The FCC Software

FCC-ee workshop, CERN
4th of February, 2016

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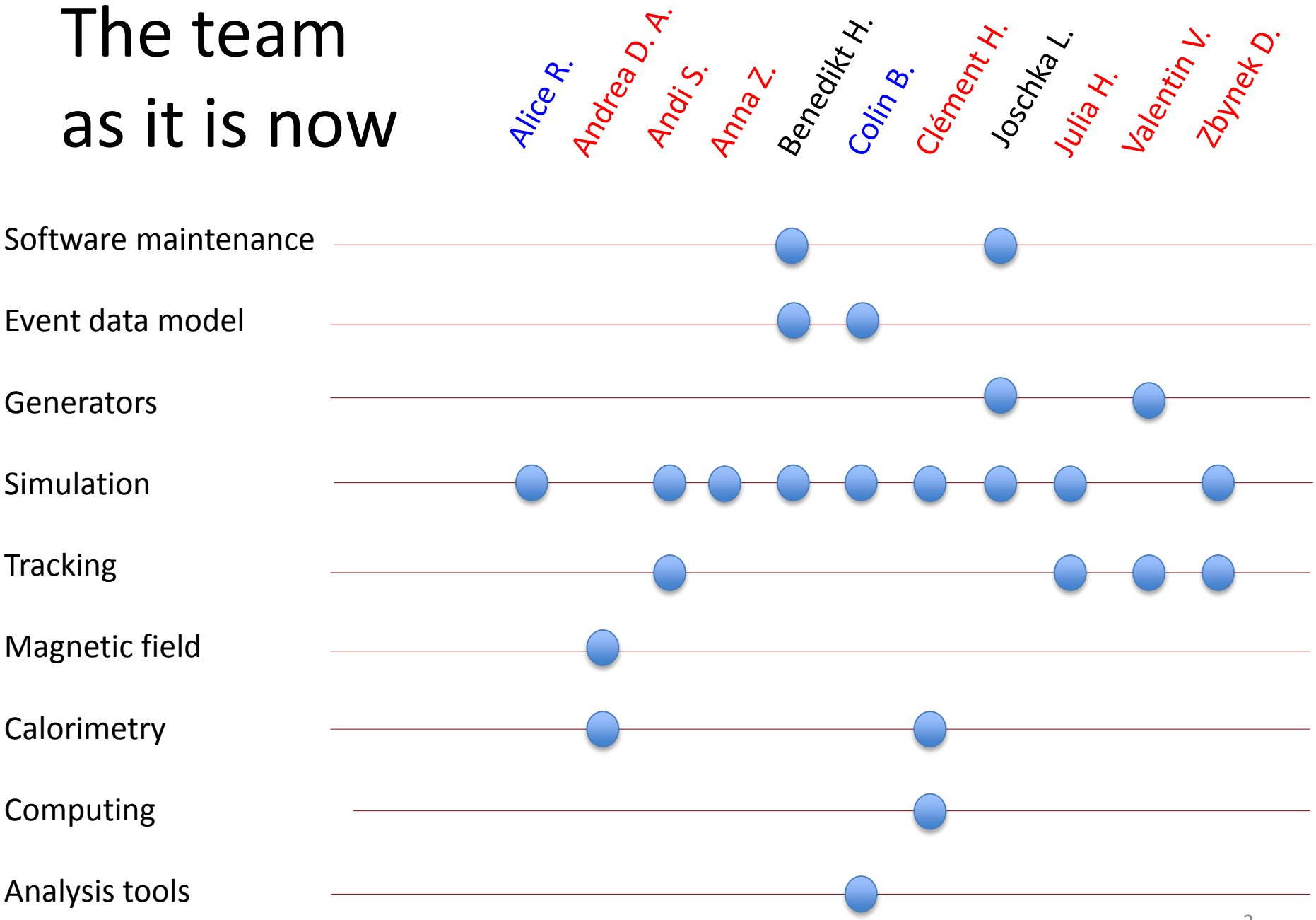
on behalf of the FCC software group

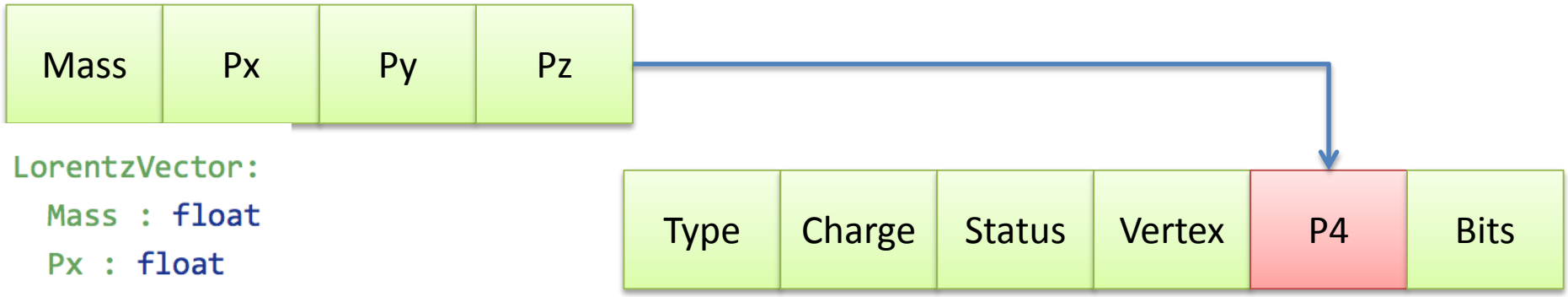
The team as it is now



More circles not necessarily better ;-)

Event Data Model : **podio**

- data stored as PODs
  - Plain Old Data, ~ simple structures
  - supports parallel computing, fastest solution




```
LorentzVector:
  Mass : float
  Px : float
  Py : float
  Pz : float
```

```
BareParticle:
  Type: int
  Charge: int
  Status: unsigned
  Vertex: Point
  P4: LorentzVector
  Bits: unsigned
```

- definition in yaml file
  - then C++ code generation

Event Data Model : **fcc-edm**

- Major evolution just occured
  - albers-core → podio (Benedikt H.)
  - finalizing … need to keep all packages and tutorial in sync

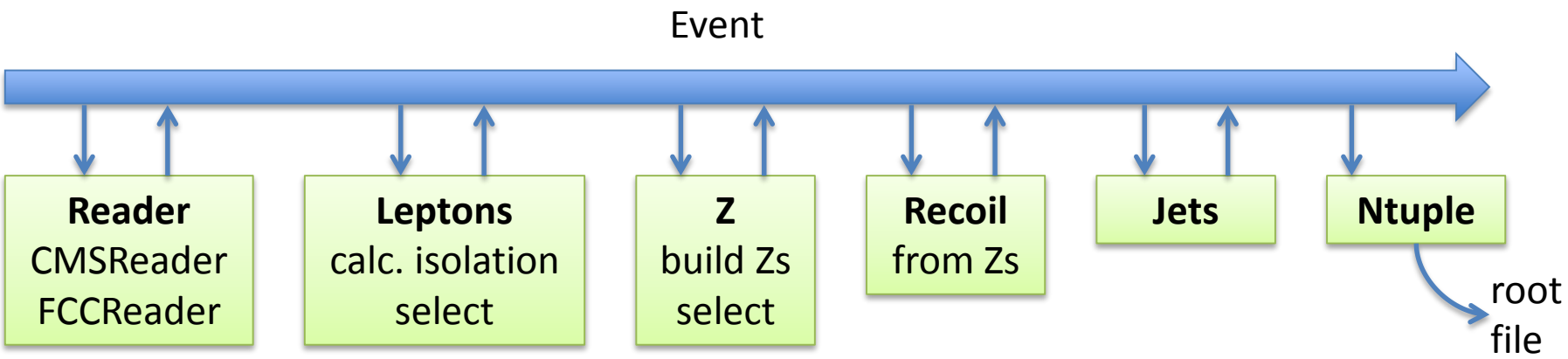
- Version 1 of the FCC event data model ready and complete https://github.com/cbernet/fcc-edm/blob/master/edm_1.yaml
    - inspired by LCIO, easy to modify
    - used in FCCSW or standalone packages, e.g. https://github.com/cbernet/pythiafcc

Analysis Tools

- In C++ : **analysis-cpp**
  - shows how to
    - read FCC EDM events in C++
    - fill histograms
    - create shared library loadable in ROOT
    - create ROOT-based executable
  - contains tools
    - e.g. fastjet interface for jet reclustering
- In Python : **heppy** (next slide)
- Supported on lxplus, macos, ubuntu 13
  - get started fast:
    lxplus or virtual machine on your laptophttps://twiki.cern.ch/twiki/bin/view/FCC/FccVirtualMachine

Analysis in python: heppy

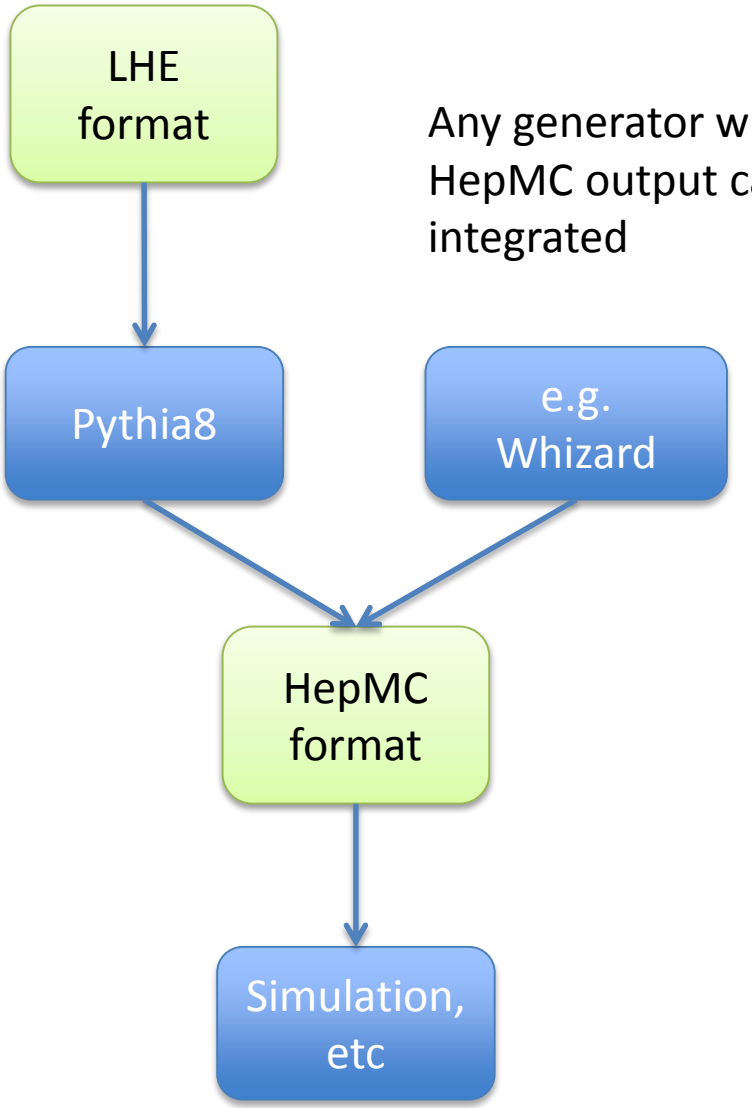
- Generic analysis framework
  - Also used in CMS and with plain root.
    ATLAS, ILC/CLIC planned
  - 50 users
  - lxplus batch processing tools included
  - heppy example analyses on the way for FCC-ee and FCC-hh



- Can write any analyzer you want
- Can reuse existing analyzers from other analyses, other people, other experiments
  work e.g. on CMS and FCC *at the same time!*

Generators : now

Any generator with LHE output already supported

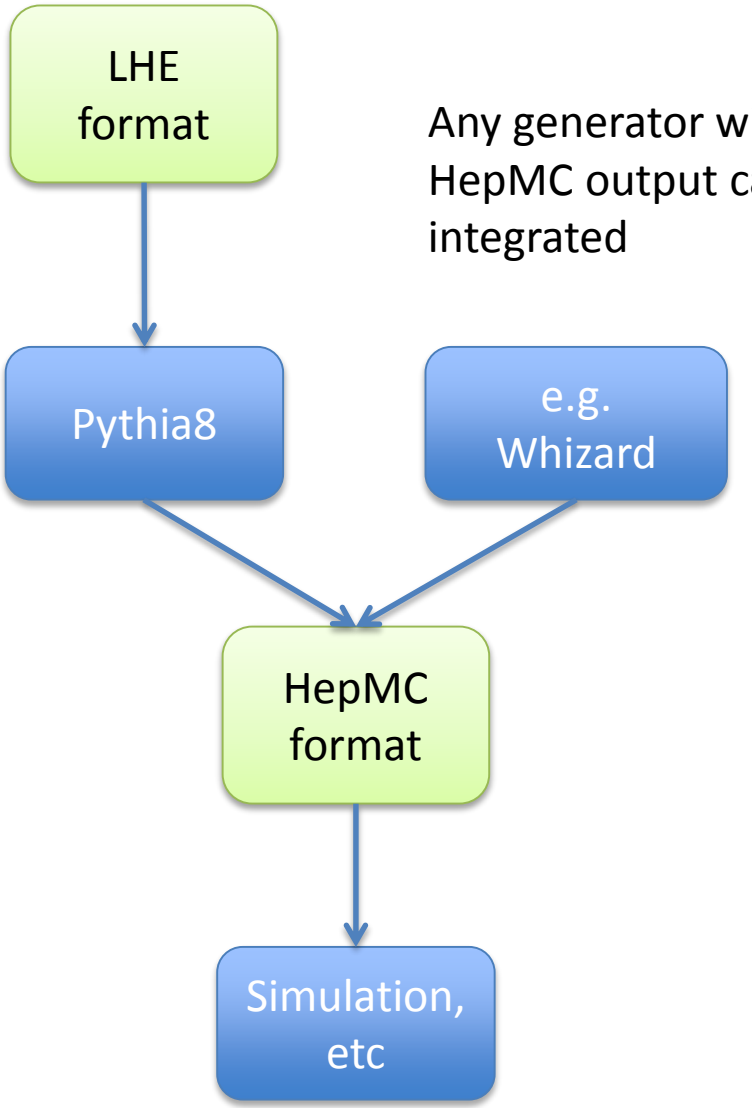


Any generator with HepMC output can be integrated

- Homemade tools
  - Ercan P., Clement H., C.B.
- Working
- Perfect for detector studies and basic physics studies

Generators : soon

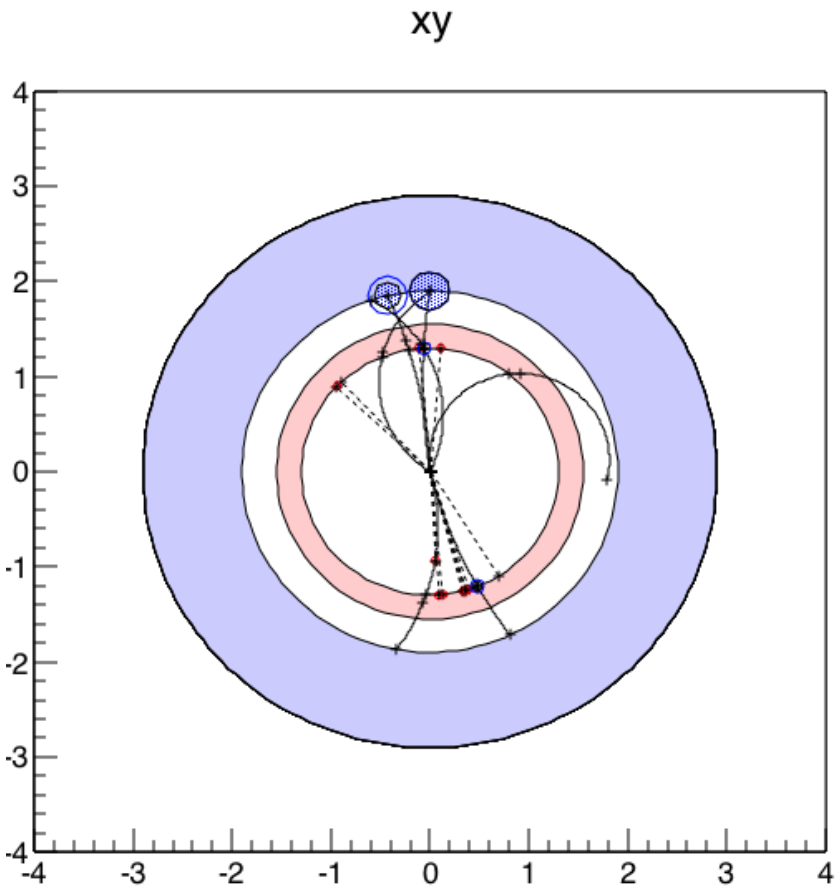
Any generator with LHE output already supported



Any generator with HepMC output can be integrated

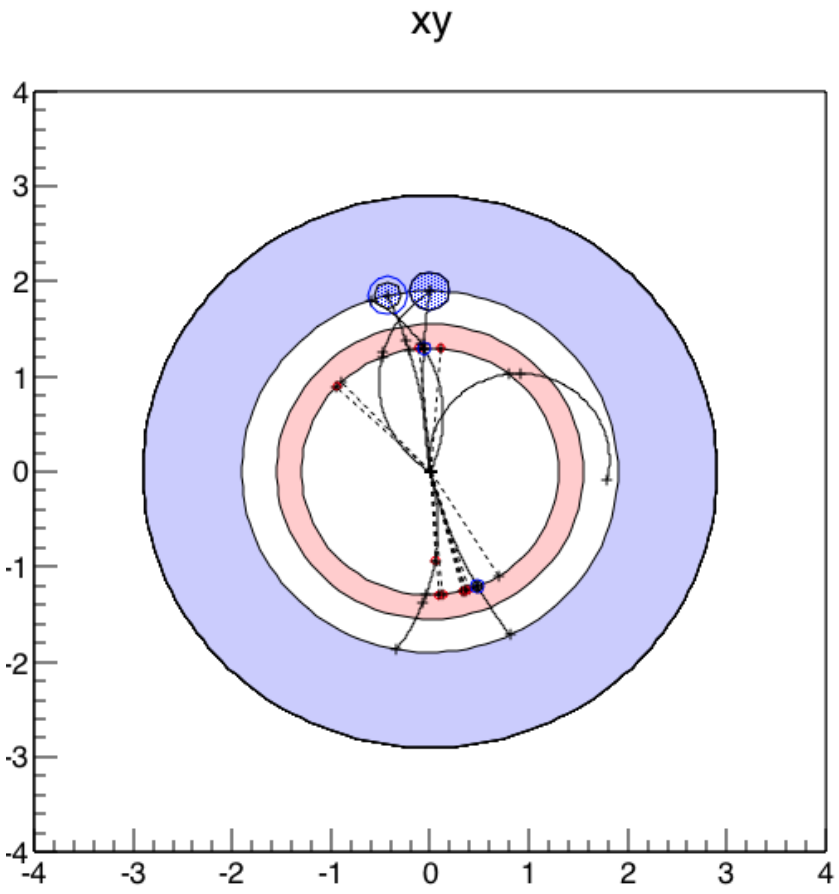
- Borrowing the LHCb generation framework, **Gaussino** (Joschka L., Valentin V.)
  - same idea
- Most generators available
  - See GENSER, > 35 generators / gen tools
    - but not whizard – yet
- Full integration with Gaudi
  - python configuration
- Additional gen tools
  - e.g. gen level filtering

PAPAS



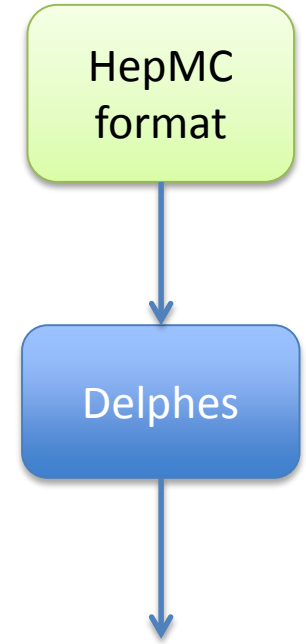
- Runs in heppy
- Can model
  - any kind of calorimeters
    - change cluster size, resolution geometry, …
  - simple tracker
    - acceptance, resolution, efficiency
    - detailed tracking effects can be implemented (e.g. displaced vertices)
- e and mu model up to user

PAPAS



- Real particle flow algorithm prototype
  - Takes clusters and tracks
  - Produces particles
    - can develop particle-based algorithms
      e.g. tau ID, analysis
- Simulation and particle flow algorithm being ported to C++ (Alice)
  - for fast / full simulation (see next slides)
  - for reconstruction
  - most of the structure in place, simulating 1st particles

Delphes integration



GenParticles
GenJets
Particles
MET
Jets
b&tau tag info

- Project almost done:
  - Software integration : done (Michele de G., Benedikt H.)
  - Gaudi interface: 90% done (Zbynek D.)
    - Reads HepMC event from Gaudi : Done
    - Working on the output
      - some adaptation needed
      - **ready since yesterday!needs integration**

Simulation: Fast/Full

- Integrated fast / full sim approach based on Geant 4 (Anna Z., Julia H., Andi S., Benedikt H.)
- Status
  - framework ready, **full sim ready!**
  - need to work on simulation
    - create geant 4 models
    - integrate fast sim algorithms
      - from ATLAS
      - from CMS
      - PAPAS
      - Delphes

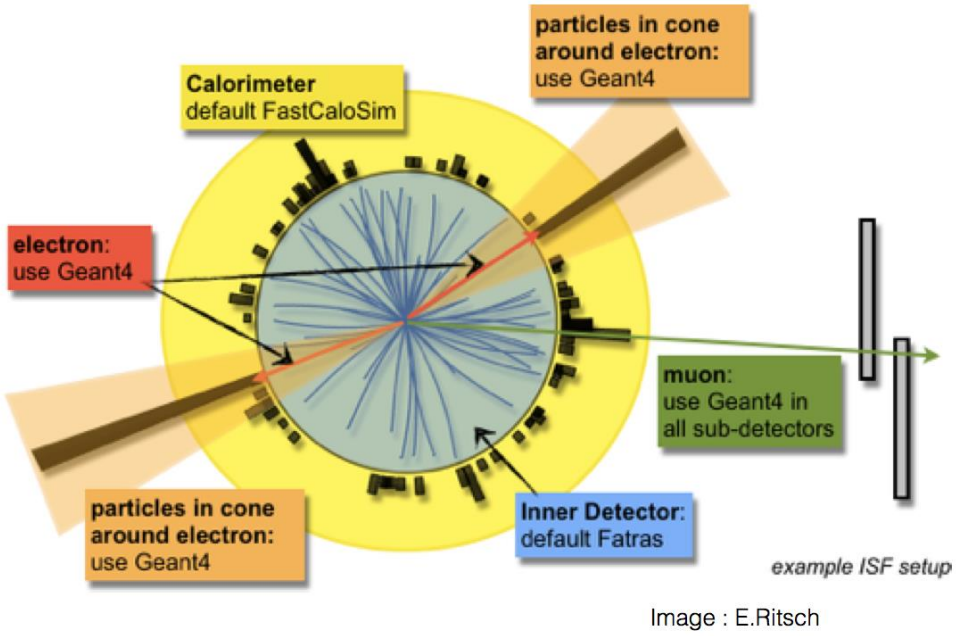


Image : E.Ritsch

what is done in ATLAS

Tracking : ATS

- The ATLAS tracking software as a standalone package (Julia H., Andi S.)

- Features:
  - Geometry
    - translation : DD4Hep → ATS geometry
    - navigation, material, …
  - Internal event data model
  - Track reconstruction tools

- Status:
  - core classes extracted can build in ATLAS or FCC
  - Started to integrate missing classes, e.g. Kalman fitter
  - Started to build a first dummy detector
  - FCC week Roma: 1st demonstrator

- https://indico.cern.ch/event/446600/

How to get started?

- Software meeting at 11:00 every other Wednesday
  - when no meeting, plan to use the slot for technical user support
- Get a CERN account (possibly lightweight)
- Subscribe to the fcc-experiments-sw-dev to get access to the documentation
- https://twiki.cern.ch/twiki/bin/viewauth/FCC/FccSoftware#Tutorials

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?