Status of CEPC software

Gang Li for the CEPC study group

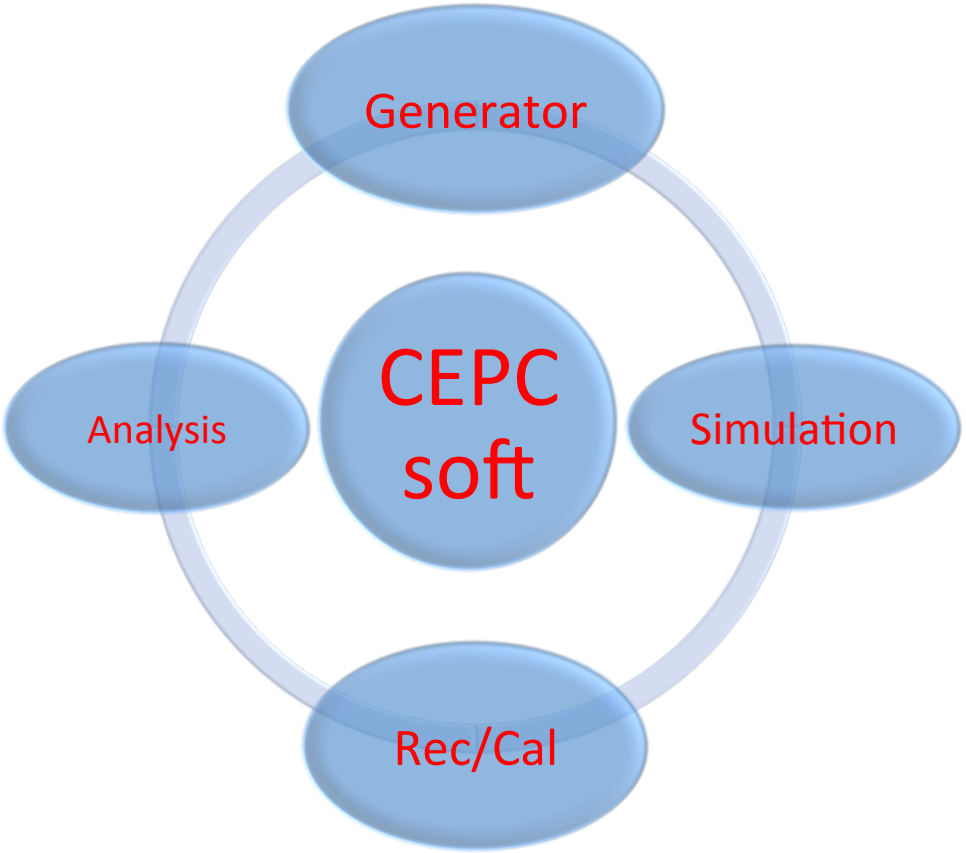
li.gang@mail.ihep.ac.cn

Institute of High Energy Physics, CAS

Outline

- Introduction
- Status of CEPC software
  - preCDR stage
  - Towards CDR
- Long term plan
- Summary

Software: a chain of (G)SRCA



- Generator: usually independent
- Simulation: flexible to edit/ change geometry
- Rec/Cal: cope with the changes of detector and maximize the performance
- Analysis: precision

Why we need a dedicated software?

- CEPC: HZW (top?) physics
  - H (Higgs): first priority
  - Z and W (electroweak): large FREE data @ 250GeV
  - W@160GeV and Z@91GeV necessary?

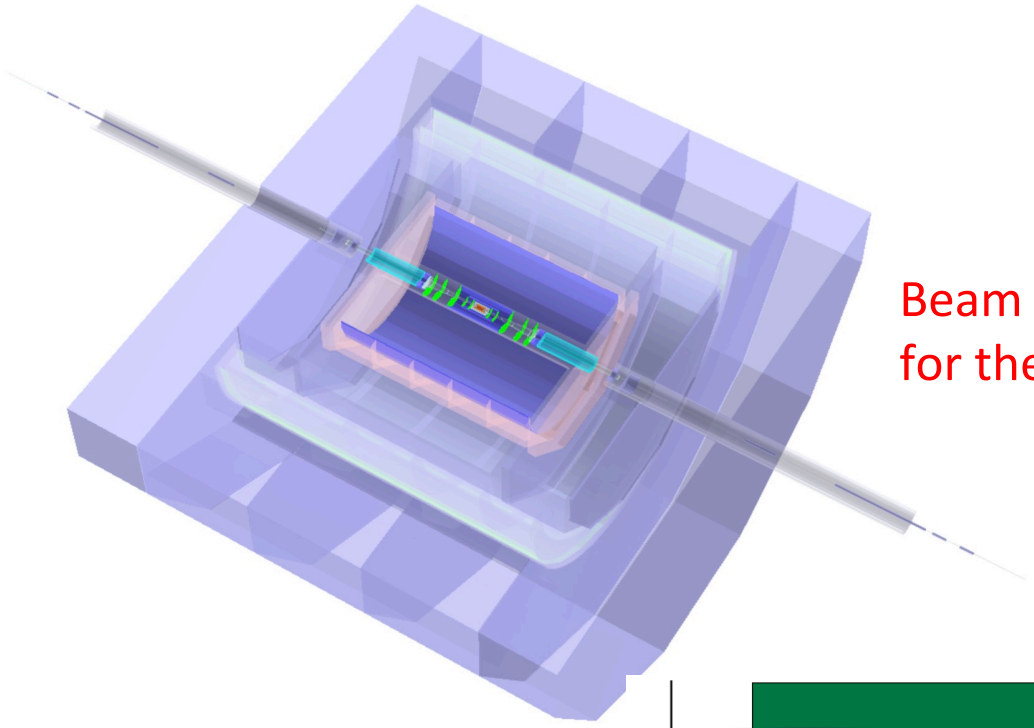
- Answer 1: Demonstrate and evaluate the physics potential of HZW(top)

Why we need a dedicated software?

- Pre-CDR: Detector model from ILD with some modifications
- Next CDR&TDR:
  - Alternative choice: silicon
  - Detector geometry: smaller for less expense
  - Key technical problems: MDI, active cooling, B …
  - More precise vertex for jet flavor identification
  - …
- Answer 2: Optimize the detector design to balance physics and expense

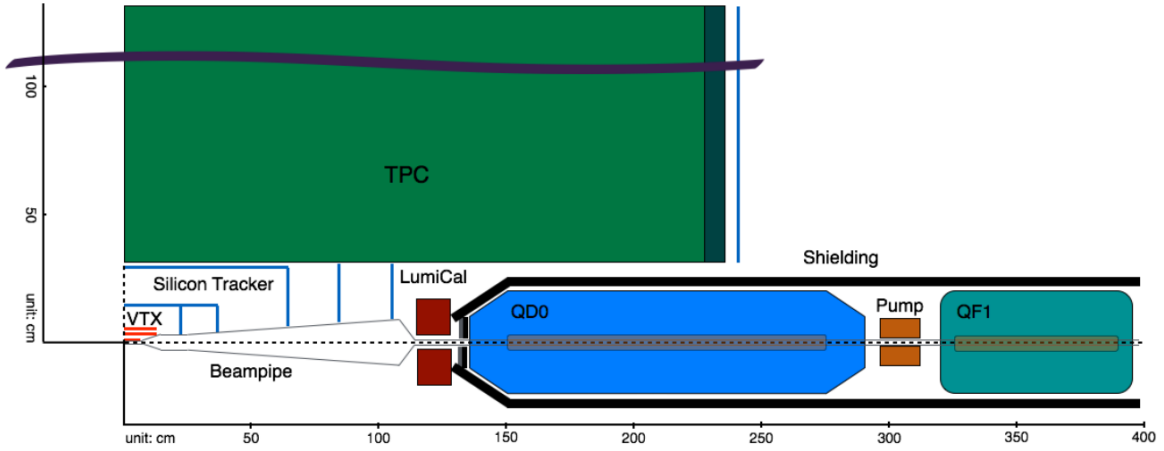
Status at pre-CDR

Detector: CEPC_v1

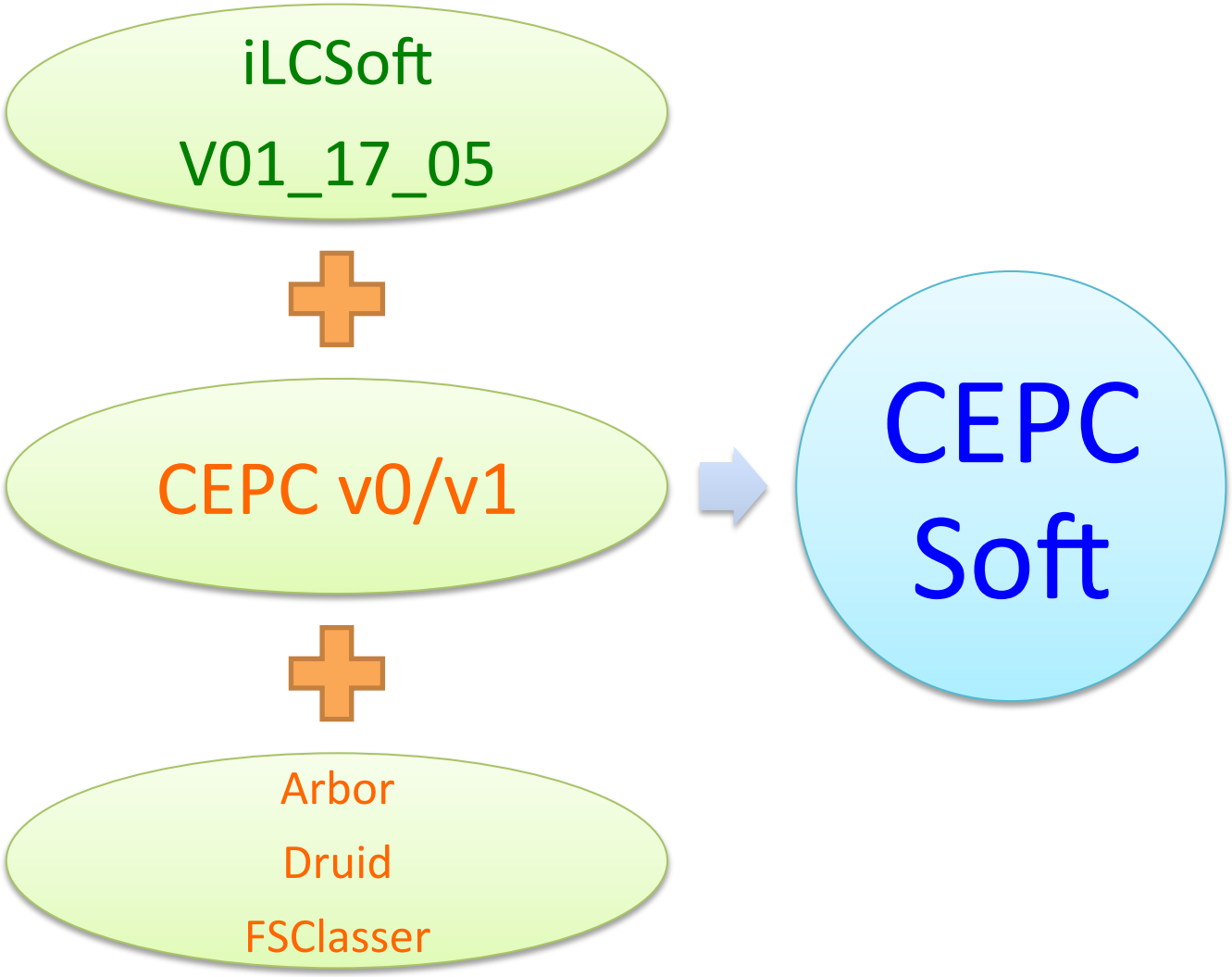


Beam backgrounds studied carefully for the MDI design

ILD reference, necessary changes

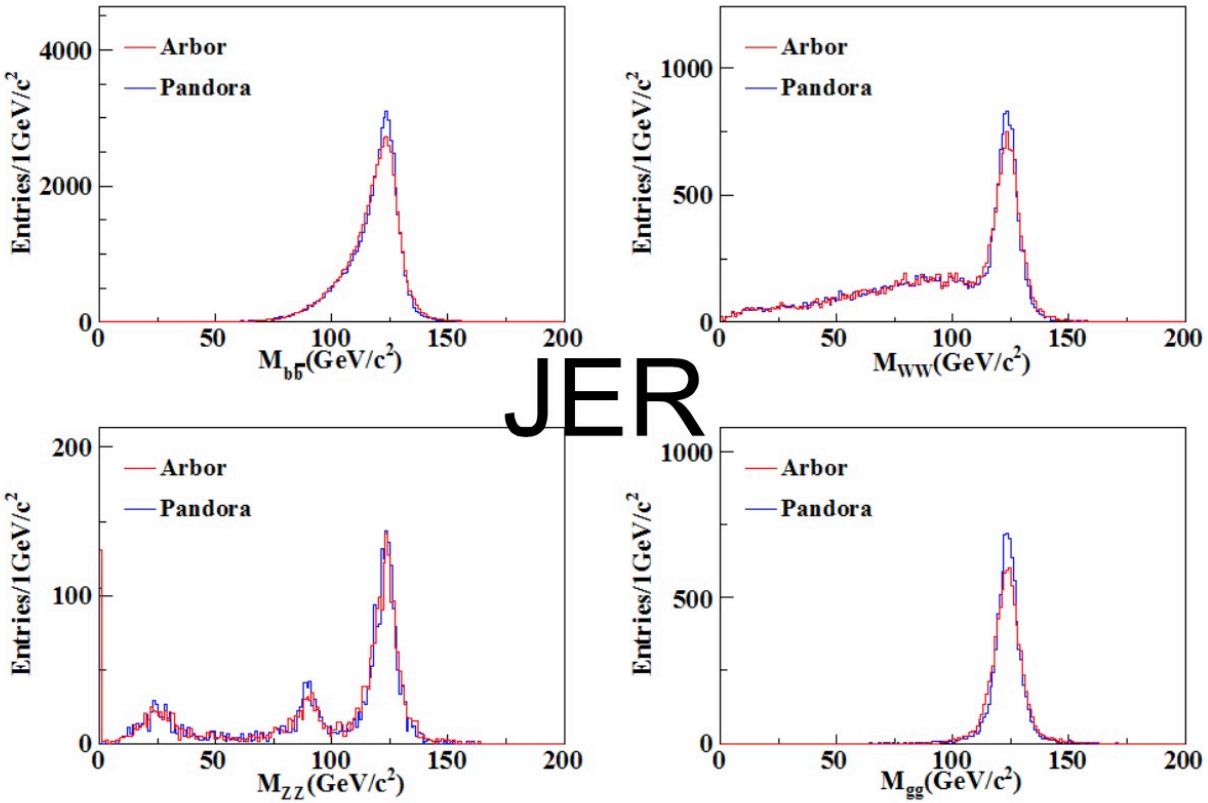


Dedicated homemade tools developed for CEPC conceptual design

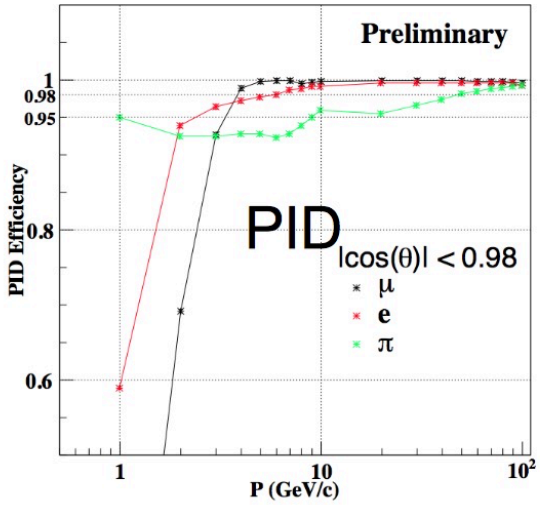


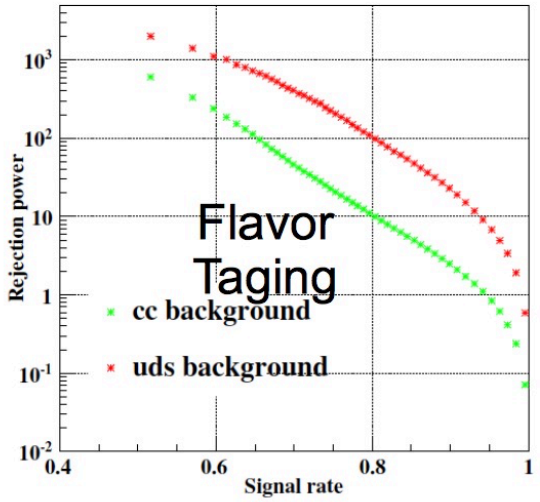
Reconstruction at PreCDR

- Fully validated simulation – reconstruction chain
- Developing and optimization needed



JER

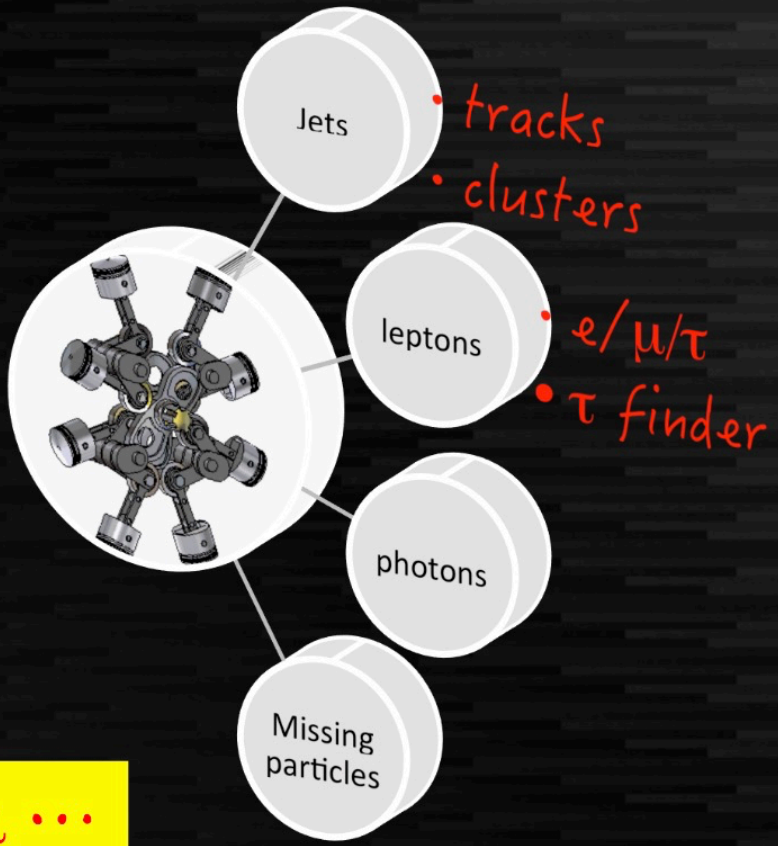




A dedicated analysis framework

Novices can start from root …

Feed all types of particle object to the combination engine for further processing



ee+X, μμ+X, jj+ee, jj+μμ …

Data → ntupes → plots

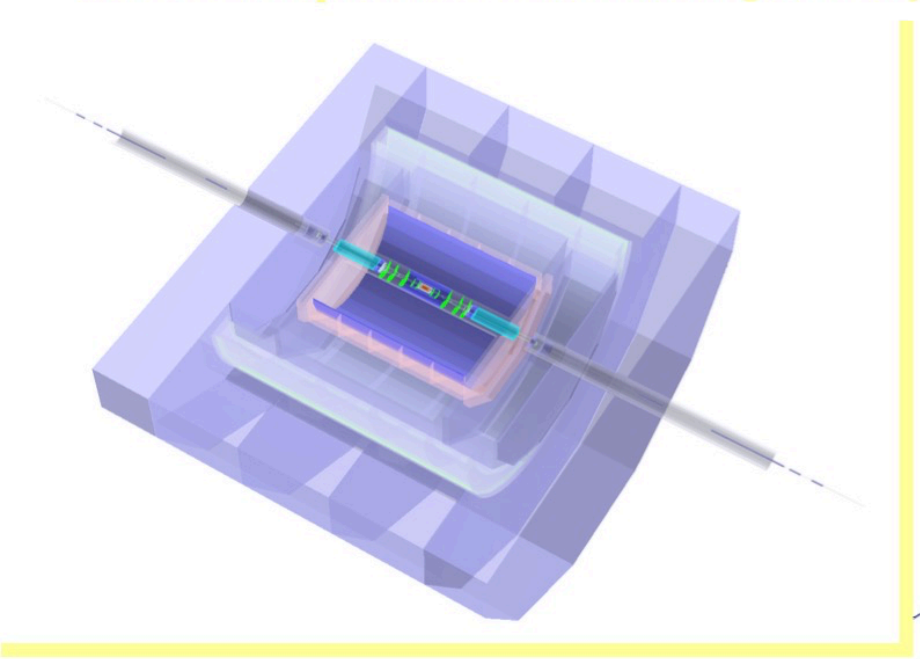
Towards CDR&TDR

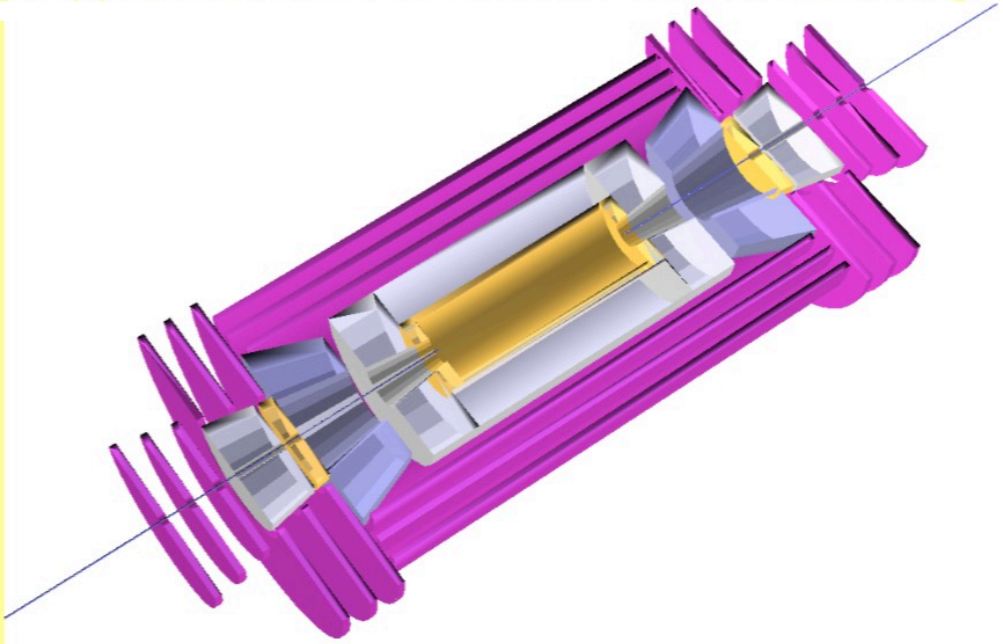
Two tasks of software

- Designing/optimizing detector and answering key questions
- Systematics control
  - Calibration
  - Dedicated physics object algorithms: e, μ, τ, γ, jet
  - MC/theoretical inputs

Geometry tools preparation

C. Fu: **Simplified** Calorimeter geometry, applied to both CEPC & SPPC Detector design





```
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/Mokka/init/globalModelParameter SiCalWThick 10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,...,10
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/Mokka/init/globalModelParameter SiCalBarrelHalfZ  8000 #2450
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/Mokka/init/globalModelParameter SiCalEndcapOuterR  6120
```
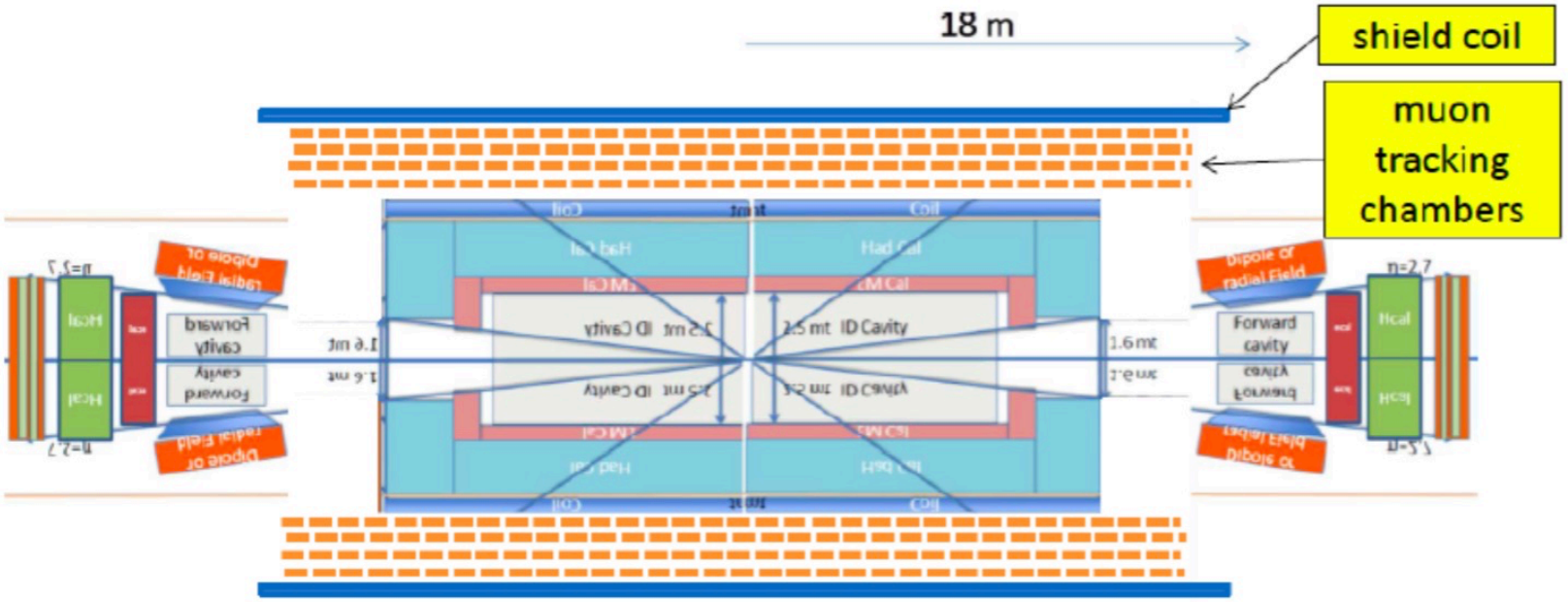
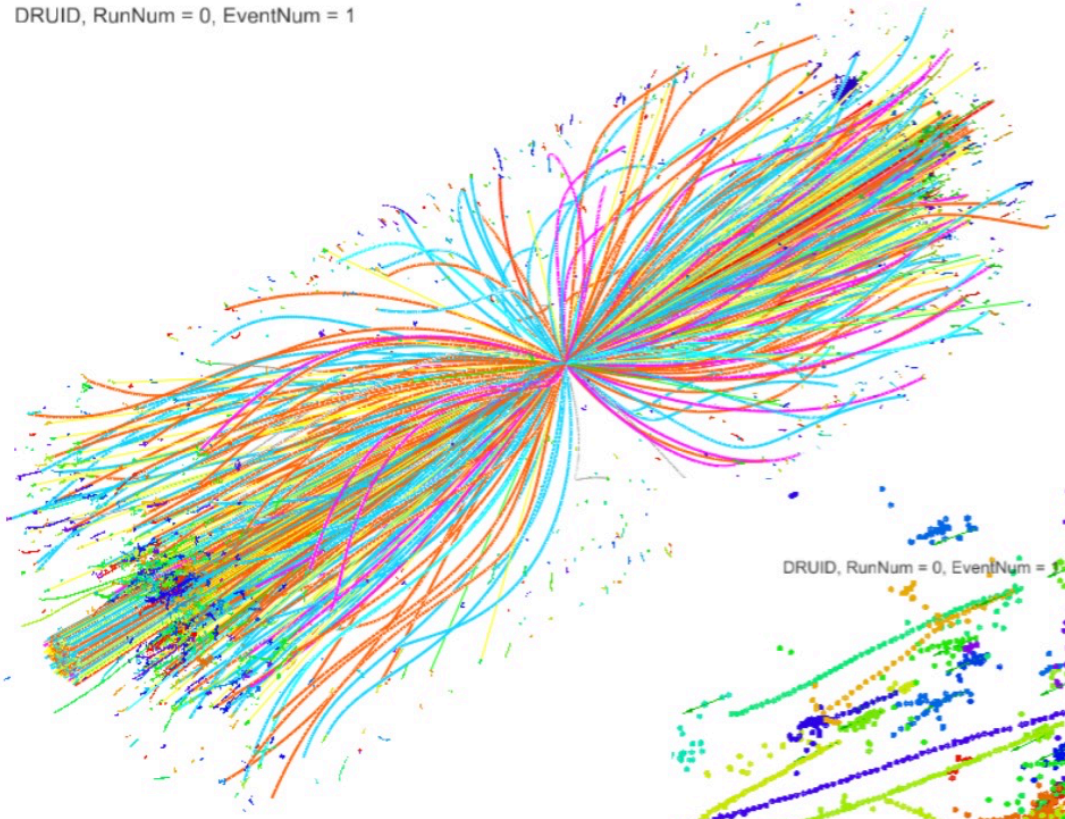

Will PFA oriented detector adequate to 100 TeV pp collision?

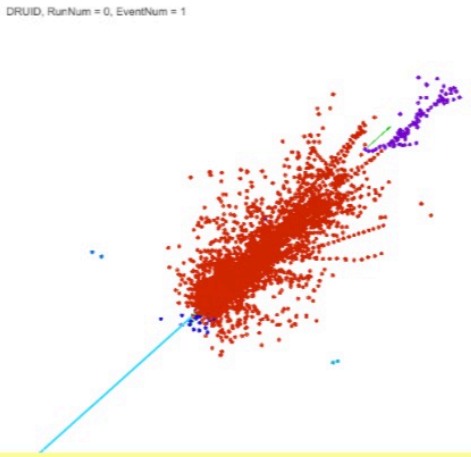
Defect free, deep ECAL style

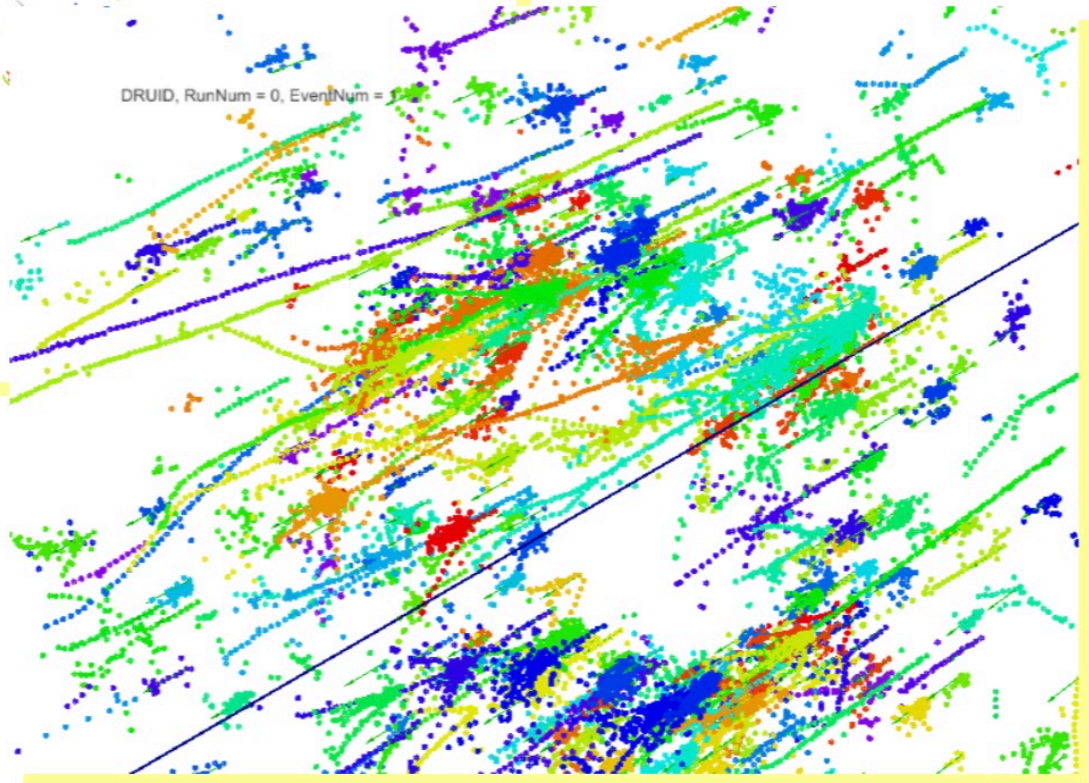
SPPC detector: exploration



C. Young: Solenoid + Dipole pairs for 100 TeV pp collider





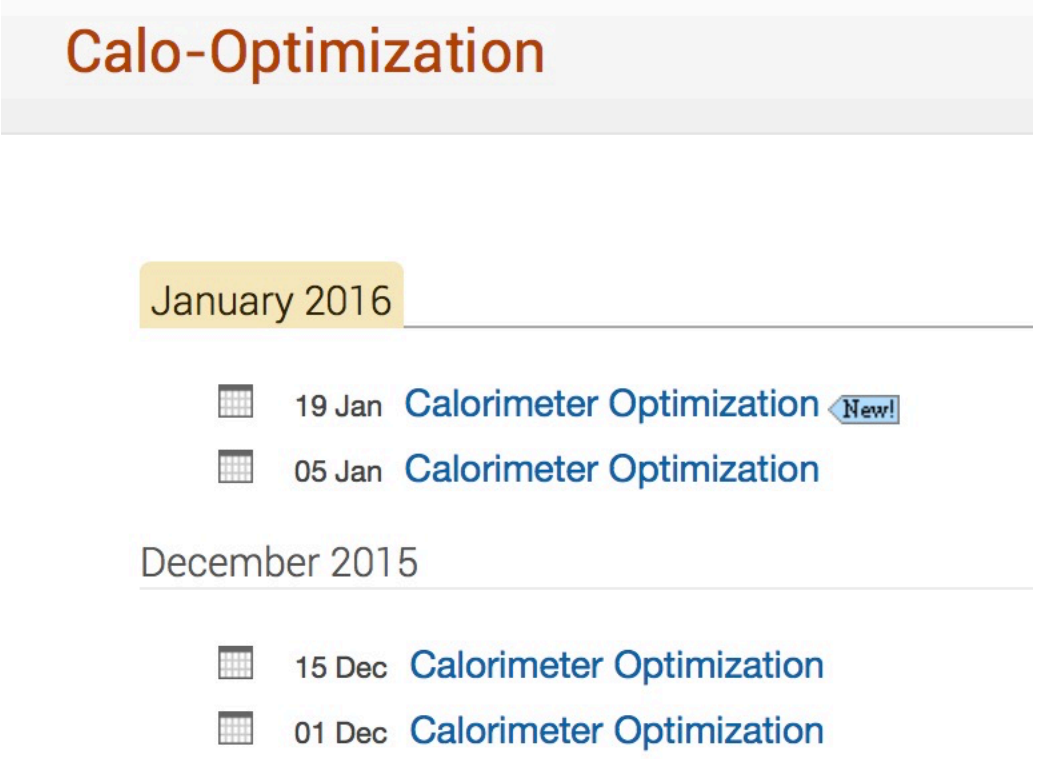


Messy Environments

Overlap 20
Min-bias events

Regular meeting~6 students

Guidance from experienced people can make the study more efficiently



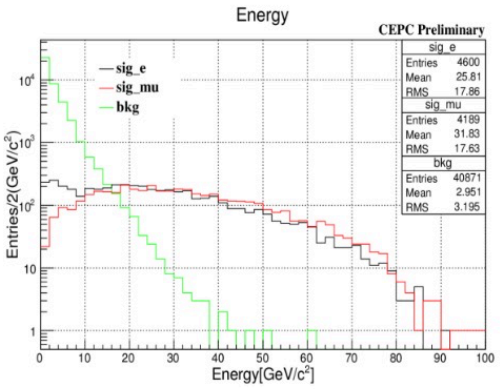
Higgs precision in pre-CDR

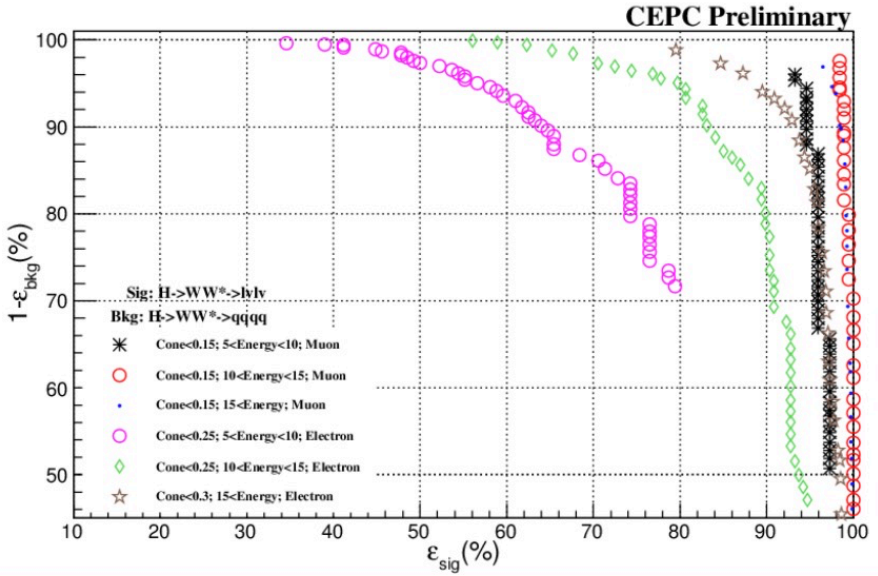
ΔM_H	Γ_H	$\sigma(ZH)$	$\sigma(\nu\bar{\nu}H) \times \mathrm{BR}(H \to b\bar{b})$
5.9 MeV	2.8%	0.51%	2.8%

Decay mode	$\sigma(ZH) \times \mathrm{BR}$	BR
$H \to b\bar{b}$	0.28%	0.57%
$H \to c\bar{c}$	2.2%	2.3%
$H \to gg$	1.6%	1.7%
$H \to \tau\tau$	1.2%	1.3%
$H \to WW$	1.5%	1.6%
$H \to ZZ$	4.3%	4.3%
$H \to \gamma\gamma$	9.0%	9.0%
$H \to \mu\mu$	17%	17%
$H \to \mathrm{inv}$	–	0.28%

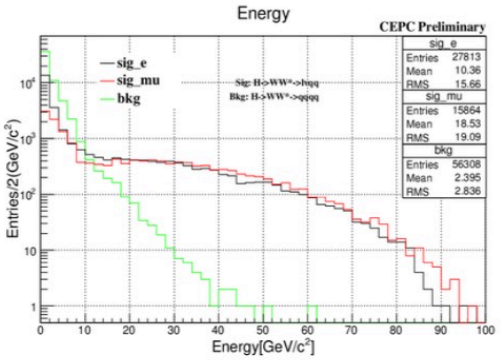
Physics objects: isolated lepton

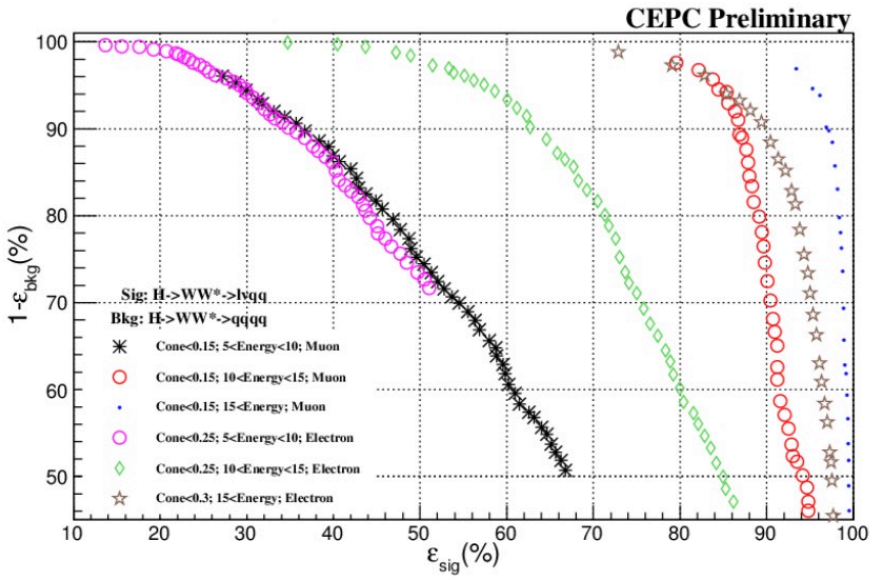
Full-Leptonic Decay





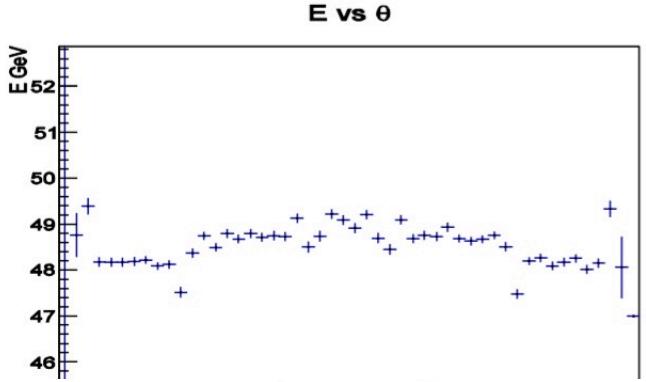
Semi-Leptonic Decay

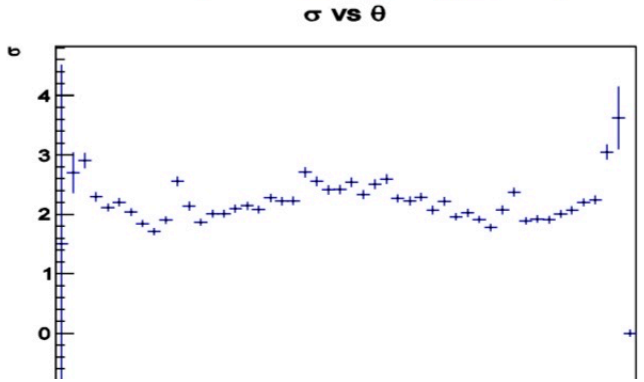




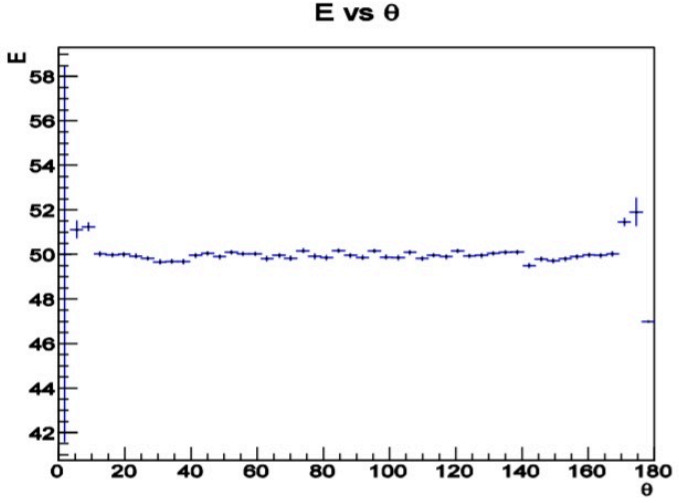
Physics objects: photon

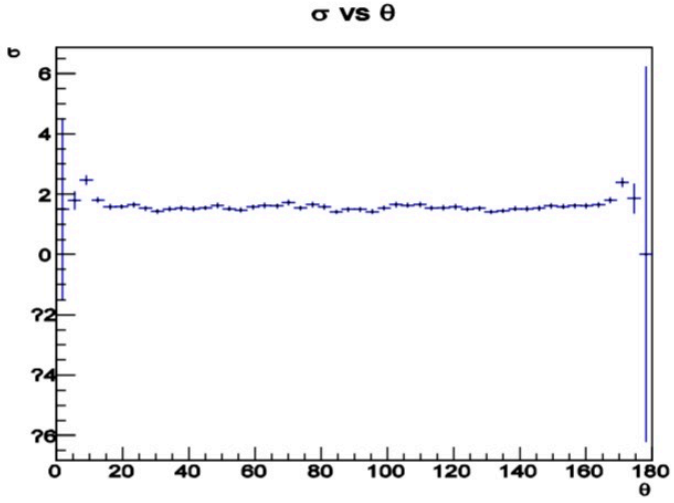
E (50 GeV) vs θ without θ correction (Arbor_v3_Diag_SL6)





E (50 GeV) vs θ with θ correction (Arbor_v3_Diag_SL6)



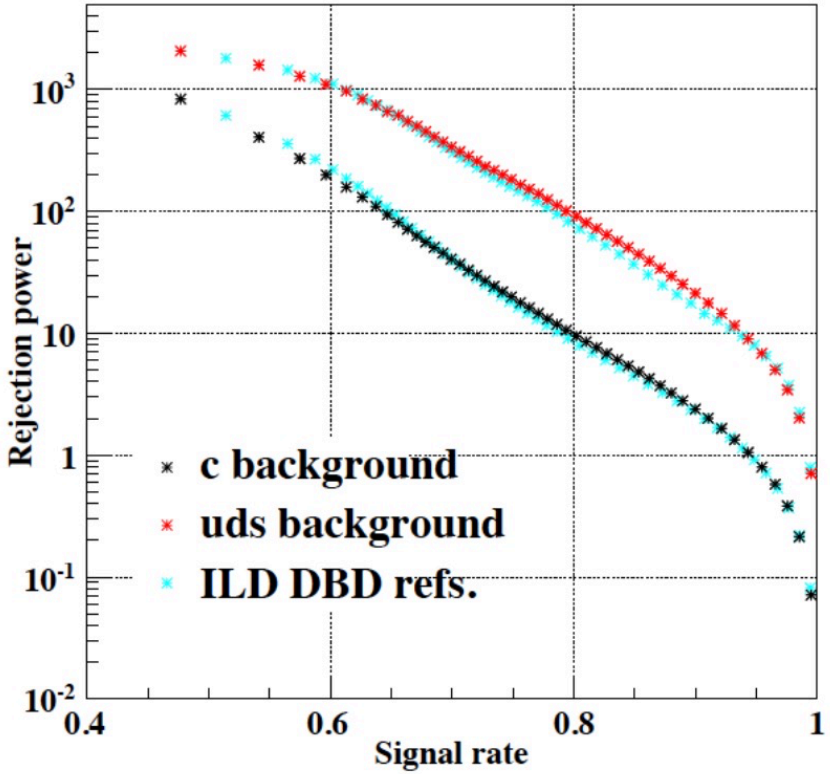


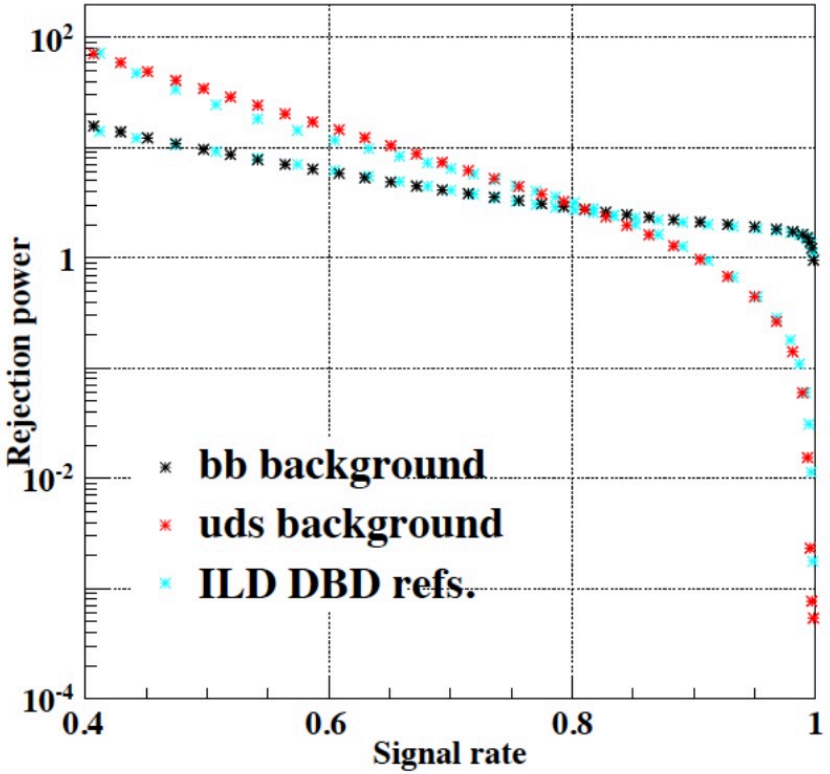
Jet algorithm

- LCFIplus also from iLCSoft, which includes jet-clustering and flavor-tagging
- Jet performances are same between CEPC and ILD for b, c and light jets
- New approaches are needed, for examples, the estimation of jet correlation, gluon vs. uds, jet charge …

Latest results

Flavor tagging





Long term goal --- a real experiment

New framework: a team formed

- **CEPC Software framework:**
  a. **Developed from iLCSoft**
  b. **Sufficient for R&D & optimization studies**
  c. **Has difficulties to support experimental data taking & processing**
- **Future requirements**
  a. **Parallel computing**
  b. **Data base handling**
  c. **User friendly, efficiency, etc**
  d. **Need top level engineering/ organization**
  e. **…**

Summary

- CEPC soft, based on iLCSoft, has some homemade tools
- Sufficient at present stage
- But cannot support a real experiment

- New software framework proposed
  - Good top level design is indispensable
  - New ideas, new developments should be implemented for physics potential and attracting more (young) people
  - Expertise, experiences and all types of corporation are welcome