technische universität dortmund

Fakultät Physik

UNIVERSITÉ Clermont Auvergne

LPC Particules pLasmas Univers applicationS

Laboratoire de Physique de Clermont

$B^0 \rightarrow \mu\mu$

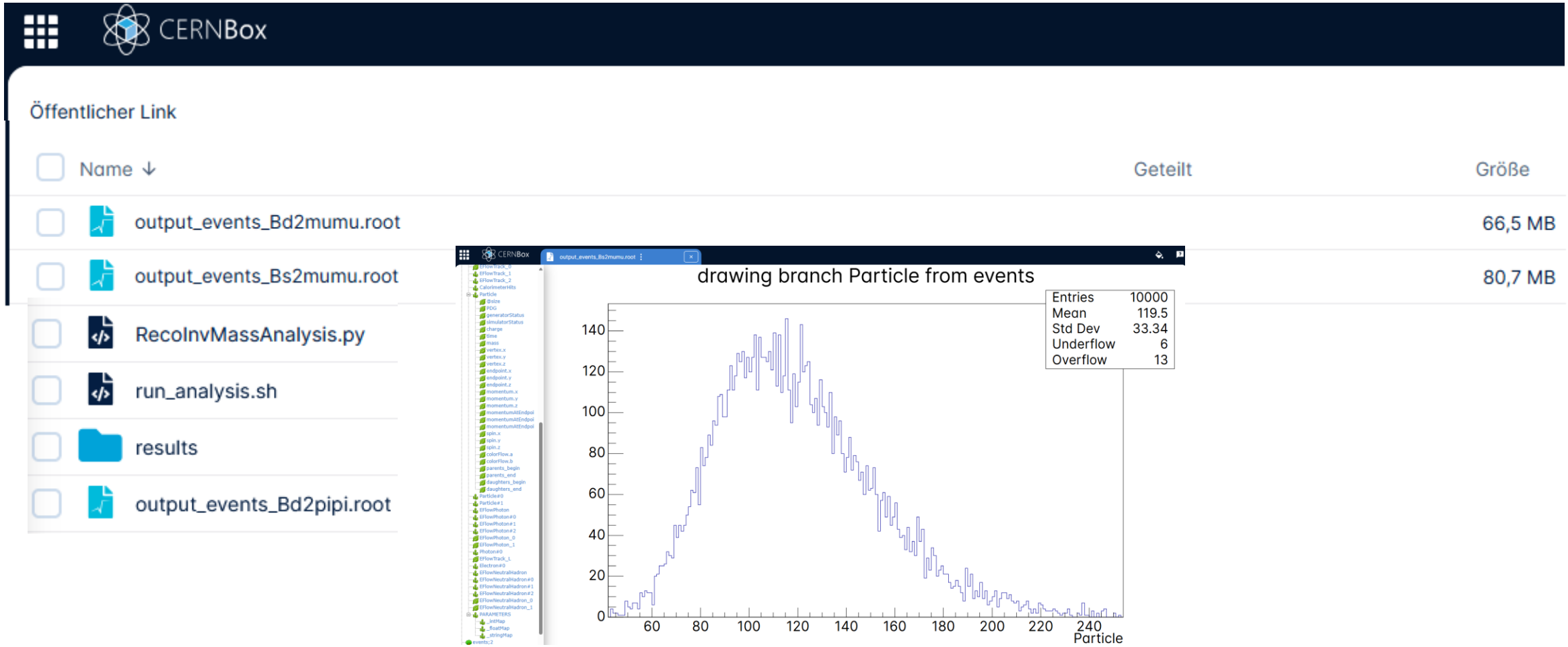
Willy Weber

(willy.weber@tu-dortmund.de)

(Study of electroweak observables in the heavy flavour sector at FCC-ee)

Link to the samples:

https://cernbox.cern.ch/files/link/public/VUEb99Hm6kWCNUq



Working with FCCAnalyses

https://github.com/HEP-FCC/FCCAnalyses

README

FCCAnalyses

DOI 10.5281/zenodo.13871482

Build and Test failing | Documentation passing

Common framework for FCC related analyses. This framework allows one to write full analysis, taking EDM4hep input ROOT files and producing the plots.

Quick Start

Running analysis script can be done using `fccanalysis` command which is shipped in Key4hep stack:

```
source /cvmfs/sw.hsf.org/key4hep/setup.sh
fccanalysis run analysis_script.py
```

FCC Tutorials

FUTURE CIRCULAR COLLIDER

Search docs

The FCC Tutorials

The FCC Tutorials

These are the lessons taught during the FCC Software Tutorials

```
#############################################################
# Cut the collection to only consider muons over 2.5 GeV
#############################################################
cut_value=2.5
dframe2 = (
    dframe2
    .Define("muons_e","ReconstructedParticle::get_e(muons)")
    .Redefine("muons", f"muons[muons_e>{cut_value}]")
)
```

First analysis with FCCAnalyses

I prepared a brief example of calculating the invariant mass of the muon pairs:

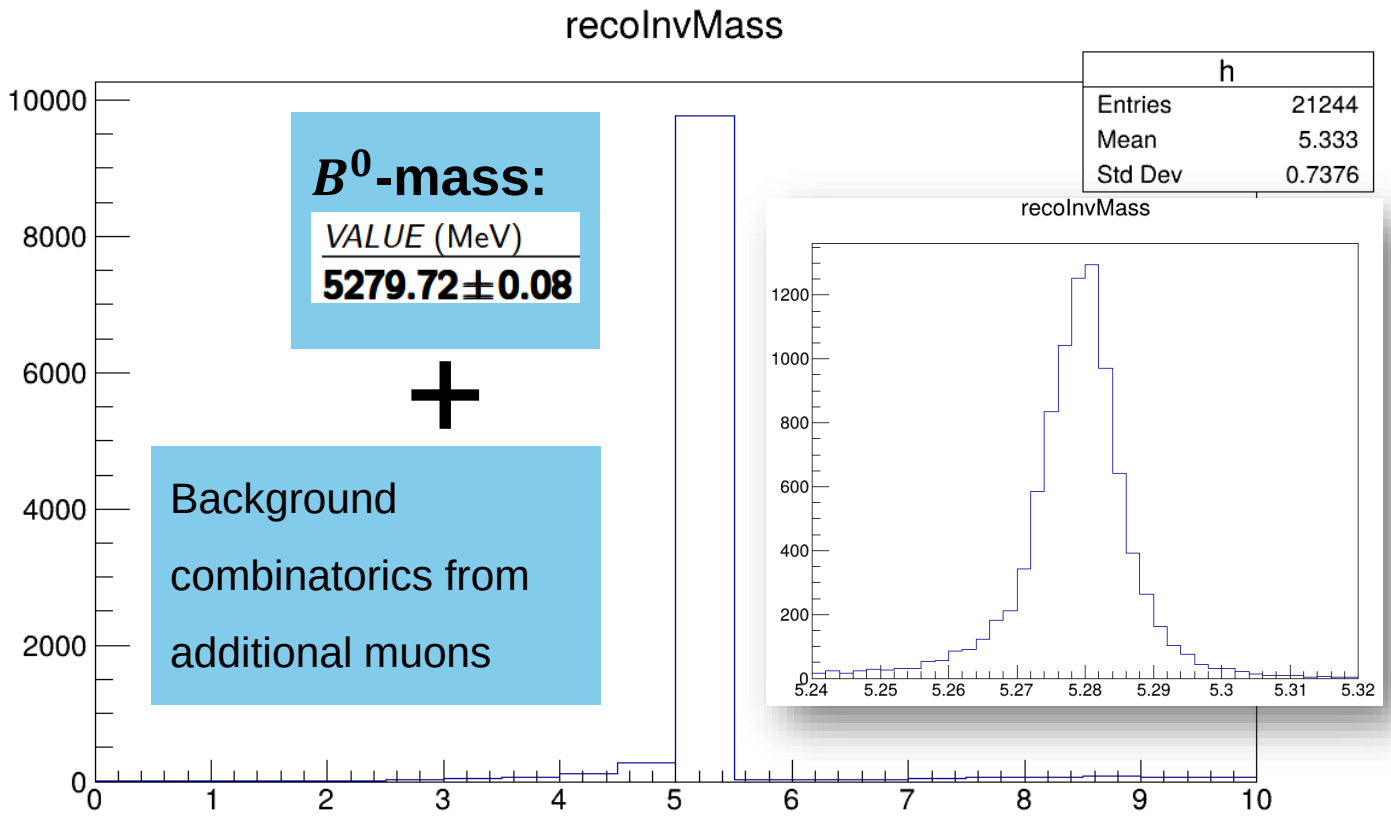
```
    dframe2 = (
        dframe2
        .Define("recoInvMass", "calculaterecoInvMass(muons)")
    )

    ##################################################################
    # Return final data frame at the end of the analysis
    ##################################################################
    return dframe2

##################################################################
# Mandatory: output function, return the branch list as a pyt
##################################################################
def output(self):
    """
    Output variables which will be saved to output root file.
    """
    branch_list = ["muons","recoInvMass"]

    return branch_list
```

```
events->Draw("recoInvMass>>h(20,0,10)","","")
```



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$$D^0 \rightarrow \pi^0\pi^0 \rightarrow 4\gamma$$

Study of electroweak observables in the heavy flavour sector at FCC-ee

Willy Weber

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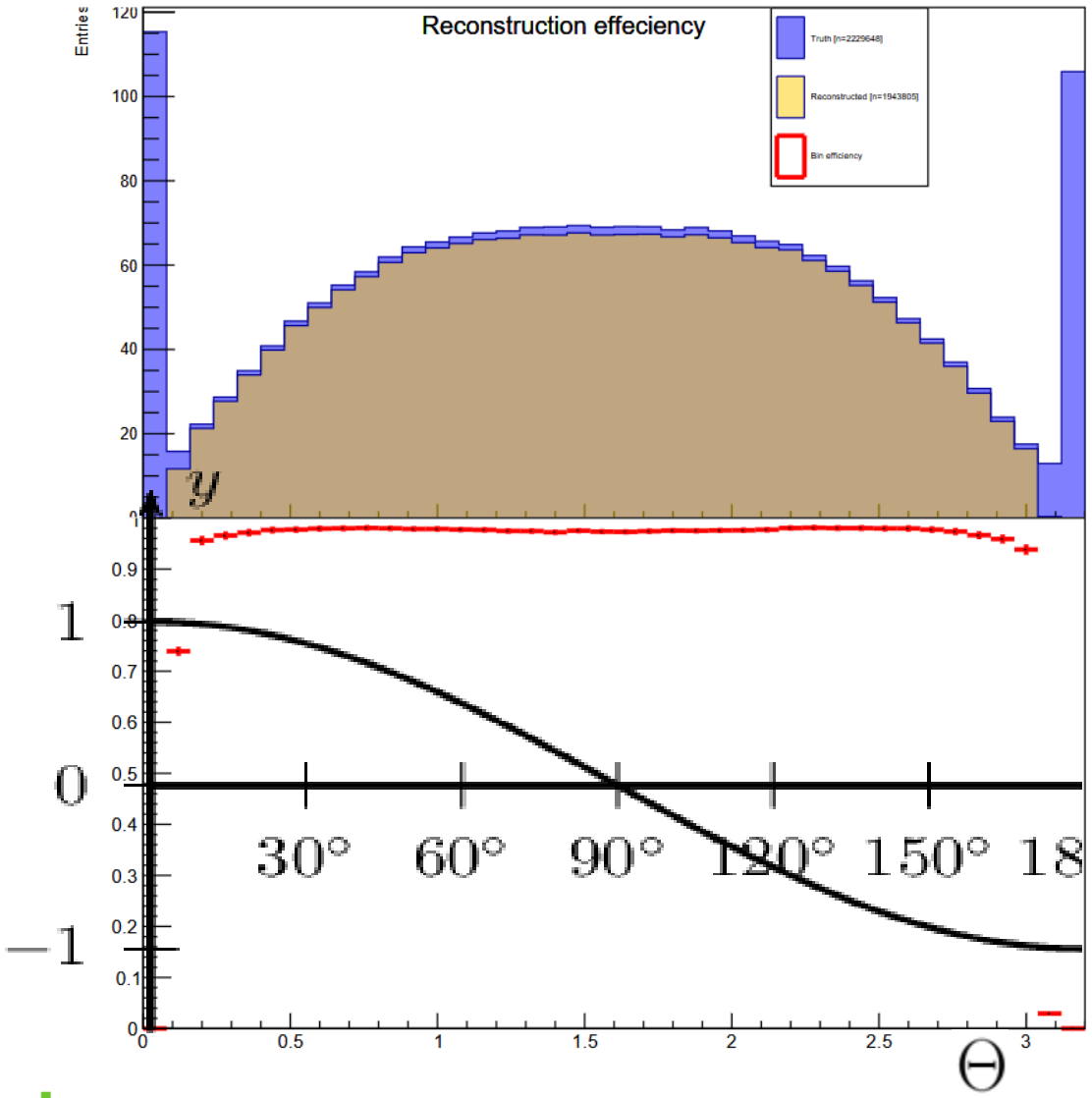
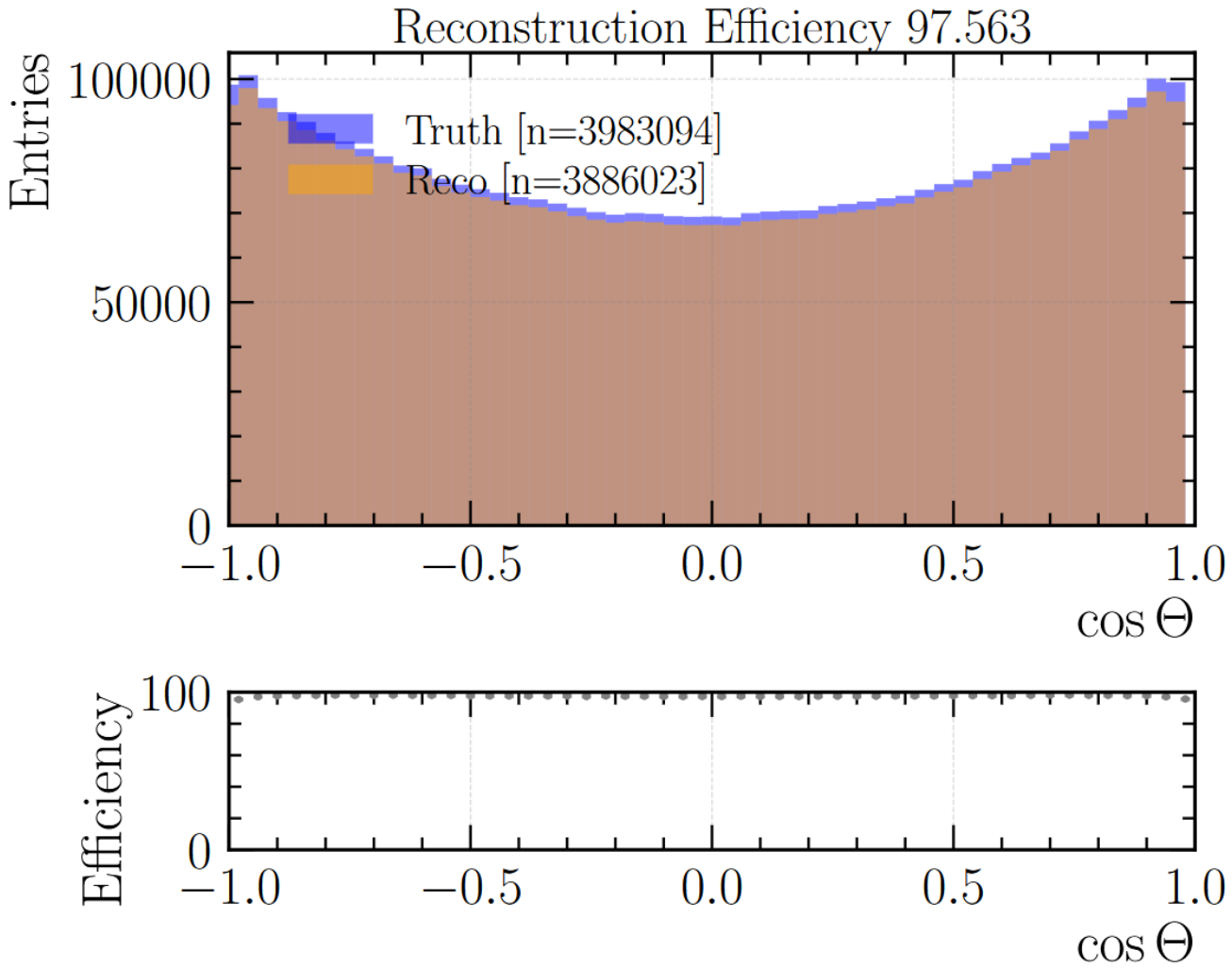
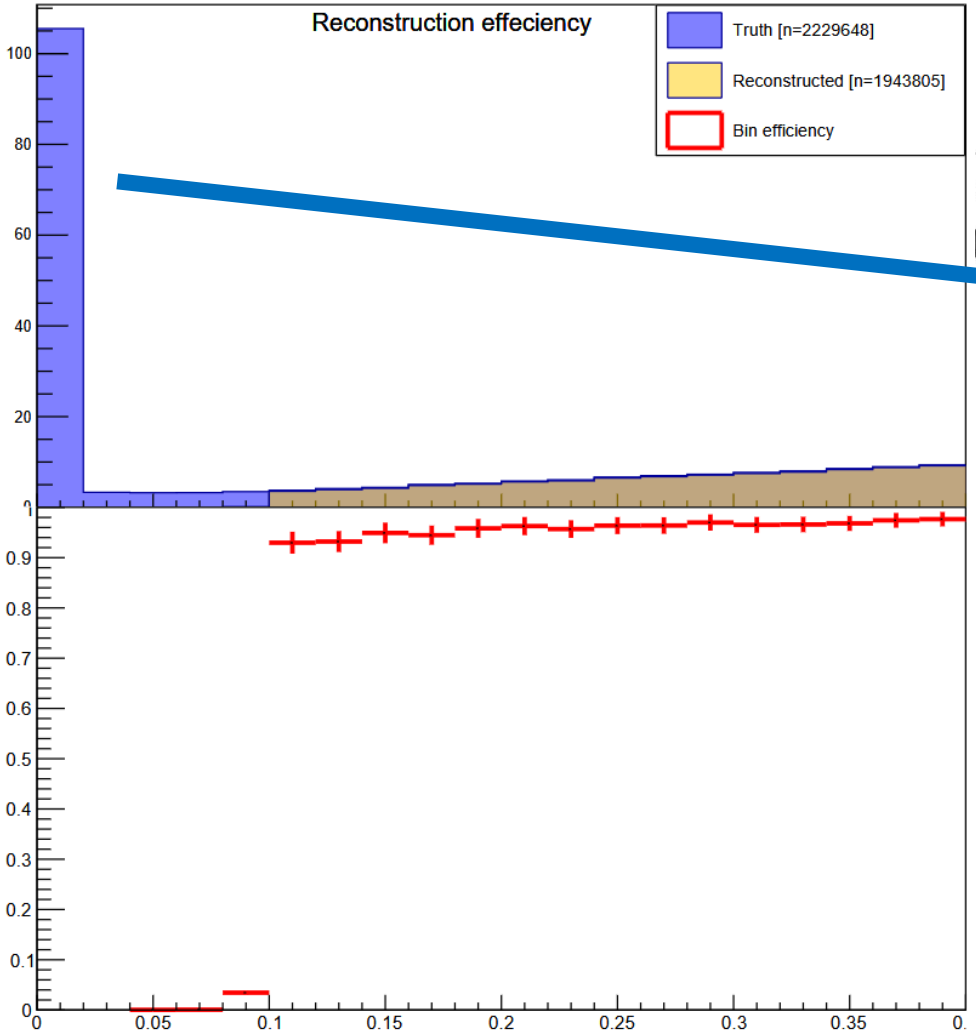
Reconstruction effeciency vs. photon angle

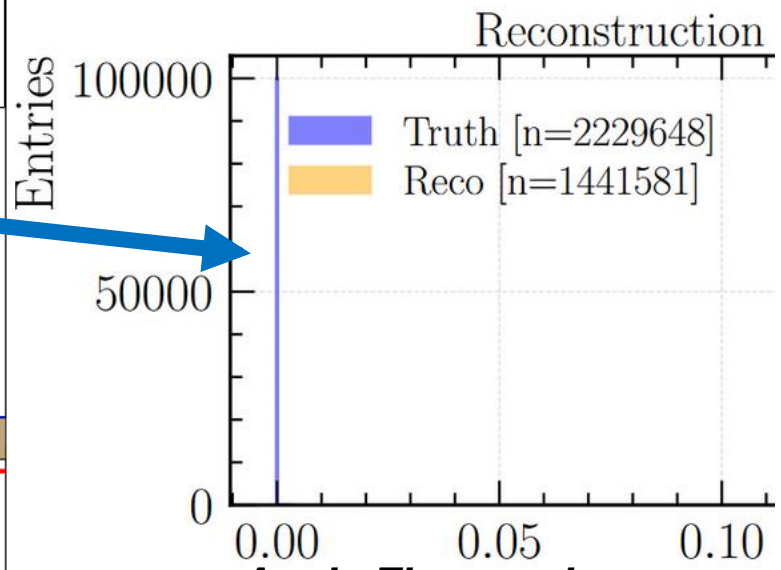




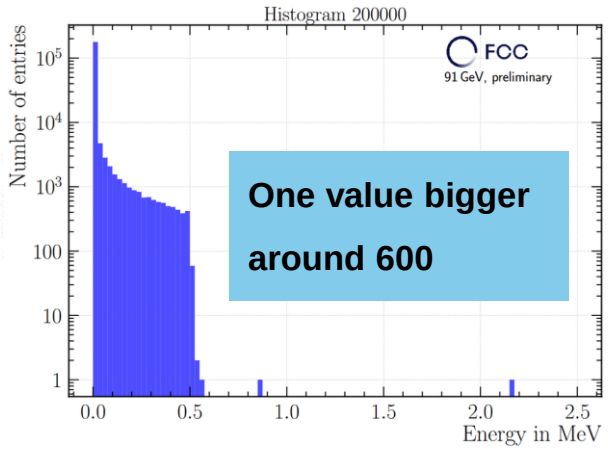
Reconstruction effeciency vs. photon angle



Angle Theta to beam

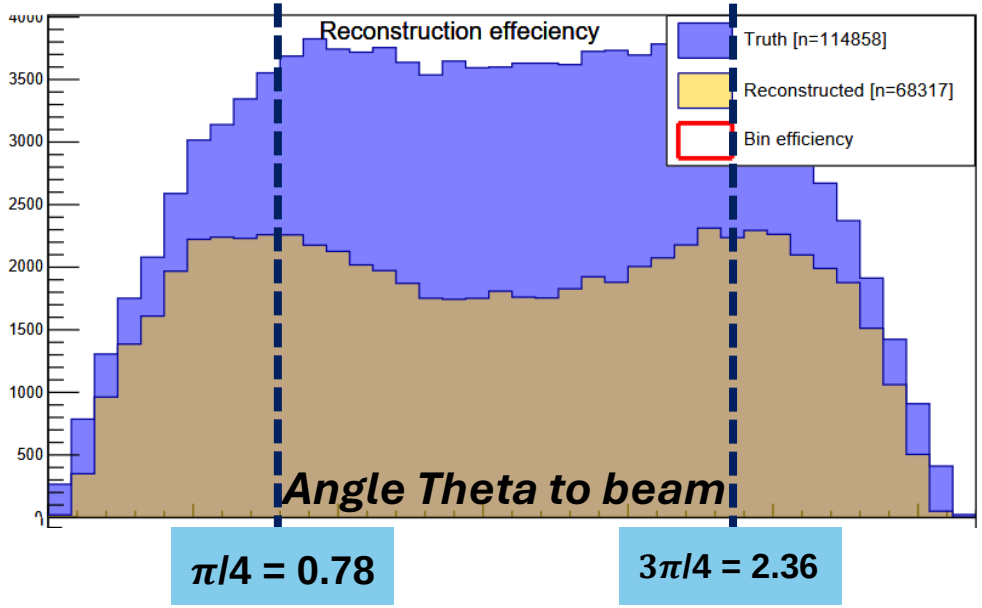


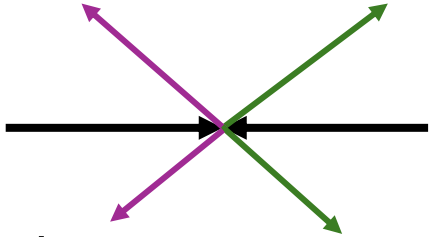
Angle Theta to beam



- 2 **“weird” low-energy photons** per Event
- One **exactly in** each **beam direction**
- **Origin** are **electron/positron**
- Just **removed**

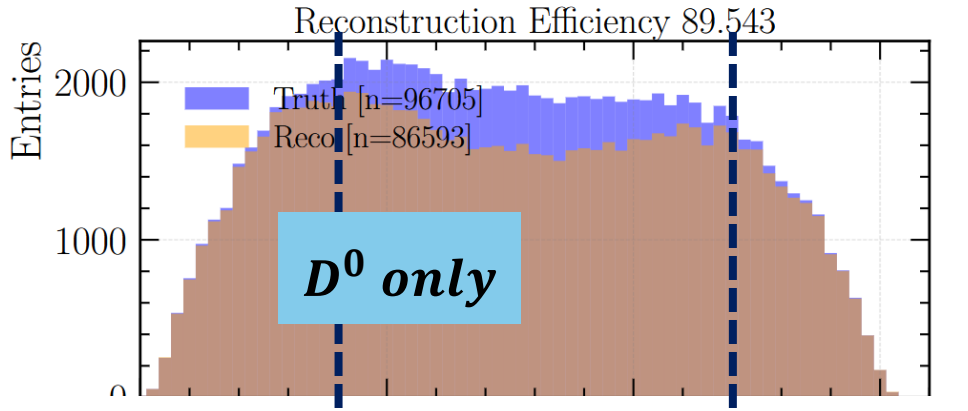
Consideration of the two local maxima:

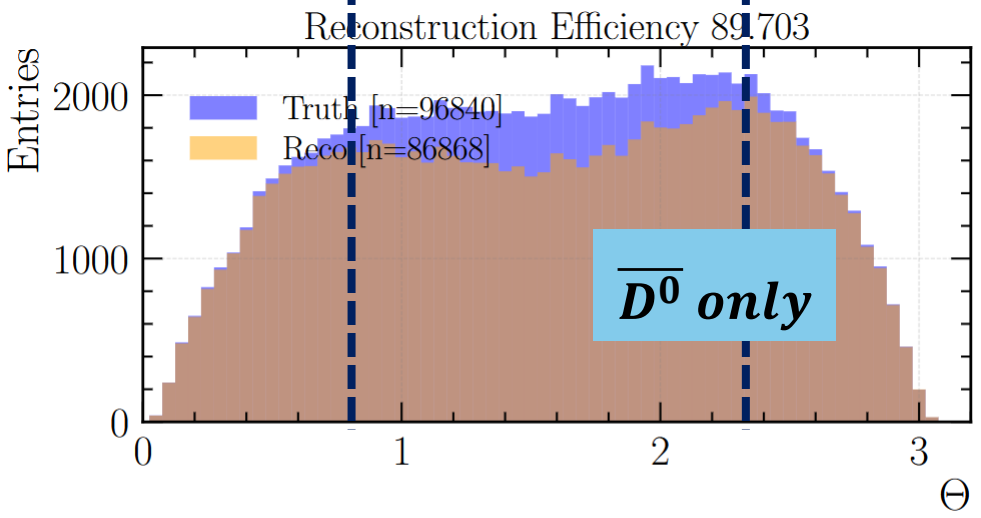


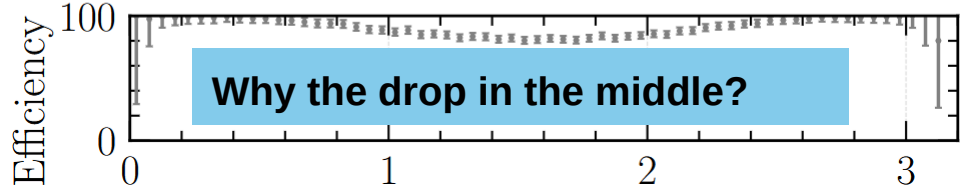


- **Two** local **maximums** at $\pi/4$ & $3\pi/4$
- D^0 fly **prefered** in $\pi/4$ direction
- $\overline{D^0}$ fly **prefered** in $3\pi/4$ direction

Why $\pi/4$?

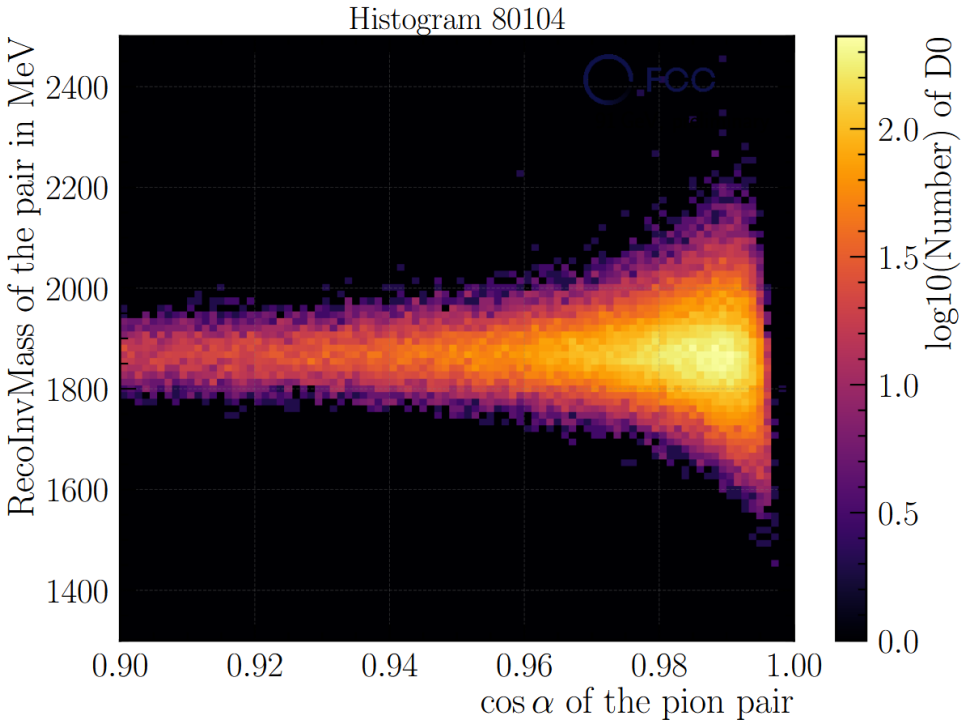


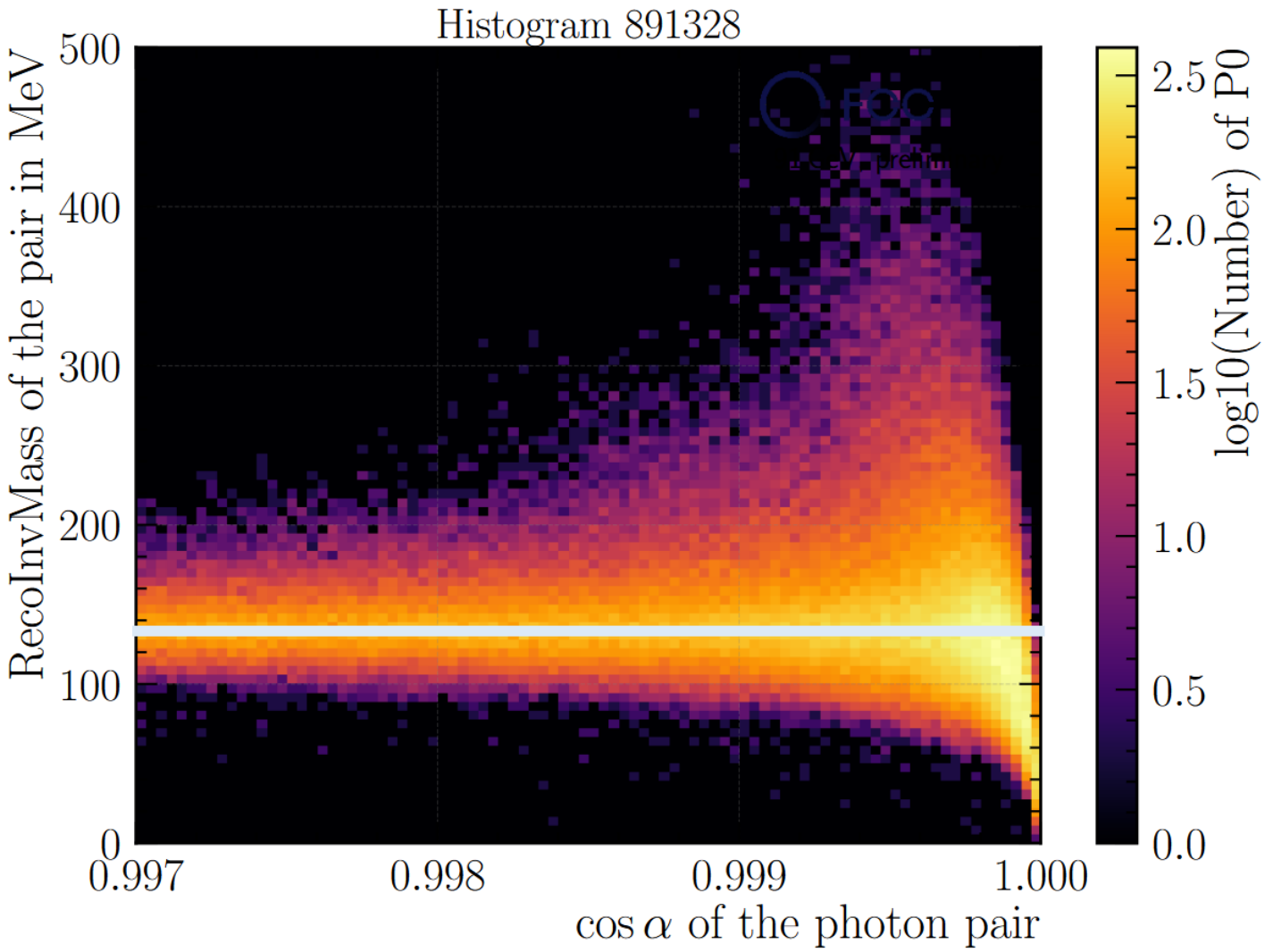




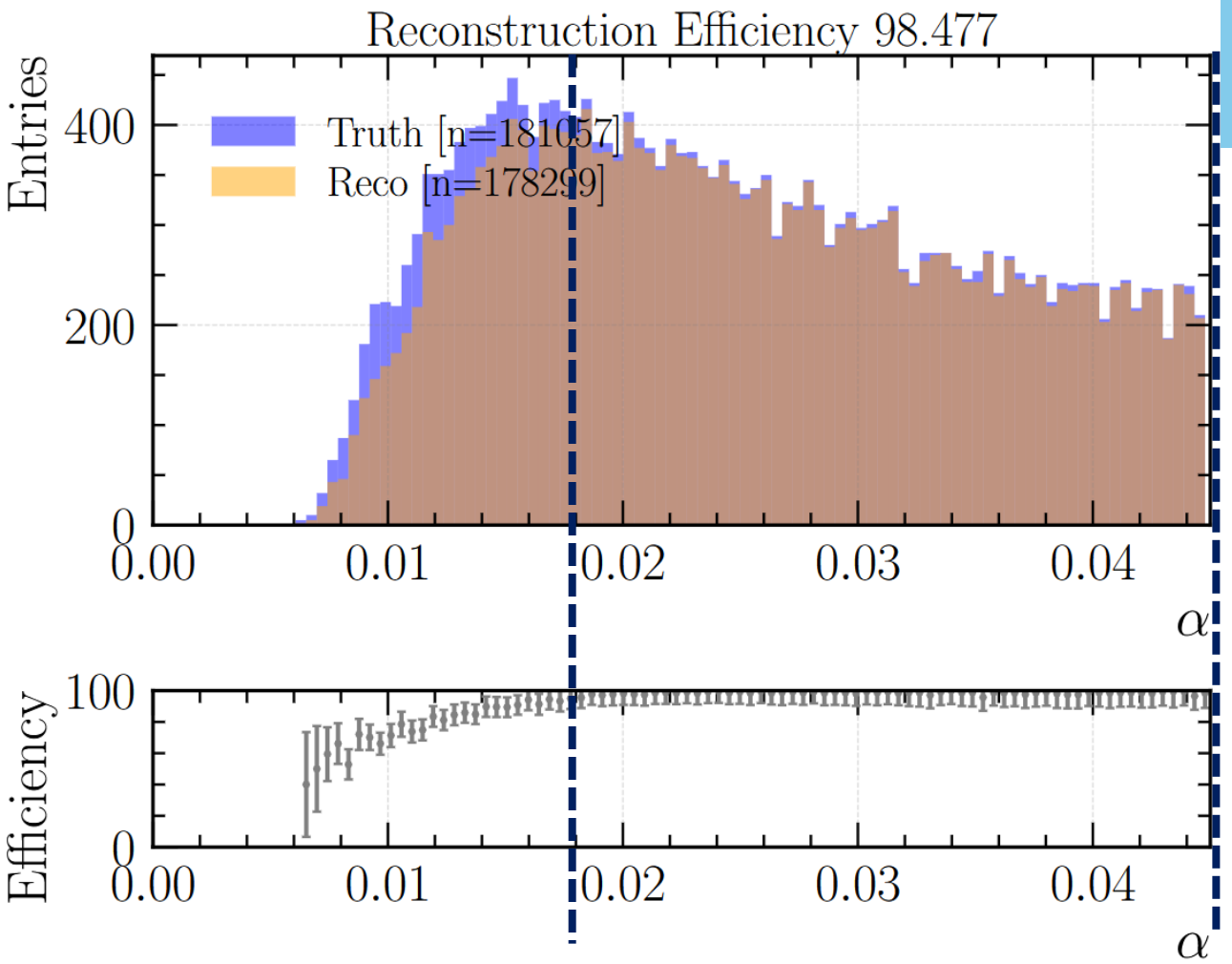
Resolution bad for small angle

- **Most π^0** have a **close angle**
  - Badly reconstructed inv. mass
- **Less problems** for D^0



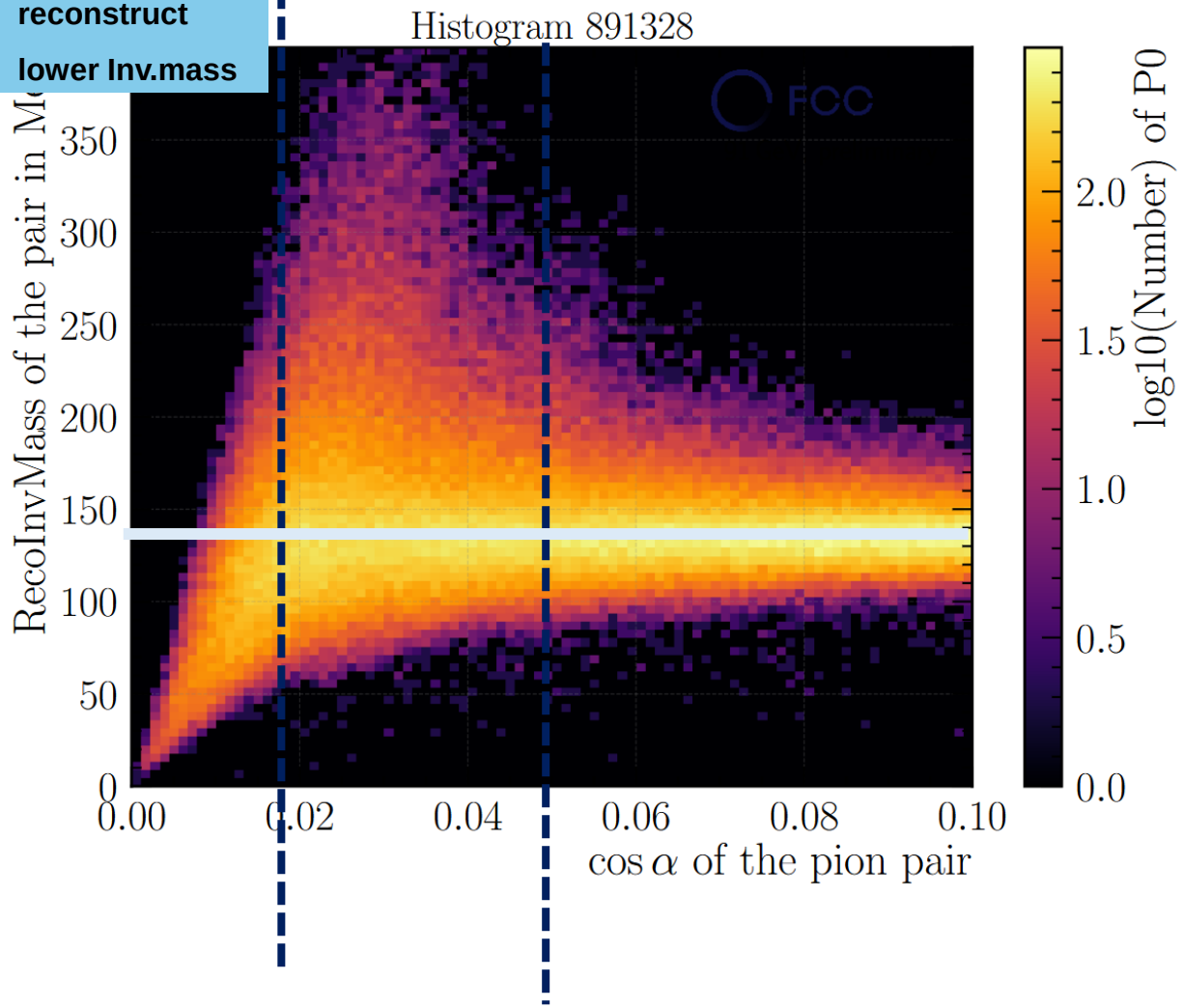


Pion-Reco effeciency



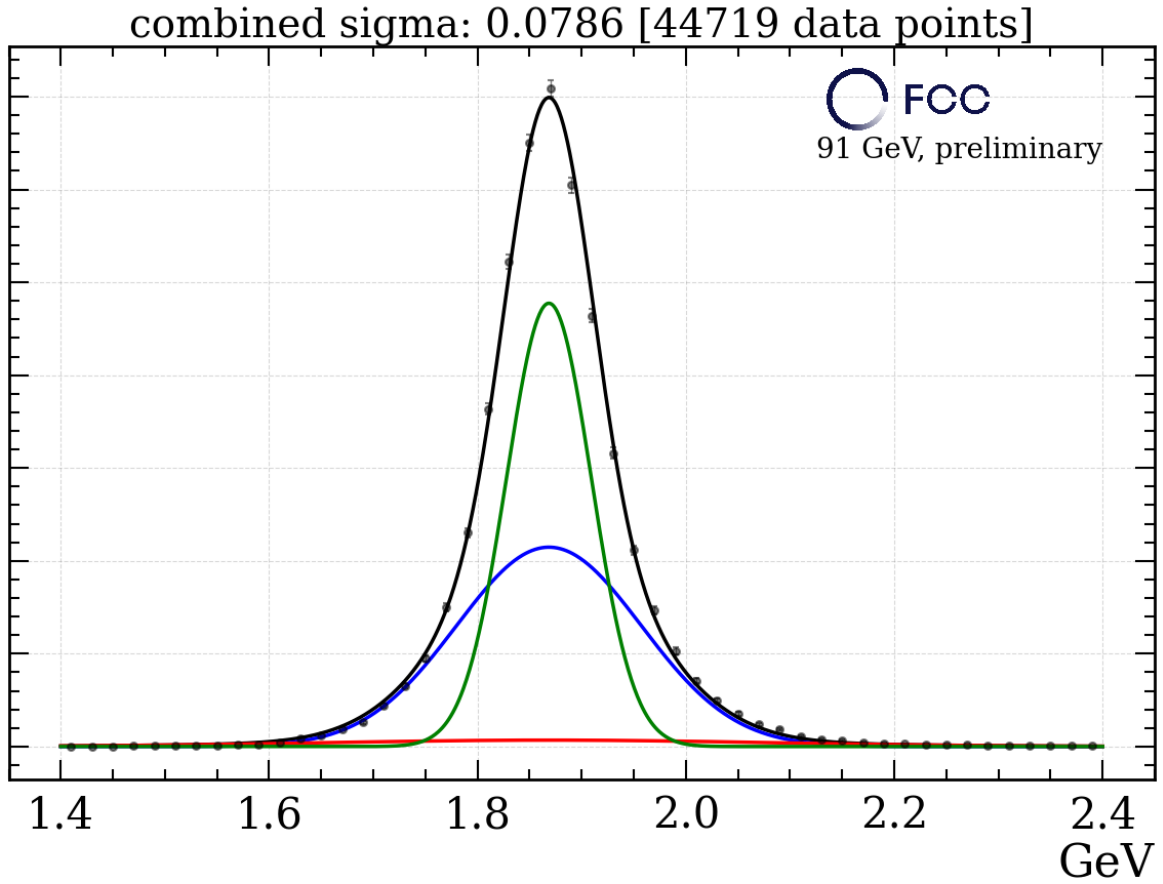
Tendence: reconstruct lower Inv.mass

Tendence: reconstruct higher Inv.Mass



Triple-Gaussian-Fit

- **Lars used** in his thesis a **triple Gaussian** fit
- It seems that a **double gaussian** already matches the distribution
- May future cuts make the triple gaussian necessary



Thanks for listening ☺