EW precision measurement at Z pole

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Z pole physics in pre-CDR

- Some study on expected precision based on extrapolation from LEP results.
- No full simulation study yet

Observable	LEP precision	CEPC precision	CEPC runs	$\int \mathcal{L}$ needed in CEPC
m_Z	2 MeV	0.5 MeV	Z lineshape	> 150 fb^{-1}
m_W	33 MeV	3 MeV	ZH (WW) thresholds	> 100 fb^{-1}
A_{FB}^b	1.7%	0.15%	Z pole	> 150 fb^{-1}
$\sin^2\theta_W^{\text{eff}}$	0.07%	0.01%	Z pole	> 150 fb^{-1}
R_b	0.3%	0.08%	Z pole	> 100 fb^{-1}
N_ν (direct)	1.7%	0.2%	ZH threshold	> 100 fb^{-1}
N_ν (indirect)	0.27%	0.1%	Z lineshape	> 150 fb^{-1}
R_μ	0.2%	0.05%	Z pole	> 100 fb^{-1}
R_τ	0.2%	0.05%	Z pole	> 100 fb^{-1}

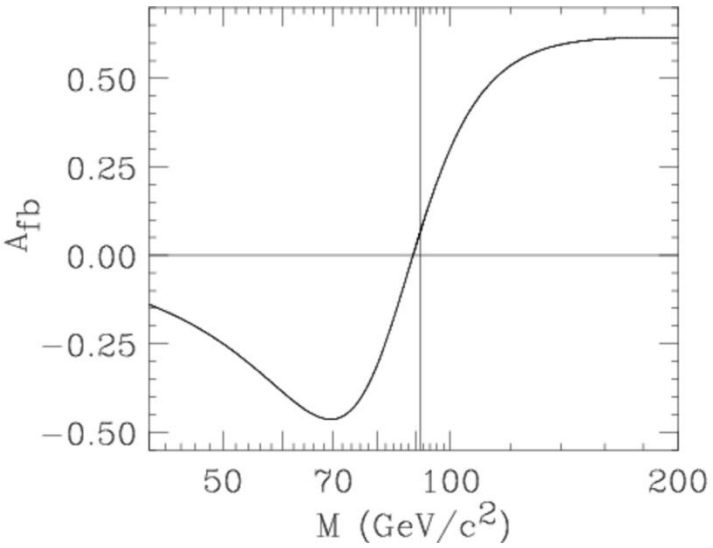
Z pole physics: Plan for CDR

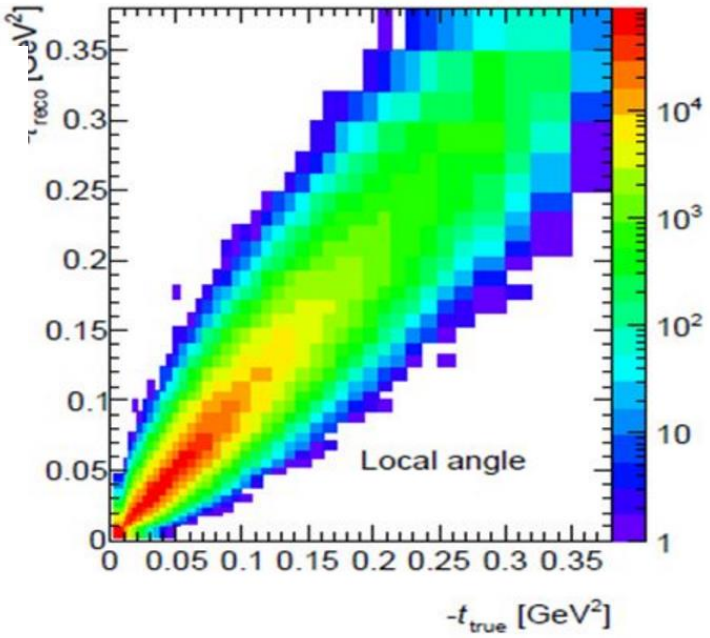
- Study Physics Requirement for accelerator
  - Z mass
  - Weak mixing angle
  - W mass

- Requirement for detector
  - Z->bb branching ratio (R_b)
  - Z->cc branching ratio (R_c)

Plan for Weak mixing angle

- More details in Mengran's talk





Truth distribution From Z fitter → unFolding matrix → Reco level distribution

Physics Requirement for accelerator

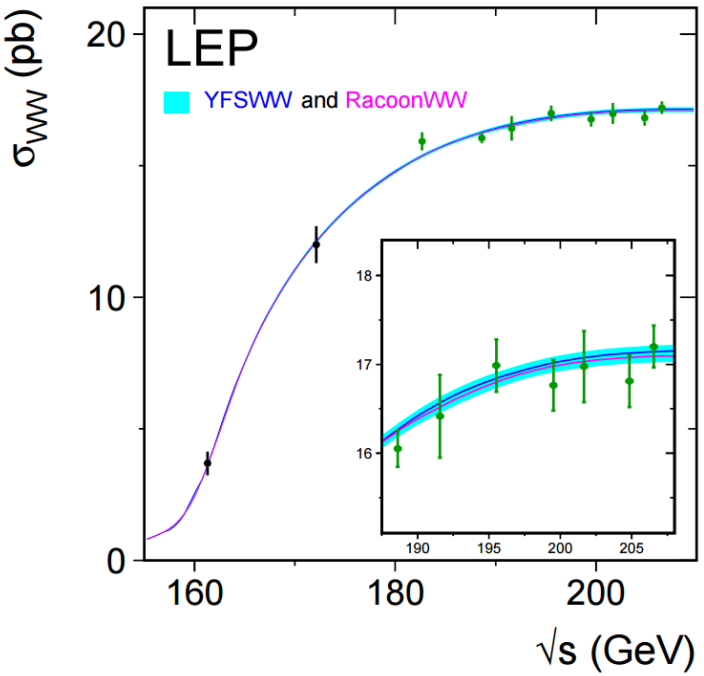
- Expected Beam momentum scale uncertainty
  - CEPC pre-CDR : 500keV (10^{10} Z)
  - FCC-ee : 100keV (10^{13} Z)
- Requested by FCC-ee experts to do more study
- Propagate beam momentum scale uncertainty to all EW measurement.
- Give a clear physics requirement to accelerator

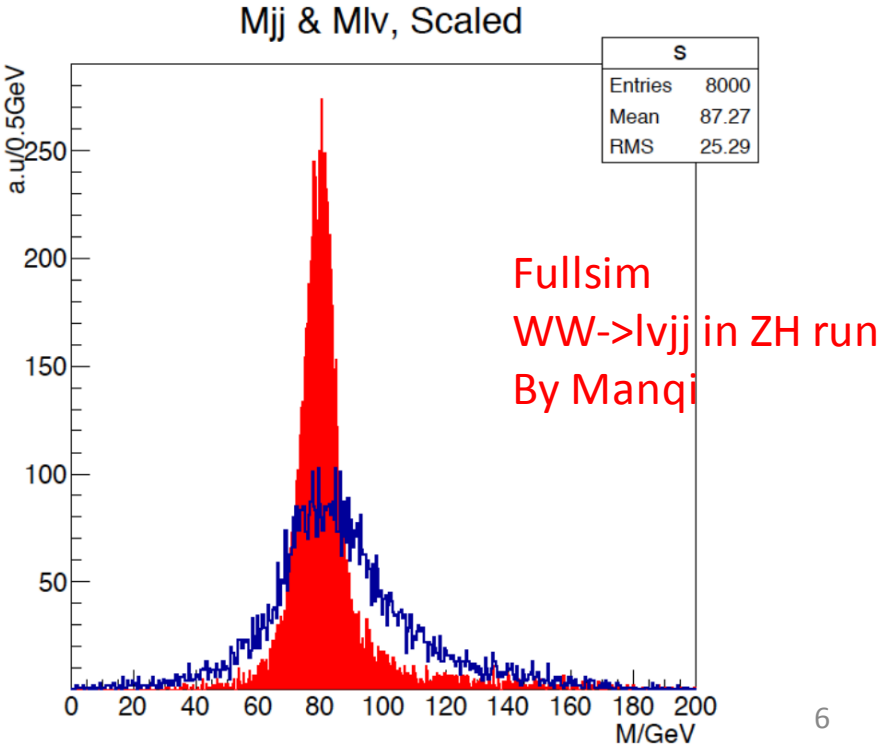
		Correlations				
		m_Z	Γ_Z	σ^0_{had}	R^0_ℓ	$A^{0,\ell}_{FB}$
$\chi^2/dof = 172/180$		ALEPH				
m_Z [GeV]	91.1893 ± 0.0031	1.000				
Γ_Z [GeV]	2.4959 ± 0.0043	0.038	1.000			
σ^0_{had} [nb]	41.559 ± 0.057	−0.092	−0.383	1.000		
R^0_ℓ	20.729 ± 0.039	0.033	0.011	0.246	1.000	
$A^{0,\ell}_{FB}$	0.0173 ± 0.0016	0.071	0.002	0.001	−0.076	1.000

W Mass measurement

- Two methods for W mass measurement
  - WW threshold scan (beam momentum uncertainty)
    - Requested by FCC/ILC experts at ICHEP2016
  - Direct measurement in ZH runs in WW->lvjj events
    - Jet energy scale/resolution uncertainty
    - beam momentum uncertainty

WW threshold scan by LEP





Candidate of branch mark channel at Z pole

- Requirement on CEPC beam momentum uncertainty
  - Weak mixing angle and Z mass , semi-fullsim
  - W Mass (threshold scan), Z fitter level study
- Requirement on TPC detector occupancy (track efficiency)
  - Weak mixing angle
- Requirement on pixel detector optimization (impact parameter)
  - Z->bb branching ratio (R_b) ,need fullsim
  - Z->cc branching ratio (R_c)
- Requirement on calorimeter (Jet energy scale/resolution)
  - W mass (direct method) , fullsim
- Requirement on calorimeter (granularity, tauID)
  - Z-> tautau branching ratio

Summary

- Lots of work for Z pole physics CDR study.
- Aim for publication of CEPC Z pole physics prospect in one year.
- Lots of room for contribution
- We need your contribution !