



CEPCSW Analysis Tutorial

Kaili Zhang

zhangkl@ihep.ac.cn

- We assume you are familiar with:
 - Linux, git, ssh
 - C++/Python
 - ROOT

Get access to IHEP Cluster



Windows: WSL, vscode, putty, mingw, Mobaxterm.....

Linux/Mac: your terminal

ssh -XY provides X11 forwarding.
(mobaxterm for windows)

- ssh youraccount@lxlogin.ac.cn

- export PATH=/cvmfs/container.ihep.ac.cn/bin:\$PATH

- hep_container shell CentOS7 -g higgs

Request sub-linux group higgs if you need!

- You will see:

```
Singularity>
```

You can source your bashrc in the container to get your setting back.

For hepjob,
export PATH=/cvmfs/common.ihep.ac.cn/software/hepjob/bin:\$PATH

- If you do not need any changes for CEPCSW, use the official release:
 - In CENTOS7 container:
 - `source /cvmfs/cepcsw.ihep.ac.cn/prototype/releases/tdr24.10.0/CEPCSW/setup.sh`
 - `cd /cvmfs/cepcsw.ihep.ac.cn/prototype/releases/tdr24.10.0/CEPCSW/`
 - `./run.sh Examples/options/helloalg.py`

```
Singularity> ./run.sh Examples/options/helloalg.py
# setting LC_ALL to "C"
# --> Including file '/cvmfs/cepcsw.ihep.ac.cn/prototype/releases/tdr24.10.0/CEPCSW/Examples/options/helloalg.py'
# <-- End of file '/cvmfs/cepcsw.ihep.ac.cn/prototype/releases/tdr24.10.0/CEPCSW/Examples/options/helloalg.py'
ApplicationMgr      SUCCESS
=====
                                     Welcome to ApplicationMgr (GaudiCoreSvc v36r16)
                                     running on lxlogin003.ihep.ac.cn on Sat Oct 26 14:52:13 2024
=====
ApplicationMgr      INFO Application Manager Configured successfully
helloAlg           INFO MyInt: 42
EventLoopMgr       WARNING Unable to locate service "EventSelector"
EventLoopMgr       WARNING No events will be processed from external input.
ApplicationMgr      INFO Application Manager Initialized successfully
ApplicationMgr      INFO Application Manager Started successfully
ApplicationMgr      INFO Application Manager Stopped successfully
EventLoopMgr       INFO Histograms converted successfully according to request.
ApplicationMgr      INFO Application Manager Finalized successfully
ApplicationMgr      INFO Application Manager Terminated successfully
```

you /afs only 500M. Maybe in /cefs/higgs/your directory.

- If you would like maintain your own fork:

- Login <https://code.ihep.ac.cn>
- Manage your own ssh key

- Fork

<https://code.ihep.ac.cn/cepc/CEPCSW>

- git clone

`git@code.ihep.ac.cn:you/CEPCSW.git`

- git clone <https://code.ihep.ac.cn/cepc/CEPCSW.git>

- `cd CEPCSW`
- `git checkout tdr24.10.0`
- `source setup.sh`
- `./build.sh`
- `source setup.sh`
- `./run.sh Examples/options/helloalg.py`

If build error, try to use other nodes. (close vscode remote ssh?)

Your second process



Make sure you are in CENTOS7
container with CEPCSW tdr24.10.0.

- copy scripts in `Reconstruction/RecPFACyber/script/` to your working dir.
 - Run them one by one
 - `./run.sh sim.py`
 - `./run.sh digi.py`
 - `./run.sh tracking.py`
 - `./runsh rec.py`

sim.py performs GEANT4 full simulation.
use stdhep file as input.

Calo Digitalization

Get "CompleteTracks" from tracking.py

After reconstruction, finally, you get
`RecAnaTuple_TDR_o1_v01_mu.root`
and
`Rec_TDR_o1_v01.root`

Scripts you may modify:

- Sim.py stdheprdr.Input =

“/cefs/data/stdhep/CEPC240/higgs/update_from_LiangHao_1M/data/E240.Pnnh_gg.e0.p0.whizard195/nnh_gg.e0.p0.00001.stdhep”

Found other samples in data dirs.

- rec.py out.filename = "Rec_TDR_o1_v01.root"

- rec.py EvtMax=10

Do not run too much events in front end.

Optional: Generator input

- Generator and CEPCSW are decoupled.
 - You can use either stdhep/HepMC/Hepevt/slcio/ParticleGun as input.
 - Existing samples in `/cefs/data/stdhep/CEPC240/higgs/update_from_LiangHao_1M/data/`
- Normal users are not suggested to generate your own sample
 - Limited computing source and disk quota.
 - Most SM sample will be officially provided for CEPC240/360 with Whizard1.9.5.
 - For generating stdhep files, <https://code.ihep.ac.cn/zhangkl/whizardais>
 - Whizard1.9.5 with ISR. If you use MadGraph or other processes, validate them.

Optional: job submitting

- git clone https://code.ihep.ac.cn/zhangkl/cepcsw_tutorial.git
- cd `cepcsw_tutorial/scripts`
- See script for submitting jobs
 - Please only submit when you know what you are doing.
- Template `temp_output.py`
 - 1 script for 4 steps. Need maintain manually when CEPCSW update
 - 2 output files; one for complete files and one for analyzer only.
 - Jet clustering algo included.

```
unset PYTHONHOME
```

You may need this if `hep_sub` not correctly set;

```
-os CentOS7
```

You can submit CEPCSW jobs either in containers or not.

But you need to submit to CENTOS7 condor.

```
-g higgs
```

Can also be other groups like ATLAS.

```
-mem 6000
```

Memory setting. At least 4G needed.

Structure of outputs

- root -b Rec_TDR_o1_v01.root
- .ls
- events->Print()
- events->Show(0)

```
Warning in <TClass::Init>: no dictionary for class podio::ObjectID is available
Warning in <TClass::Init>: no dictionary for class edm4hep::Vector3f is available
Warning in <TClass::Init>: no dictionary for class edm4hep::Vector3d is available
Warning in <TClass::Init>: no dictionary for class edm4hep::MCParticleData is available
Warning in <TClass::Init>: no dictionary for class edm4hep::Vector2i is available
Warning in <TClass::Init>: no dictionary for class edm4hep::ReconstructedParticleData is available
Warning in <TClass::Init>: no dictionary for class podio::GenericParameters is available
Warning in <TClass::Init>: no dictionary for class podio::CollectionIDTable is available
Warning in <TClass::Init>: no dictionary for class podio::version::Version is available
(TFile *) 0x1cc8b30
```

This indicates that you are not in CEPCSW env.
However, you don't need it for ntuple reading.

Tree events are organized like normal ntuple.
You can play with it with your good old tools.

Analysis: Dimuon mass plot

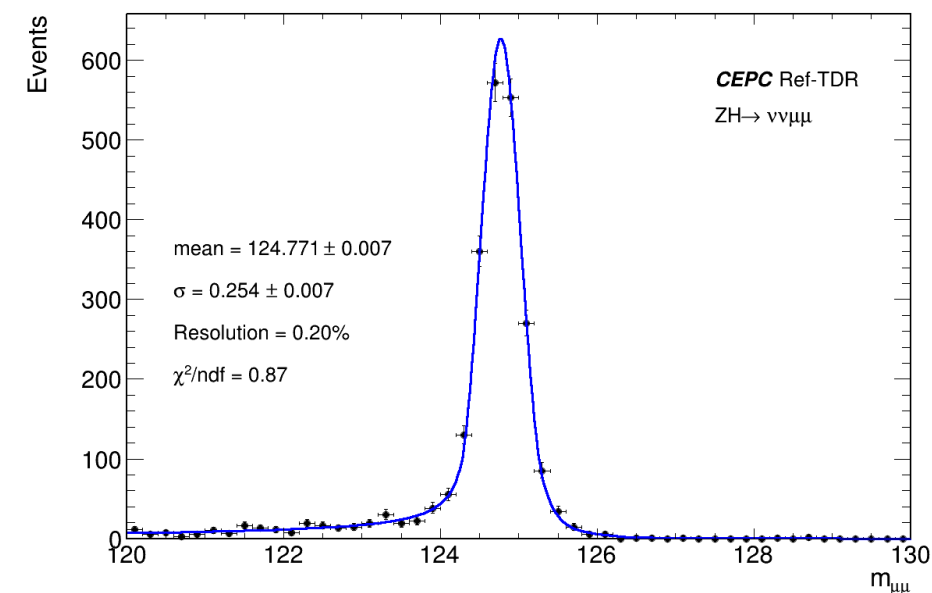


- `cd cepcsw_tutorial/analysis`
- `root -b`
- `.x HggTwoSidedCBPdf.cxx`
- `.x Reader_CEPCSW_mmGenmatch.cxx`

Analysis codes Highlights

- Simple way loading External RooFitPdf by .x
- CEPCStyle.h: Recommended to use in CEPC.
- TChain + TTreeReader(Array);
- CyberPFO for reco and MCParticleGen for truth info.
- Gen-Reco Match by DeltaR
- RooFit: DSCB Fit
- 1D/2D plotting, formatting

Please explore more after the tutorial.



Current constrains in tdr24.10.0



- In ATLAS/CMS, you drive. At CEPC, you build the wheels first.
- No Endcap Calo. Ready in one month?
 - Particle/Jets with $\cos\theta > 0.85$ not correct.
 - MET related variables not correct.
- No “Good” PID and Jets
 - Dimuon mass can be done due to the clean final states.
- Please join us for contribution.