

HepSim Monte Carlo samples and their interface with detector simulations

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FCC-hh detectors' strategy meeting

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Public Monte Carlo event samples

- **HepSim provides high-statistics truth-level MC samples with public access**
 - includes events generated using HPC (Mira)
- **Catalog theoretical calculations from LO+PS, NLO etc. programs if**

$$\frac{\text{time to download \& analyse}}{\text{CPU*h needed to create the prediction}} \equiv \varepsilon \ll 1$$

For 100 TeV:

$\varepsilon \sim 0.01-0.5$ for LO MC

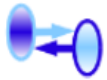
$\varepsilon \ll 0.01$ for NLO etc.

- **Recent progress:**
 - a mechanism for data validation / analysis using Python scripts published online
 - No installation. Easy for students & theorists
 - allows comparison with HepData from Durham
- **Storage back-ends are provided by ANL, Connect (UChicago / ANL Computational institute) and NERSC**



HepSim. A catalog with simulated events

<http://atlaswww.hep.anl.gov/hepsim/>



Requesting events Help Login

Show all

$p \rightarrow p$

7 TeV

8 TeV

13 TeV

14 TeV

33 TeV

100 TeV

$e \rightarrow e$

500 GeV

HepSim

Repository with Monte Carlo predictions for HEP experiments

Show 25 entries

Previous 1 2

Id	$\rightarrow \leftarrow$	E [TeV]	Name	Generator	Pr
1	pp	100	tev100_higgs_pythia8	PYTHIA8	gg2Httba qqbar2H
2	pp	100	tev100_higgs_ttbar_mg5	MADGRAPH/HW6	Higgs+tt (NLO+PS)

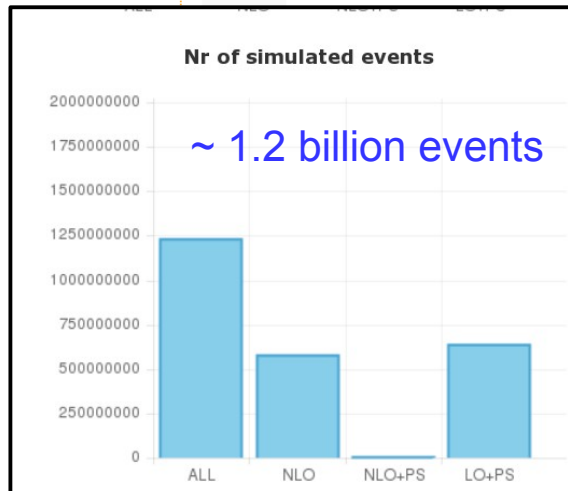
Statistics of HepSim

Number of public file servers	3
Number of data samples	98
Number of NLO samples	17
Number of NLO+PS samples	10
Number of LO (+PS) samples	71
Number of events	1247996000
NLO events	583000000
NLO+PS events	106550000
LO (+PS) events	654341000
Total size (GB)	6763.766
NLO size (GB)	238.06
NLO+PS size (GB)	55.95
LO (+PS) size (GB)	6469.756
Number of files	310315

Data hosted by:

Nr	Data servers
1	faxbox.usatlas.org
2	mc.hep.anl.gov
3	portal.nersc.gov

Analysis & validation plots can be done using web browsers & data streaming over network

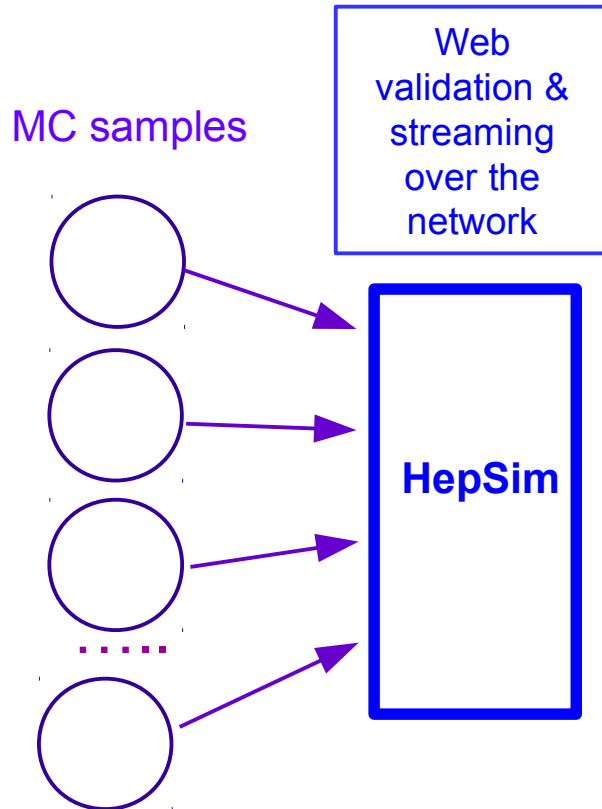


herwigpp	HERWIG++	Direct photons	SM	Info	1.21E+03	URL
herwigpp_pt2700	HERWIG++	All dijet QCD events	SM	Info	3.34E+01	URL
100_kkgluon_ttbar_pythia8	PYTHIA8					
100_qcd_pythia8_pt300	PYTHIA8					
100_qcd_pythia8_pt900	PYTHIA8					
100_qcd_pythia8_pt2700	PYTHIA8					
100_qcd_pythia8_pt8000	PYTHIA8					
100_ttbar_mg5	MADGRAPH					
100_ttbar_pt2500_mg5_lo	MADGRAPH					

Nr	Analysis code	Output plot (SVG)
1	pythia8_qcdpt3000.py Launch	

Talks, papers: <http://atlaswww.hep.anl.gov/hepsim/about.php>

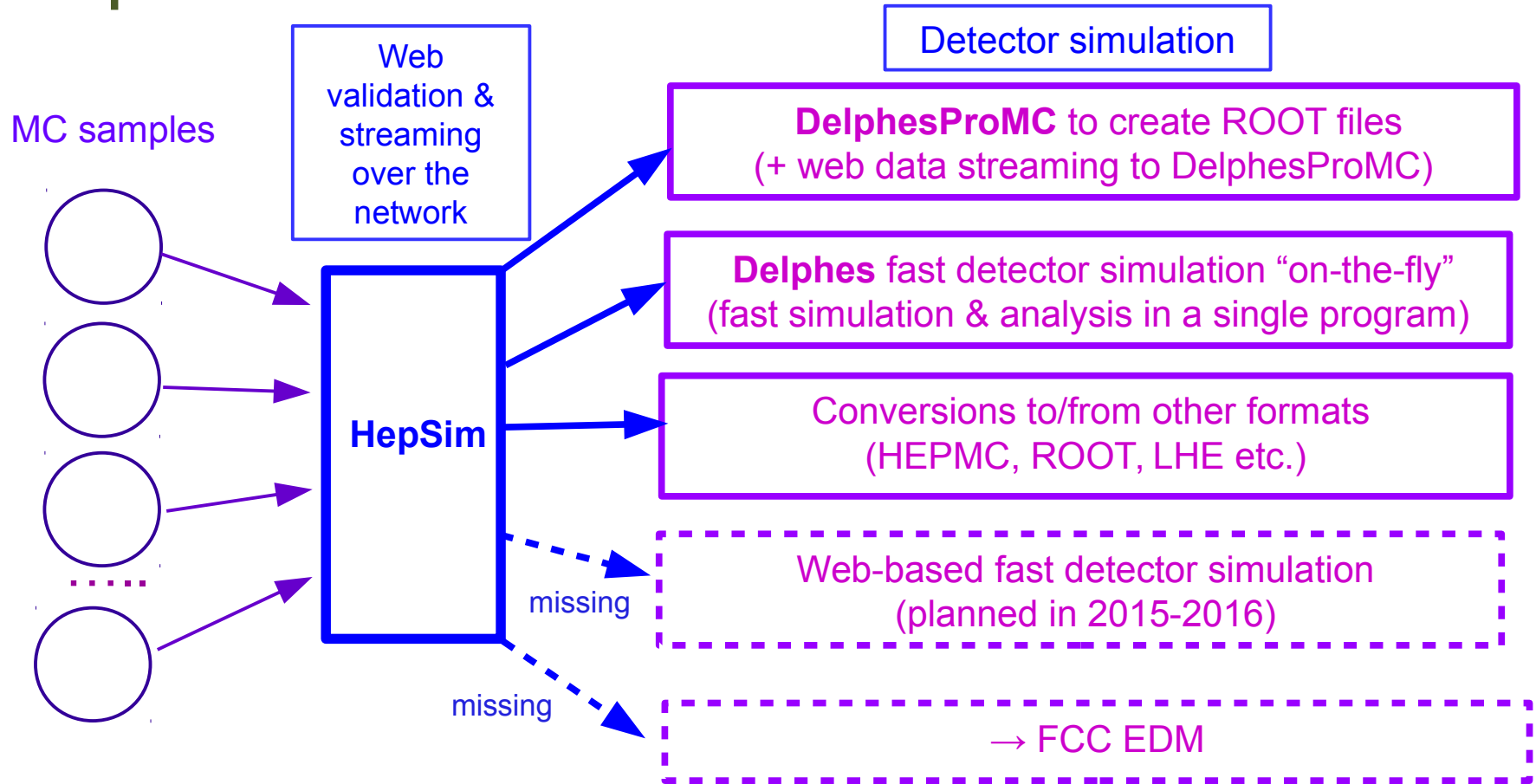
Validation of Monte Carlo samples



- **Focusing on web-based, platform neutral, MC validation mechanism with a data streaming technology**
- **Based on Python scripts (but with Java back-end)**
 - no installation, any OS, low maintenance
- **Scripts generate SVG and XML outputs**
- **Validation API provides all necessary tools:**
 - Lorentz vectors
 - Histogram classes (from FreeHep)
 - 2D and 3D plotting canvases
 - Jet algorithms:
 - “Fast” jets (kT, anti-KT, C-A) implemented in Java (~N*N algorithm) by I.Pogrebnyak (MSU)
 - ongoing benchmarks / test

- **Description:** <http://atlaswww.hep.anl.gov/hepsim/description.php>
- **HepSim API:** https://atlaswww.hep.anl.gov/asc/wikidoc/doku.php?id=community:refhepsim_analysis
- **Java / C++ jet algorithm benchmarks:** <https://github.com/chekanov/hepjet/>

HepSim interface for detector simulations



Solutions for FCC EDM:

- HepSim files → HEPMC text files (~x12 larger) → FCC EDM
- HepSim files → FCC EDM (internal conversion to HEPMC record)
Can be based on the existing code "promc2hepmc"

← preferred solution (missing man power)

Present HCAL geometry studies

- **Redesigned “DelphesProMC” using “on-the-fly” approach**
 - fast simulation & analysis in one program
 - <https://atlaswww.hep.anl.gov/asc/wikidoc/doku.php?id=vlhc:hcal>
 - Fast & efficient
 - **Example:** *analysis.exe fcc_towers.tcl histograms.root filelist.txt*
- **Includes benchmarks for HCAL segmentation studies:**
 - jet masses, substructure variables, etc.
- **12 Delphes cards using different HCAL / ECAL cell sizes**
 - including realistic energy fractions in HCAL / ECAL (important!)
- **Studies presented at the FCC meeting in Washington DC:**
 - <http://indico.cern.ch/event/340703/session/101/contribution/200>
 - See backup slides of that presentation