CEPC LLP Simulation Study

Xiang Chen, Yulei Zhang, Cen Mo, Jifeng Hu, Liang Li

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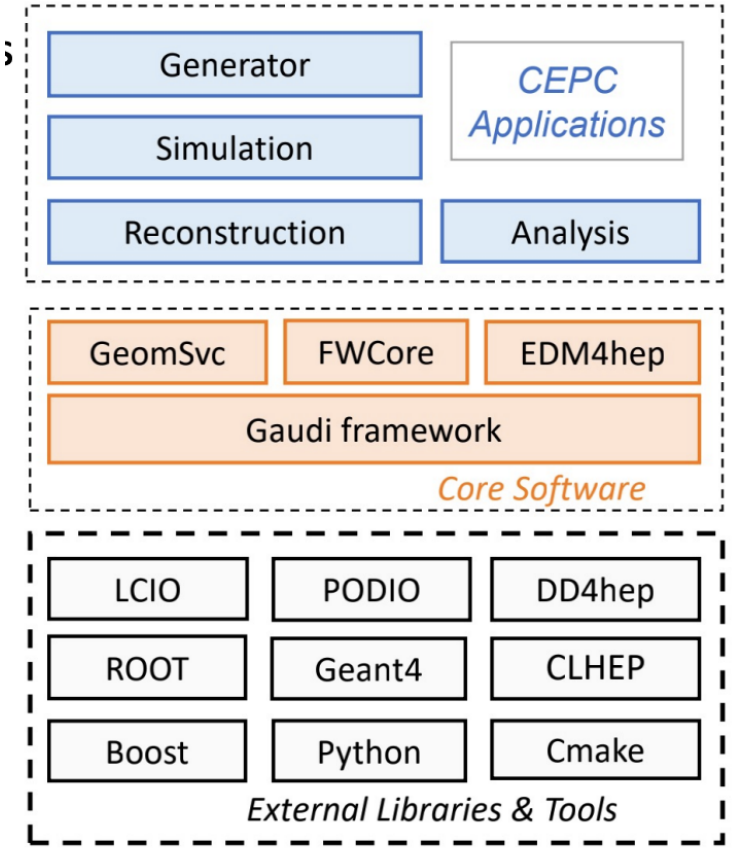
CEPC SW

- New framework based on Gaudi framework: use new simulation framework based on key4hep
- Many validation works are on-going: jet performance
- Easier for customize: all the detector modules are implemented

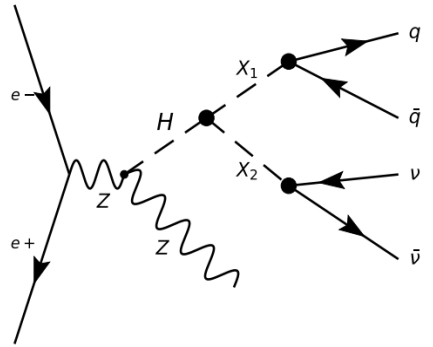
- Comparing to CDR, many detectors have changes
- TPC: drift chamber
- ECAL/ HCAL design
- Muon chamber are added with 6 layers



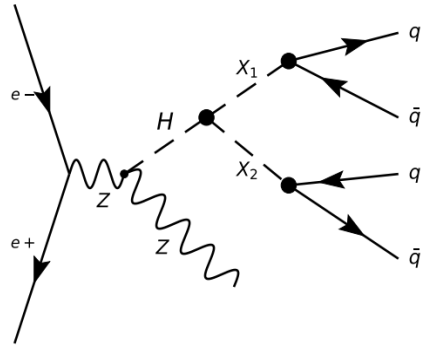
LLP Signal Simulation

- Simulating with CEPCSW to generate LLP 4j events and LLP 2j events.
- Use the default TDR_v1_01 setup including muon chamber with 6 layers
- The simulation time are longer than before, 200 events are simulated at a time:
  - The LLP 4j events cost more time in digitization compared to simulation
  - The LLP 2j events spend less time for less jets, contributing to less hits in the calorimeter

Process	Simulation time (per event)	Digitization time (per event)	Total time (per events)
LLP 4j, Z->qq	**40s**	**60s**	**100s**
LLP 2j, Z->vv	**12s**	**2s**	**10s**
Z->vv H->bb	40s	30s	70s



2-jet



4-jet

Total events: 1e6 for one LLP signal simple
Need **1150 days** with 1 cpu and 4 GB RAM
Assuming 200 parallel jobs (4GB RAM): **6 days**

LLP background time projection:
1e7 events (eeqq, W/Z, ZH)
~60days

Kaili's talk

LLP Signal Simulation Issues

- No muon digitization setup in the example
- No ECAL endcap digitization information

```
from Configurables import PodioInput
podioinput = PodioInput("PodioReader", collections=[
#    "EventHeader",
    "MCParticle",
    "EcalBarrelCollection",
    "EcalBarrelContributionCollection",
    "HcalBarrelCollection",
    "HcalBarrelContributionCollection",
    ])
```

```
##HCAL##
from Configurables import HcalDigiAlg
HcalDigi = HcalDigiAlg("HcalDigiAlg")
HcalDigi.ReadOutName = "HcalBarrelCollection"
HcalDigi.SimCaloHitCollection = "HcalBarrelCollection"
HcalDigi.CaloHitCollection = "HCALBarrel"
HcalDigi.CaloAssociationCollection = "HCALBarrelAssoCol"
HcalDigi.CaloMCPAssociationCollection = "HCALBarrelParticleAssoCol"
HcalDigi.SkipEvt = 0
HcalDigi.Seed = 2079
#Digitalization parameters
HcalDigi.MIPResponse = 0.007126  # MeV / MIP
HcalDigi.MIPThreshold = 0.1    # Unit: MIP
HcalDigi.CalibrHCAL = 1.
HcalDigi.UseRealisticDigi = 1    # Flag to use digitization model.
HcalDigi.SiPMPixel = 57600       # 57600 for 6025PE (6*6 mm, 25 um pi
HcalDigi.TileNonUniformity = 0.0
HcalDigi.EffAttenLength = 1e7
HcalDigi.ADCError = 0.0
HcalDigi.MIPADCMean = 80.*30.0   # Light yield 80 pe/mip
HcalDigi.PeADCMean = 30.0
HcalDigi.PeADCSigma = 0.
HcalDigi.ADCBaselineHG = 0
HcalDigi.ADCBaselineSigmaHG = 0.
HcalDigi.ADCBaselineLG = 0
HcalDigi.ADCBaselineSigmaLG = 0.
HcalDigi.ADCHLRatio = 1
HcalDigi.ADCSwitch = 1e7
HcalDigi.ADCLimit = 1e7
HcalDigi.WriteNtuple = 0
HcalDigi.OutFileName = "Digi_HCAL.root"
```

Summary and Next Step

- Estimated time for sample production: 100s per event for LLP signal
- Future study:
  - Add digitization step for muons
  - Examine the experimental sensitivity of LLP search, compare to previous results with cepc_v4 setup