LHC Monte Carlo Workshop

Peter Richardson
(CERN, TH) and IPPP, Durham

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Introduction

- The workshop lasted for a whole month and there were many working groups:
  - Minimum bias and tunings;
  - Decays;
  - PDF tools;
  - C++ Event Generators;
  - CLHEP;
  - BSM tools;
  - Matrix Element tools;
  - EW tools;
  - N(N)LO Tools.
- Obviously I didn't go to all of them, and most of you aren't interested in most of them anyway.
- I will concentrate on the BSM with highlights from other groups I attended.

General

- The experimental attendance was VERY poor, with the exception of the minimum bias group.
- In many sessions there were no experimentalists present.
- This annoyed some of the theorists present, myself included, who felt a lot of our time had been wasted (I got no other work done during the whole month for example).
- I accept that there are reasons for this but still the experimental participation could have been better.

BSM sessions

- The BSM sessions were spread over a week.
- We started with a presentation of the available simulation tools.
- This was followed by talks from the experiments on their needs.
- A wish list from ATLAS was discussed.
- The wish list was of little use, contained many things which were all ready done and none of the experimental physicists present had any interest in any of the remaining BSM items.

BSM sessions

- A major result of the discussion was on the provision of the latest BSM models.

- The majority view was as follows
  - The coding of the latest pink elephant production model was a waste of the time of the limited number of generator authors.
  - Their time is better spend doing the things only they can do, e.g. parton showers, hadronization modeling etc.

- This means that
  - If you ask for a new BSM process for HERWIG or PYTHIA you are likely to be told to go and do it yourself.
  - The Les Houches Accord on interfacing matrix elements and general purpose event generators should make this relatively easy.

BSM sessions

- To help with this I wrote a short tutorial together with example code for the Little Higgs model.

  http://www.ippp.dur.ac.uk/montecarlo/leshouches/tutorial/

- There were a lot of fruitful discussions about the Les Accord for SUSY spectrum calculations which will be talked about later.

Minimum Bias and Tunings

- This was certainly the most successful group.
- A number of interested experimentalists attended from the LHC experiments.
- Rick Field from CDF also was there.
- There was a lot of useful discussion on what the LHC people could learn from the Tevatron experiments.
- This means there are now tunes of PYTHIA available which can be used from LHC physics which give the right result for the Tevatron underlying event.

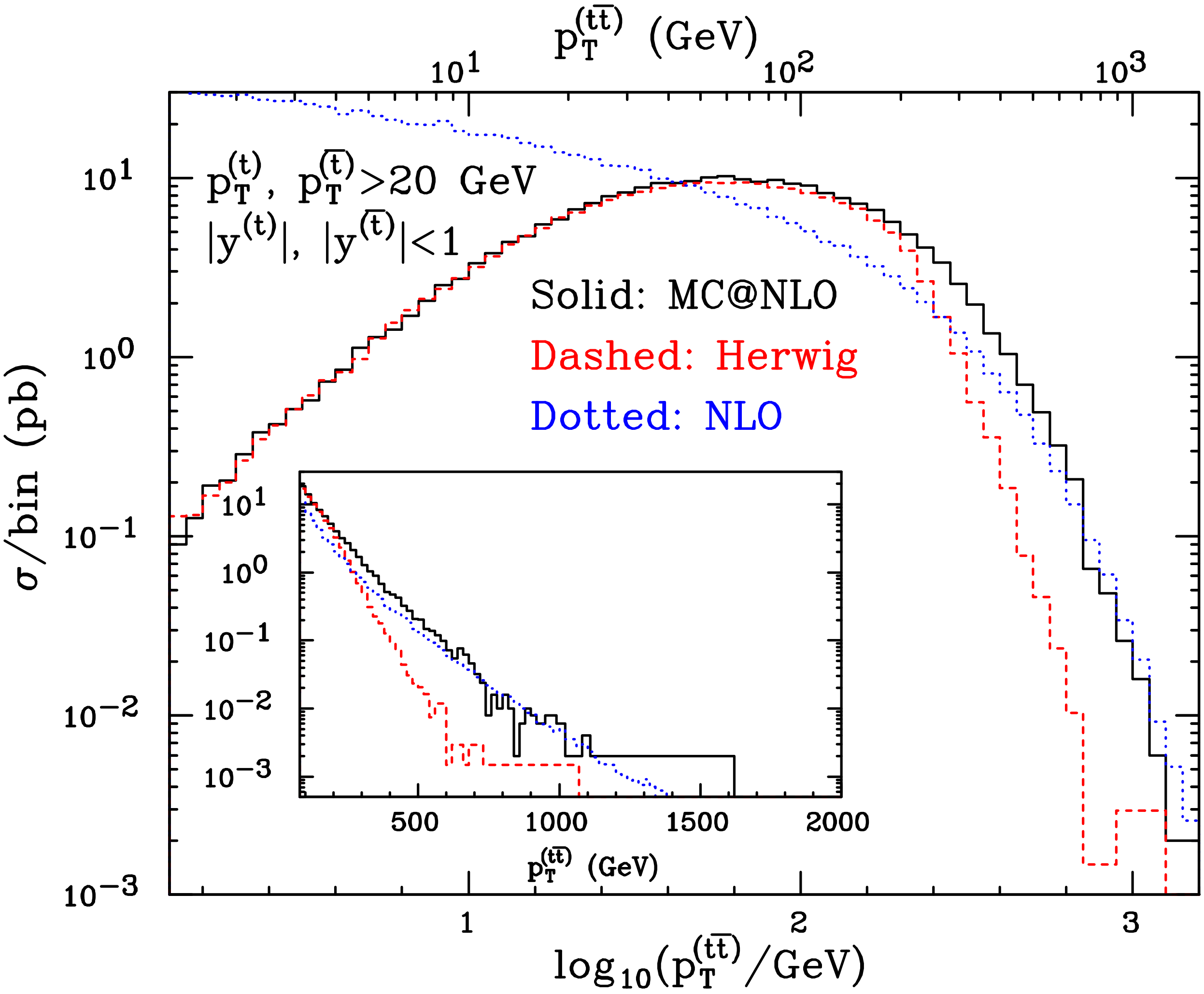
Matrix Element Calculations

- There were many useful comparisons of the code (I'm told this is true I wasn't there)
- There was a lot of discussion of merging matrix elements and parton showers
- A number of approaches were presented the basic idea of all of these is:
  - Use the matrix element to generate hard emission which it is good at;
  - Use the parton shower to do the soft and collinear physics it is good at.
- The aims is to provide better simulation of additional hard radiation which is not well described by HERWIG and PYTHIA.
- There have been major advances both in
  - The first NLO Monte Carlo simulations (mainly the work of Webber and Frixione)
  - Ideas for merging with more jets (CKKW)

Matching at NLO

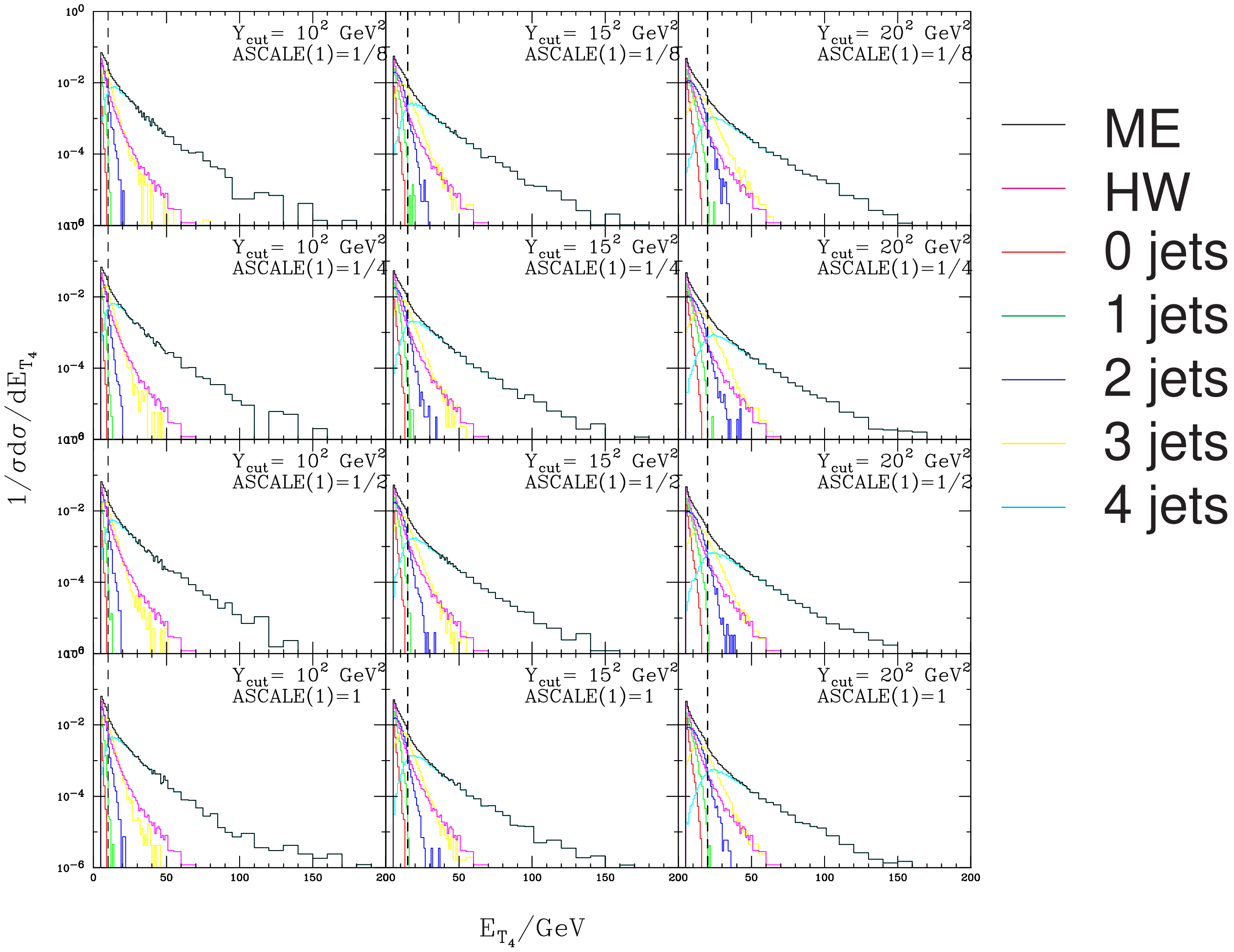
- These methods get the hardest emission correct together with the correct NLO cross section.

- These simulations are now available for a range of processes using the method of Frixione and Webber.



CKKW Matching at leading-order

- Still has leading-order normalization.
- However gets the emission of many hard jets correct.



Matrix Element Calculations

- This work is important to BSM as a better calculation of the background.
- For LHC studies it is no longer to sufficient to run HERWIG/PYTHIA off the shelf for the backgrounds
- For many backgrounds with large numbers of jets it is probably wrong.
- Better tools are out there use them.

C++ Generators

- The workshop saw the first usable versions of the C++ generators HERWIG++, PYTHIA7 and SHERPA.
- No experimentalists attend the tutorials.
- These programs are still at the development stage but they will be the generators of the LHC era.
- Support for FORTRAN HERWIG and PYTHIA will eventually cease.
- Its important the experiments start looking at these programs now.
- If not don't expect much sympathy in a few years time when you find out what you wanted/needed isn't there.

Other Groups

- I didn't attend many of the other sessions.
- Here's a brief summary of what I understand happened.
  - The (N)NLO sessions were mainly theoretical and pretty much separate from the rest of the workshop.
  - The decays session was also poorly attended. Agreement was reached on general methods and EvtGen is becoming the package of choice for hadronic (particularly b) decays in the experimental community

Conclusions

- In general the workshop was useful, although perhaps a bit too long.

- More experimental participation would have been very useful.

- A lot of progress still needs to be made before the start of the LHC.