

$ee \rightarrow \mu\mu$ forward-backward asymmetry at CEPC

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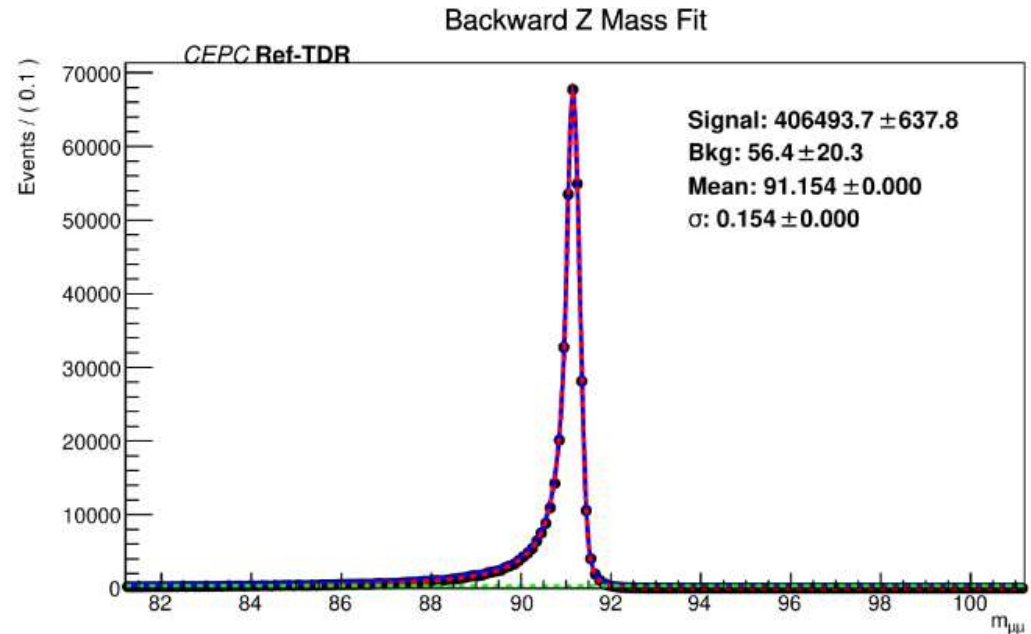
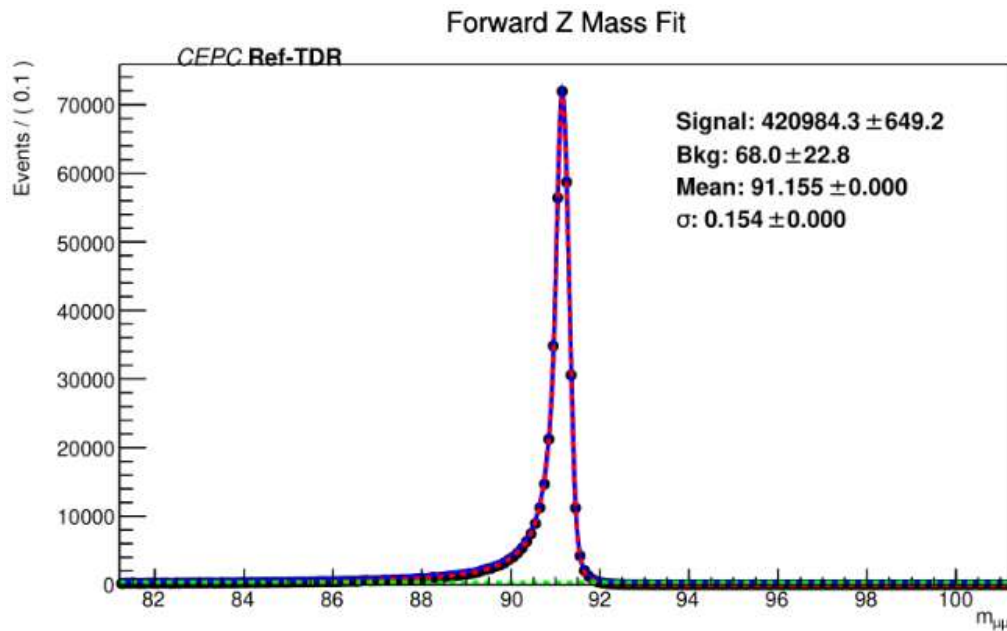
PFO CUTFLOW

- Reco-level selection for a pair of opposite charge muon from Z with muon ID
- Selection in a ± 10 GeV Z mass window
- Count for muon- $\cos\theta > 0$ or < 0
- WP : 98%

CEPCSW 25.3.6	Z ->mumu	Z->tautau	Z->bb	Z->ee
Total	984396	187855	88200	32397
PID selection	907804	6691	9715	3
Z mass window	854634	7	0	0
$ \cos\theta > 0.05$	827597	7	0	0
Wrong selection	2			
$\cos\theta > 0$	421049	1	0	0
$\cos\theta < 0$	406548	6	0	0
AFB	0.0175218			

The interference between Z/γ^*

- $Z \rightarrow \mu^+\mu^-$ process is modeled by a double-sided crystal ball (DSCB) function
- $\gamma^* \rightarrow \mu^+\mu^-$ process is modeled by a uniform function
- Count: 421049(forward) 406548(backward)
- Fit: 420984(forward) 406494(backward)



PFO selections vs MCP selections

- Apply $|\cos(\theta)|$ and p_T selections on the MC particles instead of PFO
- Compare the result based on MC particles with the nominal result based on PFO
- PFO Level:

Forward/Backward: 419403 / 404951

Asymmetry: 0.0175313

- MCP Level:

Forward/Backward: 419693 / 405237

Asymmetry: 0.0175239

- The uncertainty is estimated to be 7×10^{-6}

Summary

- We investigated the $Z \rightarrow ee$ channel and found it can be ignored ($< 1 \times 10^{-5}$)
- We calculated five types of uncertainties:
 - Energy spread: result assuming gaussian distribution of E_{cm} with a 0.13% energy spread, compared with no energy spread, this uncertainty is 2×10^{-5}
 - The impact of $\gamma^* \rightarrow \mu\mu$: result from counting forward/backward events, compared with fitting $m(\mu\mu)$, this uncertainty is 1×10^{-5}
 - The acceptance of $|\cos(\theta)| > 0.05$ and other kinematic cuts: result by cutting on MC particles, compared with nominal result, this uncertainty is 7×10^{-6}
 - The θ_{CM} resolution: result by using PFO, compared with the result using their $\Delta R < 0.05$ matched MC particles, this uncertainty is 5×10^{-6}
 - The uncertainty from mis-identification and backgrounds are smaller than 1×10^{-6}

How to include energy spread and its uncertainty

- Energy spread has 2 impacts: cross-section of forward/backward events, and the energy resolution of PFO
 - The AFB vs Ecm function only estimates the impact on cross-section
 - Recomputing PFO p4 only estimates the impact on energy resolution
 - Whizard 1.95 doesn't support energy spread
- Proposal: generate 5 samples with same stats. @@
 - Z mass, Z mass ± 0.53 sigma, Z mass ± 1.4 sigma
 - sigma = 0.13%, with 0.26% or 0.065% as systematic variations

