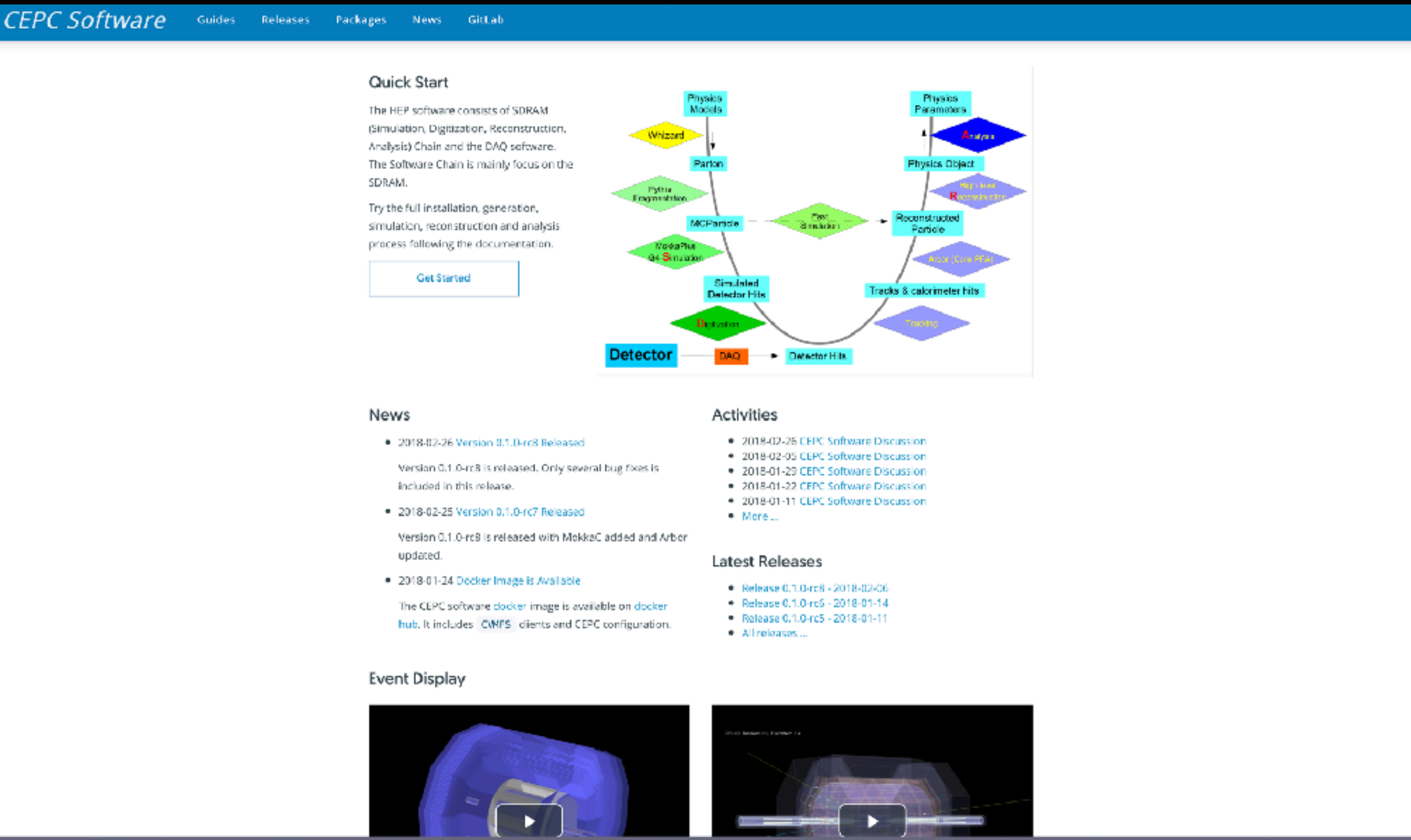
Status of simulation group

Gang LI

March 7th, 2018

CEPC soft webpage: http://cepcsoft.ihep.ac.cn



To be released soon,

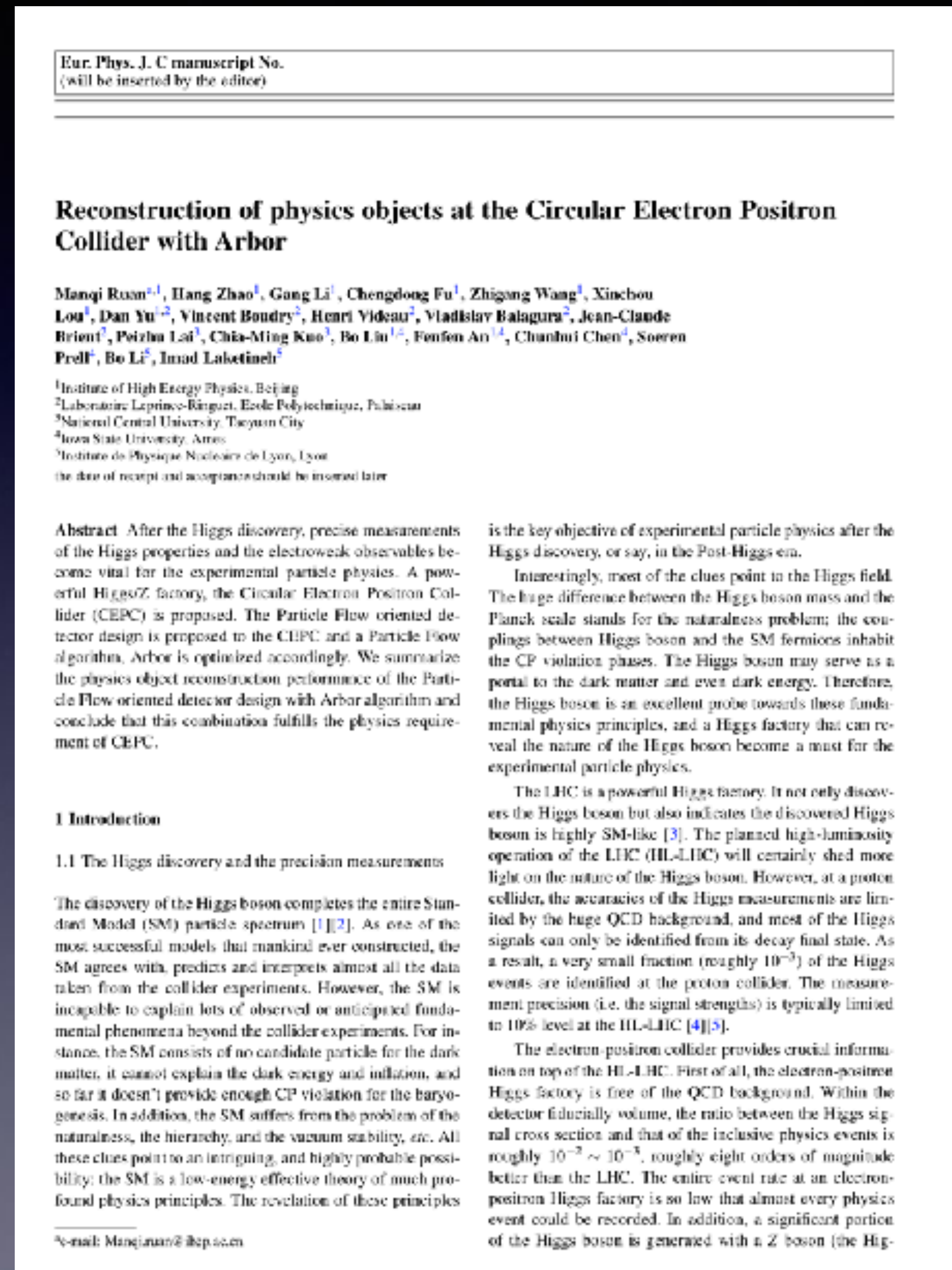
Need more work to make it complete, please join us!

Physics objects validated and summarized into a note

CEPC-RECO-2018-001
Which is on our DocDB server:

http://cepcdoc.ihep.ac.cn/cgi-bin/DocDB/ShowDocument?docid=171

15 pages, Welcome to read it



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(will be inserted by the editor)

Reconstruction of physics objects at the Circular Electron Positron Collider with Arbor

Manqi Ruan[a,1], Hang Zhao[1], Gang Li[1], Chengdong Fu[1], Zhigang Wang[1], Xinchou Lou[1], Dan Yu[1,2], Vincent Boudry[2], Henri Videau[2], Vladislav Balagura[2], Jean-Claude Brient[2], Peizhu Lai[3], Chia-Ming Kuo[3], Bo Liu[1,4], Fenfen An[1,4], Chunhui Chen[4], Soeren Prell[4], Bo Li[5], Imad Laktineh[5]

[1]Institute of High Energy Physics, Beijing
[2]Laboratoire Leprince-Ringuet, Ecole Polytechnique, Palaiseau
[3]National Central University, Taoyuan City
[4]Iowa State University, Ames
[5]Institute de Physique Nucleaire de Lyon, Lyon

the date of receipt and acceptance should be inserted later

Abstract After the Higgs discovery, precise measurements of the Higgs properties and the electroweak observables become vital for the experimental particle physics. A powerful Higgs/Z factory, the Circular Electron Positron Collider (CEPC) is proposed. The Particle Flow oriented detector design is proposed to the CEPC and a Particle Flow algorithm, Arbor is optimized accordingly. We summarize the physics object reconstruction performance of the Particle Flow oriented detector design with Arbor algorithm and conclude that this combination fulfills the physics requirement of CEPC.

1 Introduction

1.1 The Higgs discovery and the precision measurements

The discovery of the Higgs boson completes the entire Standard Model (SM) particle spectrum [1][2]. As one of the most successful models that mankind ever constructed, the SM agrees with, predicts and interprets almost all the data taken from the collider experiments. However, the SM is incapable to explain lots of observed or anticipated fundamental phenomena beyond the collider experiments. For instance, the SM consists of no candidate particle for the dark matter, it cannot explain the dark energy and inflation, and so far it doesn't provide enough CP violation for the baryogenesis. In addition, the SM suffers from the problem of the naturalness, the hierarchy, and the vacuum stability, *etc.* All these clues point to an intriguing, and highly probable possibility: the SM is a low-energy effective theory of much profound physics principles. The revelation of these principles is the key objective of experimental particle physics after the Higgs discovery, or say, in the Post-Higgs era.

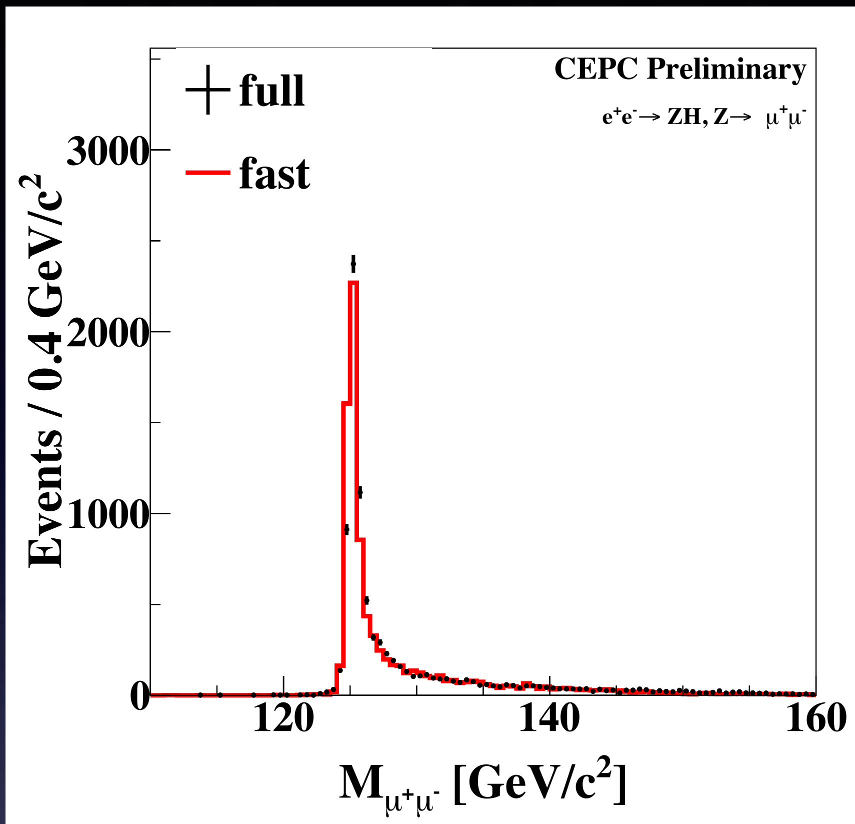
Interestingly, most of the clues point to the Higgs field. The huge difference between the Higgs boson mass and the Planck scale stands for the naturalness problem; the couplings between Higgs boson and the SM fermions inhabit the CP violation phases. The Higgs boson may serve as a portal to the dark matter and even dark energy. Therefore, the Higgs boson is an excellent probe towards these fundamental physics principles, and a Higgs factory that can reveal the nature of the Higgs boson become a must for the experimental particle physics.

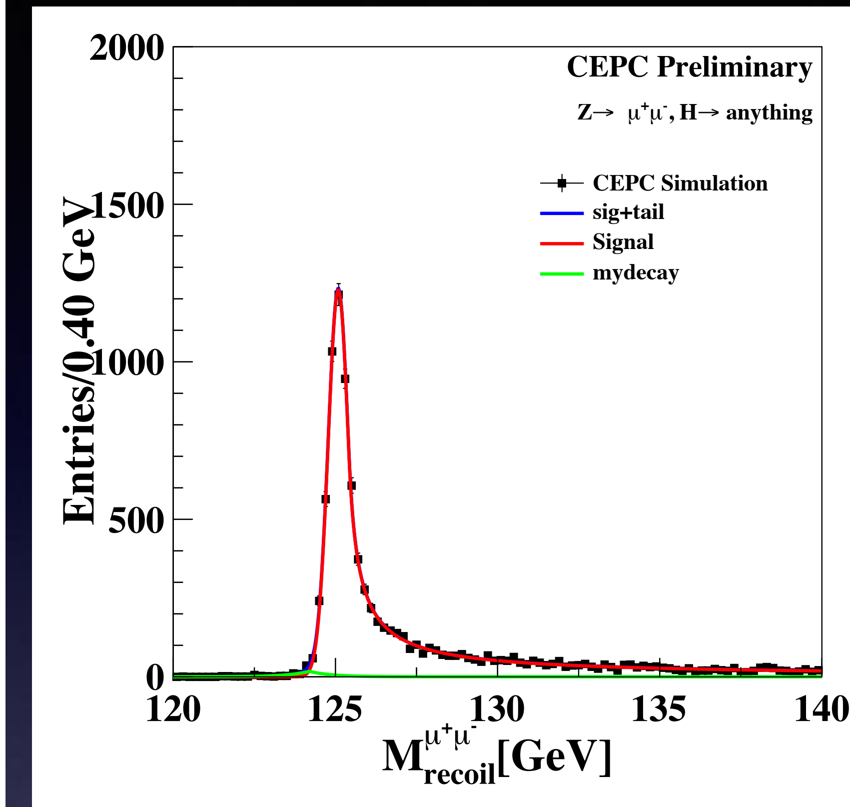
The LHC is a powerful Higgs factory. It not only discovers the Higgs boson but also indicates the discovered Higgs boson is highly SM-like [3]. The planned high-luminosity operation of the LHC (HL-LHC) will certainly shed more light on the nature of the Higgs boson. However, at a proton collider, the accuracies of the Higgs measurements are limited by the huge QCD background, and most of the Higgs signals can only be identified from its decay final state. As a result, a very small fraction (roughly 10^{-3}) of the Higgs events are identified at the proton collider. The measurement precision (i.e. the signal strengths) is typically limited to 10% level at the HL-LHC [4][5].

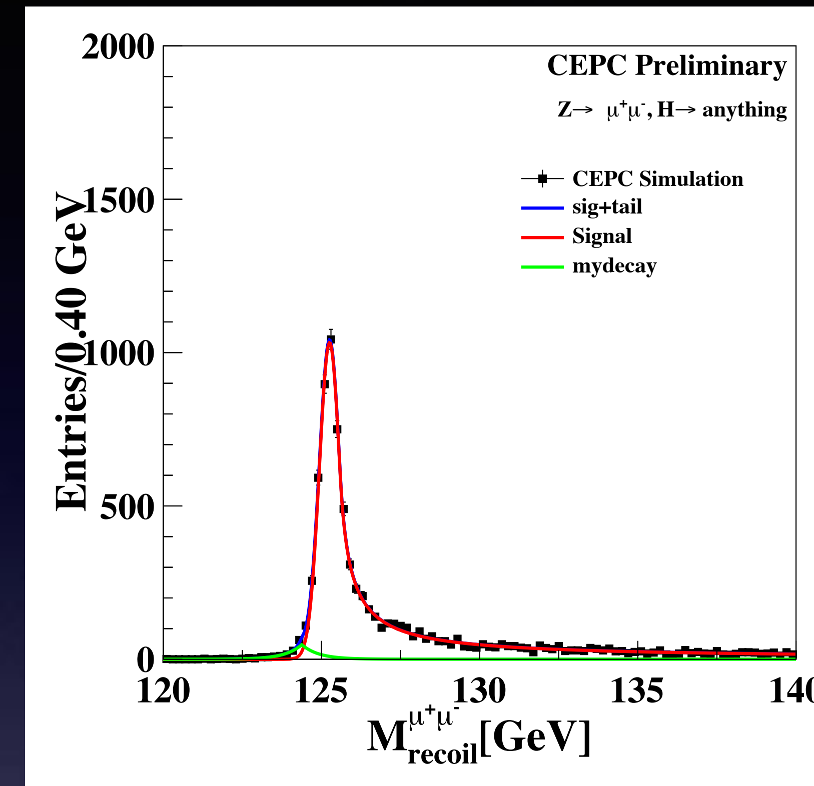
The electron-positron collider provides crucial information on top of the HL-LHC. First of all, the electron-positron Higgs factory is free of the QCD background. Within the detector fiducially volume, the ratio between the Higgs signal cross section and that of the inclusive physics events is roughly $10^{-2} \sim 10^{-3}$, roughly eight orders of magnitude better than the LHC. The entire event rate at an electron-positron Higgs factory is so low that almost every physics event could be recorded. In addition, a significant portion of the Higgs boson is generated with a Z boson (the Hig-

[a]e-mail: Manqi.ruan@ihep.ac.cn

On 3Tesla fast simulation sample@240GeV







~10k events each

Fast:full = 312 : 322 (MeV): consistent

Eff.: 97%, 91% for fast and full

Pid not optimized for new version

Need validation and iterations
Quite fast, one day to produce full set

- Ecm=240GeV, Int L = 5/ab
- Samples at

/cefs/data/FastSim/CEPC240/v02

  - ✳ Higgs signal and
  - ✳ 4fermions background

✤ 2fermions will be processed as request

```
.
|-- 4fermions
|   |-- E240.Psw_l.e0.p0.whizard195
|   |-- E240.Psw_sl.e0.p0.whizard195
|   |-- E240.Psze_l.e0.p0.whizard195
|   |-- E240.Psze_sl.e0.p0.whizard195
|   |-- E240.Pszeorsw_l.e0.p0.whizard195
|   |-- E240.Psznu_l.e0.p0.whizard195
|   |-- E240.Psznu_sl.e0.p0.whizard195
|   |-- E240.Pww_h.e0.p0.whizard195
|   |-- E240.Pww_l.e0.p0.whizard195
|   |-- E240.Pww_sl.e0.p0.whizard195
|   |-- E240.Pzz_h.e0.p0.whizard195
|   |-- E240.Pzz_l.e0.p0.whizard195
|   |-- E240.Pzz_sl.e0.p0.whizard195
|   |-- E240.Pzzbosons.e0.p0.whizard195
|   |-- E240.Pzzorww_h.e0.p0.whizard195
|   `-- E240.Pzzorww_l.e0.p0.whizard195
|-- higgs
|   |-- E240.Pe1e1h_X.e0.p0.whizard195
|   |-- E240.Pe2e2h_X.e0.p0.whizard195
|   |-- E240.Pe3e3h_X.e0.p0.whizard195
|   |-- E240.Pnnh_X.e0.p0.whizard195
|   `-- E240.Pqqh_X.e0.p0.whizard195
|-- jobs
|   |-- all_stdhep_files.txt
|   |-- combined.py
|   |-- combined.py~
|   |-- init.xml
|   |-- init.xml~
|   `-- pbsjob
`-- work
    |-- 4fermions
    `-- higgs
```