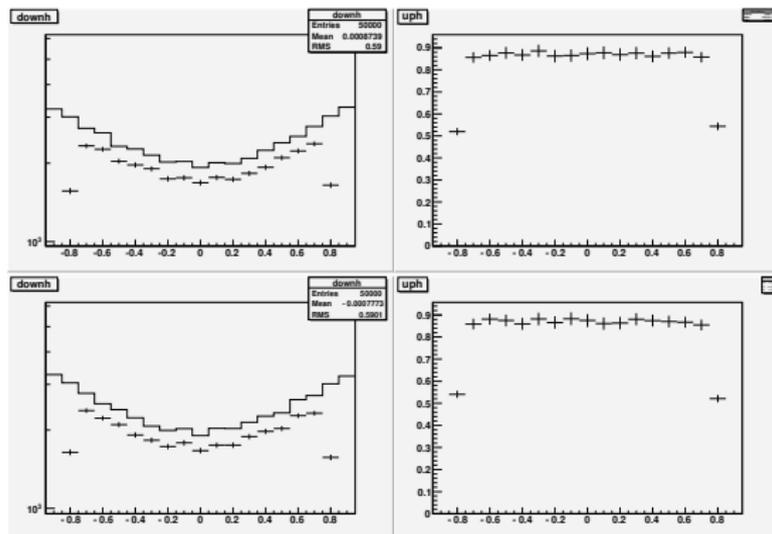


Figure: Only efficiency from MC here. A C++ class is being written to implement the efficiency determination, correction and systematic errors calculation automatically, **not finished** yet.

a fast scan on continuum data

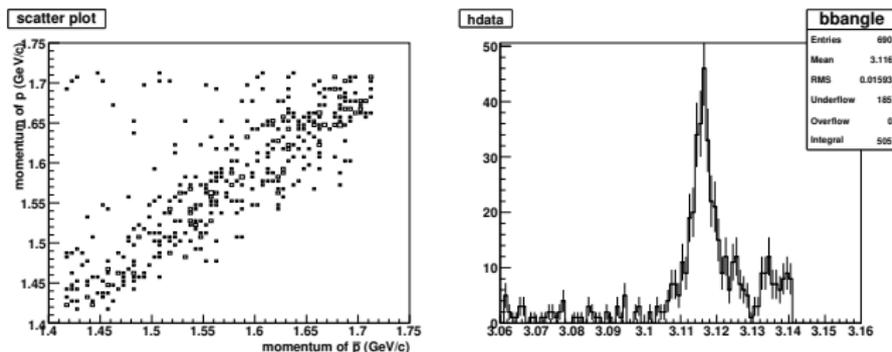


Figure: Scatter plot with bangle cut at 3.1

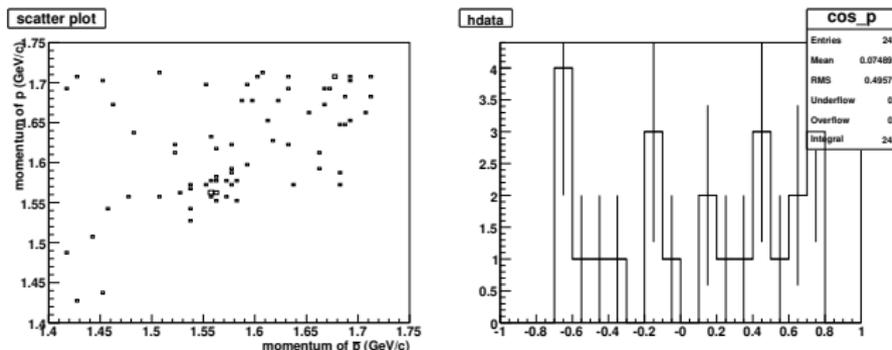


Figure: Scatter plot with bangle cut at 3.13

to do for $\psi' \rightarrow p\bar{p}$

- study the unknown background in data
- input/output check with inclusive MC
- resolution smear for MC
- efficiency correction

- The meaning of electronics saturation has been misunderstood, that causes low tracking efficiency for low transverse momentum of proton in data, no effect on MC. Now BOSS655p01 is released to patch it, but there need more checks and will be no reconstructed data in near future (at least one month).
- I have not put my hands on $\psi' \rightarrow n\bar{n}$ yet, maybe it's time to start now. At first some MC samples should be prepared.
- From Jianming's works, GEANT4 dose not simulate the energy deposition in EMC well for anti-neutron, then he refer to data. It's maybe also interesting to improve the simulation.