W/Z physics in CDR

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News
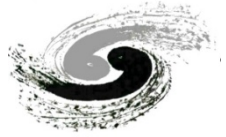
- **Some discussion about CEPC Z pole running .**
  - **http://indico.ihep.ac.cn/event/7709/**
  - **Two possibility:**
    - **E=90 GeV, L=1.6 X 10^{35} cm^{-2}s^{-1}, solenoid field = 3T (new default)**
    - **Two year running proposed by accelerator team**
- **WW threshold scan**
  - **Proposal from accelerator team**
  - **One year running about 160GeV , 3T**
  - **Total luminosity 3.2 ab^{-1}**

W mass (direct method)
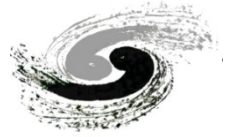
- **With Maarten Boonekamp's help, Peizhu Lai and Bo Liu and working on evaluation jet energy scale systematics (eg: jet flavor dependence)**
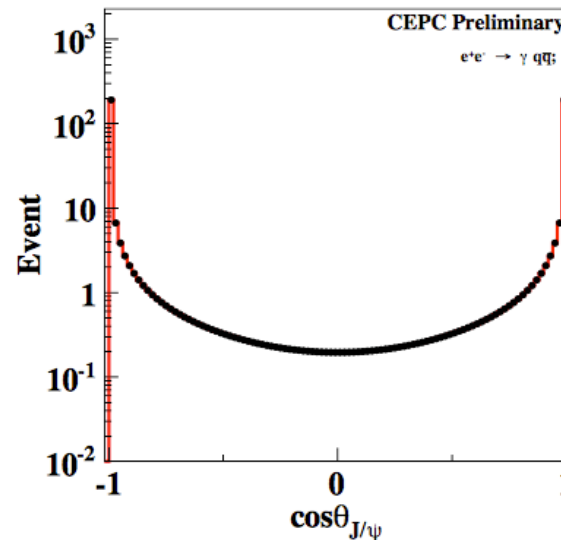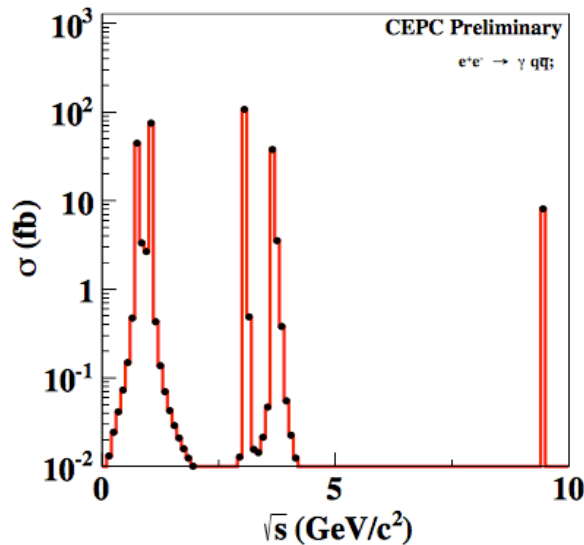- **Plan to implement heavy flavor jet veto in Z->jj sample**
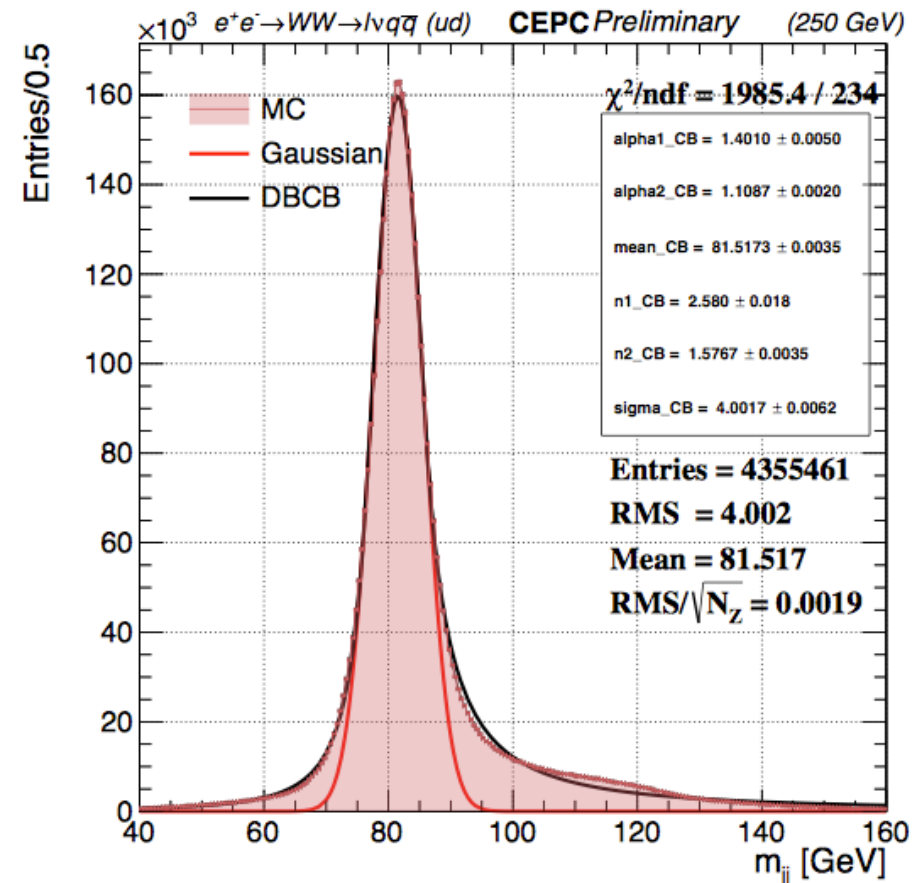
	Z→uu	Z→dd	Z→cc	Z→ss	Z→bb
Entries	277624	337688	276937	338912	337928
RMS	4.400	4.398	4.975	4.738	5.443
Mean	92.164	92.004	91.126	91.653	89.958
RMS/√Nz	0.0084	0.0076	0.0095	0.0081	0.0094

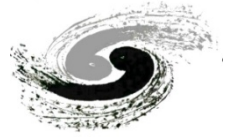|	W→ud	W→cs	W→us	W→cd
Entries	4355461	9178827	4593124	4592346
RMS	4.002	4.168	4.009	4.007
Mean	81.517	81.250	81.507	81.499
RMS/√Nw	0.0019	0.0014	0.0019	0.0019

W mass (direct method)
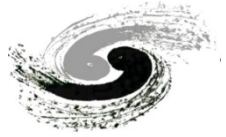
- **Bo Liu is looking into PFA object energy scale calibration**
  - **One idea from Maarten and Manqi is that to use J/pi sample**
- **Peixun Shen has calculated the production cross section for J/psi in Z pole and ZH runs.**

240 (GeV)	ω	ϕ	J/ψ	$\psi(2S)$
σ_{tot} (fb)	42.4	75.7	106.4	37.7
Accept.($|cos\theta < 0.98|$)	0.14	0.14	0.14	0.14

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W mass measurement (WW threshold scan)

- **Peixun Shen is optimizing the WW scan runs**
  - **Considering the beam energy uncertainty, energy spread, theory unc.**

With the beam energy spread, the $\sigma_{W^+W^-}$ becomes:

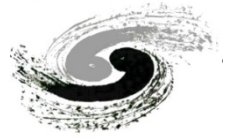$$\sigma_{W^+W^-}(E) = \int_0^\infty \sigma(E') \times G(E, E') dE'$$

$$\approx \int_{E-6\sqrt{2}E_{BS}}^{E+6\sqrt{2}E_{BS}} \sigma(E') \times \frac{1}{\sqrt{2\pi}\sqrt{2}E_{BS}} e^{\frac{-(E-E')^2}{2(\sqrt{2}E_{BS})^2}} dE' \quad (1)$$

For simulation, $E_{BS} = E_{BS}^0 + \Delta E_{BS}$, and $E_{BS} = E_{BS}^0$ for the fit formula. Here, the ΔE_{BS} is the shift between true value of data and the nominal one in the fit.
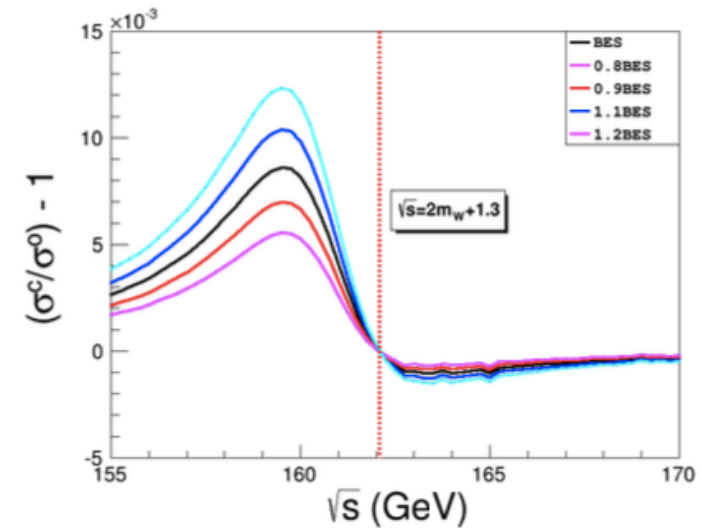
| ΔE_{BE} (%)	20	15	10	9	8	7	6	5	4	3	2	1
m_W shift (-MeV)	2.3	1.7	1.1	1.0	0.9	0.7	0.6	0.5	0.4	0.3	0.2	0.1

CEPC W/Z physics Plan for CDR

- **Plan to cover the prospects of 6-7 key parameters.**
- **Text for CDR is going to commit into git this weekend**
- **Contributions are welcome**
- **Some study need to be done with new MC simulation**
  - **New detector geometry, B field**
  - **This study will not change the text, just change some number in CDR.**
  - **Eg: jet energy resolution, lepton resolution, acceptance uncertainty …**

Observable	LEP precision	CEPC precision	CEPC runs	$\int \mathcal{L}$ needed in CEPC
m_Z	2 MeV	0.5 MeV	Z threshold scan runs	$1ab^{-1}$
m_W	33 MeV	2-3 MeV	WWthreshold, ZH runs	$5ab^{-1}$
A_{FB}^b	1.7%	0.1%	Z threshold scan runs	$1ab^{-1}$
$\sin^2\theta_W^{\text{eff}}$	0.07%	0.01%	Z threshold scan runs	$1ab^{-1}$
R_b	0.3%	0.05%	Z pole	$1ab^{-1}$
N_ν	1.7%	0.05%	ZH runs	$5ab^{-1}$
R_μ	0.2%	0.01%	Z pole	$1fb^{-1}$

Performance input

- **Identify some performance input needed to support the W/Z physics prospect study**
  - **May need to repeat some study with 3T magnetic field and new detector geometry**
- **Afb(l): lepton angular resolution**
- **R_b: "B jet efficiency" vs "cjet/light rejection "**
- **W mass (direct approach)：jet energy resolution**
- **W mass (threshold scan): ?**
- **N_v : photon energy resolution**
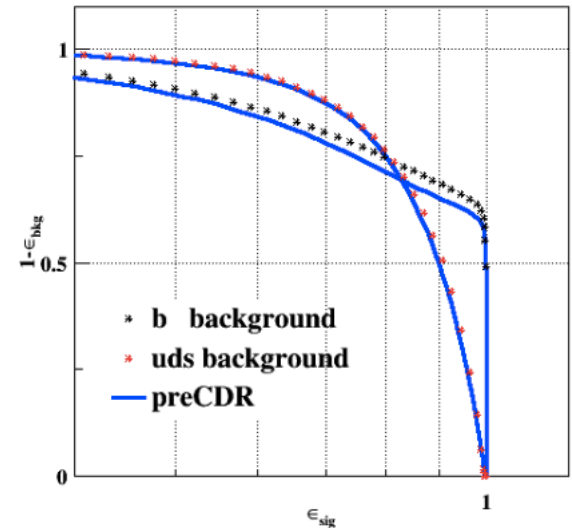
MC Production plan for W/Z physics

- **Afb(l):**
  - 100k Z->ll full simulation for angular resolution study
  - 10M ~ 100M Z->ll and Z->tautau fast simulation for background study and event-by-event fitting.

- **W mass (direct measurement)：**
  - 1M WW->lvqq fullsim in ZH run ?

- **R(b) :**
  - 200k fullsim Z->bb, Z->cc , Z->qq at Z pole ?
  - Could we use fast sim for b tagging ?