A_{FB} study at Z pole

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Introduction

- CEPC have good potential in electroweak precision physics at Z pole.
  - L=1.6 X 10^{35} $cm^{-2}s^{-1}$
  - Aim to have 10^{11} Z boson for electroweak precision physics

Contribute to measurement of weak mixing angle $\sin^2 \theta_{eff}^{lept}$

Observerable	**LEP precision**	**CEPC precision**	**CEPC runs**	**$\int L$ needed in CEPC**
$A_{FB}^{0,\mu}$	7.7%	0.3%	Z threshold scan	3.2ab^{-1}

MC sample

- 1M events are generated by Whizard 1.95 and CEPCv4 geometry at 91.1876 GeV.
- Fast simulation on all these events to calculate A_{FB}
- Run 100K full simulation to study reconstructed angle resolution.

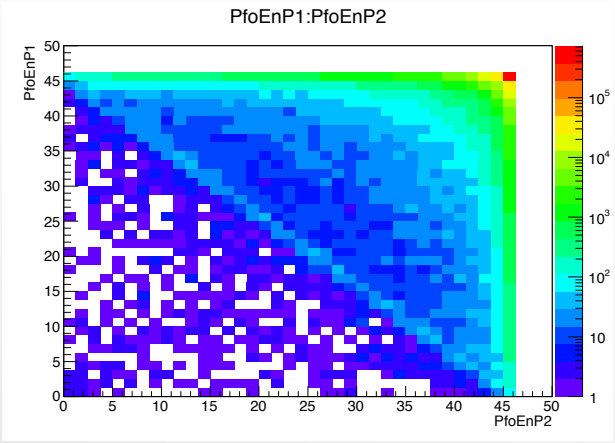
Selections / Efficiency

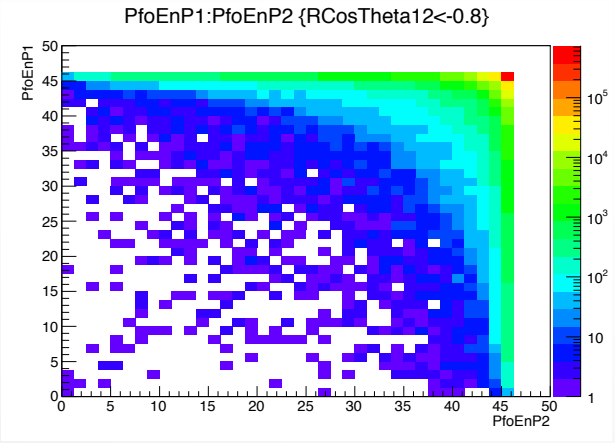
2 muons

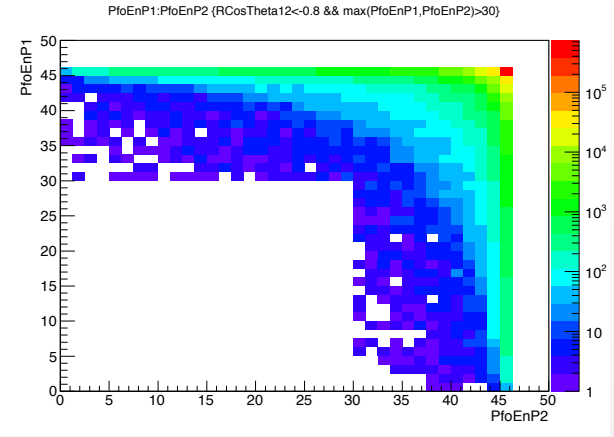
$\Delta\cos\theta < -0.8$

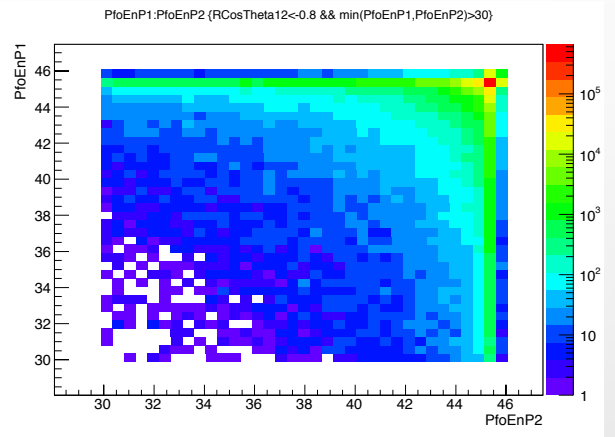
Max(E_{l1},E_{l2})>30GeV

Min(E_{l1},E_{l2})>30GeV



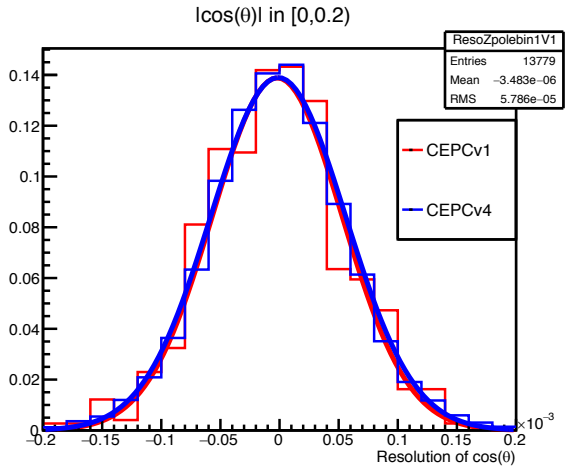


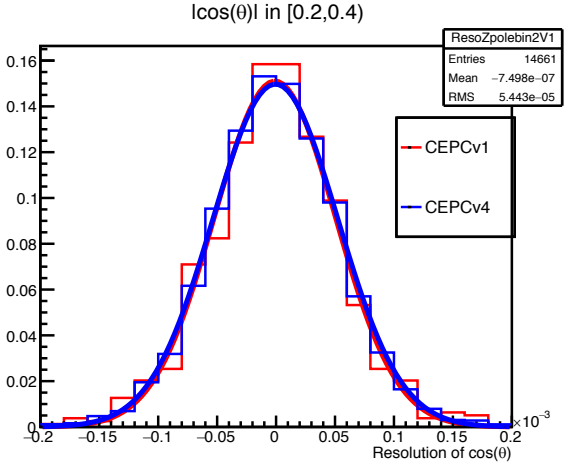


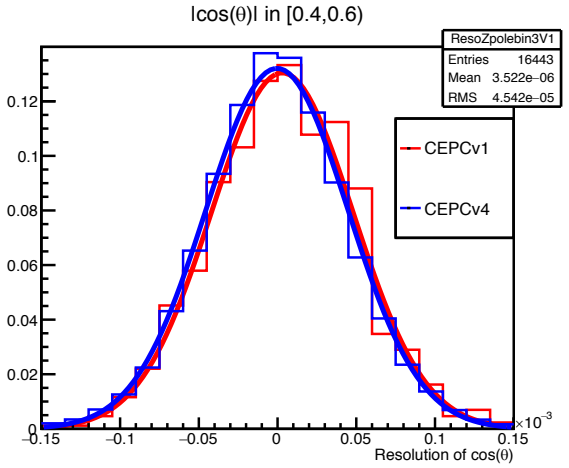


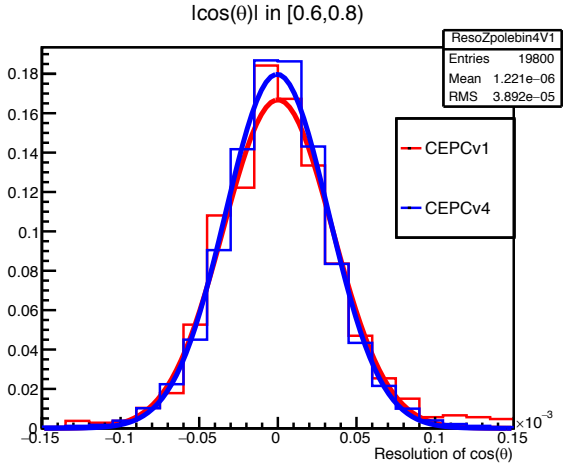
No cut	2 muons		$\Delta\cos\theta < -0.8$		Max(E_{l1},E_{l2})>30GeV		Min(E_{l1},E_{l2})>30GeV	
	Step Eff.	Total Eff.	Step Eff.	Total Eff.	Step Eff.	Total Eff.	Step Eff.	Total Eff.
Efficiency	(97.78±0.05)%	(97.78±0.05)%	(97.46±0.05)%	(95.30±0.05)%	(99.35±0.03)%	(94.67±0.07)%	(90.3±0.1)%	(85.5±0.1)%

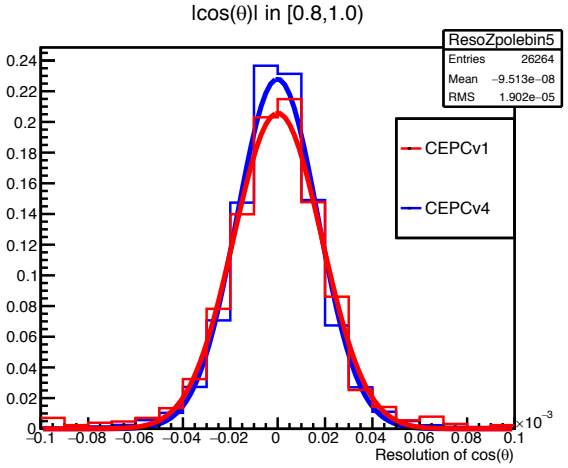
Angle ($\cos\theta$) Resolution Comparison between Old and New CEPC geometry (Full-simulation)









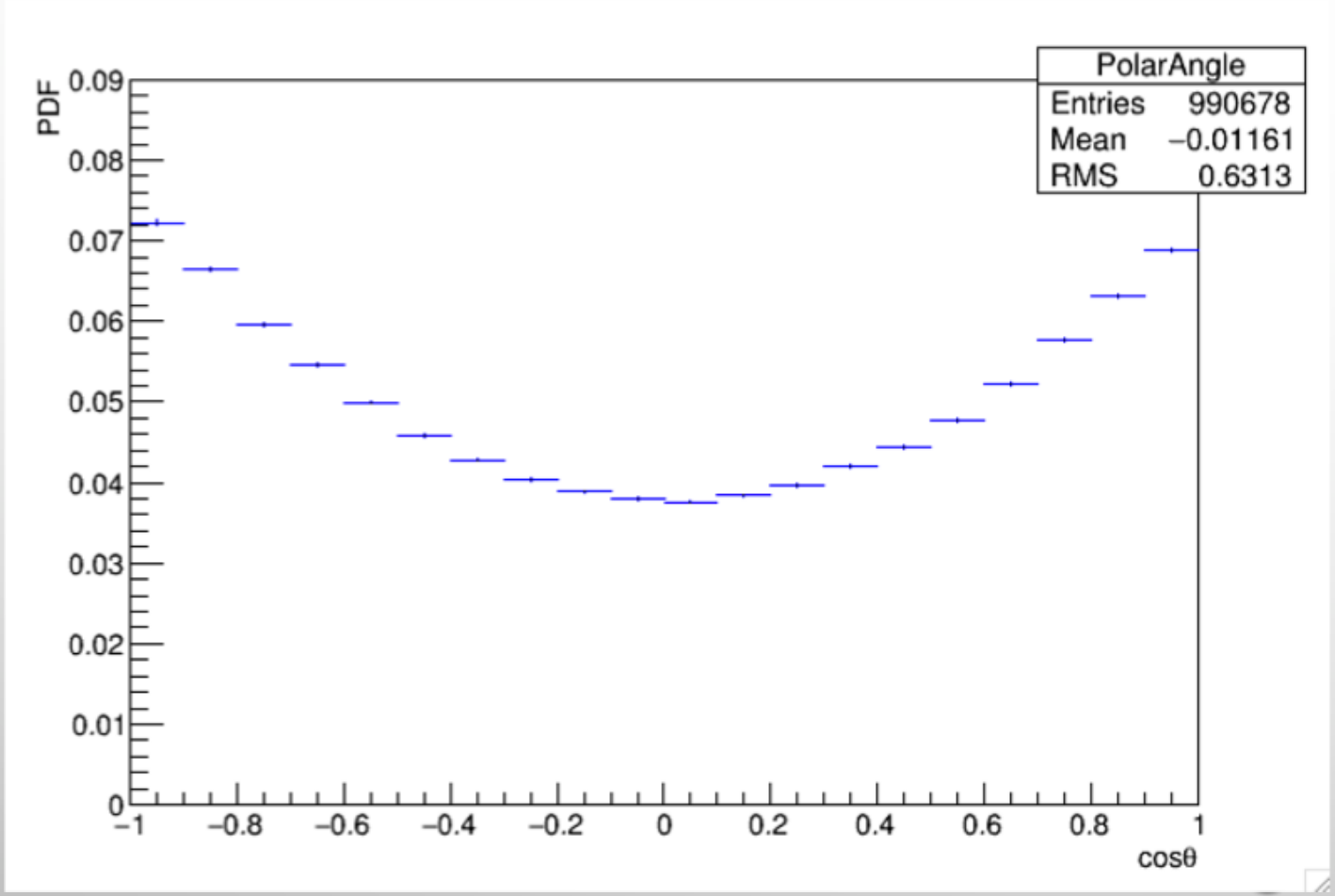


$\delta(cos\theta)$ $[10^{-5}]$	v1	v4
[0,0.2)	5.50	5.71
[0.2,0.4)	5.14	5.30
[0.4,0.6)	4.51	4.52
[0.6,0.8)	3.47	3.28
[0.8,1.0]	1.86	1.71

CEPC.v1 old geometry and 3.5T magnetic field vs CEPC.v4 new geometry and 3T magnetic field

A_{FB} calculation

Fast-Simulation



PDG and gFitter results: 0.0171 ± 0.001

Equation 1:

$A_{FB} = (F-B)/(F+B)$,

Where F is count for events with $\cos\theta>1$, and B is that for $\cos\theta<1$.

Equation 2:

Fit function to $P_0+P_1\cos\theta+P_2\cos^2\theta$, ($P_0 \simeq P_2$)

And $A_{FB} = P_1/P_0$

A_{FB} calculation:

E1:0.0169

E2:0.0167

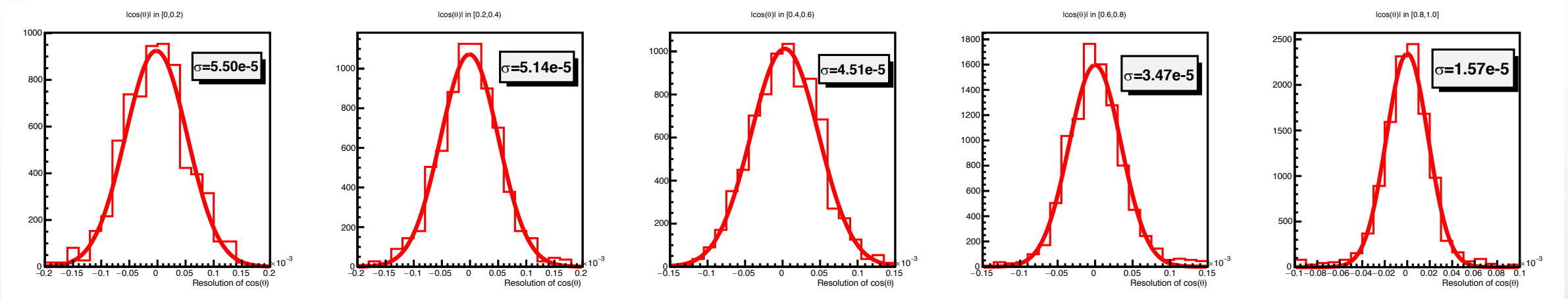
Uncertainty estimation:

0.3% with $3.2ab^{-1}$

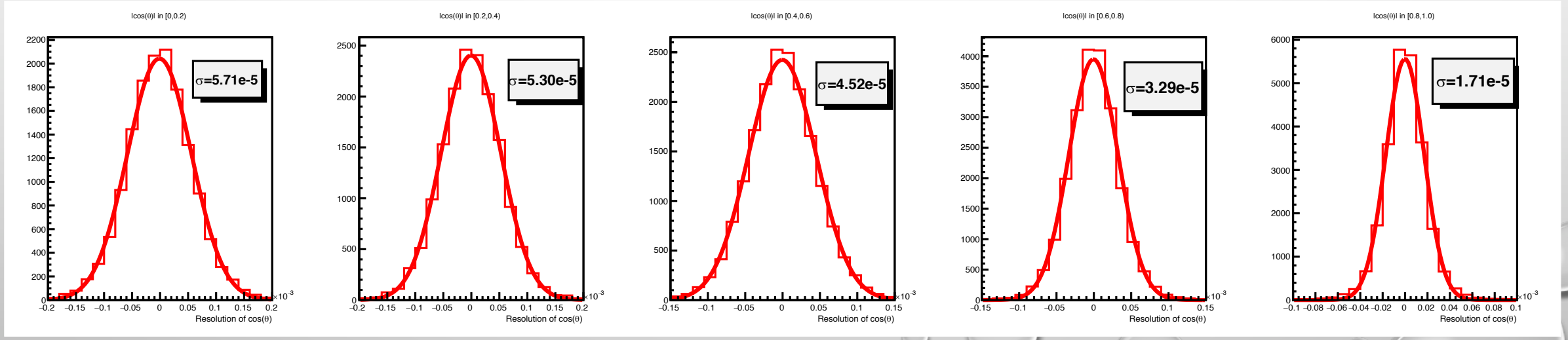
Summary

- Full simulation for muon angle resolution, which is of magnitude of 10^{-5}.
- Angle resolution is better when the muons are closer to beam axis.
- Selections for Afb study, with efficiency of ~85%. (to be optimized)

BackUp:



CEPC.v1 old geometry and 3.5T magnetic field



CEPC.v4 new geometry and 3T magnetic field