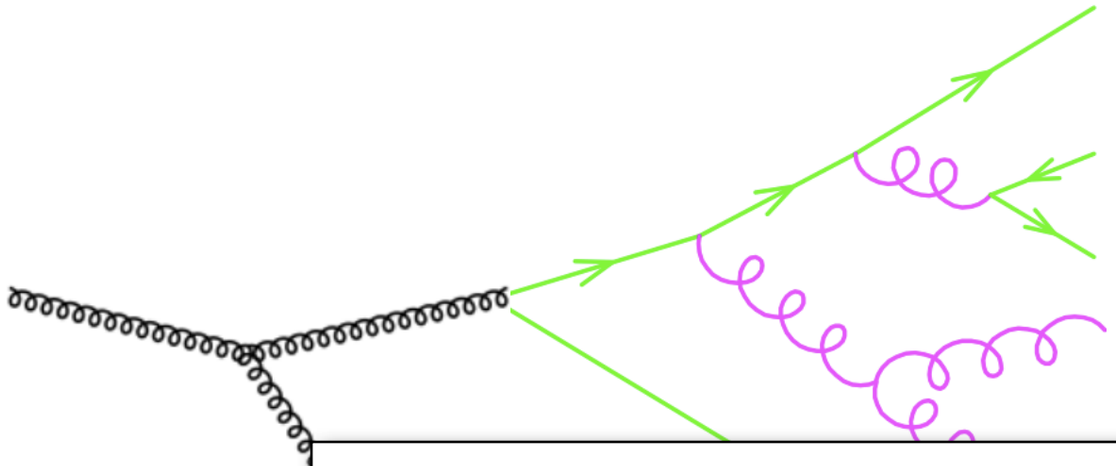

MG/ME tutorial: running the code and gridpack preparation

S.de Visscher

Université catholique de Louvain

On Behalf of the MG/ME Team

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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 Production

- 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*

The multi-jet events generation

- 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-Showers
- If Matrix-Element and Parton Shower contributions are mixed without control: double couting 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.

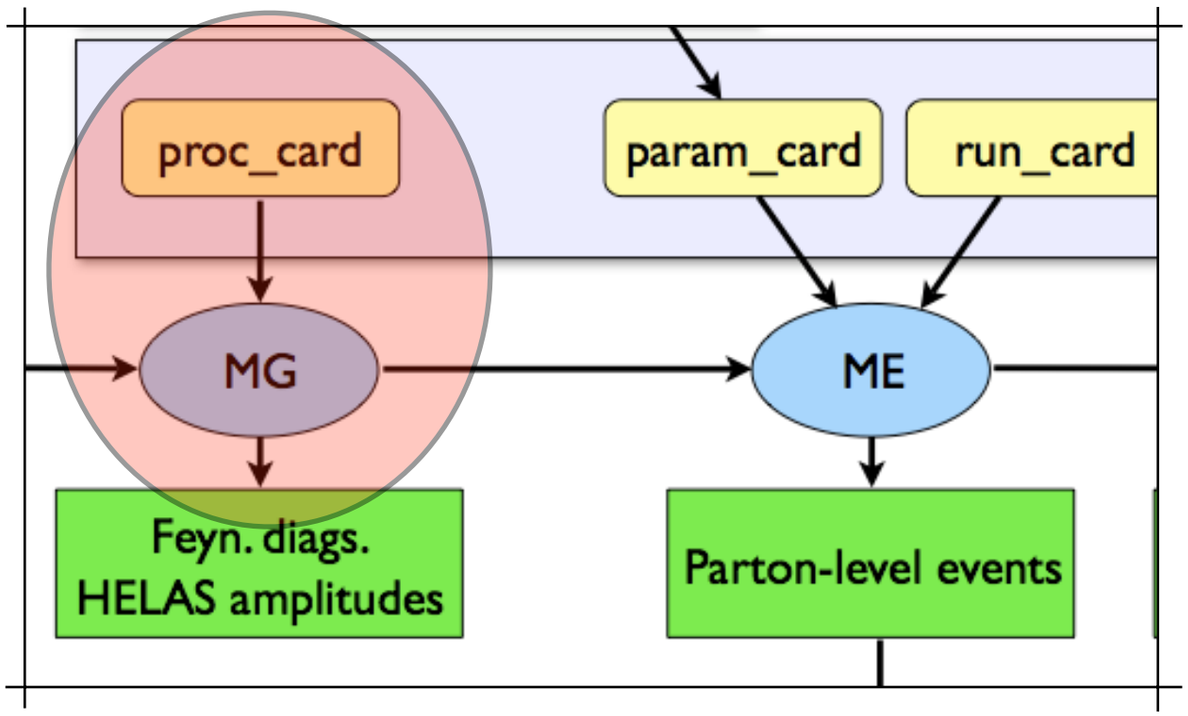
For more details see J.Alwall, SdV, F.Maltoni hep-ph/8105350

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 ttbar+0,1 jet gridpack

I) Generate the diagrams

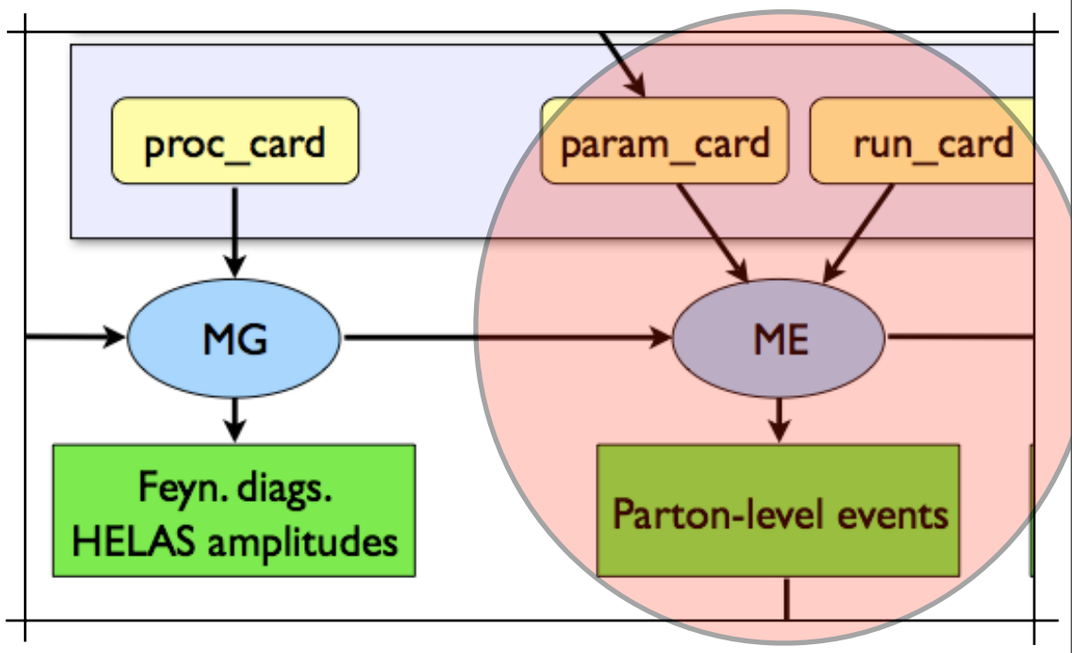


- Madgraph works with proc_card.dat:
  - process definition
  - Model used
- Let's see how it works!

Production of ttbar+0,1 jet gridpack

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 independant 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”

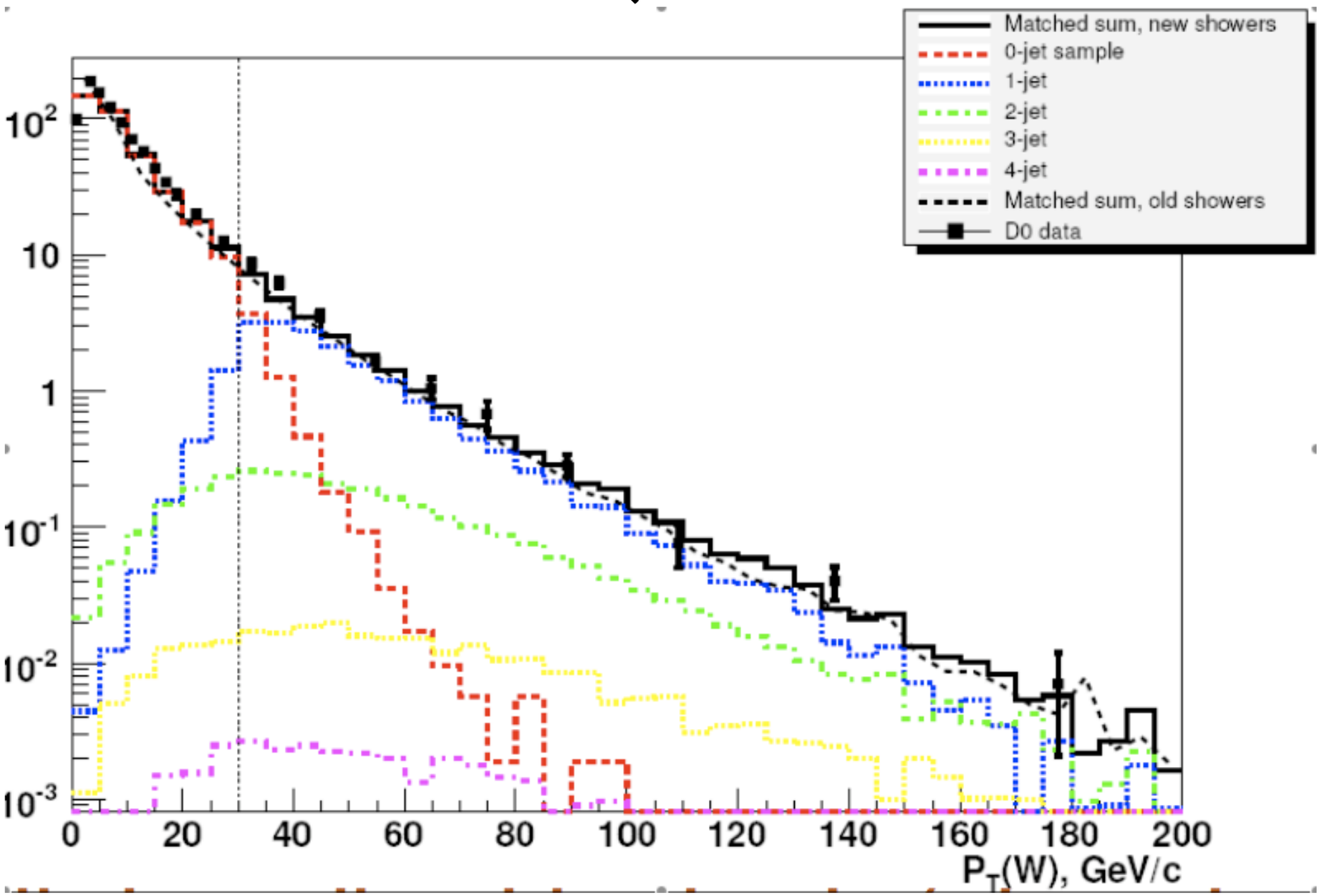
Parallel by nature

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

- ★ Provides unweighted events in “Les Houches” format

Does it work?

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

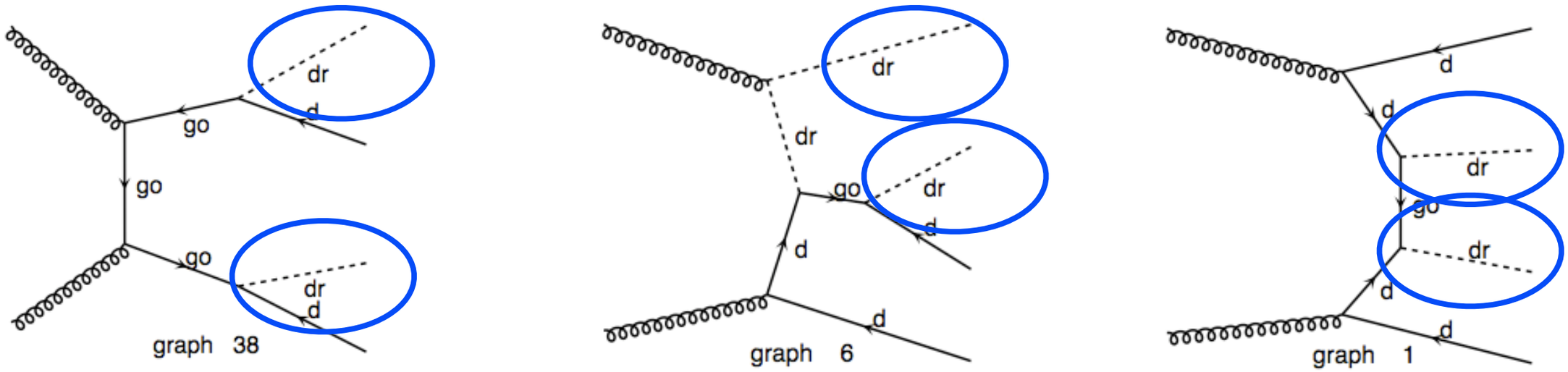


- For other SM processes:
  Theoritical validation for ttbar+jets, QCD, bbar+jets,photon +jets, we come to that in a while...

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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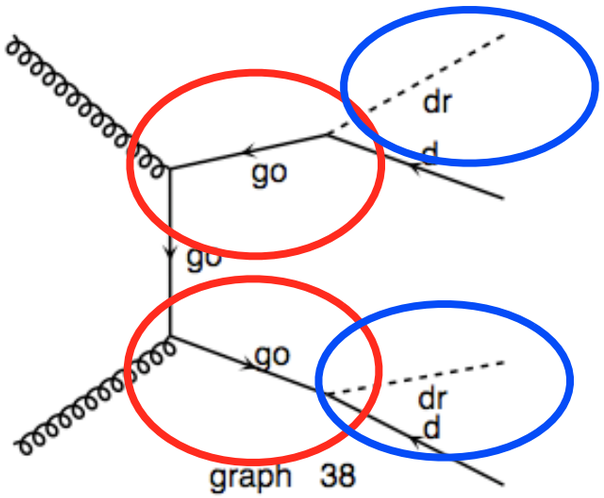
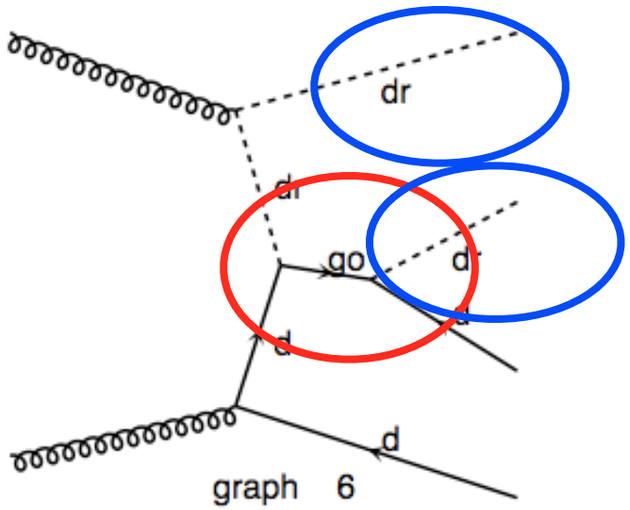
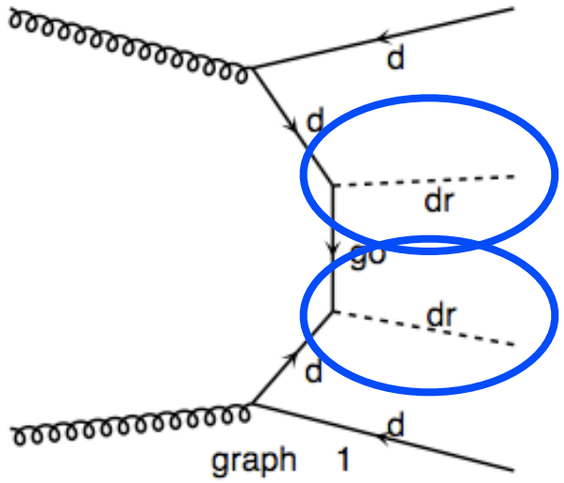
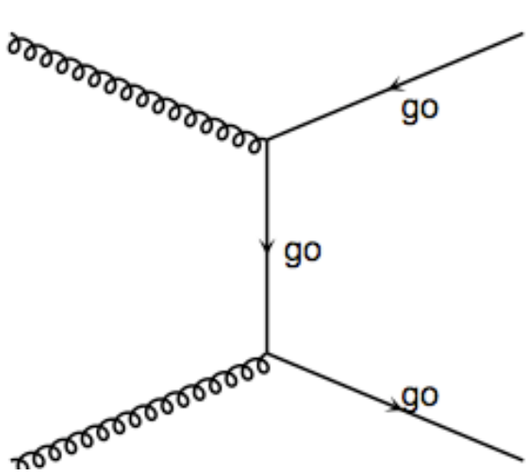
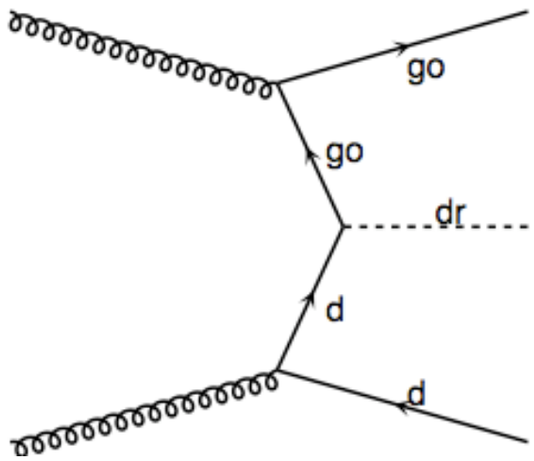






If Go's on resonance:
double counting with





with go→dr+q in pythia

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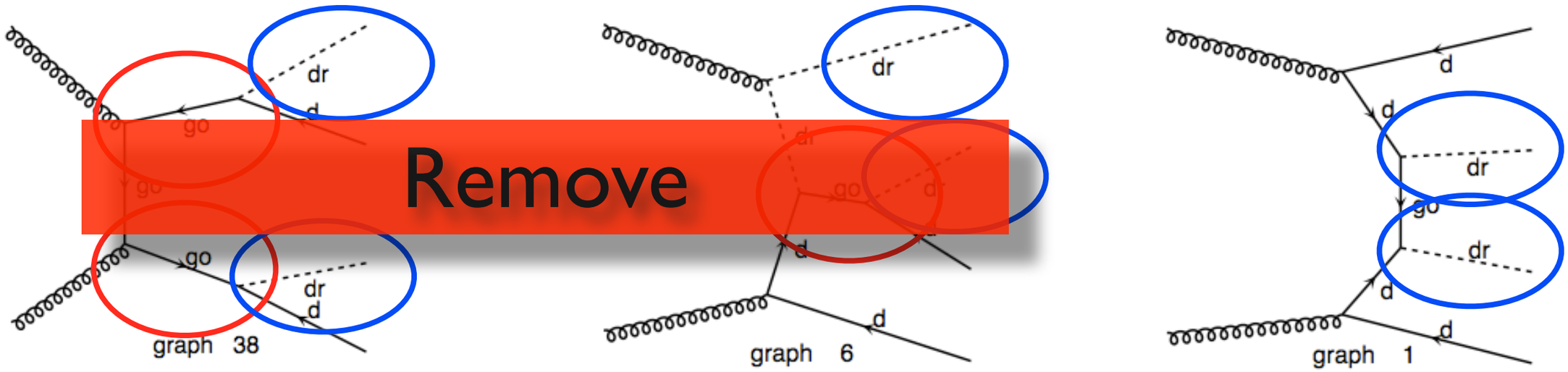

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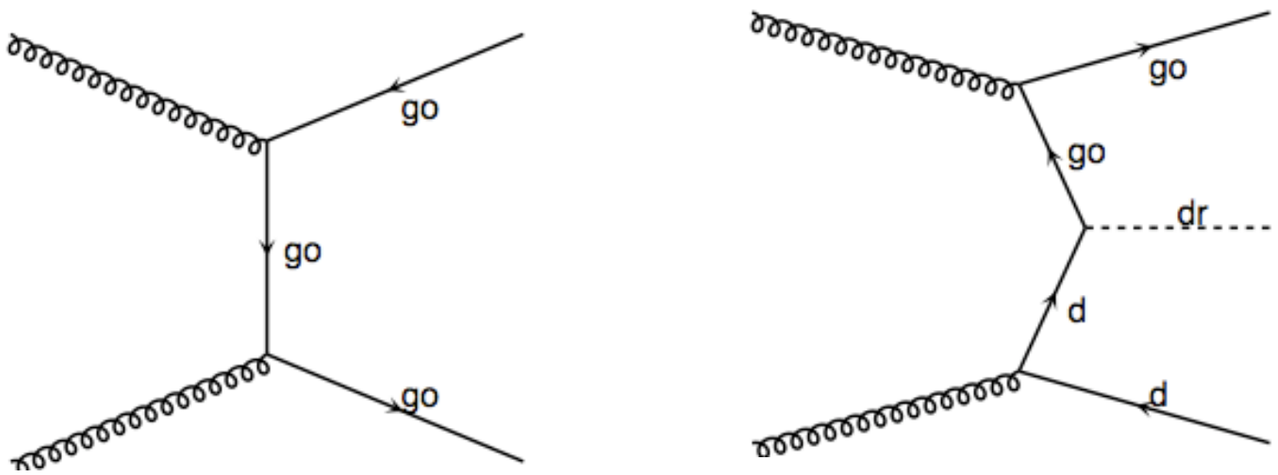

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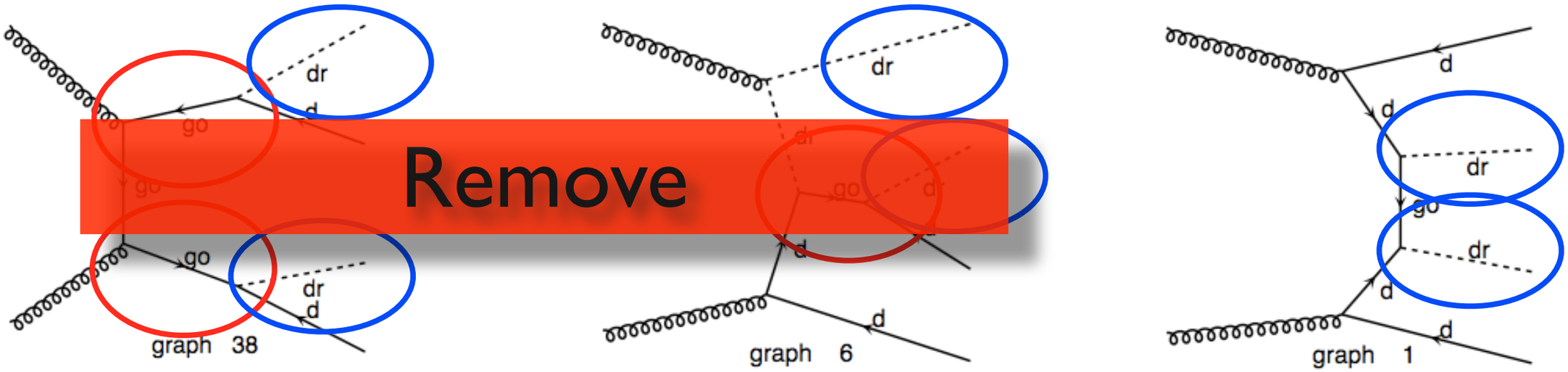
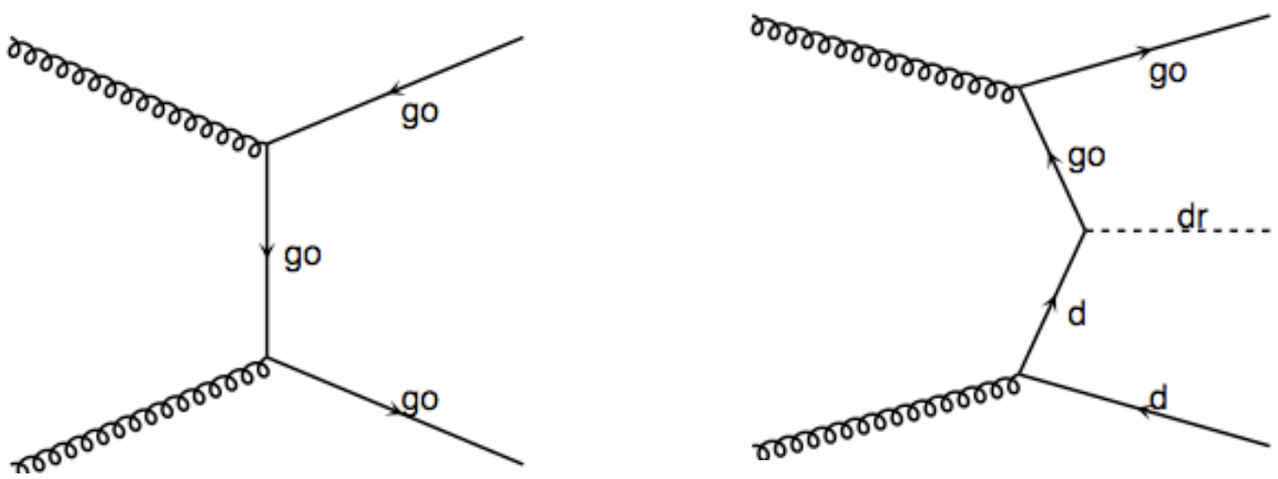


Remove

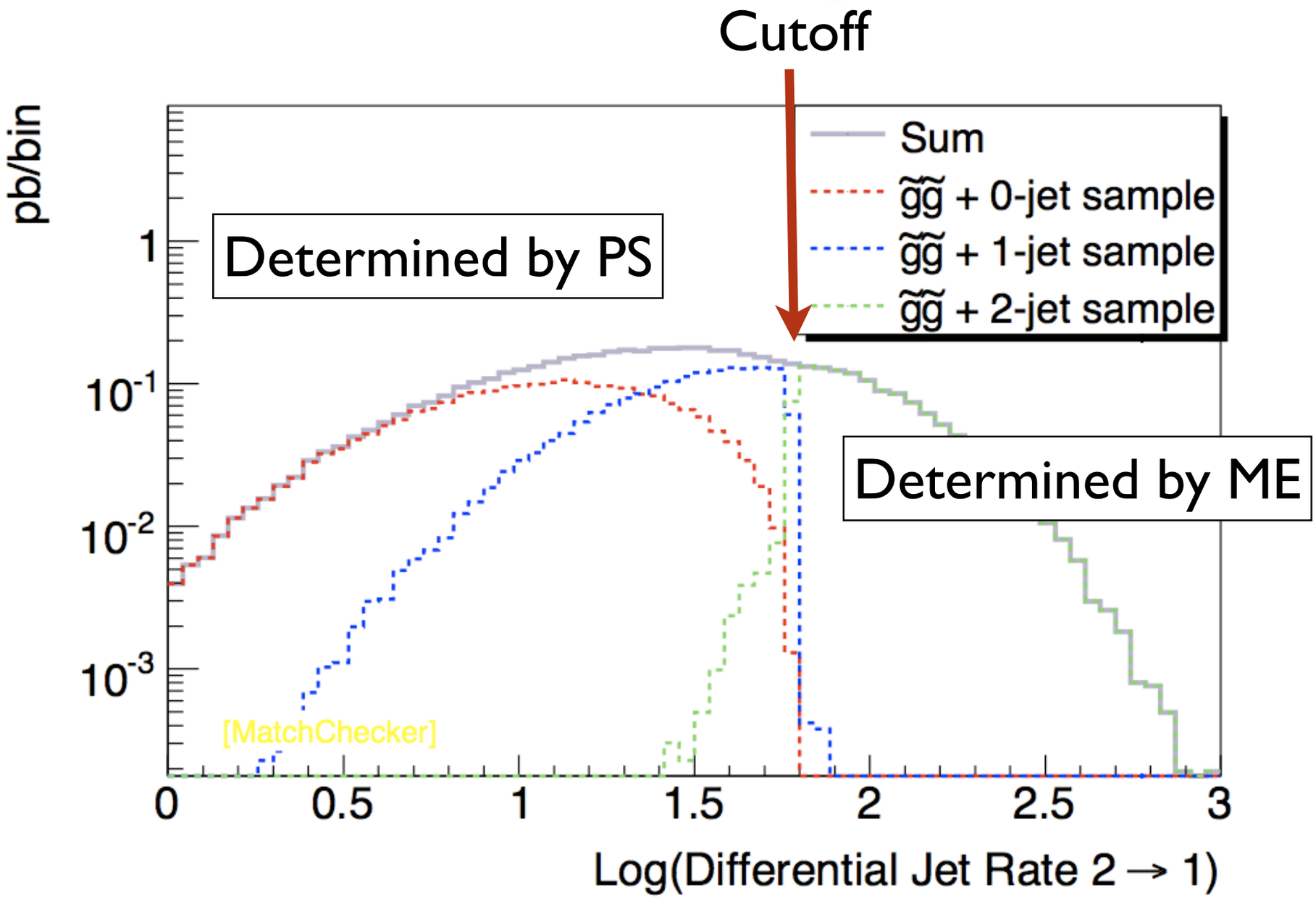
If Go's on resonance:
double counting with



OK!

with go→dr+q in pythia

Check differential jet rates

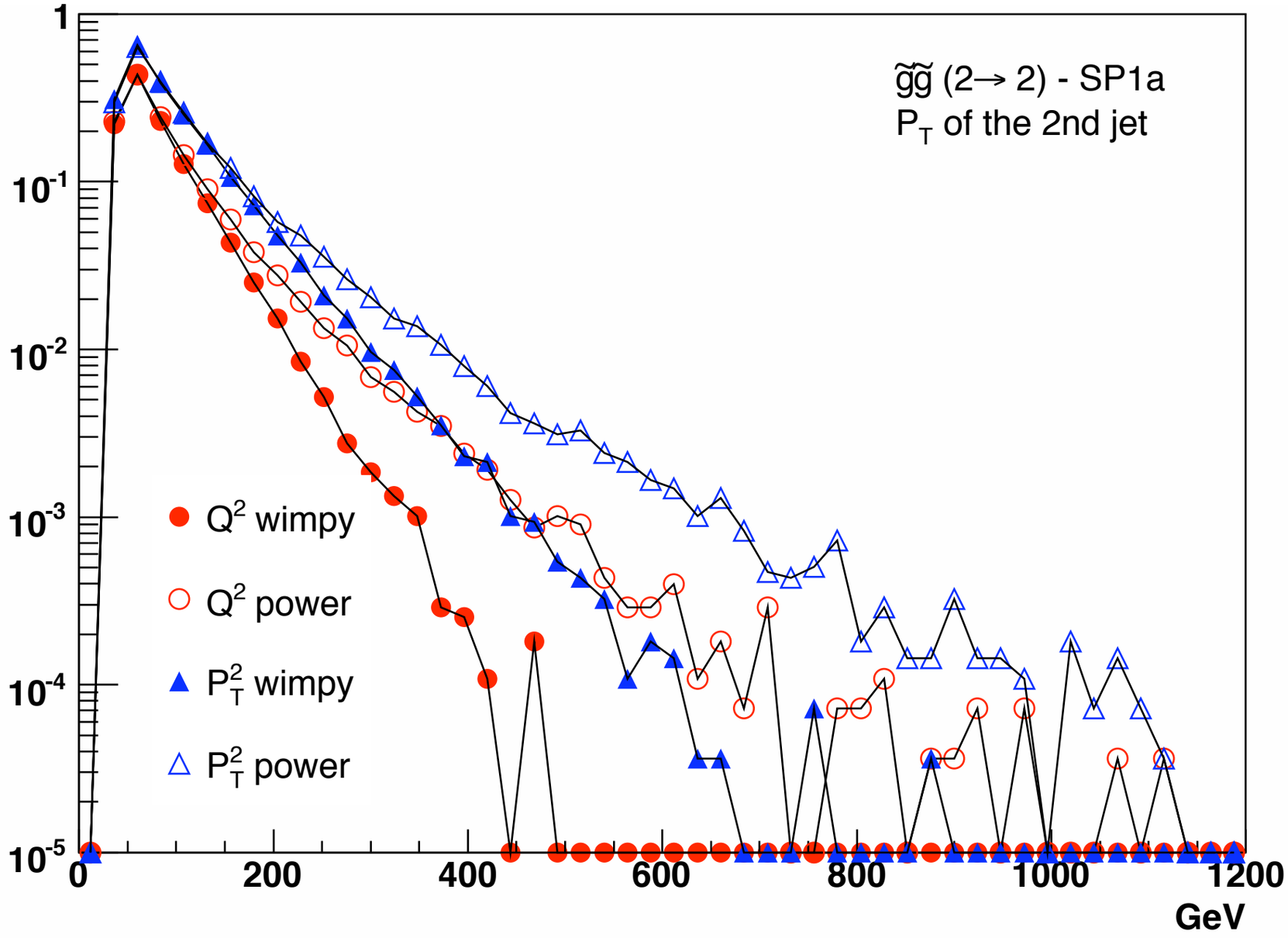


- Transition from PS to ME regime is smooth
- Cross section is stabilized
- Global shape remains invariant under cutoff change

How to get DJR? http://cp3wks05.fynu.ucl.ac.be/twiki/bin/view/Software/MatchChecker

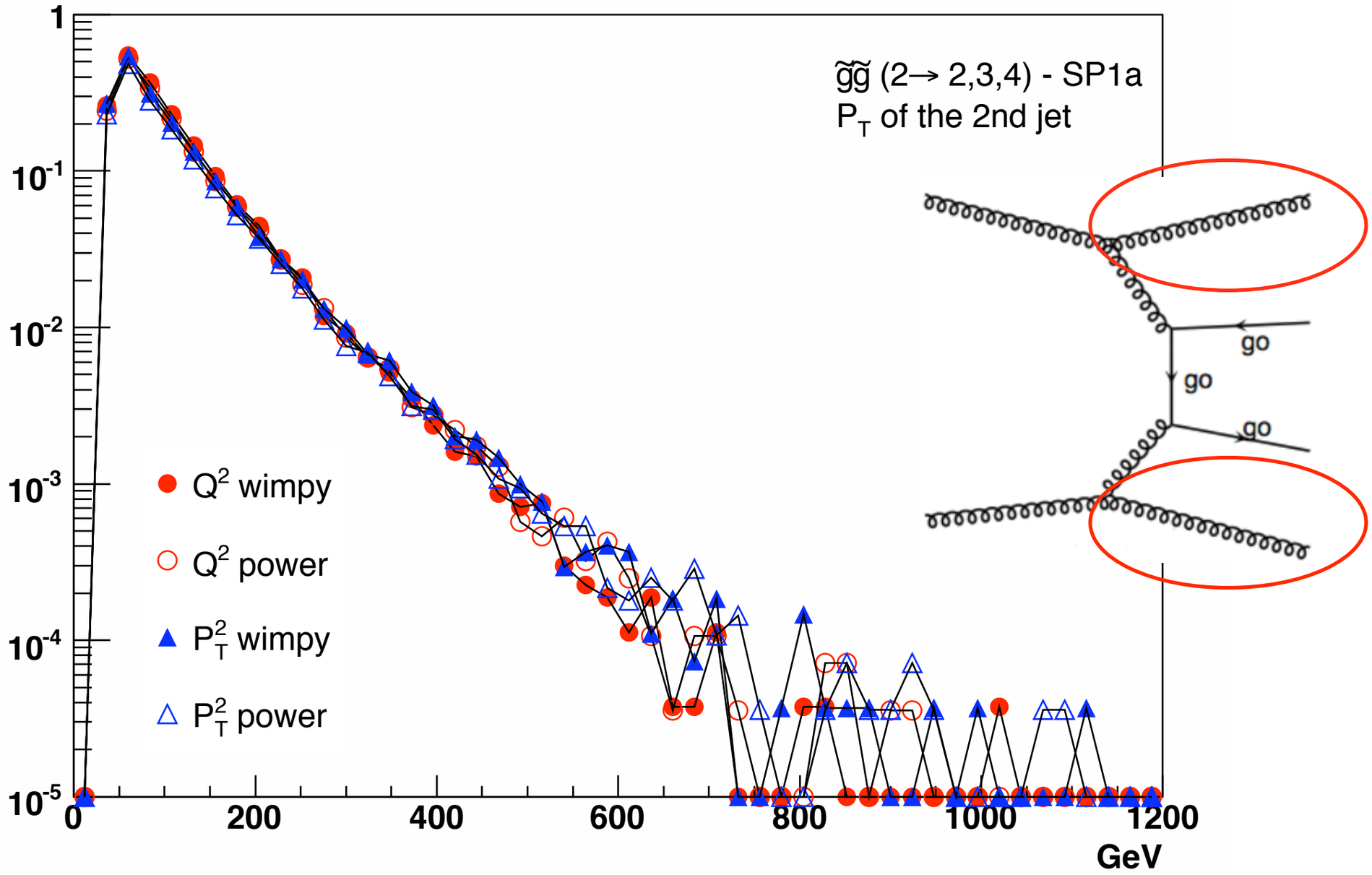
The IS radiation in Pythia only

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



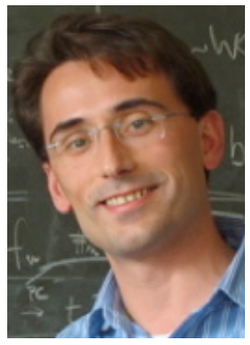
The IS radiation with ME + Pythia

- 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:

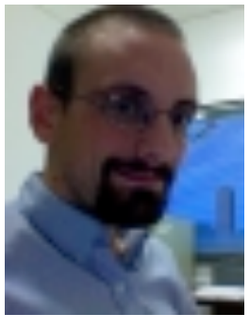



PostDocs:



PhD stud's:




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