Simulations for the Energy Frontier

S. Chekanov
HEP/ANL

JLab Detector Working Group meeting
+ ANL

Jan 13, 2016

Future of particle collisions

- is an exploration territory. Future projects include:

High-Luminosity LHC

ILC (International Linear Collider)

FCC (Future Circular Collider). FCC-ee and FCC-hh

CEPC (Circular Electron Positron Collider)

SPPC (Super Proton-Proton Collider)

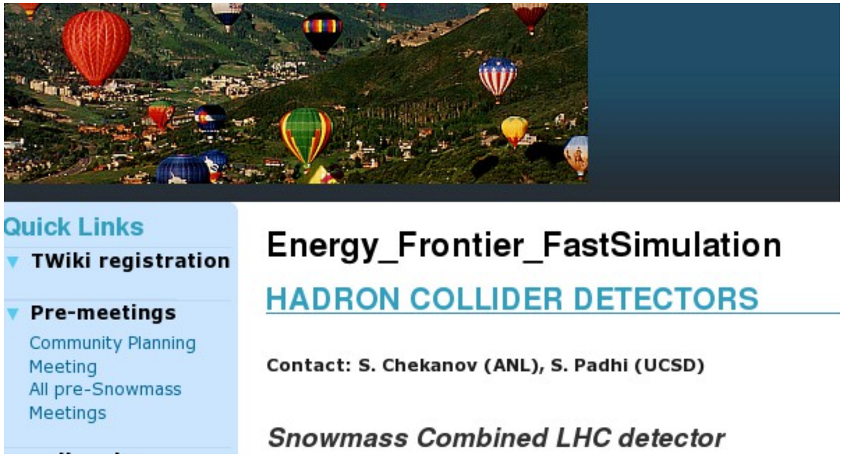
EIC (Electron Ion Collider)

In the next decade we will deal with exploration of physics reach, detector parameters and new technology options for post-LHC era

→ Requires detailed simulation of physics processes and detector responses

Monte Carlo simulation for DPF (Snowmass 2013)

- First Snowmass meeting with large-scale MC production with open data access
  - ~billion events with Delphes fast simulation
  - 140 pileup scenarios for HL-LHC
- Used OSG-grid and other resources



Described in the report "Snowmass Energy Frontier Simulations" ***(arXiv:1309.1057)***

Lessons learned

- General community (especially theorists) is reluctant to use grid to access data
  - security certificate & approvals are too complicated?

    → Use OSG grid to make samples, but use HTTP to get them!
- Limited file storage & large EVGEN event files when using pileup
  - EVGEN files deleted, ROOT files slimmed → *EVGEN is lost!*
- No sufficient MC description → *logfiles removed!*
- No sustainable web servers for data preservation

  → *Most MC files cannot be accessed any longer*

Each experiment has its own resources & proprietary tools.
How to share resources using project-specific infrastructure?

Technology choices for post-DPF simulations

- **Output from Monte Carlo generators (EVGEN)**
  - STDHEP, HEPMC, LHE, formats etc → new ProMC format
  - Keep NLO, logfiles etc. in a single format → everything you need for long-term archiving

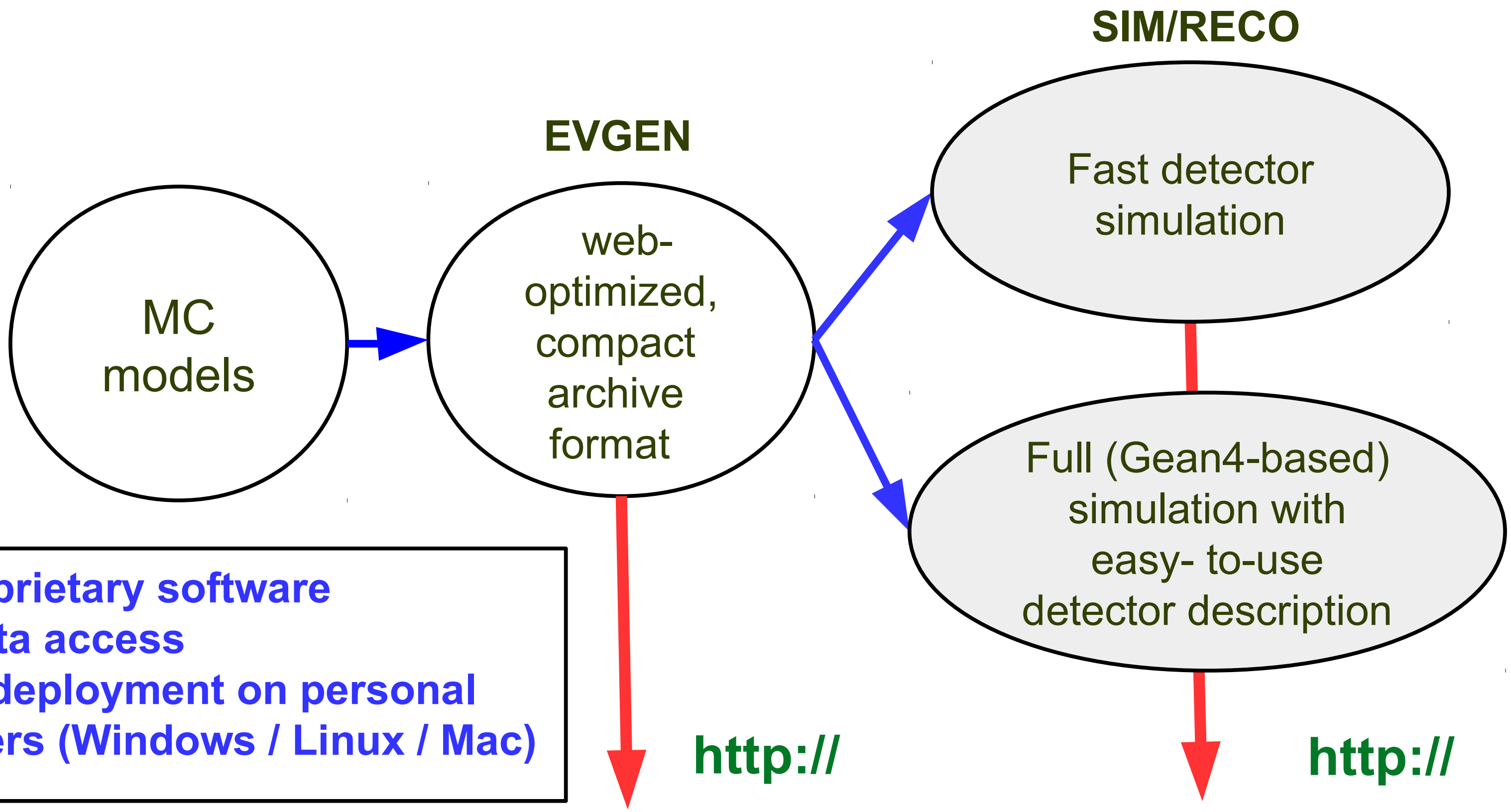
- **Fast detector simulation**
  - DELPHES 3.3 as for DPF 2015. Maintained by Université catholique de Louvain
  - Easy to install
  - Available ATLAS, CMS, ILD, LHC-B and "HERA-like" detectors
  - **Output: ROOT files**

- **Full detector simulation:**
  - no "Project" or R&D money to develop → reuse the existing software.
  - ANL/Fermilab choice: Simulator For The Linear Collider (SLIC) developed at SLAC
    - Easy to use and configure detectors
    - Expertise in the USA
  - Output: **SLCIO files**

- **Analysis: C++/ROOT, CPython/ROOT, Jython/Java**

Moving forward: HepSim

Learning from DPF & building a public Monte Carlo repository



- → **Non-proprietary software**
- → **Open data access**
- → **Simple deployment on personal computers (Windows / Linux / Mac)**

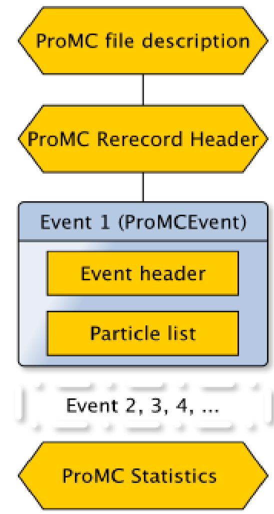
New data format for EVGEN

S.Chekanov, E.May, K. Strand, P. Van Gemmeren, Comp. Physics Comm. 185 (2014), pp. 2629-2635

- Simple & can be deployed on Mira (unlike ROOT)
- Supported by C++, Java, etc.
- 30% smaller files than any HEP format after compression
  - Uses “Varint” for int64 instead of “fixed bytes”
  - Each byte in a varint, except the last byte. The most significant bit indicates that there are further bytes to come.

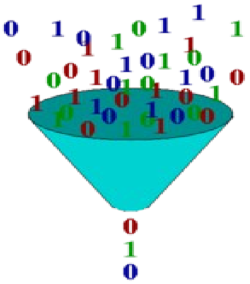
Value: 0-10:	2 bytes
Value: 10-1000:	4 bytes
Value: 1000-10,000:	6 bytes
>10,000	8 bytes

protobuf
Protocol Buffers - Google's data interchange format



- ~20-100 times faster than XML and 3-10 times smaller
- “Archive” format → Keeps event records, original logfiles, PDG tables etc
- Separate events can be streamed as “records”
  - similar to avi frames for web video players
- Self-describing format: C++/ Java code can be created from files

When the file size is matter



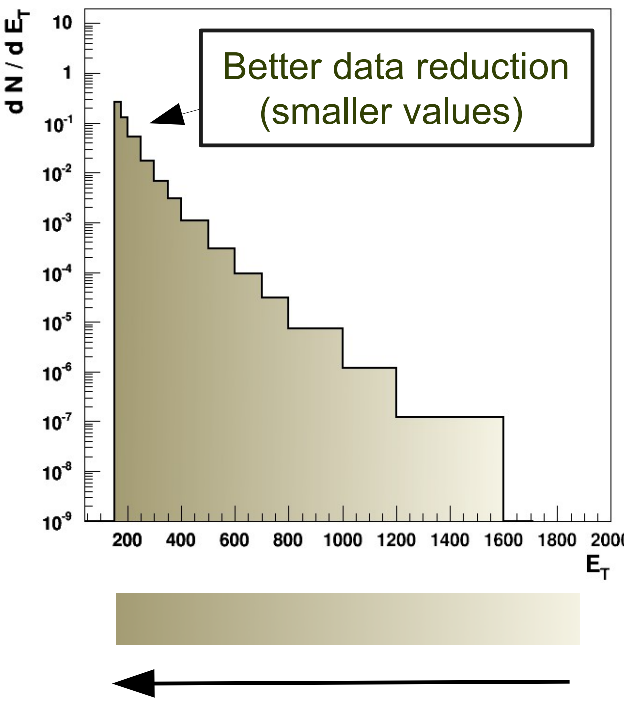
"MP3" format for HEP data

- A typical at 100 TeV event with 200 pileup MinBias events can contain up to 20,000 particles
- Low momenta → small values

Number of used bytes depends on values.
Small values use small number of bytes

- Key for data reduction for high-luminosity LHC
  - effective compression of pile-up particles
- Many convertors & tools
- FORTRAN Monte Carlo generators also supported (FortranProMC by K.Strand/E.May)

https://atlaswww.hep.anl.gov/asc/promc/



"compression" strength keeping precision of representation constant

Benchmarks for EVGEN files

ProMC files are 12 times smaller than HEPMC and 30% smaller than ROOT and ~30% faster to process

File format	File Size (MB)	C++ (sec)	CPython (sec)	Java (sec)	Jython (sec)
ProMC	307	15.8	980	11.7 (12.1 +JVM startup)	33.3 (35 +JVM startup)
ROOT	423	20.4	66.7 (PyROOT)	-	-
LHEF	2472	84.7	30.4	9.0 (9.6 +JVM startup)	-
HEPMC	2740	175.1	-	-	-
LHEF (gzip)	712	-	-	-	-
LHEF (bzip2)	552	-	-	-	-
LHEF (lzma)	513	-	-	-	-
HEPMC (gzip)	1021	-	-	-	-
HEPMC (bzip2)	837	-	-	-	-
HEPMC (lzma)	802	-	-	-	-

Table 1. Benchmark tests for reading files with 10,000 ttbar events stored in different file formats. For each test, the memory cache on Linux was cleared. In case of C++, the benchmark program reads complete event records using appropriate libraries. CPython code for ProMC file is implemented in pure CPython and does not use C++ binding (unlike PyROOT that uses C++ libraries). In case of LHEF files. JAVA and CPYTHON benchmarks only parse lines and tokenize the strings, without attempting to build an event record, therefore, such benchmarks may not be accurate while comparing with ProMC and ROOT.

https://atlaswww.hep.anl.gov/asc/wikidoc/doku.php?id=asc:promc:introduction

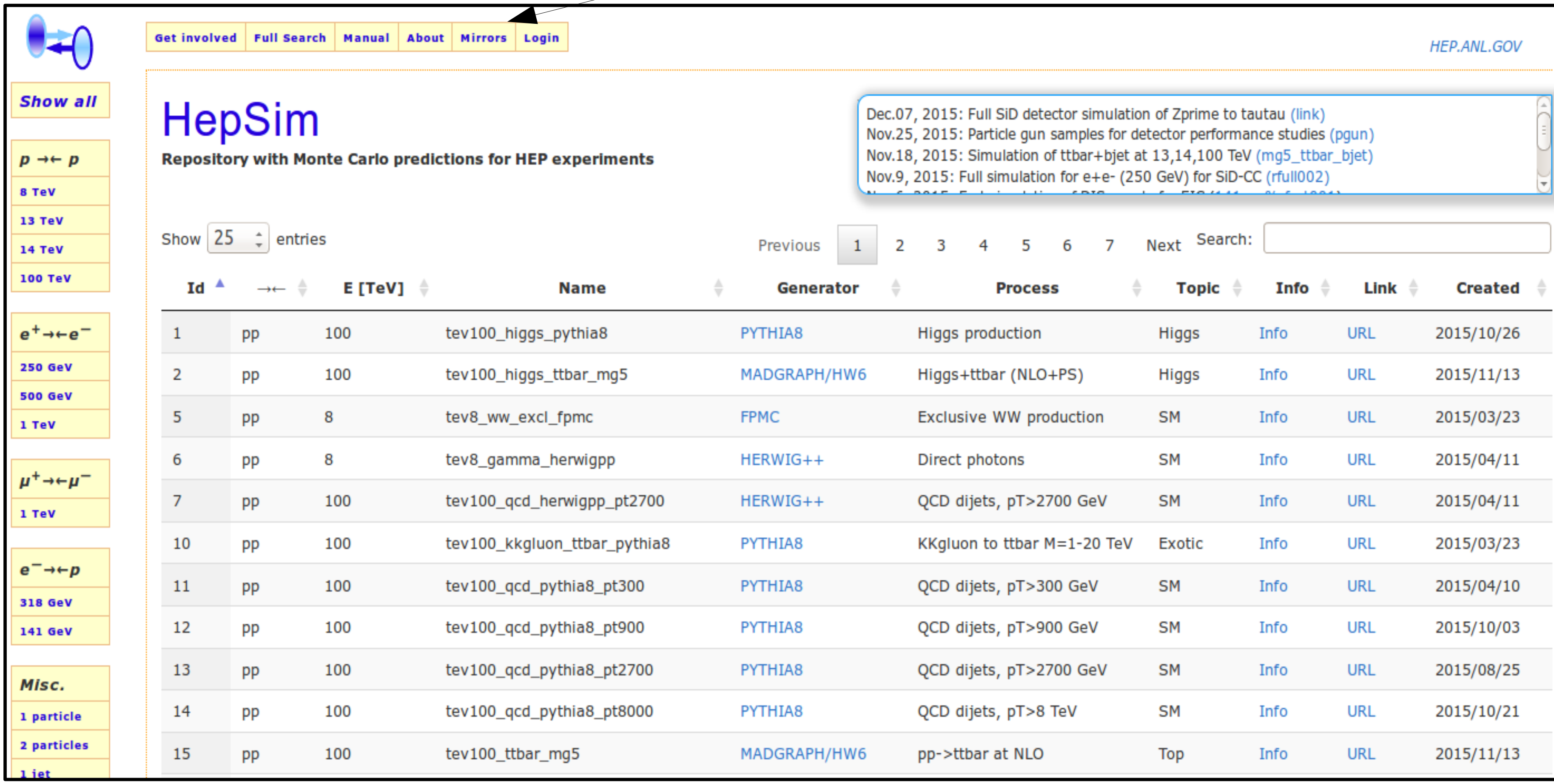
HepSim simulation   http://atlaswww.hep.anl.gov/hepsim/

- **2013-14:   A community project to keep EVGEN files**
- **2015-now: Stores fast and full simulations using "tags"**
- **Open data access**
- **Maintained at HEP-ANL**
- **Used for future circular collider studies (ANL/Fermilab/CERN):**
  - LHC physics
  - Phase-II LHC upgrade
  - HL-LHC (pp 14 TeV 3000 fb-1)
  - FCC-hh studies (100 TeV pp, 3 ab-1)
  - HGCAL for CMS
  - Circular Electron Positron Collider (since Sep 2015)
  - EIC?
- **Theorists can add their MC simulations**
  - .. and analyze events the way experimentalists do!
- **Can be used for outreach too**

HepSim simulation

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

NERSC mirror



Get involved | Full Search | Manual | About | Mirrors | Login

HEP.ANL.GOV

Show all

$p \to\leftarrow p$
8 TeV
13 TeV
14 TeV
100 TeV

$e^+\to\leftarrow e^-$
250 GeV
500 GeV
1 TeV

$\mu^+\to\leftarrow\mu^-$
1 TeV

$e^-\to\leftarrow p$
318 GeV
141 GeV

Misc.
1 particle
2 particles
1 jet

HepSim

Repository with Monte Carlo predictions for HEP experiments

Dec.07, 2015: Full SiD detector simulation of Zprime to tautau (link)
Nov.25, 2015: Particle gun samples for detector performance studies (pgun)
Nov.18, 2015: Simulation of ttbar+bjet at 13,14,100 TeV (mg5_ttbar_bjet)
Nov.9, 2015: Full simulation for e+e- (250 GeV) for SiD-CC (rfull002)

Show 25 entries

Previous 1 2 3 4 5 6 7 Next

Search:

Id	→←	E [TeV]	Name	Generator	Process	Topic	Info	Link	Created
1	pp	100	tev100_higgs_pythia8	PYTHIA8	Higgs production	Higgs	Info	URL	2015/10/26
2	pp	100	tev100_higgs_ttbar_mg5	MADGRAPH/HW6	Higgs+ttbar (NLO+PS)	Higgs	Info	URL	2015/11/13
5	pp	8	tev8_ww_excl_fpmc	FPMC	Exclusive WW production	SM	Info	URL	2015/03/23
6	pp	8	tev8_gamma_herwigpp	HERWIG++	Direct photons	SM	Info	URL	2015/04/11
7	pp	100	tev100_qcd_herwigpp_pt2700	HERWIG++	QCD dijets, pT>2700 GeV	SM	Info	URL	2015/04/11
10	pp	100	tev100_kkgluon_ttbar_pythia8	PYTHIA8	KKgluon to ttbar M=1-20 TeV	Exotic	Info	URL	2015/03/23
11	pp	100	tev100_qcd_pythia8_pt300	PYTHIA8	QCD dijets, pT>300 GeV	SM	Info	URL	2015/04/10
12	pp	100	tev100_qcd_pythia8_pt900	PYTHIA8	QCD dijets, pT>900 GeV	SM	Info	URL	2015/10/03
13	pp	100	tev100_qcd_pythia8_pt2700	PYTHIA8	QCD dijets, pT>2700 GeV	SM	Info	URL	2015/08/25
14	pp	100	tev100_qcd_pythia8_pt8000	PYTHIA8	QCD dijets, pT>8 TeV	SM	Info	URL	2015/10/21
15	pp	100	tev100_ttbar_mg5	MADGRAPH/HW6	pp->ttbar at NLO	Top	Info	URL	2015/11/13

MC generator files (including NLO), fast simulations (ROOT), full simulations (SLCIO)

Entry metadata: http://atlaswww.hep.anl.gov/hepsim/

Requesting events | Help | Login

Show all

p →← p
7 TeV
8 TeV
13 TeV
14 TeV
33 TeV
100 TeV

e →← e
500 GeV

e →← p
920 GeV

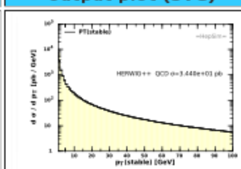
HepSim

Repository with Monte Carlo predictions for HEP experiments

Information about "*tev100_qcd_herwigpp_pt2700*" dataset

Name:	*tev100_qcd_herwigpp_pt2700*
Collisions:	pp
CM Energy:	100 TeV
Entry ID:	7
Topic:	SM
Generator:	HERWIG++
Calculation level:	LO+PS+hadronisation
Process:	All dijet QCD events
Total events:	1160000
Number of files:	116
Cross section (σ):	34.7 ± 0.0 pb
Luminosity (L):	33,429.3948 pb^{-1} *(or)* 33.4294 fb^{-1} *(or)* 0.0334 ab^{-1}
Format:	ProMC
Submission date:	Fri Oct 31 14:20:17 CDT 2014
Download URL:	http://mc.hep.anl.gov/asc/hepsim/events/pp/100tev/qcd_herwigpp_full/qcd_herwigpp_pt2700
Dataset size:	12.03 GB
Description:	Inclusive QCD dijets/. The log file is attached to ProMC.
Dataset files:	View files
Author:	S.Chekanov

Analysis scripts:

Nr	Analysis code	Output plot (SVG)	Output (XML)
1	qcd_herwigpp_pt2700.py		qcd_herwigpp_pt2700.jdat

URL for download or data streaming

Format with "variable-byte" encoding based on Google's protocol buffers

40% smaller than fixed-bytes in ROOT

Shows a typical validation distribution created using Jython script.

Also supports Java, Groovy, (J)Ruby, CPython and C++

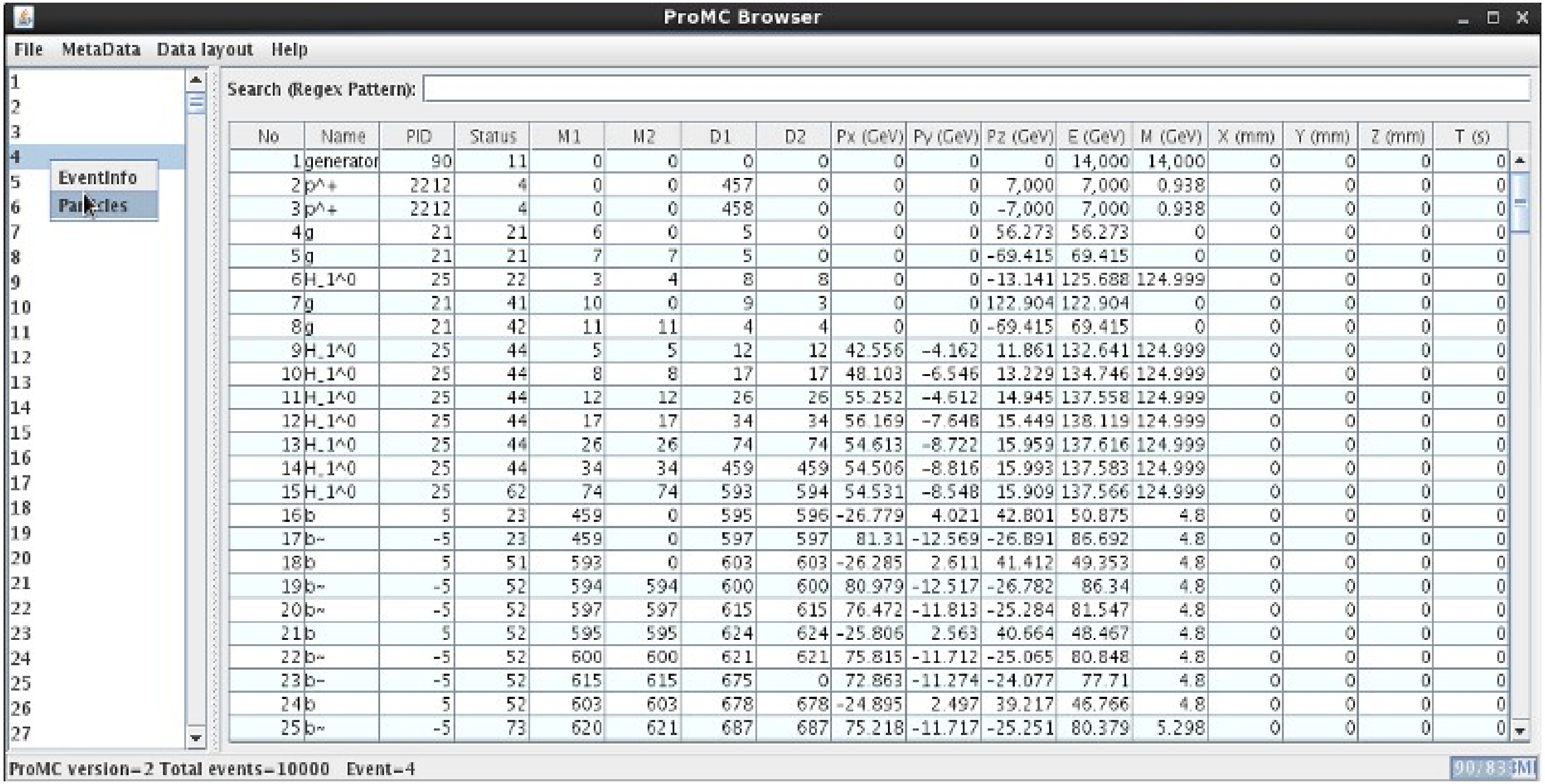
The manual explains how to download or stream events using client-side Java analysis tool

Available Monte Carlo generators

- MG5/PY6 (NLO+PS+hadr): TTbar, Higgs+jj, Higgs+TTbar etc
- MG5/Herwig (NLO+PS+hadr)
- PYHIA8 (many processes)
- FPMC (exclusive WW, Higgs)
- HERWIG++ pp collisions (QCD dijets)
- SuperChic 2 - A Monte Carlo for Central Exclusive Production
- MCFM (NLO):: Higgs -> γγ , Inclusive gamma, TTbar
- NLOjet++ (NLO) for inclusive jets (bins in pT)
- JETPHOX (NLO) for inclusive photons (bins in pT)
- PYTHIA6 for e+e and mu+mu- collisions
- LEPTO/PYTHIA for ep DIS
- LEPTO/ARIADNE for ep DIS
- Single particle guns (+ pileup)

~20% samples generated on BlueGene/Q (Mira) (Jetphox, MCFM)
~40% HEP-ANL (mainly Madgraph)
~40% OSG-CI grid (ANL/UChicago) and USATLAS CI (for phase II)

Output of “hs-view” (based on http://atlaswww.hep.anl.gov/asc/promc/)



No	Name	PID	Status	M1	M2	D1	D2	Px (GeV)	Py (GeV)	Pz (GeV)	E (GeV)	M (GeV)	X (mm)	Y (mm)	Z (mm)	T (s)
1	generator	90	11	0	0	0	0	0	0	0	14,000	14,000	0	0	0	0
2	p^+	2212	4	0	0	457	0	0	0	7,000	7,000	0.938	0	0	0	0
3	p^+	2212	4	0	0	458	0	0	0	-7,000	7,000	0.938	0	0	0	0
4	g	21	21	6	0	5	0	0	0	56.273	56.273	0	0	0	0	0
5	g	21	21	7	7	5	0	0	0	-69.415	69.415	0	0	0	0	0
6	H_1^0	25	22	3	4	8	8	0	0	-13.141	125.688	124.999	0	0	0	0
7	g	21	41	10	0	9	3	0	0	122.904	122.904	0	0	0	0	0
8	g	21	42	11	11	4	4	0	0	-69.415	69.415	0	0	0	0	0
9	H_1^0	25	44	5	5	12	12	42.556	-4.162	11.861	132.641	124.999	0	0	0	0
10	H_1^0	25	44	8	8	17	17	48.103	-6.546	13.229	134.746	124.999	0	0	0	0
11	H_1^0	25	44	12	12	26	26	55.252	-4.612	14.945	137.558	124.999	0	0	0	0
12	H_1^0	25	44	17	17	34	34	56.169	-7.648	15.449	138.119	124.999	0	0	0	0
13	H_1^0	25	44	26	26	74	74	54.613	-8.722	15.959	137.616	124.999	0	0	0	0
14	H_1^0	25	44	34	34	459	459	54.506	-8.816	15.993	137.583	124.999	0	0	0	0
15	H_1^0	25	62	74	74	593	594	54.531	-8.548	15.909	137.566	124.999	0	0	0	0
16	b	5	23	459	0	595	596	-26.779	4.021	42.801	50.875	4.8	0	0	0	0
17	b~	-5	23	459	0	597	597	81.31	-12.569	-26.891	86.692	4.8	0	0	0	0
18	b	5	51	593	0	603	603	-26.285	2.611	41.412	49.353	4.8	0	0	0	0
19	b~	-5	52	594	594	600	600	80.979	-12.517	-26.782	86.34	4.8	0	0	0	0
20	b~	-5	52	597	597	615	615	76.472	-11.813	-25.284	81.547	4.8	0	0	0	0
21	b	5	52	595	595	624	624	-25.806	2.563	40.664	48.467	4.8	0	0	0	0
22	b~	-5	52	600	600	621	621	75.815	-11.712	-25.065	80.848	4.8	0	0	0	0
23	b~	-5	52	615	615	675	0	72.863	-11.274	-24.077	77.71	4.8	0	0	0	0
24	b	5	52	603	603	678	678	-24.895	2.497	39.217	46.766	4.8	0	0	0	0
25	b~	-5	73	620	621	687	687	75.218	-11.717	-25.251	80.379	5.298	0	0	0	0

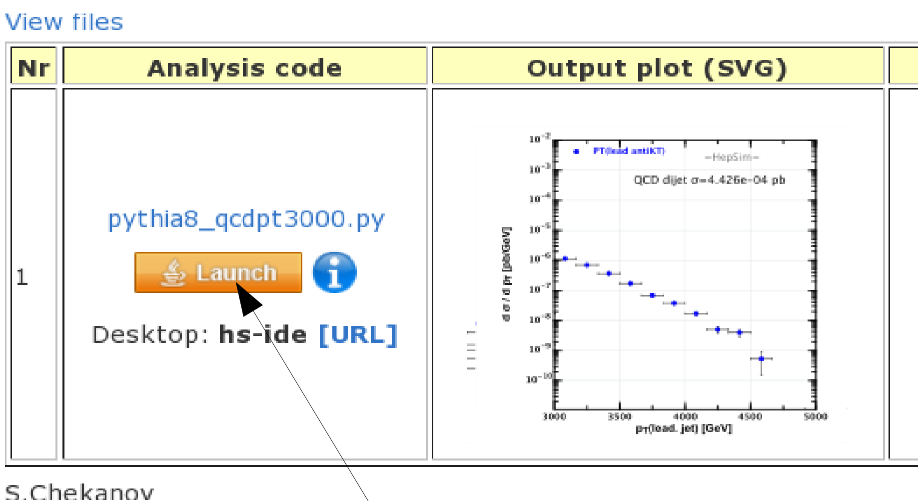
The browser unpacks “varints” into the usual numbers and show particle names using a look-up table

Can view event records from very large files (tested with ~10 GB files)

Example: Exploring high-pT jets

Go to **http://atlaswww.hep.anl.gov/hepsim/info.php?item=45** (Pythia8, pT(jet)>3 TeV)

Run the analysis code from the Web browser (without installing the toolkit)



To use Java Web Start, configure Java permissions:

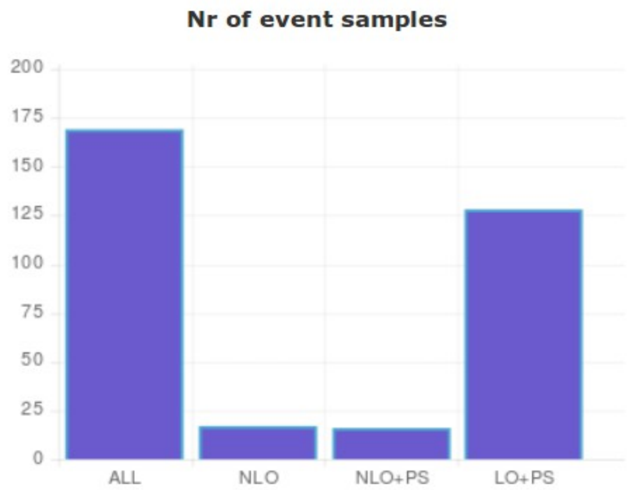
- For Linux, run "ControlPanel", go to the "Security" tab and add "http://atlaswww.hep.anl.gov" to the exception list

- For Windows, find "Java Control Panel" and do the same.

Click here to see the editor with Python script. Click “run”

You will see updated in real time jet pT distribution as you stream over online events

HepSim dataset statistics



Data hosted by:

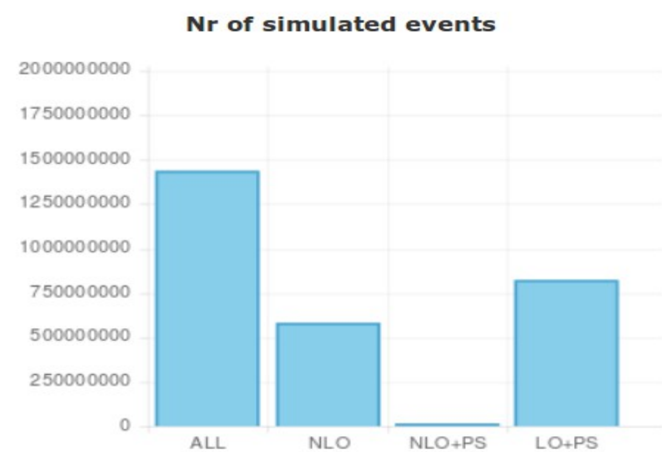
Nr	Data servers
1	mc.hep.anl.gov
2	raw.stash2.ci-connect.net
3	faxbox.usatlas.org
4	portal.nersc.gov

Number of public file servers	4
Number of event samples	169
Number of NLO samples	17
Number of NLO+PS samples	16
Number of LO (+PS) samples	128
Number of events	1437939816
NLO events	583000000
NLO+PS events	15900595
LO (+PS) events	823536521
Total size (GB)	6486.634
NLO size (GB)	238.06
NLO+PS size (GB)	117.773
LO (+PS) size (GB)	6127.386
Number of files	306046

~ 170 data samples

(some are "compound", i.e. consists of subsamples)

~1.4 billion events



How it works: EVGEN

Event Generators

- PYTHIA6
- PYTHIA8
- HERWIG++
- Madgraph5
- MCFM
- JetPhox
- FPMC
- NLOjet++
- LEPTO/Ariadne

osg connect

CONNECT

Files created on
HEP servers, Mira,
OSG-grid (CI connect)
U Chicago / ANL comp. Institute
Or users

EVGEN files stored on several public web servers (Apache)

- **Unified ProMC format**
- varint encoding
- C++, Java, Python
- Web streaming
- Can be installed on BG/Q

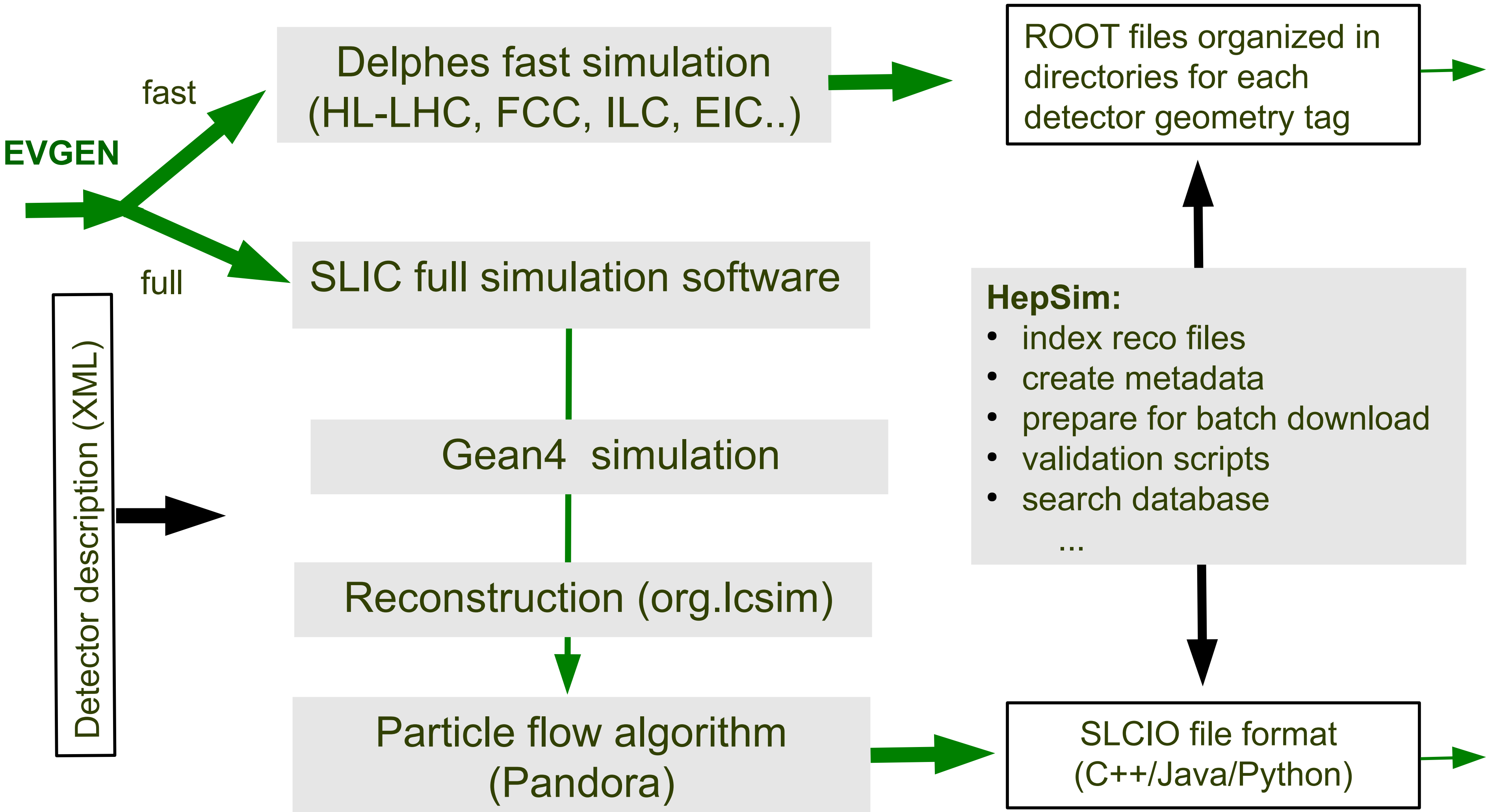
Data hosted by:

Nr	Data servers
1	mc.hep.anl.gov
2	raw.stash2.ci-connect.net
3	faxbox.usatlas.org
4	portal.nersc.gov

HepSim:

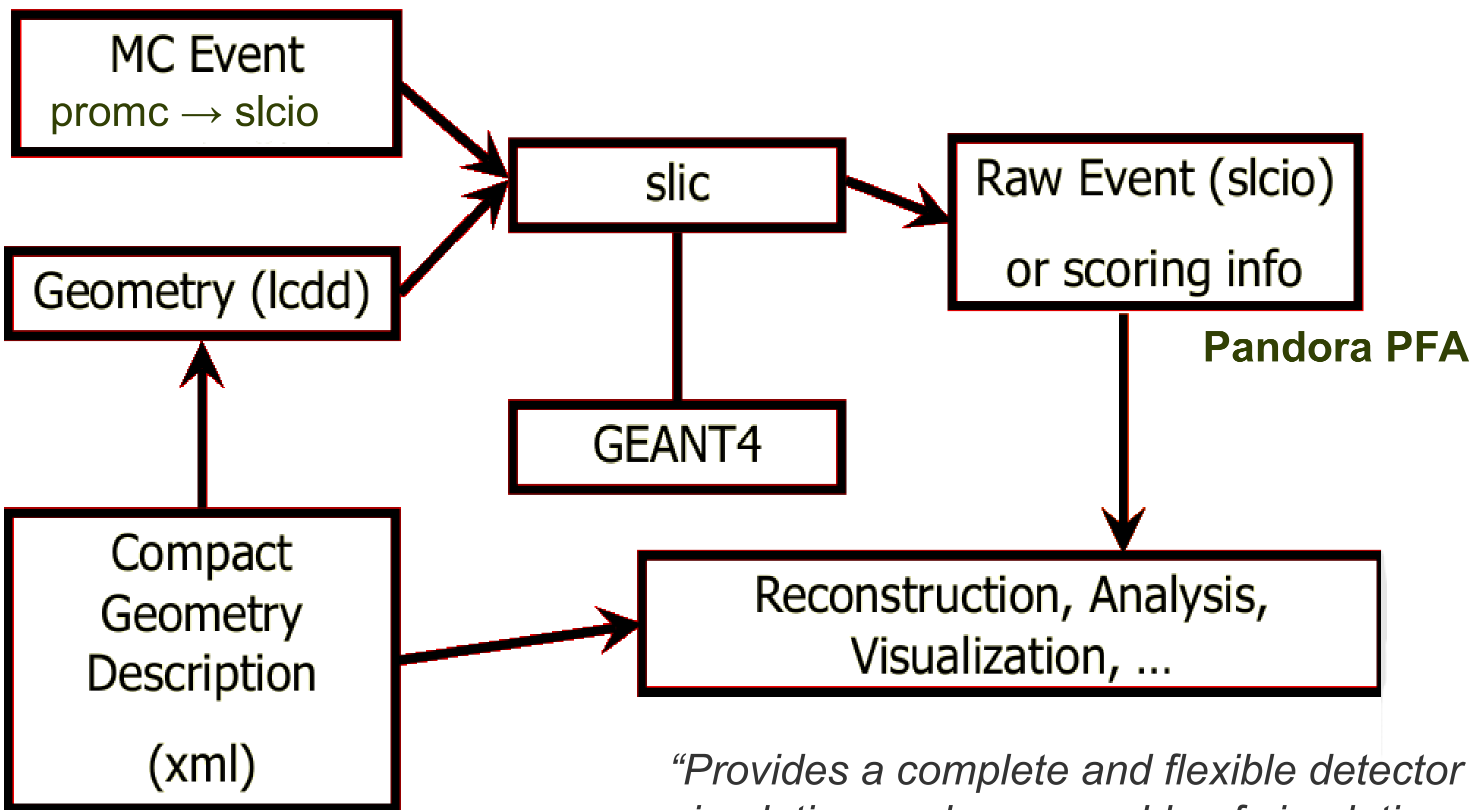
- index files
- create metadata
- prepare for batch download
- validate with Jython scripts
- create search database

Simulation of detector response



Full G4 simulation & analysis

Developed at SLAC (T.Johnson, N.Graph, J.McCormick) for the SiD detector (ILC)
Included to ilcsoft (J.Srube, PNNL)
Includes analysis tools (Jas3, Wired4)



"Provides a complete and flexible detector simulation package capable of simulating arbitrarily complex detectors with runtime detector description"..

adopted from N.Graf & J.McCormick

Example: Software for future circular colliders

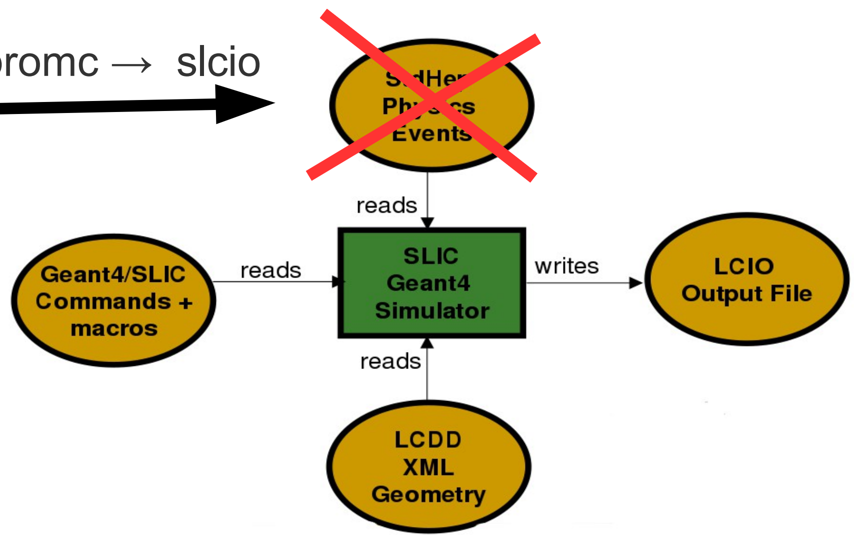
Adopted for future collider studies at ANL/Fermilab (S.C., A.Kotwal, J.Strube):

- Integrated with HepSim. Output files are publicly accessible
- Supported by HEP ANL and deployed on OSG-grid
- User analysis package:
  - **FPaD**soft - software for “Future Particle Detector” studies
  - Uses Python on the Java platform (C++ can be used too)
  - Does not require “installation”. Runs on Linux/Mac/Windows

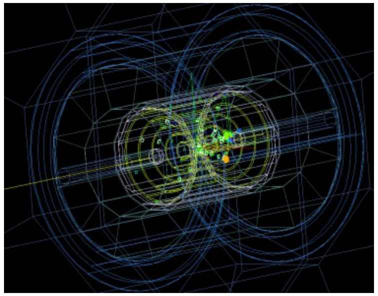
HEPSIM
EVGEN
files

ee, ep, pp
collisions

promc → slcio



Data analysis software
(FPadSoft)



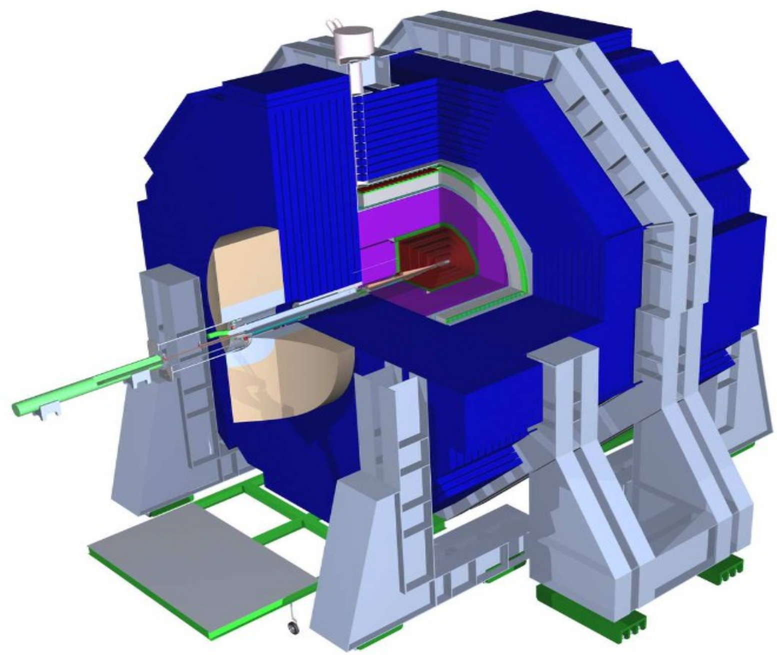
Note:
Jas3 with Wired4
can be used too!

User analysis:

https://atlaswww.hep.anl.gov/asc/wikidoc/doku.php?id=fcs:fpad

SiD detector

- A multi-purpose detector
- Optimized for separate particles (unlike LHC)
- The key characteristics of the SiD detector:
  - 5 Tesla solenoid
  - Silicon tracker:
    - 50 um readout readout pitch
    - 25 um distance between pitches
  - 3.5 mm cell size for ECAL
  - W absorber with silicon readout)
  - 10x10 mm cell size for HCAL :
    - Steal (absorber with RPC)
    - 40 layers for barrel (HCAL)
    - 45 layers in forward (FCAL)
- Optimized for particle-flow algorithms.



SiD detector

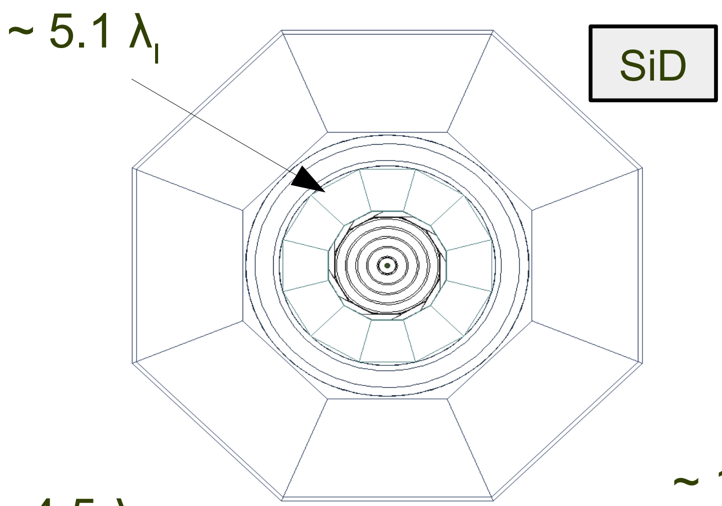
Barrel	**Technology**	**Inner radius**	**Outer radius**	**z extent**
Vertex detector	Silicon pixels	1.4	6.0	+/- 6.25
Tracker	Silicon strips	21.7	122.1	+/- 152.2
ECAL	Silicon pixels-W	126.5	140.9	+/- 176.5
HCAL	RPC-steel	141.7	249.3	+/- 301.8
Solenoid	5 Tesla SC	259.1	339.2	+/- 298.3
Flux return	Scintillator-steel	340.2	604.2	+/- 303.3
Endcap	**Technology**	**Inner z**	**Outer z**	**Outer radius**
Vertex detector	Silicon pixels	7.3	83.4	16.6
Tracker	Silicon strips	77.0	164.3	125.5
ECAL	Silicon pixel-W	165.7	180.0	125.0
HCAL	RPC-steel	180.5	302.8	140.2
Flux return	Scintillator/steel	303.3	567.3	604.2
LumiCal	Silicon-W	155.7	170.0	20.0
BeamCal	Semiconductor-W	277.5	300.7	13.5

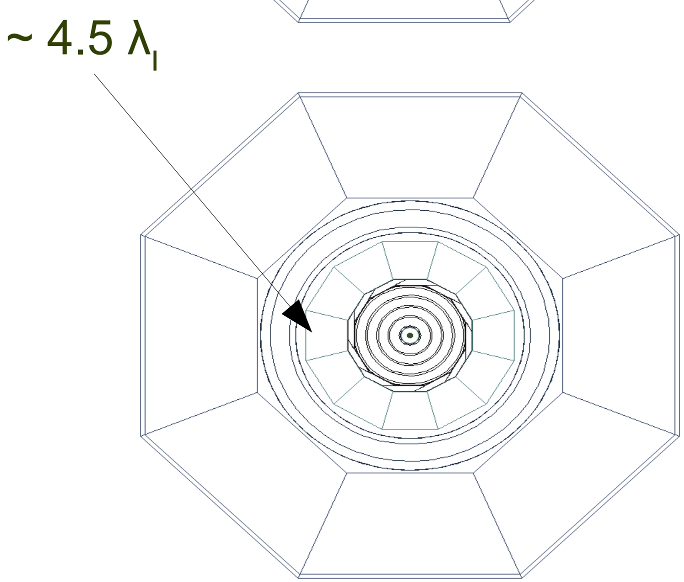
All of this can be changed using XML configuration files

Designing future detectors

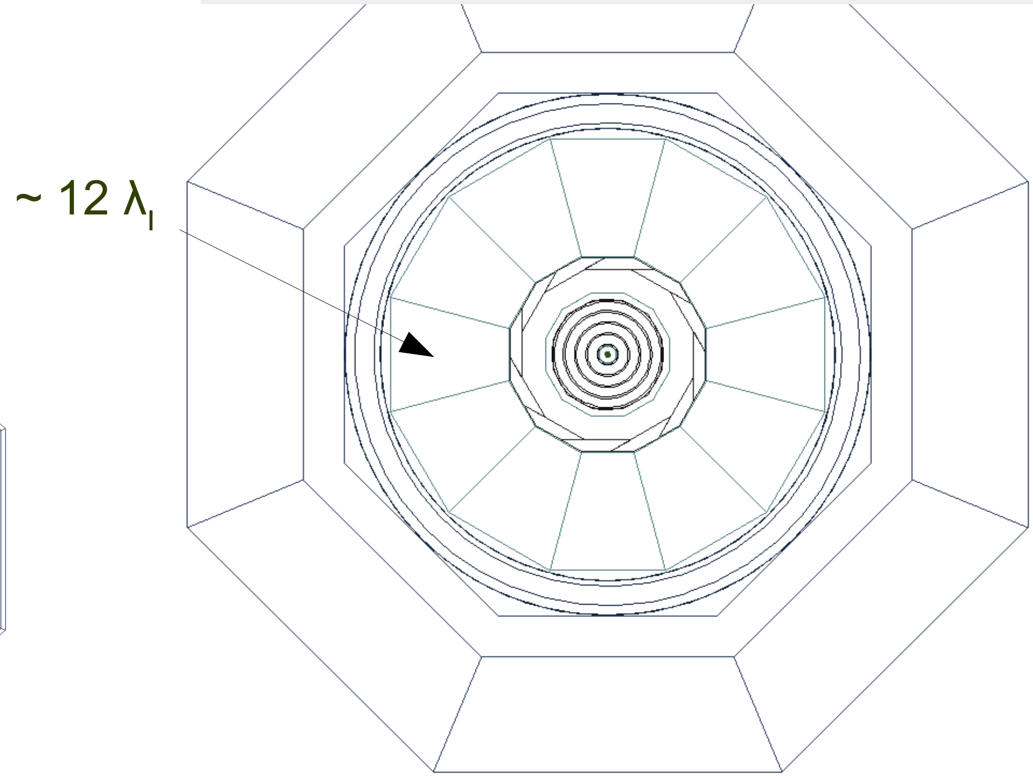
Focus on physics & performance studies of certain detector aspects and physics processes, rather than creating "complete" detectors

Studies of CAL transverse and longitudinal granularity, depth, material, magnetic fields, pixel sizes etc, responses to particles etc.





simplifying for CPEC
(e+e- at 250 GeV)



expanding to FCC-hh
(pp at 100 TeV)

Programming languages

- **EVGEN: ProMC format → C++ (or) Java. Support for Fortran**
- **Delphes fast simulation → C++/ROOT**
- **SLIC software:**
  - Geant4 simulation → C++/C
  - Reconstruction → Java
  - Pandora particle flow algorithm → C++
- **Analysis: C++/ROOT or Jython/Java (Python on the Java platform)**
  - No manpower to maintain platform specific libs → minimize the usage of C++
  - Currently, many studies are done using Python on the Java platform
    - can read PROMC and SLCIO files
    - easy to deploy, no LINUX specific libraries
    - runs on Windows/Mac

https://atlaswww.hep.anl.gov/asc/wikidoc/doku.php?id=fcs:fpad

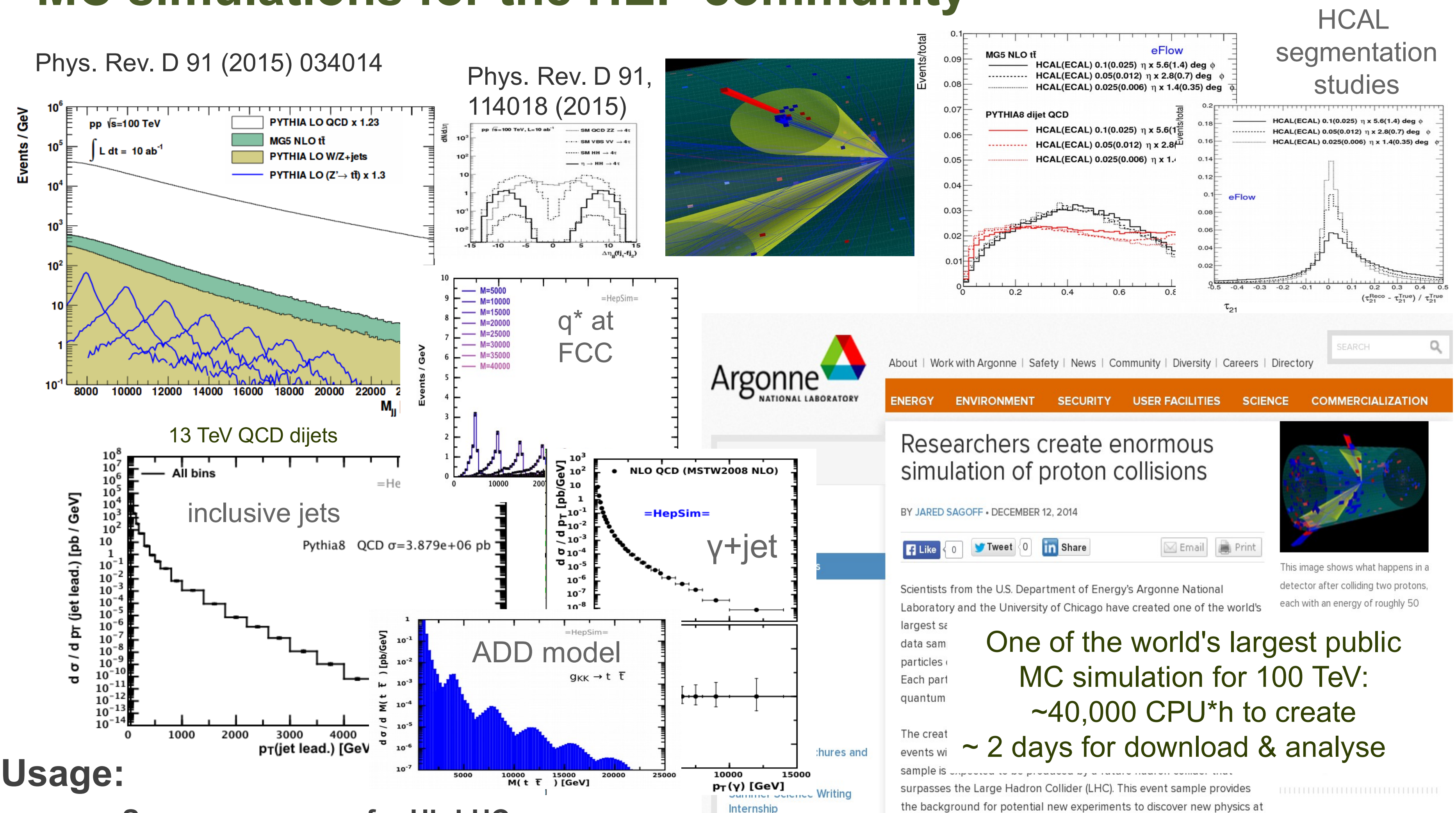
Java

- Most popular object-oriented programming language
- TIOBE Index for January 2016:
  http://www.tiobe.com/index.php/content/paperinfo/tpci/index.html

Jan 2016	Jan 2015	Change	Programming Language	Ratings	Change
1	2	^	Java	21.465%	+5.94%
2	1	v	C	16.036%	-0.67%
3	4	^	C++	6.914%	+0.21%
4	5	^	C#	4.707%	-0.34%
5	8	^	Python	3.854%	+1.24%
6	6		PHP	2.706%	-1.08%

- Students who want to find a job outside HEP should learn Java
- Remember, no Project or R&D money for software support at this stage
- Cannot spend research time on compilation / chasing constantly changing Linux libraries

MC simulations for the HEP community



One of the world's largest public MC simulation for 100 TeV:
~40,000 CPU*h to create
~ 2 days for download & analyse

Usage:

- **Snowmass papers for HL-LHC**
- **ATLAS run I & II analyses:** excl. H^0, excl. WW, direct photons with MCFM NLO, JETPHOX NLO, Long-lived particles, ADD model for gravitons, H → φγ) → validated and shipped to ATLAS
- **FCC physics studies, CPEC (recently)**
- **Detector studies.** List of public talks/papers in **http://atlaswww.hep.anl.gov/hepsim/about.php**

Contributions

- E. May - ProMC format development, benchmarks on BlueGene/Q (ANL)
- K. Strand (SULI 2014) - ProMC conversion tools
- P. Van Gemmeren - testing ProMC format
- T. Sjöstrand - ProMC integration with Pythia8
- P. Demin - ProMC integration with Delphes
- I. Pogrebnyak - (U.Michigan) software validation toolkit, fastjet in Java
- D. Wilbern (SULI 2015) - Pileup mixing tool based on ProMC
- M. Selvaggi - Delphes card for ILD geometry and "**EIC"-like (requested by S.C.)**
- H. Gray - Delphes card for FCC-hh geometry
- J. Strube (PNNL) - LCIO/SLIC for full simulation
- A. Kotwal (Duke Univ.) - LCIO/SLIC for full simulation
- J. Adelman (NIU) – H+tt sample + post-Snowmass Delphes 3.3 card for 13/14 TeV
- S. Padhi - prototyping Snowmass Delphes 3.1 during Snowmass 2013
- K. Pedersen - alternative b-tagging for rfast003 in HepSim
- Shin-Shan Yu - Heavy Higgs MG5 simulations for HepSim

A lot of help / advise from J.McCormick and N.Graph (SLAC)

How to contribute

- Generate EVGEN files and point to their location
  - Fill ProMC correctly, i.e. append complete logfile, cross sections etc.
  - Validate using the HEPSIM tools (if can)
- Contribute to the software tools
- Run Apache server and maintain your own EVGEN & full simulation files

Support (limited, on a voluntary basis): **(contact hepsim@anl.gov)**

- HEPSIM integration, deployment, OSG-grid, EVGEN MC, fast sim etc.
  - ANL: S.C.
- Some support for changes inside SLIC soft (used for ILC)
  - SLAC: N.Graf & J.McCormick
  - PNNL: J.Strube
- Configure detectors, physics, analysis package for circular colliders
  - ANL/Fermilab: S.C., A.Kotwal

Test samples for EIC

- DIS. e-p collisions. 141 GeV: LEPTO+PYTHIA, LEPTO+ARIADNE

Selected: e^{-} p collisions, 141 GeV CM energy. p(250 GeV), e(20 GeV), all type

Show 25 entries   Previous 1 Next   Search:

Id	→←	E [TeV]	Name	Generator	Process	Topic	Info	Link	Created
156	e-p	0.141	gev141ep_lepto6_dis100q2	LEPTO/PYTHIA	DIS events at Q2>100 GeV2	SM	Info	URL	2015/12/10
157	e-p	0.141	gev141ep_lepto6_dis1000q2	LEPTO/PYTHIA	DIS events at Q2>1000 GeV2	SM	Info	URL	2015/12/10
159	e-p	0.141	gev141ep_lepto6_dis5q2	LEPTO/ARIADNE	DIS events at Q2>5 GeV2	SM	Info	URL	2015/12/10

- http://atlaswww.hep.anl.gov/hepsim/index.php?c=emp&e=141&t=all
- ep. 141 CM energy. Several Q2 regions
- Includes fast and full simulations for testing:
  - SiD detector full simulations (**rfull001** tag)
  - ILD fast simulation (**rfast001** tag)

- Moving Monte Carlo code used for HERA (ARIADNE, LEPTO, AROMA, CASCADE, RAPGAP, PHOJET, PEPSI) from the RunMC project http://runmc.hepforge.org/

Analyzing EVGEN & full simulation files for e+p (DIS)

- Go to: http://atlaswww.hep.anl.gov/hepsim/info.php?item=156
- Then click “**rfull001**”. Find *.slcio files.
- Download samples as:

```
wget http://atlaswww.hep.anl.gov/asc/hepsim/soft/hs-toolkit.tgz -O - | tar -xz;
source hs-toolkit/setup.sh
hs-get gev141ep_lepto6_dis100q2               # get EVGEN files (can be large)
hs-get gev141ep_lepto6_dis100q2%rfull001      # get full simulation files (~100 events)
```

- EVGEN files can be analyzed as explained in http://atlaswww.hep.anl.gov/hepsim/description.php
- Analysis of full simulation files (reconstructed particles & calorimeter hits, tracks) can be done as explained here for e+e-:
  - **https://atlaswww.hep.anl.gov/asc/wikidoc/doku.php?id=fcs:fpad**
  - **pay attention to “electron container” (DIS!)**

Good Luck!