Summary

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Outline

- Top quark mass measurements with CEPC at the $t\bar{t}$ threshold
- H->Z a, Z->ll, a ->ee/ μ μ on ATLAS
- ITk production

Top quark mass measurements with CEPC at the t ¯t threshold

- Paper finished and submitted to EPJC, waiting for reply.
- Using the cross section of tt threshold with ISR and LS of CEPC.
  - Use the method of threshold scan to measure the properties.
  - Considering different uncertainties.

Source	m_{top} precision (MeV)	
	Optimistic	Conservative
Statistics	9	9
Theory	9	26
Background	4	18
Beam energy	2	2
Luminosity spectrum	3	5
Total	14	34

Table 7: The expected statistical and systematical uncertainties of the top quark mass measurement in optimistic and conservative scenarios at CEPC.

Top quark mass measurements at the $t\bar{t}$ threshold with CEPC

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Abstract. We present a study of top quark mass measurements at the $t\bar{t}$ threshold based on CEPC. A centre-of-mass energy scan near two times of the top quark mass is performed and the measurement precision of top quark mass, width and α_S are evaluated using the $t\bar{t}$ production rates. Realistic scan strategies at the threshold are discussed to maximise the sensitivity to the measurement of the top quark properties individually and simultaneously in the CEPC scenarios assuming a total luminosity limited to 100 fb^{-1}. With the optimal scan for individual property measurements, the top quark mass precision is expected to be 9 MeV, the top quark width precision is expected to be 26 MeV, and α_S can be measured at a precision of 0.00039, considering only the statistical uncertainty. Taking into account the uncertainties from theory, background subtraction, beam energy and luminosity spectrum, the top quark mass can be measured at a precision of 14 MeV optimistically and 34 MeV conservatively at CEPC.

PACS. XX.XX.XX No PACS code given

1 Introduction

Top quark, the heaviest fundamental particle observed so far, plays an important role in the Standard Model (SM). It provides the strongest coupling to the SM Higgs boson and opens doors to new physics beyond the SM (BSM). Till now, the top quark mass have only been measured at hadron collisions, e.g. the Tevatron and the Large Hadron Collider (LHC), using the direct reconstruction of the invariant mass of the top quark decay products. In future electron-positron colliders the top quark mass can be measured not only by the direct reconstruction but also by a scan on the centre-of-mass energy at the $t\bar{t}$ threshold. The cross-section of $t\bar{t}$ increases sharply as the centre-of-mass energy goes through the $t\bar{t}$ threshold and depends strongly on the top quark mass, width and α_S, which provides a sensitive probe to these measurements. This is the so-called threshold-scan method that was discussed for top quark mass measurements at an electron-positron collider [1–4].

In experiments, the top quark mass has been measured by using the direct reconstruction of the top quark decay products as 174.30 ± 0.35 (stat.) ± 0.54 (syst.) GeV from the combined results of CDF and D0 at Tevatron [5], 172.69 ± 0.25 (stat.) ± 0.41 (syst.) GeV with ATLAS [6] and 172.44 ± 0.13 (stat.) ± 0.47 (syst.) GeV with CMS [7] at the LHC. The precision till now is about half a GeV and it is mainly limited by the systematic uncertainties that are not easily reduced in the future. On the contrary, the threshold-scan method has been widely used [8, 9] and shown good performance with a statistical uncertainty of top quark mass measurement at $\mathcal{O}(10)$ MeV that was studied previously with ILC, CLIC and FCC-ee [10–14].

The threshold-scan method also provides a theoretically well defined mass that can be calculated with a high degree of precision and can be easily converted to various theoretical schemes. This cannot be realised in the reconstructed top mass peak method in which the generated mass peak is usually used as a template to fit to the observed data, since the generator mass is not well-defined theoretically.

In this article, we discuss the threshold-scan method and propose realistic scan strategies for the top quark mass measurements with electron-positron collisions based on the Circular Electron Positron Collider (CEPC). The experimental conditions at CEPC are introduced in Sec. 2. The threshold-scan method applied to the CEPC senarios, the realistic scan strategies and the optimal precision in top quark measurements are discussed in Sec.3. The systematic uncertainties from the theoretical calculation on the cross-section, the beam energy, the luminosity spec-

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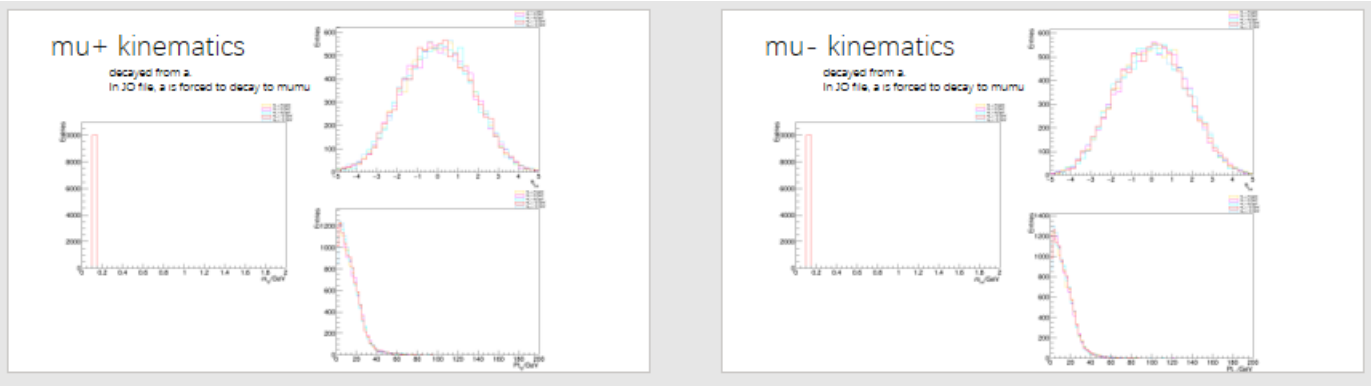
H->Z a, Z->ll, a ->ee/ μ μ

- Use pythia8 to generate samples:
  - m_A=5, 6, 8, 10, 12, 15, 20, 25, ⋯, 60 GeV
    - a ->ee
    - a -> μ μ
- Validation finished on Jun. 28th



- Signal request submitted on Jul. 29th.
- Signal samples produced on Aug. 29th.
- Now we are testing the framework.

ITk Production

- Prepare PPB SQ:
  - Metrology: Hybrid
  - Metrology: Module
- Make hybrid and module
  - Debug the glue dispenser and fix the compressed air system.
  - Assemble the first ITk hybrid and module.
  - Assemble more hybrids.

Thank you!