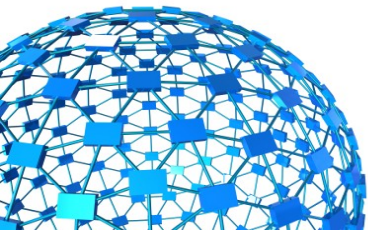


Monte Carlo samples for a 100 TeV collider

S. Chekanov (ANL)



HepSim Monte Carlo event repository

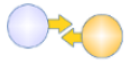
- A number of MC event samples for a 100 TeV collider were generated in 2014
- Main focus: Higgs, top and some background SM processes for top
- Currently, only truth-level events at LO+PS and NLO
 - No pileup
 - No fast detector simulation. But the instruction is available
- NLO samples were generated using ANL BlueGene/Q supercomputer
 - MCFM and JETPHOX were interfaced with MPI
- Can be used to study physics reach at a 100 collide, identify interesting processes, look at cross sections, event statistics etc.
- ANL is hosting ~40 100 TeV samples, 20k files, ~150M events (top, Higgs, etc)

Primary URL link: <https://atlaswww.hep.anl.gov/hepsim/>

Old: <http://mc.hep.anl.gov/asc/hepsim/events/>



HepSim database: <https://atlaswww.hep.anl.gov/hepsim/>



Database Help

Show all

pp collisions

7 TeV

8 TeV

13 TeV

33 TeV

100 TeV

e+e- collisions

500 TeV

ep collisions

920 TeV

HepSim

Repository with predictions for HEP experiments

Selected: pp collisions, 100000 GeV energy, all type

This is a new HepSim database. For more datasets use n [Old HepSim repository](#)

Show 25 entries

Search:

Nr		E (GeV)	Name	Generator	Process	Topic	Info	Url
1	pp	100000.0	higgs_pythia8_100tev	PYTHIA8	gg2Httbar and qqbar2Httbar	Higgs	Info	URL link
2	pp	100000.0	higgs_ttbar_mg5	MADGRAPH+HERWIG6	Higgs+ttbar	Higgs	Info	URL link
3	pp	100000.0	kkgluon_ttbar_1tev_pythia8	PYTHIA8	KKgluon (1 TeV) to ttbar	Exotic	Info	URL link
4	pp	100000.0	kkgluon_ttbar_4tev_pythia8	PYTHIA8	KKgluon (4 TeV) to ttbar	Exotic	Info	URL link
7	pp	100000.0	kkgluon_ttbar_4tev_pythia8	HERWIG++	All dijet QCD events	Exotic	Info	URL link
8	pp	100000.0	kkgluon_ttbar_8tev_pythia8	PYTHIA8	KKgluon(8 TeV) to ttbar	Exotic	Info	URL link
9	pp	100000.0	kkgluon_ttbar_16tev_pythia8	PYTHIA8	KKgluon (16 TeV) to ttbar	Exotic	Info	URL link
10	pp	100000.0	kkgluon_ttbar_20tev_pythia8	PYTHIA8	KKgluon (16 TeV) to ttbar	Exotic	Info	URL link
11	pp	100000.0	qcd_pythia8_pt300	PYTHIA8	All dijet QCD events	SM	Info	URL link
12	pp	100000.0	qcd_pythia8_pt900	PYTHIA8	All dijet QCD events	SM	Info	URL link
13	pp	100000.0	qcd_pythia8_pt2700	PYTHIA8	All dijet QCD events	SM	Info	URL link
14	pp	100000.0	qcd_pythia8_pt8000	PYTHIA8	All dijet QCD events	SM	Info	URL link

A SQL database store file Metadata. Registered users can add MC samples
HEPMC front-end can point to any URL location. Samples are stored using ProMC:

- file archives with variable byte encoding + embedded logfiles

Also supports: ROOT, HepML, StdHEP, HEPMC, etc.

Monte Carlo for a 100 TeV pp collider

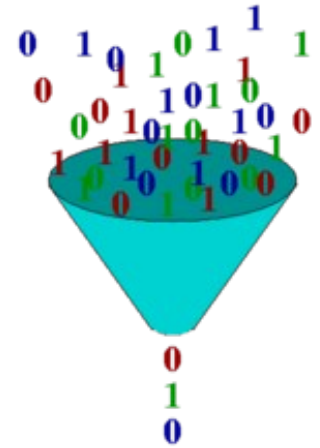


Available samples: NLO, NLO+PS, LO+PS

- MG5: $TT\bar{t}$
- MG5: Higgs+jj
- MG5: Higgs+ $TT\bar{t}$
- PYHIA8, HERWIG++ for dijet QCD (~ 100 fb)
- MCFM: Higgs $\rightarrow \gamma\gamma$
- MCFM: Inclusive gamma
- MCFM: $TT\bar{t}$
- PYTHIA8 for Z' and $g(KK)$ with masses from 6 to 20 TeV
- PYTHIA8 for W'
- PYTHIA8 W/Z+jets
- NLOjet++ for inclusive jets
- JETPHOX NLO for inclusive photons



Data size reduction



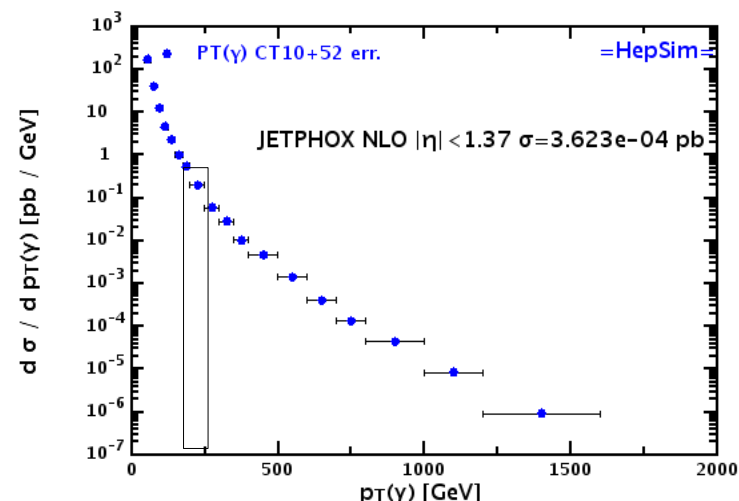
- **To reduce data size, ProMC format is used**
 - arxiv: 1311.1229 (CPC in press)
 - ~30% smaller than any fixed-byte format (like ROOT)
 - ~30% faster to process
- **Further file size reduction is done using slimming:**
 - status=1 && pT>0.3 GeV or # final states
 - (PID=5 || PID=6) or # b or top
 - (PID>22 && PID<38) or # exotics and Higgs
 - (PID>10 && PID<17) or # leptons/neutrinos
- **Most essential partons/bosons are kept**
- **Files can still be processed using “DelphesProMC”**
 - but tau reconstruction is not possible after slimming
- **Typical size: 10,000 events use ~80MB (8kB/events)**



Storing data from NLO programs

- Data from NLO/NNLO etc. are kept as ProMC “ntuple”:
 - 4-momenta (~2-3 particles)
 - all weights for systematics (40-50 floats)
- Keep central weight as **double** and deviations from the central value in form of **varint** (int!)
 - $[(1-\text{PDF}(i)/\text{PDF}(0)) * 1000]$
 - effective varint compression: 50k events ~10 MB
- **Data creation time on BlueGene/Q is ~1-2K CPU/h**
- **Typical data output ~ a few GB**
- **Processing time on a desktop <1h**

Current challenges:



- One pT bin → 10h
- 20 bins → 200h for all bins
- Few PDFs, scale variations → 2000h

HepSim for 100 TeV

<https://atlaswww.hep.anl.gov/asc/hepsim/>

=HepSim= reference HEP simulation samples

RefHepSim is a repository with reference Monte Carlo events (LO+PS, NLO, etc) for HEP experiments. Events are stored in the **ProMC** format. RefHepSim can be used to browse separate events, look at cross sections, reconstruct any distribution or use for fast detector simulations as described in the [HepSim manual](#). In order to download a folder with all files, right click on the directory below and select "Copy link location". Then use this command to copy all files: `wget -r -l1 -H -t1 -nd -N -np -A promc -E [URL]`, substituting [URL] with the correct directory name.

pp collisions	8 TeV, 13 TeV, 14 TeV, 100 TeV
e+e- collisions	500 GeV

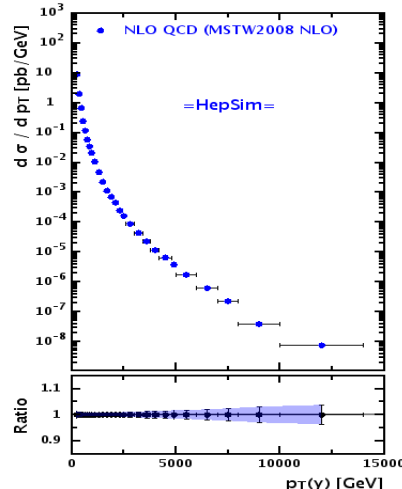
Send comments to: Sergei Chekanov (ANL) chekanov@anl.gov.

events/pp/100tev

16 directories, 0 files (51.44 GiB total)

Search files ☐ Case sensitive ☐ Current directory only

Nr	Directory/File name	Description		Size	Last Modified
1	gamma_jetphox/	JETPHOX 1.3.2 : 10M events, inclusive gamma at NLO QCD for $p_T > 1$ TeV. CT10 NLO +52 PDF errors	plot data script.py	1.24 GiB	2014-02-18 21:08
2	gamma_jetphox_ptbins/	JETPHOX 1.3.2 : 10M events, inclusive gamma at NLO QCD for $p_T > 200$ GeV. MSTW2008 NLO +41 sets. Binned in p_T	plot data script.py	6.28 GiB	2014-03-01 18:57
3	gamma_mcfm/	MCFM 6.7 : 26M events, inclusive gamma at NLO QCD for $p_T > 1$ TeV. CT10 NLO +52 PDF errors	plot data script.py	6.19 GiB	2014-02-11 20:28
4	higgsjet_gamgam_mcfm/	MCFM 6.7 : 26M events, Higgs(\rightarrow gamma+gamma)+jet at NLO QCD. CT10 NLO +52 PDF errors. $\sigma = 672.3 \pm 7.0$ fb	plot data script.py	1.47 GiB	2014-02-14 15:40
5	higgs_gamgam_mcfm/	MCFM 6.7 : 26M events, Higgs(\rightarrow gamma+gamma) at NLO QCD. CT10 NLO +52 PDF errors. $\sigma = 123.4 \pm 7.0$ fb	plot data script.py	2.07 GiB	2014-02-14 15:41
6	higgs_pythia8/	PYTHIA8 : 10,000 events, $gg2Httbar$ and $q\bar{q}b2H$	plot data script.py	852.20 MiB	2014-03-01 07:26
7	higgs_ttbar_mcfm/	MCFM 6.7 : Higgs+ttbar. 20,000x512 events. No QCD	plot data script.py	2.34 GiB	2014-02-14 15:42
8	higgs_ttbar_mg5/	MadGraph5 : $p p \rightarrow h t t$ [QCD], 100k events, aMC	plot script.py	477.77 MiB	2014-02-08 12:00
9	jets_nlojetpp/	NLOJET++ : Incl. antiK _T 4 jets at NLO QCD. pTg	plot data script.py	1.74 GiB	2014-02-25 13:16
10	qcd_pythia8/	PYTHIA8 : 100,000 events. All QCD processes. H	plot script.py	716.21 MiB	2014-02-13 16:04
11	qcd_pythia8_full/	PYTHIA8 : 400,000 events. All QCD processes. p		8.71 GiB	2014-03-10 09:17
12	ttbar_mcfm/	MCFM 6.7 : 26M events, ttbar at NLO QCD (proc	plot data script.py	5.57 GiB	2014-02-13 08:29
13	ttbar_mg5/	MadGraph5 : $p p \rightarrow t t$ [QCD], 100k events, aMC	plot data script.py	365.49 MiB	2014-03-01 07:53
14	ttbar_pythia8_full/	PYTHIA8 : 400,000 events. ttbar processes. pT=			09:19
15	wprime10000_pythia8/	PYTHIA8 : 50,000 events. Wprime to ttbar. M=10			20:32
16	zboson_ee_mcfm/	MCFM 6.7 : 20M events, Zboson(\rightarrow e+e) at NLO Q			15:41

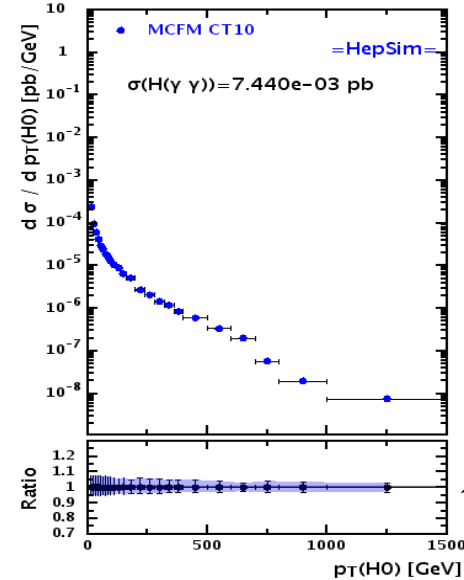
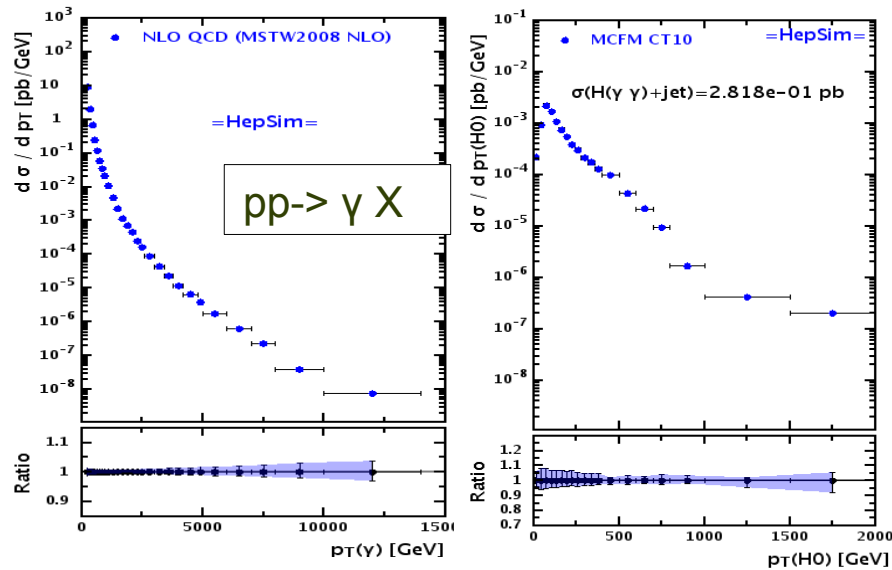


Truth levels
8, 13, 14, 100 TeV
MC LO, NLO+matched
showers, NLO (MCFM)

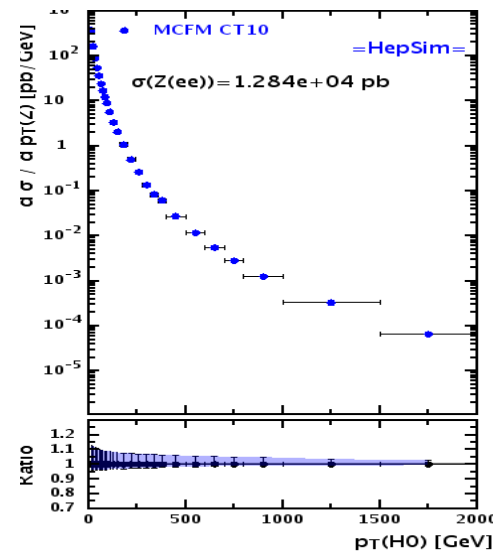
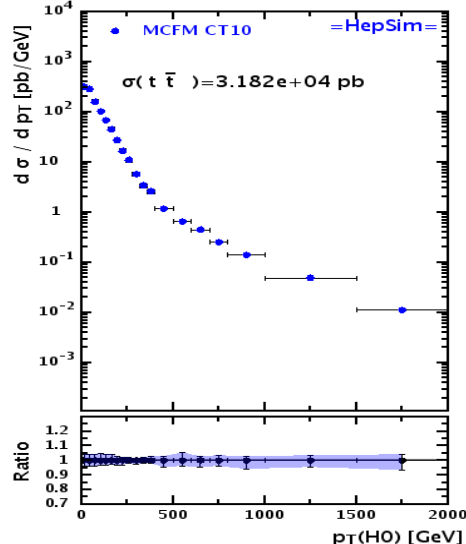
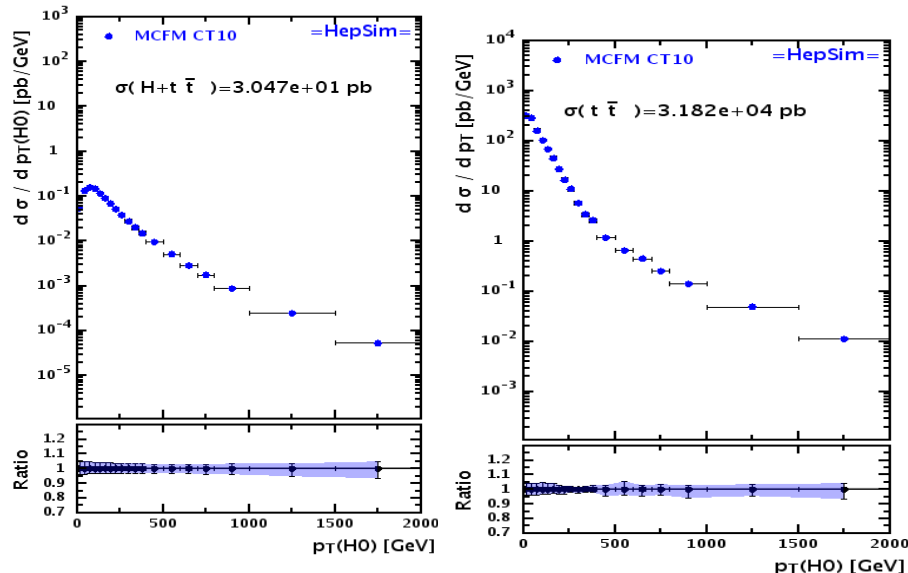
Monte Carlo for a 100 TeV pp collision



=SimHep= results for a 100 TeV pp collider



$$\frac{\sqrt{\sum_{i=1}^N (\sigma_i - \sigma_0)^2}}{\sigma_0}$$



PDF uncertainties
are within 11% for all
studied processes

Realistic plots for Z'/g(KK)

