Introduction to FCC Software

FCC Istanbul
11 March, 2016

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on behalf of / with thanks to the
FCC software group

Talk Outline

- Aims/approach of FCC software (FCCSW)
- FCC software components
- Examples of what can be done now
- Getting going, getting involved...

Aims/approach of FCC Software

Aims:

Make it easy/fast to do good physics studies

Make collaboration straightforward

Challenges:

Support wide range of studies:-

physics analyses, detailed detector design

hh and ee studies

Flexible enough to adapt to the future

Aims/approach of FCC Software

Approach:

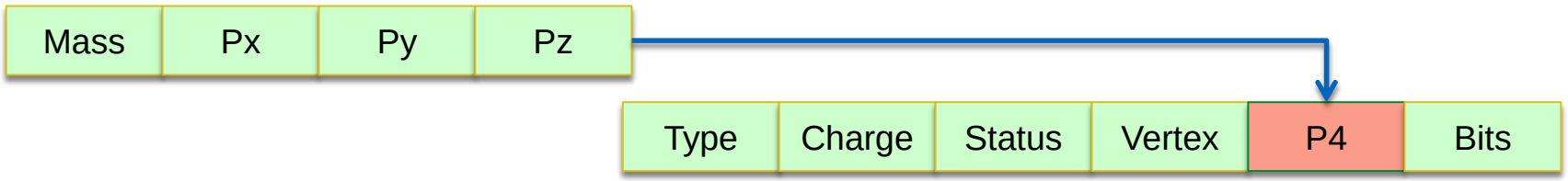
- fast/modern data structures
- modular software frameworks
- reuse/adapt existing software
- integrate fast and full simulation
- create new reconstruction algorithms

FCC Software Components

Fast/Modern Data Structures:

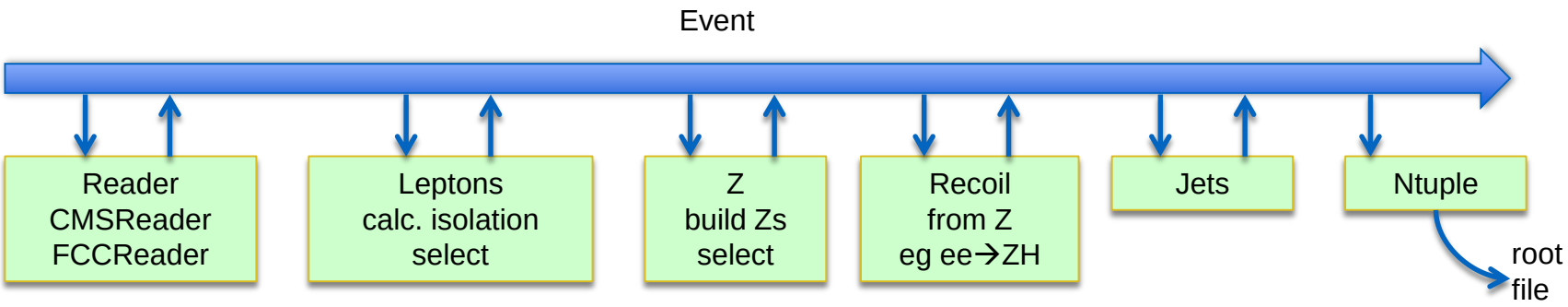
FCC Event Data Model (EDM) ready

- simple data structures
  particles, jets, vertices, …
- allows parallel processing
- efficient storage
- used to read/ write/ process/ store FCC Events
- tool (PODIO) can be used to create EDMs in other experiments



FCC Software Components

Modular Software Frameworks:



- support interchangeability/ comparisons/ upgrades
- C++ : Gaudi (base of FCCSW, used also in LHCb and ATLAS)
- Python: Heppy (used with CMS) - great for prototyping, analysis etc
- both use a similar python configuration file
- the frameworks are experiment independent

FCC Software Components

- DD4HEP for detector description
  - FCC-hh underway
  - FCC-ee not yet started (reuse ILC/CLIC)

- Generators
  - Gaudi modules:
    - Pythia8, Alpgen, Herwig++ ready
    - many coming soon (GENSER)
  - Les Houches event reader (external madgraph)
  - Also standalone executables eg Pythia8

- Reconstruction
  - tracking underway (standalone extraction of ATLAS ATS)
  - calorimeters recently started
  - particle flow reconstruction (from CMS)

FCC Software Components

Integration of Fast/Full Simulation:

- Gaudi module
- full simulation framework ready (Geant4) - detector models needed
- fast simulation algorithms to be integrated:

  eg ATLAS fastsim
  CMS fastsim
  Papas
  Delphes

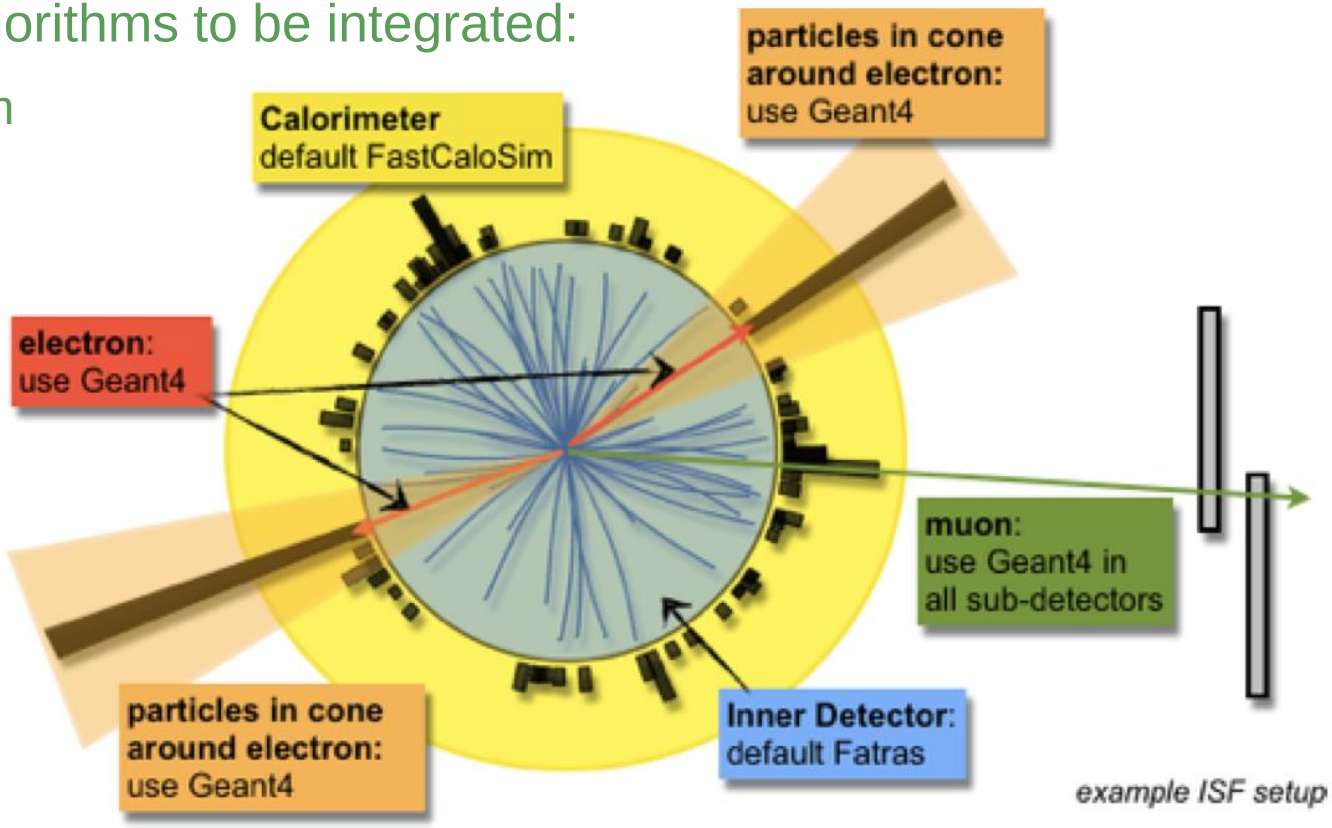
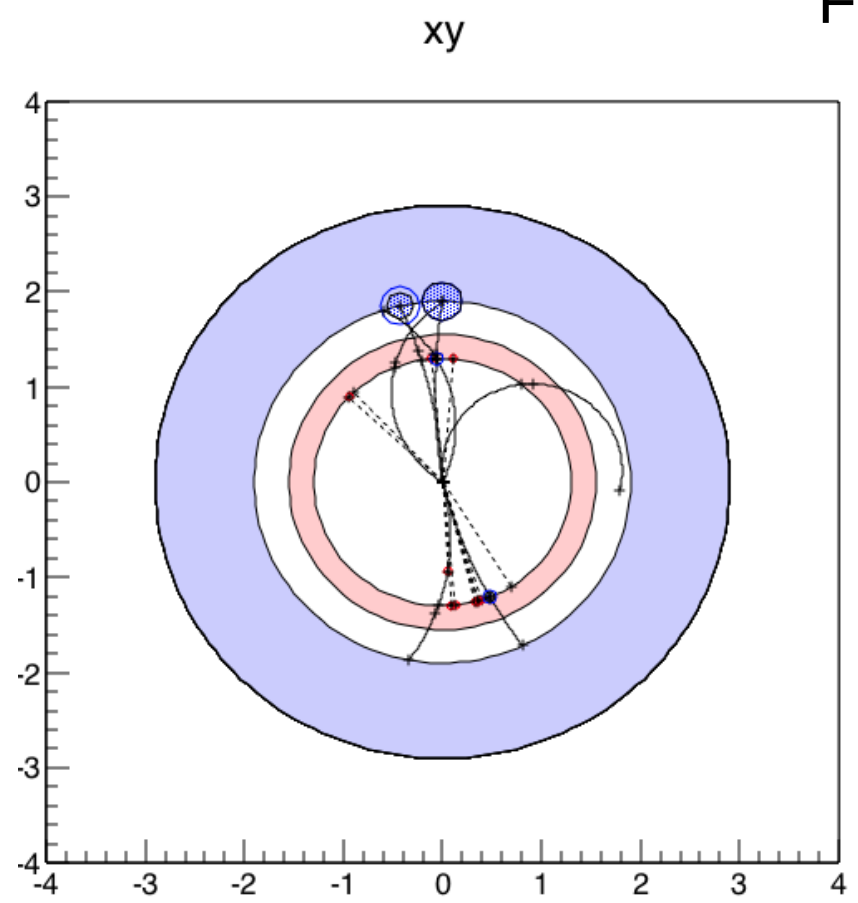


Image : E.Ritsch

ATLAS approach

FCC Software Components

Fast simulation/reconstruction: Papas



Simulation of particles

- gives clusters and tracks

Particle flow algorithm prototype

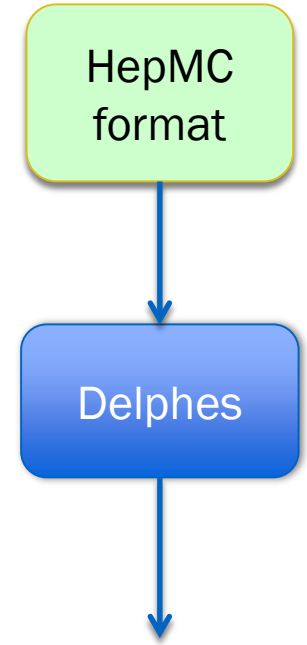
- takes clusters and tracks
- ‘reconstructs’ particles
- scope to quickly develop particle-based algorithms
  e.g. tau ID, b tagging, analysis

Python prototype ready

C++ Papas prototype under construction

FCC Software Components

Fast simulation/reconstruction : Delphes

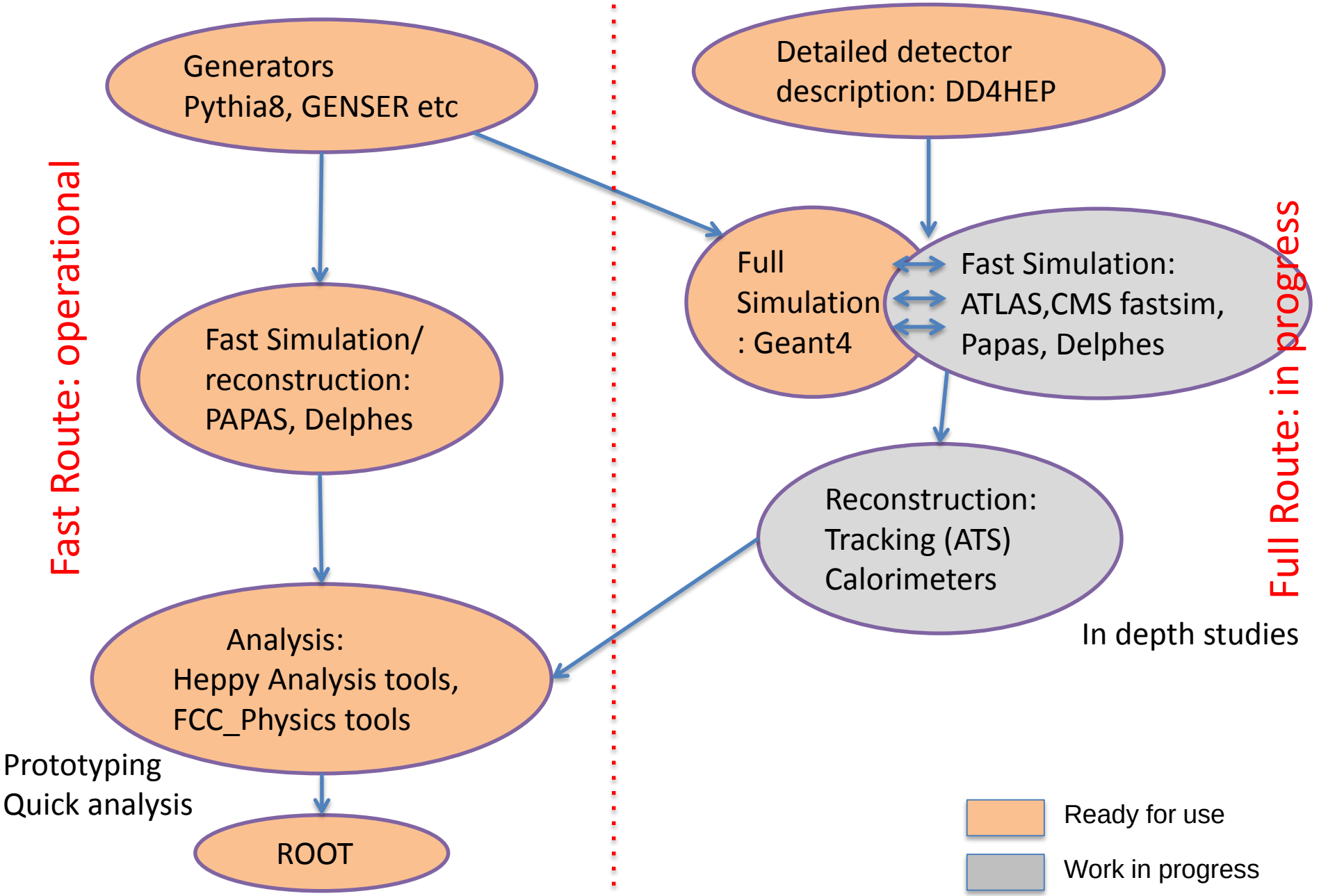


Particles
MET
Jets
b&tau tag info

Delphes integrated into FCCSW

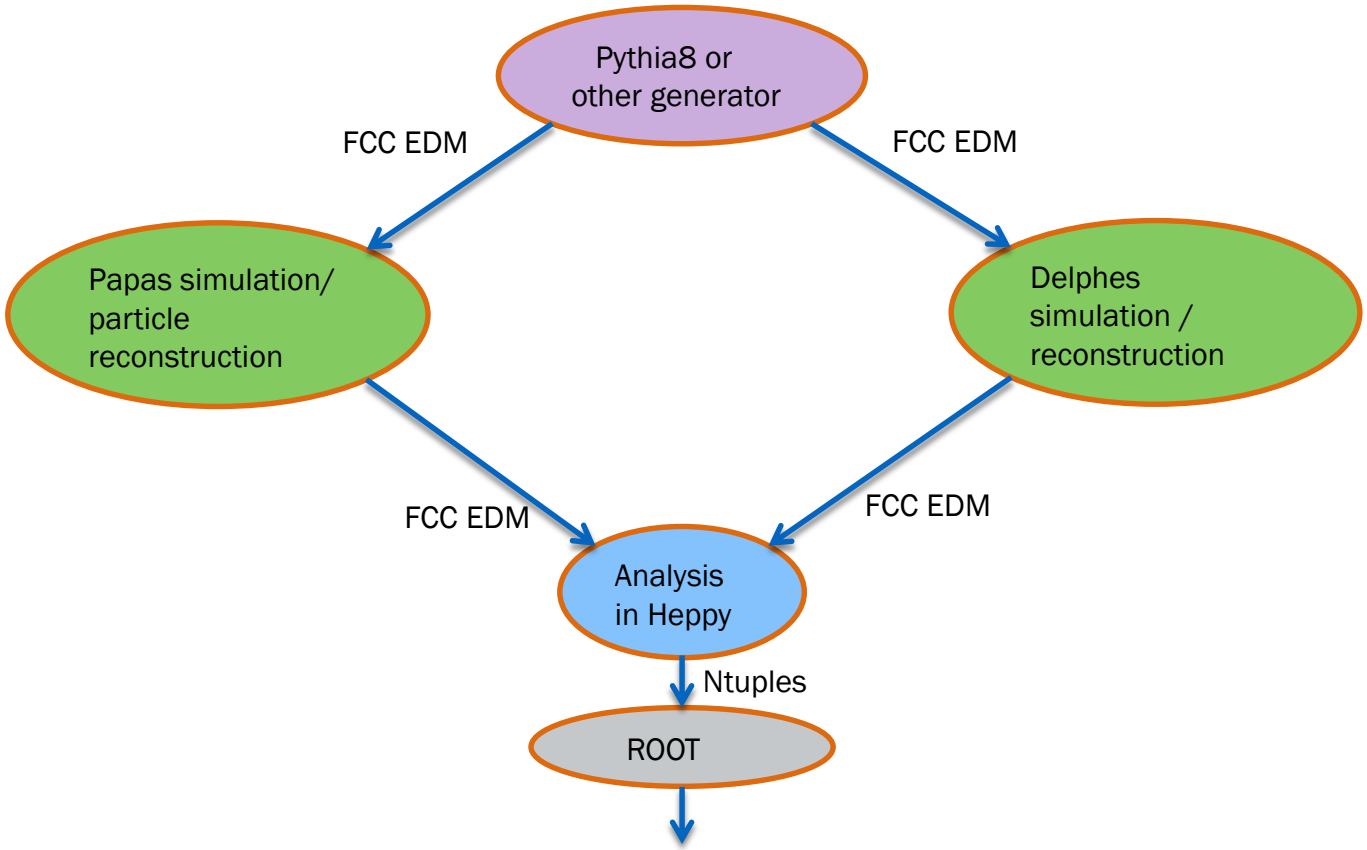
- reads HEPMC events
- runs as Gaudi module
- cards ready for
  - FCC-hh
  - CLIC card (FCC-ee)
  - ILD

FCC Software Components: status



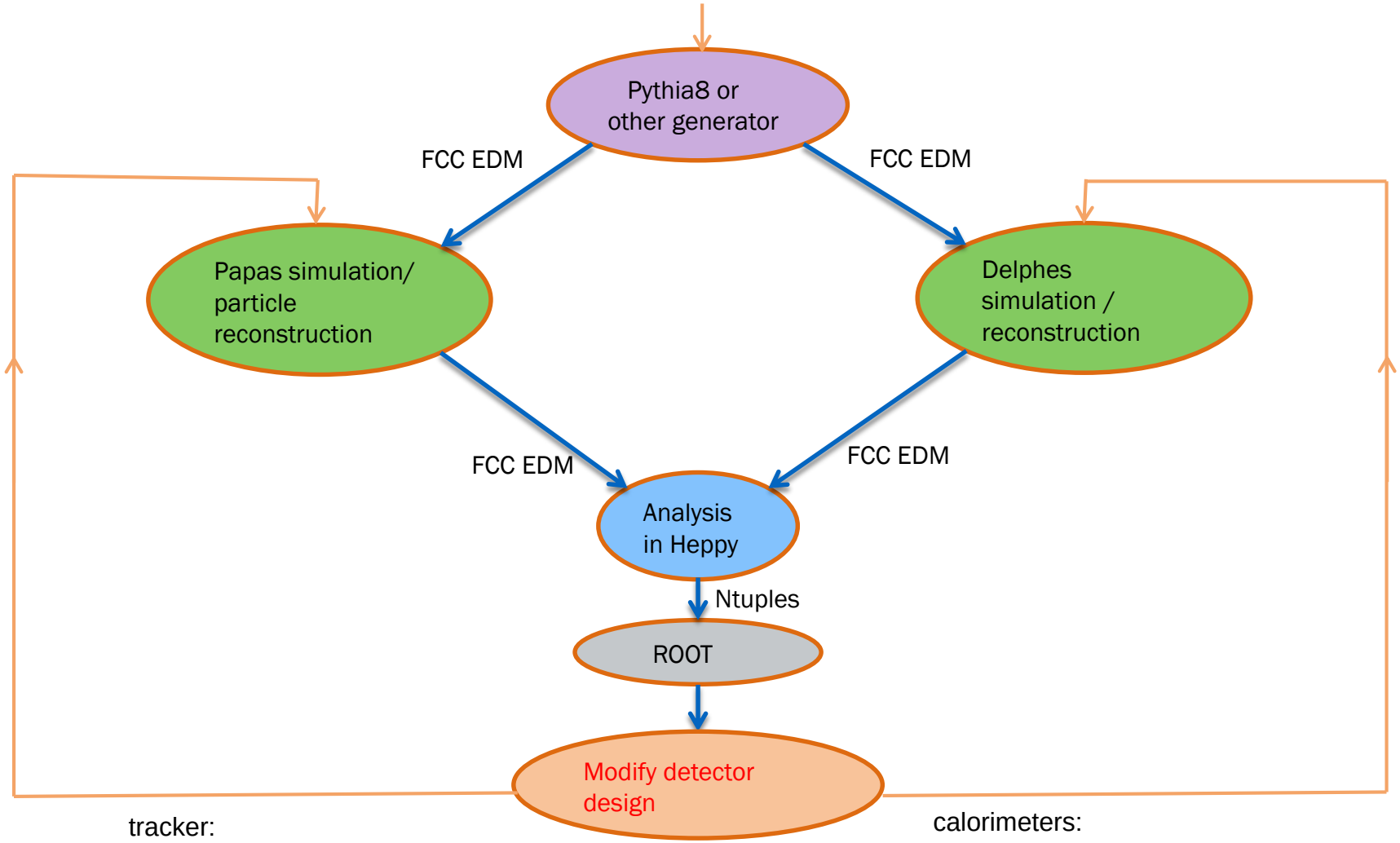
What a user can do now

Parameterised Fast Simulation

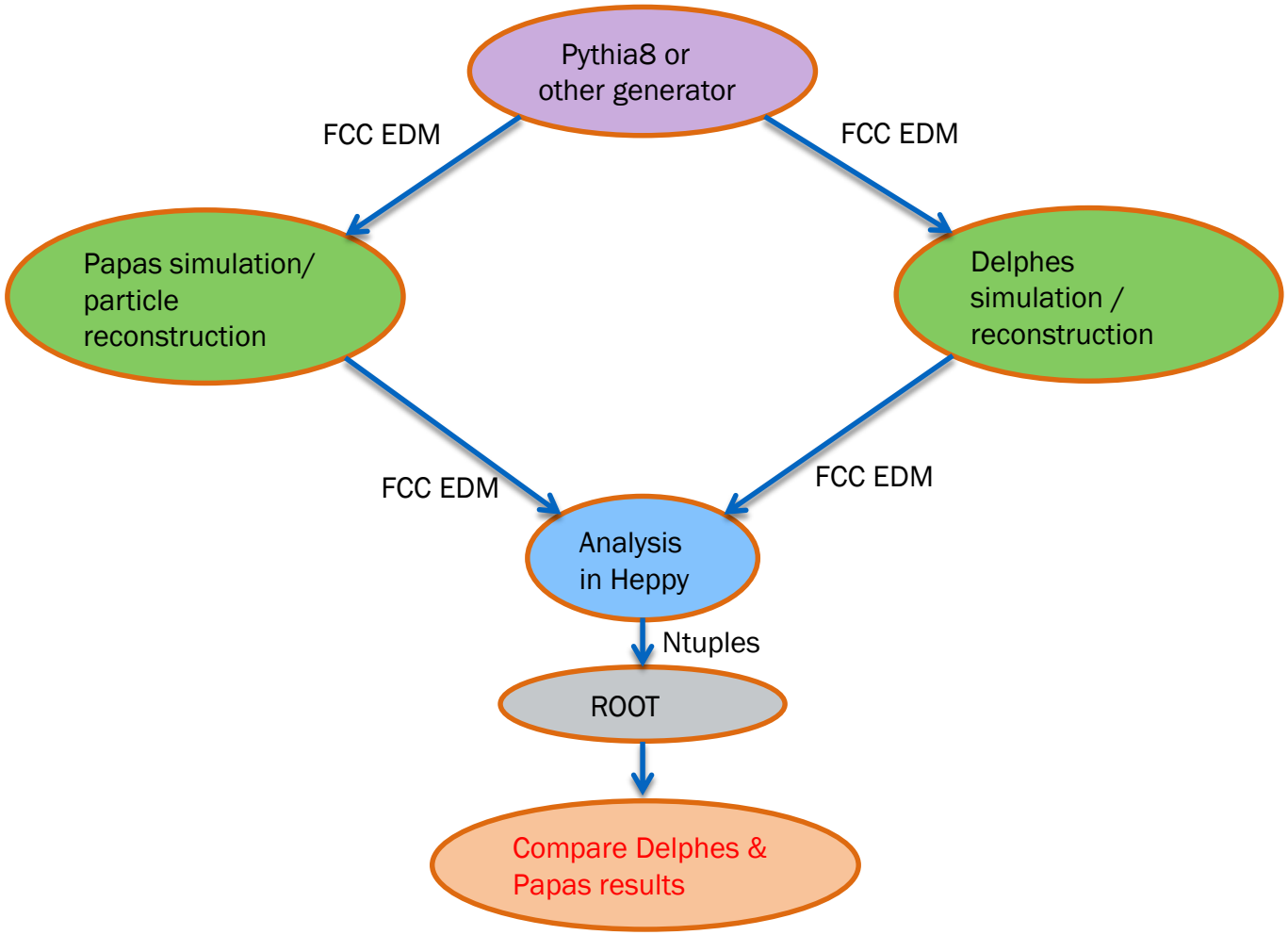


e.g. generate and analyse ZZ and ZH events or ttbar etc

Parameterised Fast Simulation: testing detector design

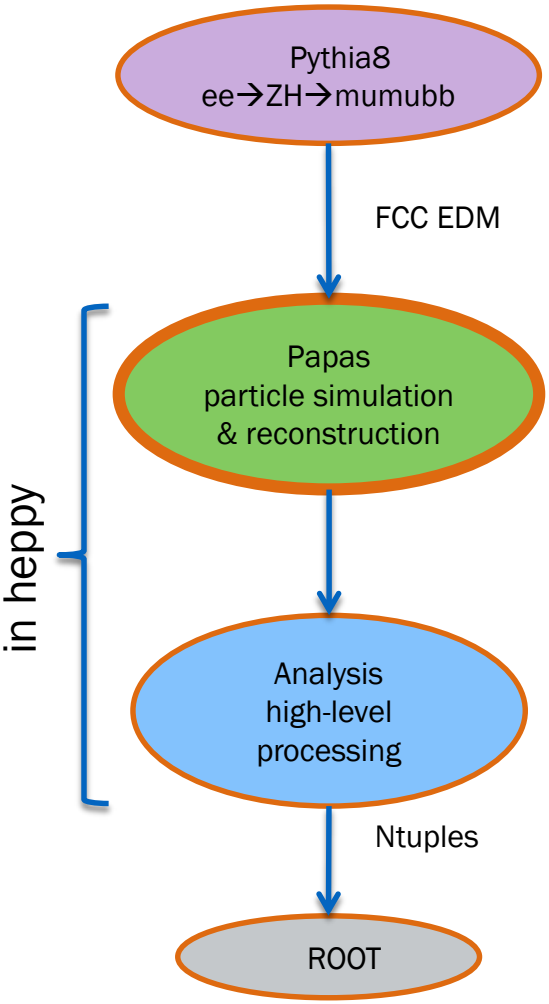


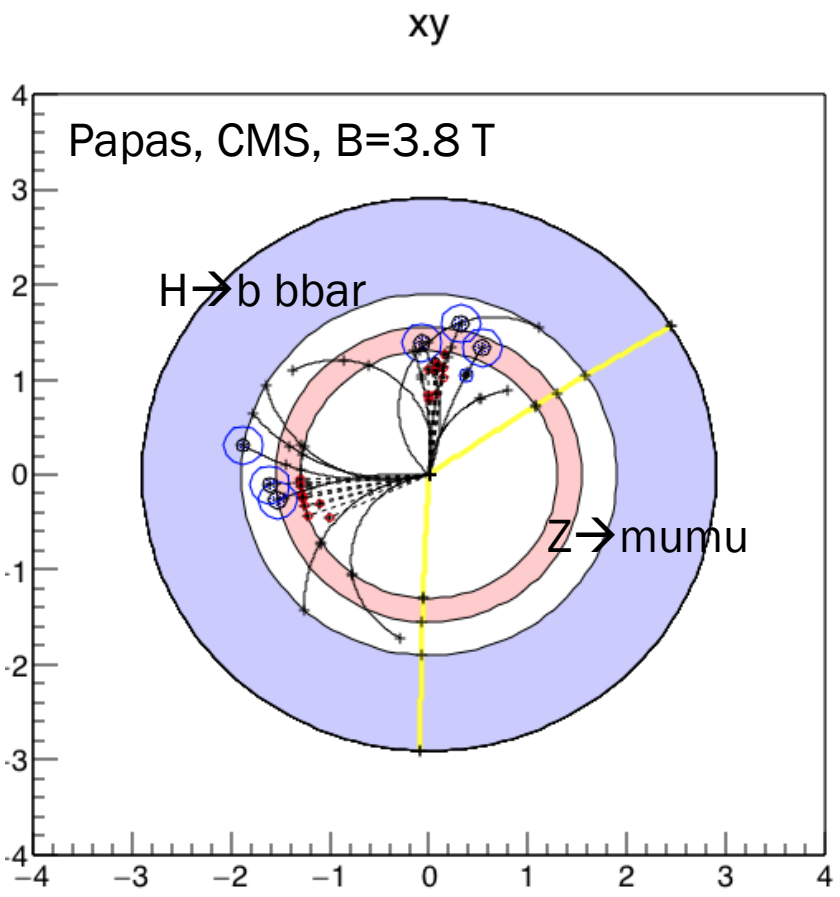
Parameterised Fast Simulation: Method comparison



What a user can do now

Example of ZH analysis





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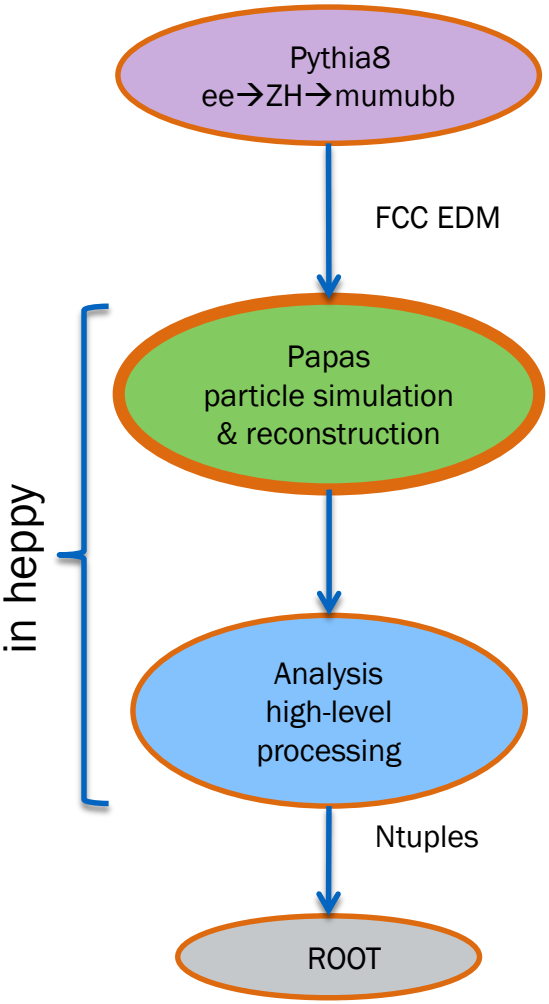

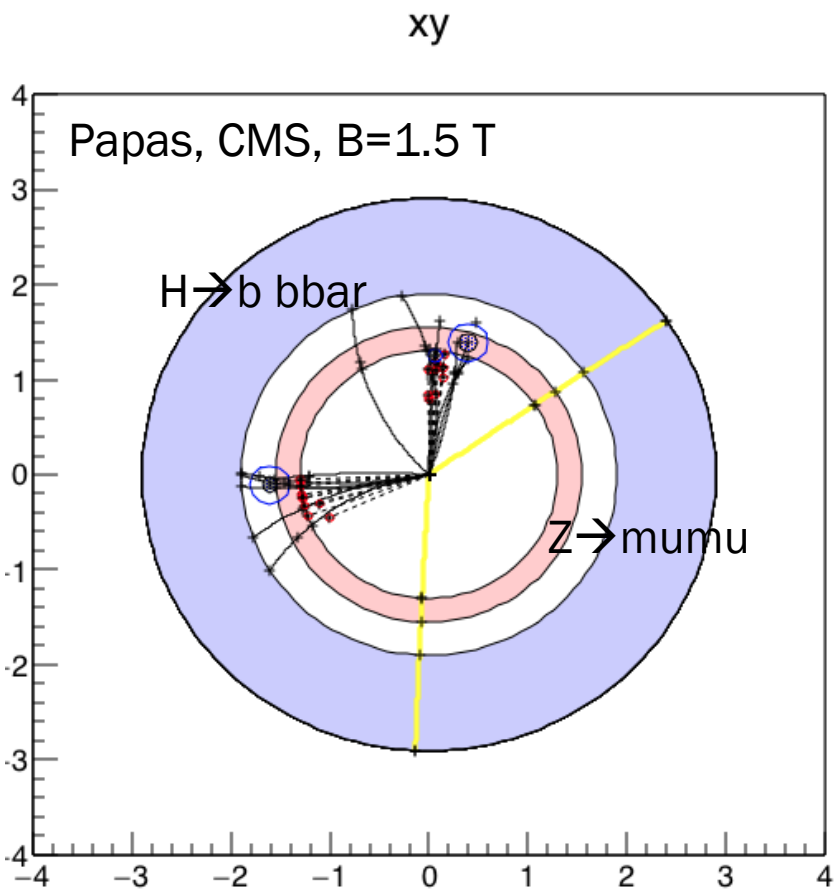

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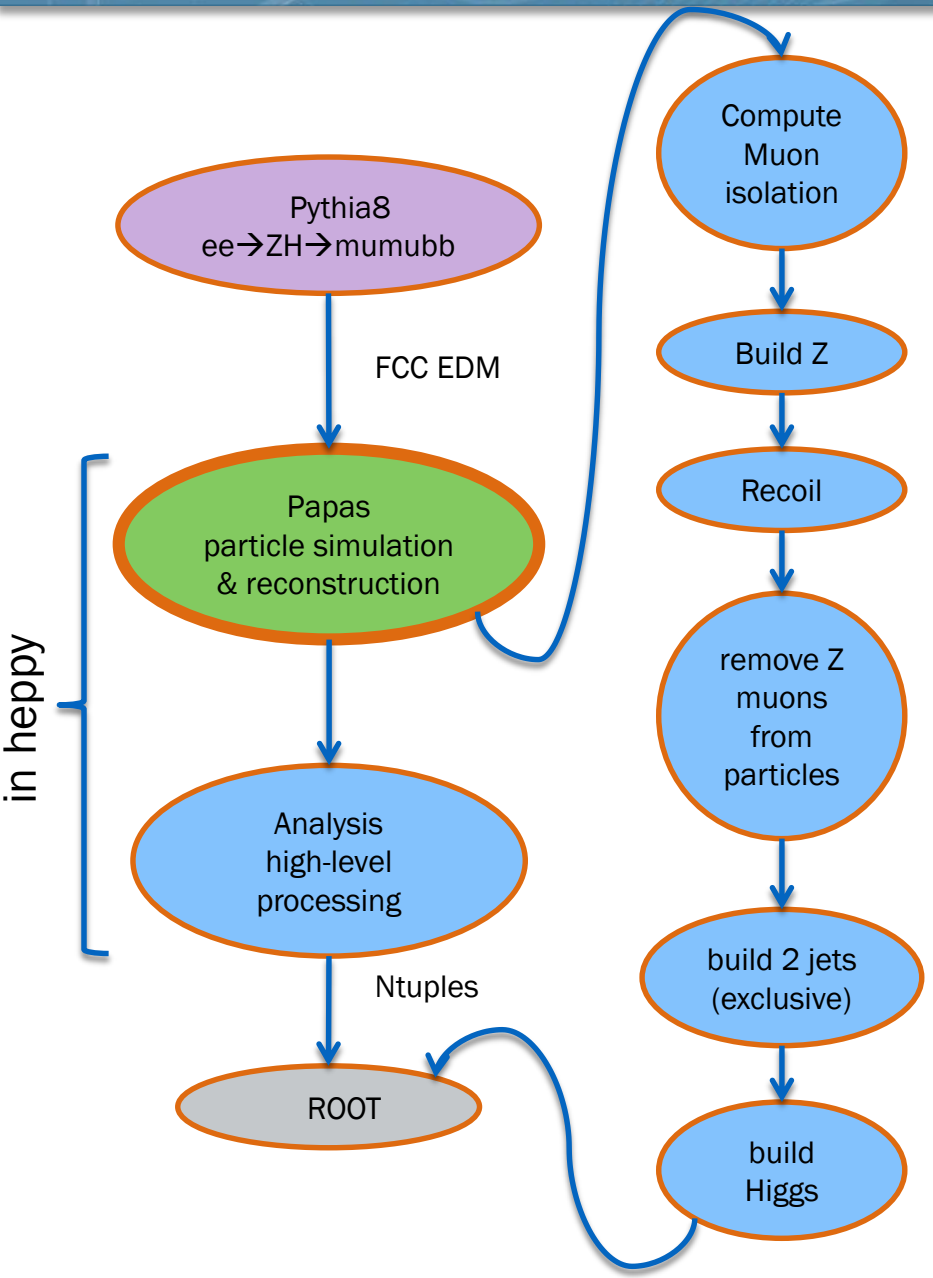
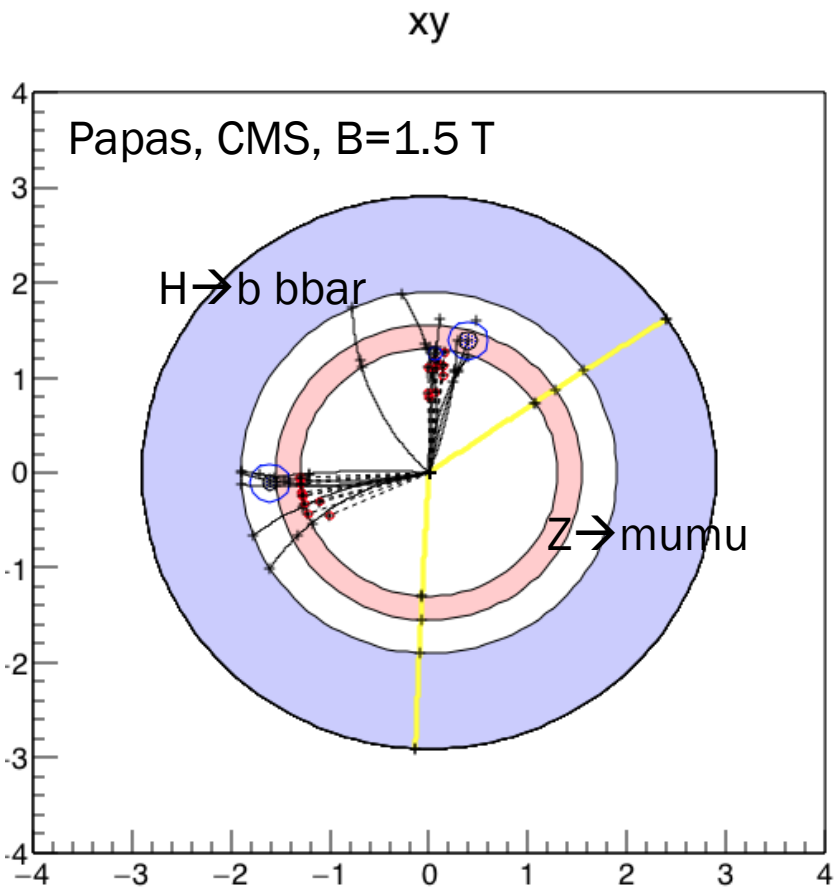


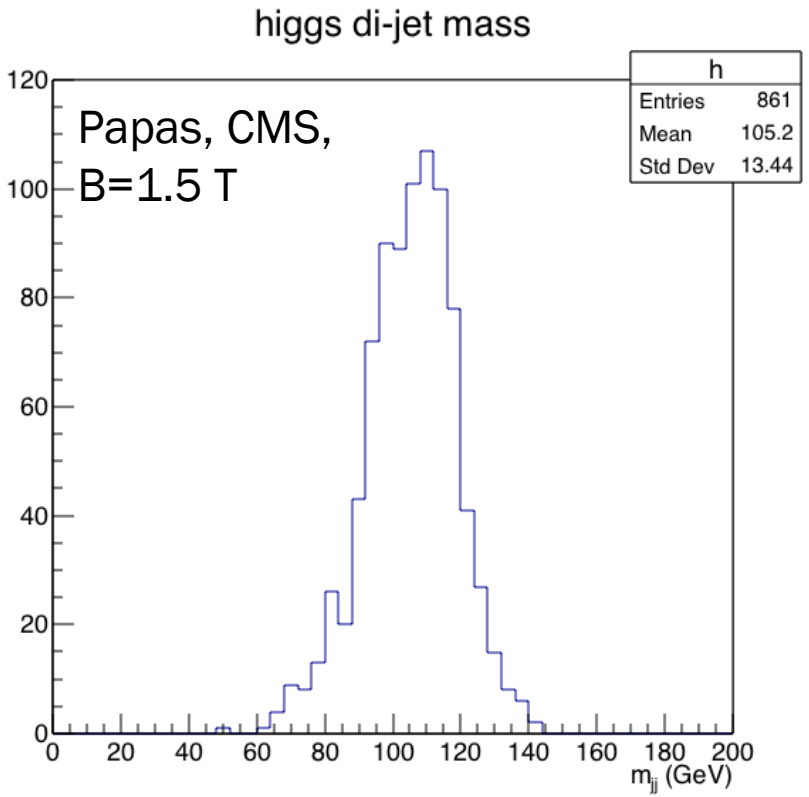


Jet Reconstruction Performance

- Mass of Higgs: use the 2 jets:
  - $m_H = m(2\ jets)$

we want to study jet reconstruction performance

- Mass of Higgs usually obtained from the recoil
  - $m_H = m(p_{ini} - p_Z)$
- Sample size of 1000



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- Mass of Higgs usually obtained from the recoil
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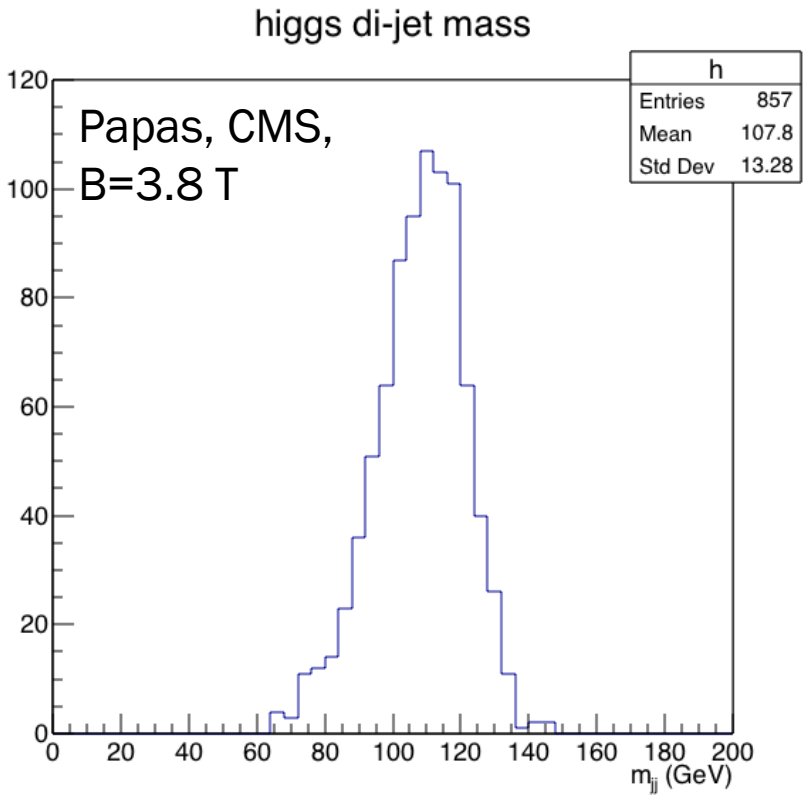
- Sample size of 1000
- small influence of B field for low-pT jets



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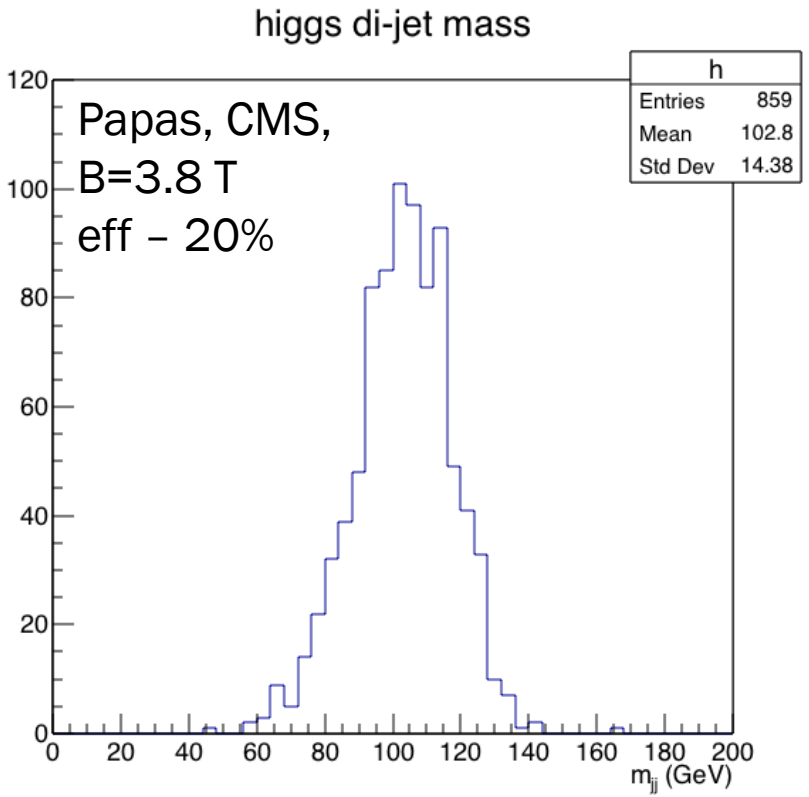
we want to study jet reconstruction performance

- Mass of Higgs usually obtained from the recoil
  - $m_H = m(p_{ini} - p_Z)$
- Sample size of 1000
- larger influence of tracking efficiency



Getting started...

Try out the FCC SW tutorials

https://twiki.cern.ch/twiki/bin/viewauth/FCC/FccSoftware#Tutorials

NB register for a CERN account

Available now, being updated ready for FCC Annual Workshop (ROME)

1. FccSoftwareGit : Git tutorial
2. FccVirtualMachine : Very fast set up for FCC analysis on any computer
3. FccSoftwareFramework : FCCSW tutorial
4. FccSoftwareEDM : Event Data Model analysis
5. FccSoftwareHeppy : Python analysis framework tutorial
6. Fcc Pythia+Delphes analysis : How to run analysis with Pythia generator and Delphes simulation?

Getting involved...

Lots of opportunities to make an impact

Lots of scope for new work

Contact Software Conveners:

- Colin Bernet
- Benedikt Hegner
- Clement Helsens

Also:

Software vidyo meeting/technical support 11:00 Wednesdays

Register with fcc-experiments-sw-dev email group

Documentation: http://fccsw.web.cern.ch/fccsw/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