

FCC Simulation Tools Overview & Discussion

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Goal is 3-fold

- Enable physics analyses
- Study influence of detector performance on physics results
- Test performance of a detector model

more pressing

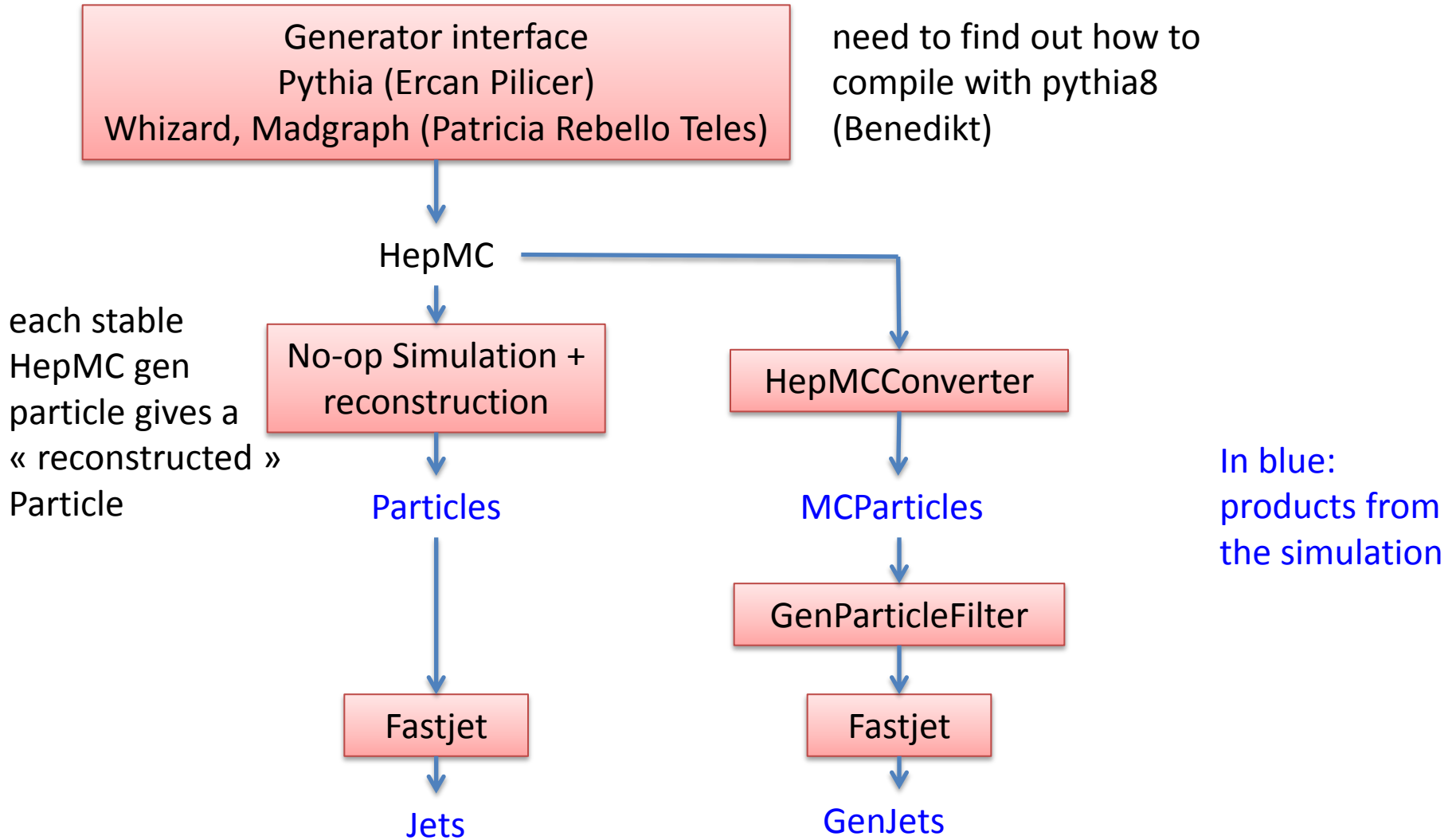


more involved

1- Enable physics analyses

- Goal: provide input to analyses:
 - jets, ME(T), leptons, photons, isolation
- Ingredients:
 - pythia 8 interface (Benedikt)
 - EDM v1 (proposed last week, in my github)
 - Dummy simulation + reconstruction (see next slide)
 - output: EDM particles and jets
 - Just the gen particles and jets converted to the EDM reco format, no smearing
 - MET, lepton id, photon id, isolation taken care of by the user
 - advantages for the user:
 - set up analysis based on the EDM
 - benefit from our generator and fastjet interfaces
- Timescale: next week

Dummy simulation



2- Define target detector performance

- Parametric simulation in FCCSW
two possibilities:
 - Delphes
 - **integration in Gaudi / EDM (?, 2 weeks)**
 - Particle-flow based simulation in Gaudi
Similar to QUFSIM in Aleph or to PFSim:
<https://indico.fnal.gov/getFile.py/access?contribId=20&resId=0&materialId=slides&confId=6983>
 - integration of PFSim in Gaudi / EDM (Colin, 2 days)
 - **development of the particle flow model (?, 1 month)**
 - integration in Geant4 (Anna, Themis?)
 - integration of ATLFAST-like *single particle* response functions?
(Anna, Themis)
- Critical!
 - Need volunteers for **these items**

3- Test performance of a detector model

- Need:
 - Geant integration in Gaudi and EDM
(Benedikt, Anna, Themis, Julia)
 - Geometry infrastructure
(Julia)
 - DD4HEP, simplified geometry for RECO, Geant interface
 - A detector model
(?)
 - Particle flow reconstruction algorithm adapted to this detector model
(?, Colin)
 - Computing infrastructure
(?)

3- Test performance of a detector model

- Fast simulation inside Geant4 (see Julia's talk)
 - similar to CMS fast sim or ATLFAST?
 - produces detector hits, just like the full sim
 - same **reconstruction** as for real data, based on particle flow
 - except for track pattern recognition
- Parametric simulation inside Geant4
 - Particle flow simulation with full sim response (?)
 - simulate and **reconstruct** single particles in full sim.
- **Need to implement a particle flow algorithm in all cases (time scale: 1 year, should start now)**

Backup

Why particle flow?

- Jet and missing transverse energy resolution improved by a factor 2
- Jet angular resolution improved by a factor 2
- Jet energy scale systematic uncertainty divided by 5 (now $\sim 1-2\%$)
- Particle-based lepton isolation more efficient and pure
- Tau identification 3 times purer at the same efficiency
- All physics objects mostly insensitive to pileup interactions in a given LHC bunch crossing (FCC hh!)
- Systematic uncertainties in analyses improved
- Used in all CMS analyses

ATLFAST?

- track smearing:
 - smear tracks to account for finite tracking resolution
 - for specific analyses: reconstruction of mesons
 - nothing to do with jets
 - can be used to model ATLAS tracking resolution in PFSim
- jets:
 - smear calorimeter jets
 - not particle based → cannot be used to smear particles
 - could produce single particle ECAL and HCAL response functions to model ATLAS in PFSim
- **PFSim algorithm anyway necessary**