MC WG

What do parton shower event generators do?

- An "event" is a list of particles (pions, protons, ...) with their momenta.
- The MCs generate events.
- The probability to generate an event is proportional to the (approximate!) cross section for such an event.
- Calculate Everything $\sim$ solve QCD $\rightarrow$ requires compromise!
- Improve lowest-order perturbation theory, by including the "most significant" corrections $\rightarrow$ complete events (can evaluate any observable you want)

The Workhorses: What are the Differences?

All offer convenient frameworks for LHC physics studies, but with slightly different emphasis:

PYTHIA: Successor to JETSET (begun in 1978). Originated in hadronization studies: Lund String.

HERWIG: Successor to EARWIG (begun in 1984). Originated in coherence studies: angular ordering parton shower. Cluster model.

SHERPA: Begun in 2000. Originated in "matching" of matrix elements to showers: CKKW.

MC WG

General purpose MC models are essential tools for the LHC.

Significant progress in MPI models of MC generators since Perugia 2008:

Herwig – new soft MPI, new colour reconnection models, new tunes, the model constrained using sigma eff.

Pythia – (already well developed MPI model in Perugia) but still significant progress: x-dependent over lap function, MPI re-scattering, a lot of tunes.

Sherpa – new model SHRiMPS, released recently (to construct a new model it takes years...).

Last by not least:
DIPSY (new fused string model), **EPOS** (LHC version), **PHOJET**, ...

Tuning

Progress in MC tuning:
- Rivet for analysis
- Professor for tuning

} Tune takes ~ days

- A lot of tuning activities
- Energy dependent tunes (TEVATRON+LHC)

  → Predictions for 13 TeV
- Need of Rivet plugins, data corrected for the detector effects, as much as possible model independent … (for example CDF/D0 sigma eff)
- Prepare measurements anticipating the development of models? (Sigma eff discussion).
- Tuning procedure is not unique (multiple choices, data sets, weights...)

Tuning

Tuning remarks: tunes from mcplots-dev.cern.ch

Sherpa 1.4.0

1. default

Herwig++ 2.6.1a

1. LHC-UE-EE-4
2. LHC-UE-EE-4-CTEQ6L1
3. LHC-UE-EE-SCR-CTEQ6L

Pythia 8.170

1. default
2. default-CD
3. default-MBR
4. default-noFsr
5. default-noRap
6. early
7. tune-1
8. tune-2c
9. tune-2m
10. tune-4c
11. tune-4cx
12. tune-A2

Pythia 6.426p12

1. 350
2. 351
3. 352
4. 353
5. 354
6. 355
7. 356
8. 357
9. 358
10. 359
11. 360
12. 361
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14. 363
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17. 370
18. 371
19. 372
20. 373
21. 374
22. 375
23. 376
24. 377
25. 378
26. 379
27. a
28. ambt1
29. atlas-csc
30. dfc
31. default
32. dw
33. dwt
34. p0
35. p2010
36. p3
37. p6
38. phard
39. pnocr
40. pro-q2o
41. psoft
42. px
43. z1
44. z1-lep
45. z2
46. z2-lep

Tuning uncertainties?
Help from the experimental collaborations?

Future

- Better description of the data (more and more detailed measurements, identified particles, high multiplicity events, ridge, unitarity bound checks,...)
- Better understanding of models components (i.e. colour reconnection – LEP constrains?, new measurements – see for example Phojet talk)
- Better models (i.e. new models of diffractions with MPI, takes time)
- Making connections between phenomenological models and theoretical calculations.
- Tuning uncertainties?

Monte Carlo

training studentships

3-6 month fully funded studentships for current PhD students at one of the MCnet nodes. An excellent opportunity to really understand and improve the Monte Carlos you use!

Application rounds every 3 months.

MCnet

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MC*net* projects

Pythia

Herwig

Sherpa

MadGraph

Ariadne

CEDAR