updated CEPC EW inputs

July 17, 2019

CEPC	reference SM value	absolute uncertainties			relative uncertainties			major uncertainty
		Δ_{tot}	Δ_{stat}	Δ_{sys}	δ_{tot}	δ_{stat}	δ_{sys}	
m_Z	91.1876	0.5 MeV	–	0.5 MeV				ΔE_{beam}
Γ_Z	2.4950 GeV	0.5 MeV	–	0.5 MeV				
σ_{had}	41.484 nb	0.005 nb	0.00005 nb	0.005 nb				
R_e	20.743	0.005	0.0004	0.005	0.0003			t-channel
R_μ	20.743	0.002	0.0004	0.002	0.0001			photon ID and scale
R_τ	20.743	0.003	0.0006	0.003	0.0002			tau ID (electron fake tau)
R_b	0.21578				0.0002			
R_c	0.17226				0.001			
$A_{\text{FB}}^{0,e}$	0.0163	0.00018	–	0.00018	**0.01**			t-channel
$A_{\text{FB}}^{0,\mu}$	0.0163	7.5×10^{-5}	5×10^{-6}	7.5×10^{-5}	**0.005**			Ebeam
$A_{\text{FB}}^{0,\tau}$	0.0163	7.5×10^{-5}	–	7.5×10^{-5}	0.005			Ebeam
$A_{\text{FB}}^{0,b}$	0.1032	0.0001	0.00002	0.0001	0.001			
$A_{\text{FB}}^{0,c}$	0.0738	0.0002	0.00003	0.0002	0.003			
A_e (τ pol)	0.1515 (PDG)				0.0003	0.0003	0.0001	statistics
A_τ (τ pol)	0.1430 (PDG)				0.0005	0.00015	0.0005	tau ID

Table 1: CEPC inputs. **The "SM value"** shows the SM prediction except for m_Z (which is an input for SM), and **only serves as a reference**. Entries filled with"–" denotes that the corresponding uncertainty is irrelevant.

	BR($W \to e\nu$)	BR($W \to \mu\nu$)	BR($W \to \tau\nu$)	BR($W \to jj$)
CEPC	3×10^{-4}	3×10^{-4}	4×10^{-4}	1×10^{-4}

Table 2: CEPC projections for W branching ratios measurements. (Same as FCC-ee projections.)

1 notes

This document provides some projections of the CEPC Z-pole measurements. We list below some of the dominate sources of systematic uncertainties. **Note that we do not include any theory uncertainties, *e.g.* the QCD uncertainties in R_b, R_c, $A_{\text{FB}}^{0,b}$ and $A_{\text{FB}}^{0,c}$.**

- $\sigma_{\rm had}$: dominated by systematics. A relative uncertainty of $\sim 10^{-4}$ from luminosity determination and $\sim 10^{-4}$ from other sources are assumed. The luminosity uncertainty comes from the theory uncertainty of Bhabha (BB) scattering cross section ($e^+e^- \to e^+e^-$),
$$\frac{\#BB}{\#Z_{had}} = \frac{\mathcal{L}}{\mathcal{L}} \frac{\sigma_{BB}}{\sigma_{\rm had}}\,, \tag{1.1}$$

- R_e: The dominate systematics comes from the contamination of the t-channel diagram, which makes its precision worse than the one of R_μ.

- R_μ dominated by uncertainty of $\sigma_{\rm had}$? Looks like the case for us, but does not work for FCC-ee. but maybe uncertainty of σ_{bb} cancel

- R_τ electron background (need Granularity improvement?) systematics 10 times better than LEP

- $A_{\rm FB}^{0,e}$: The dominate systematics comes from the contamination of the t-channel diagram.

- $A_{\rm FB}^{0,\mu}$: The dominate systematics comes from the beam energy measurement. This has an impact on the determination of the center of mass frame.

- A_τ: measured from $Z \to \tau\tau$ events. The best measured channel is $\tau \to \rho\nu_\tau$, and its main uncertainty comes from photon ID. The statistical uncertainty is at the same order but a few factor smaller, so systematics still dominates.

- A_e (from tau polarization) statistical dom? LEP also A_e systematics smaller than A_τ, so in our case sys scale from the one of A_τ is negligible

- R_b gluon splitting LEP 0.00023 , FCC assume factor of 2 improvement, we assume it goes to 10^{-5}, (FCC-ee should get 0.0006?) anyway, we assume no theory uncertainty

- R_c scale from LEP...