MG/ME tutorial: running the code and gridpack preparation

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CMS A. M. C. U. a.T.S. - CERN - 15/12/08
Plan

❖ GridPack and multi-jet events generation

❖ Live tutorial
Mass production with MG/ME

❖ For MG/ME the proposal/request: make possible a fast mass generation of SM processes

★ V,VV, photon, ttbar + jets, QCD,.. (Page accessible at http://cp3wks05.fynu.ucl.ac.be/twiki/bin/view/Library/MadGraphSamples)

❖ ⇨ Fast Mass production: need “gridpack”.

❖ ⇨ Multi-jets events: need “jet matching”.
GridPack: self-contained, phase-space optimized pack for fast mass production via the Grid

- Usual MG code (Web, cards,...)
- Standard LHE format for events

Easy to use:

- Unzip/untar a “gridpack.tar.gz”
- compile the code
- ./run.sh #events seed
At the LHC, QCD radiation will be important.

★ crucial to simulate them correctly!

Monte Carlo idea: we need a realistic multi-(extra) jets event generation with full matrix-element calculation:

★ High scales: Matrix-Element; lower scales : Parton-Shower

If Matrix-Element and Parton Shower contributions are mixed without control: double counting between QCD topologies

★ Separate phase-spaces by using a cutoff: jet matching

In MG/ME: 2 MLM-like methods widely tested, now working in BSM processes.

For more details see J.Alwall, SdV, F.Maltoni  hep-ph/8105350
Practical access to MG/ME

- Online generation: 2 official servers
  - madgraph.phys.ucl.ac.be (>500 CPU, 180 Tb)
  - madgraph.hep.uiuc.edu (36 CPU, 2 Tb)
  - to use them, just register

- Whole package downloadable

- CVS version with cgi-scripts available.

- Adaptation to Condor (with “translation” scripts), PBS.
Production of $t\bar{t}+0,1$ jet gridpack

I) Generate the diagrams

- Madgraph works with proc_card.dat:
  - process definition
  - Model used
- Let's see how it works!
II) Generate the events/gridpack

- MadEvent works with two cards
  - `param_card.dat`: Model parameters
  - `run_card.dat`: kinematics, cuts, switches:
    - to start matching procedure: 4 parameters
      - "ickkw=1": MLM-like matching
      - "xqcut": minimal authorized Kt distance between partons at the ME level
      - "drjj" has to be set to very small values to not interfere with xqcut
      - "etaj" has to be set to 5
  - To get a gridpack: just one switch to change!
Matching at the parton Shower level

❖ Pythia (pythia_card.dat): see talk of Dorian Kcira

★ "Qcut": Actual matching cutoff separating the phase-space into two independent parts.

★ Inclusive or exclusive

★ Additional cuts for BSM matching

★ Find all details for online/offline generation + jet matching + gridpack preparation from the wiki page

› https://twiki.cern.ch/twiki/bin/view/CMS/MadgraphGridpackPreparation

› http://cmsfm201.fynu.ucl.ac.be/MadgraphStorage/Gridpacks/
Summary

- MG/ME contains now fully tested methods for multi-jets events generation, in the SM and beyond.
- The gridpack feature opens a door for mass production of ME level events.
Back-up slides
Introduction to MG/ME

❖ Madgraph:

★ Generates diagrams and corresponding amplitudes for custom processes in a given model (HELAS compatibility): by default: SM, MSSM, 2HDM, HEFT, exotic resonances.

★ Fortran (self-contained)

★ Tested up to 120k diagrams Z/a*+jets

★ produces a self-containing MadEvent package
Introduction to MG/ME

❖ MadEvent:

★ Uses the information of MadGraph to compute cross-section and simulate events

★ "Single Diagram Enhanced Multi Channel Integration"

\[ | \sum_i A_i |^2 = \sum_i \left[ \frac{ | A_i |^2 }{ \sum_j | A_j |^2 } \right] \sum_k | A_k |^2 \]

Parallel by nature

★ Provides unweighted events in "Les Houches" format
Does it work?

- A real test of Kt MLM: W,Z+ jets at Tevatron

- For other SM processes: Theoretical validation for ttbar+jets, QCD, bbar+jets, photon +jets, we come to that in a while...
Beyond the SM? Again a story of double counting!

- Additional difficulty: double counting due to resonances

Example in SUSY: $\tilde{q}\tilde{q}jj$
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If Go’s on resonance:

double counting with

with go→dr+q in pythia
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If Go’s on resonance:
- double counting with $g\to d\bar{r}+q$ in pythia

OK!
Check differential jet rates

- Transition from PS to ME regime is smooth
- Cross section is stabilized
- Global shape remains invariant under cutoff change

How to get DJR? [http://cp3wks05.fynu.ucl.ac.be/twiki/bin/view/Software/MatchChecker](http://cp3wks05.fynu.ucl.ac.be/twiki/bin/view/Software/MatchChecker)
The IS radiation in Pythia only

- Case of gluino production done “a la Pythia “(2→2):
  Pt distribution of extra-jets

![Graph of pt distribution of extra-jets with legend: Q^2 wimpy, Q^2 power, P_T wimpy, P_T^2 power]
Case where gluinos are produced with ME calculation with up to 2 jets with MG/ME (2→2,3,4)
Who’s who in MG/ME team?

Boss:

PostDocs:

PhD stud’s:

+long-standing collaborators:
  S.Mrenna, D.Rainwater, T.Plehn