MadGraph Tutorial

Matching Tutorial

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Exercise 1: Matching

1. Generate p p > w+ with 0 jets, 0,1 jets and 0,1,2 jets
   (Each on different computers - use the most powerful computer for 0,1,2 jets)
   a. Generate 20,000 events for a couple of different xqcut values.
   b. Compare the distributions (before and after Pythia) and cross sections (before and after Pythia) between the different processes, and between the different xqcut values.
   c. Summarize: How many jets do we need to simulate? What is a good xqcut value? How are the distributions affected?
2. Do the same exercise for matched squark production (p p > ur ur~ + 0,1 jets)
   a. Run with and without "$ go" - how does the result change?
   b. With "$ go", do the exercises a.-c. under 1. What is a good choice for matching scale?

Matching (reminder)

Merging ME with PS

[Mangano]
[Catani, Krauss, Kuhn, Webber]

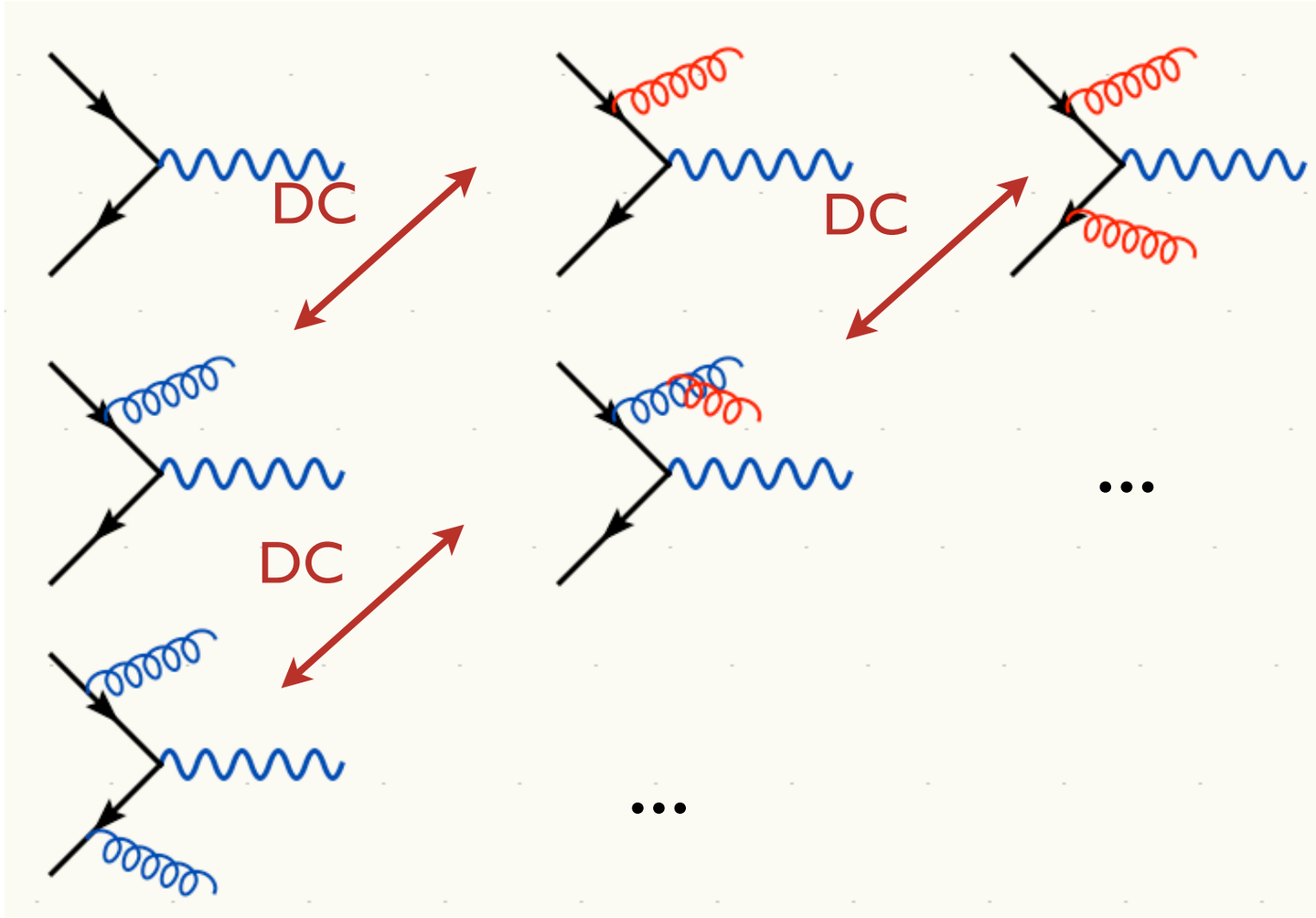
PS →

$pp \to W^+$

$pp \to W^+ j$ ME

↓

$pp \to W^+ jj$



Merging ME with PS

[Mangano]
[Catani, Krauss, Kuhn, Webber]

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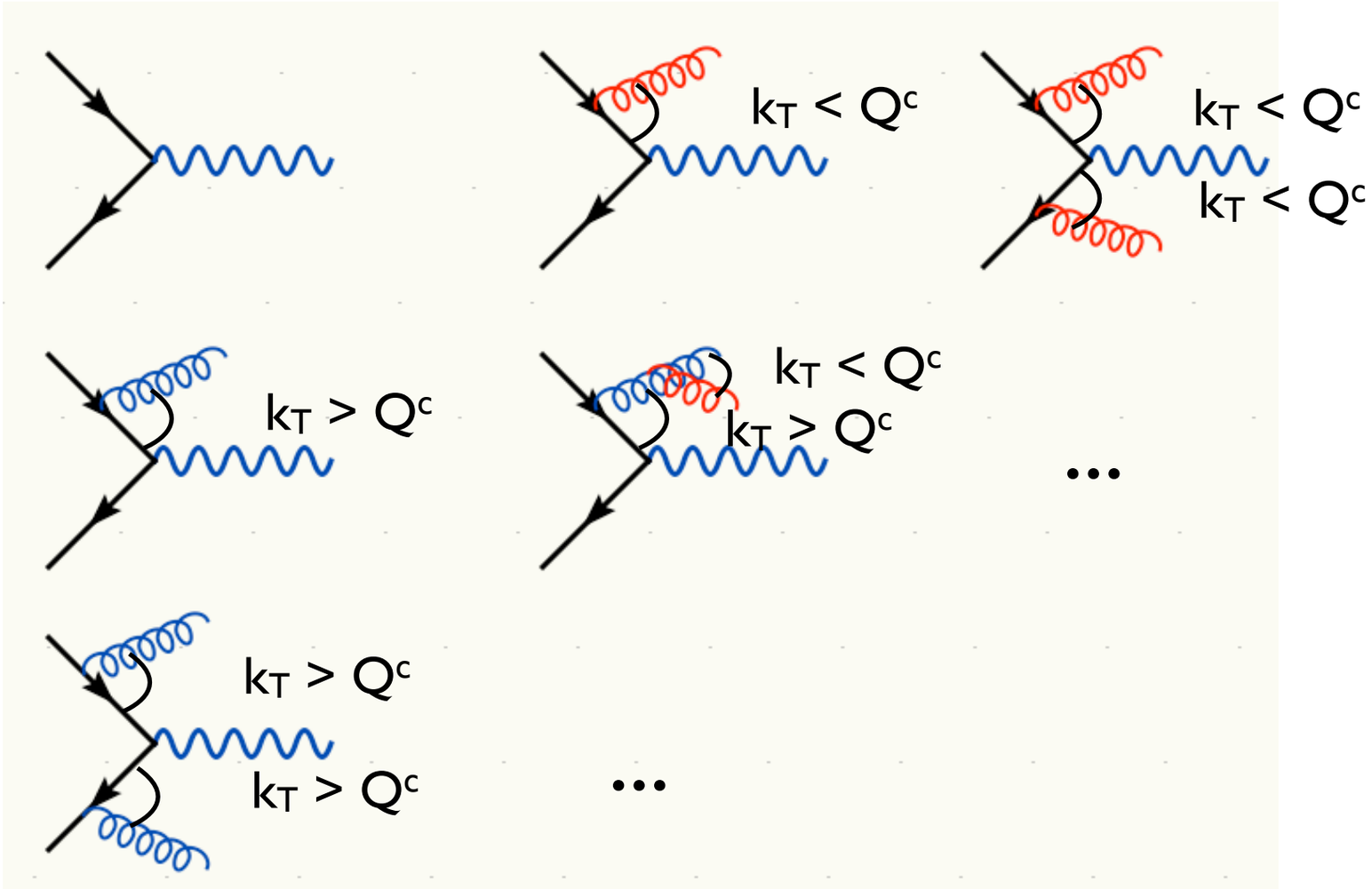
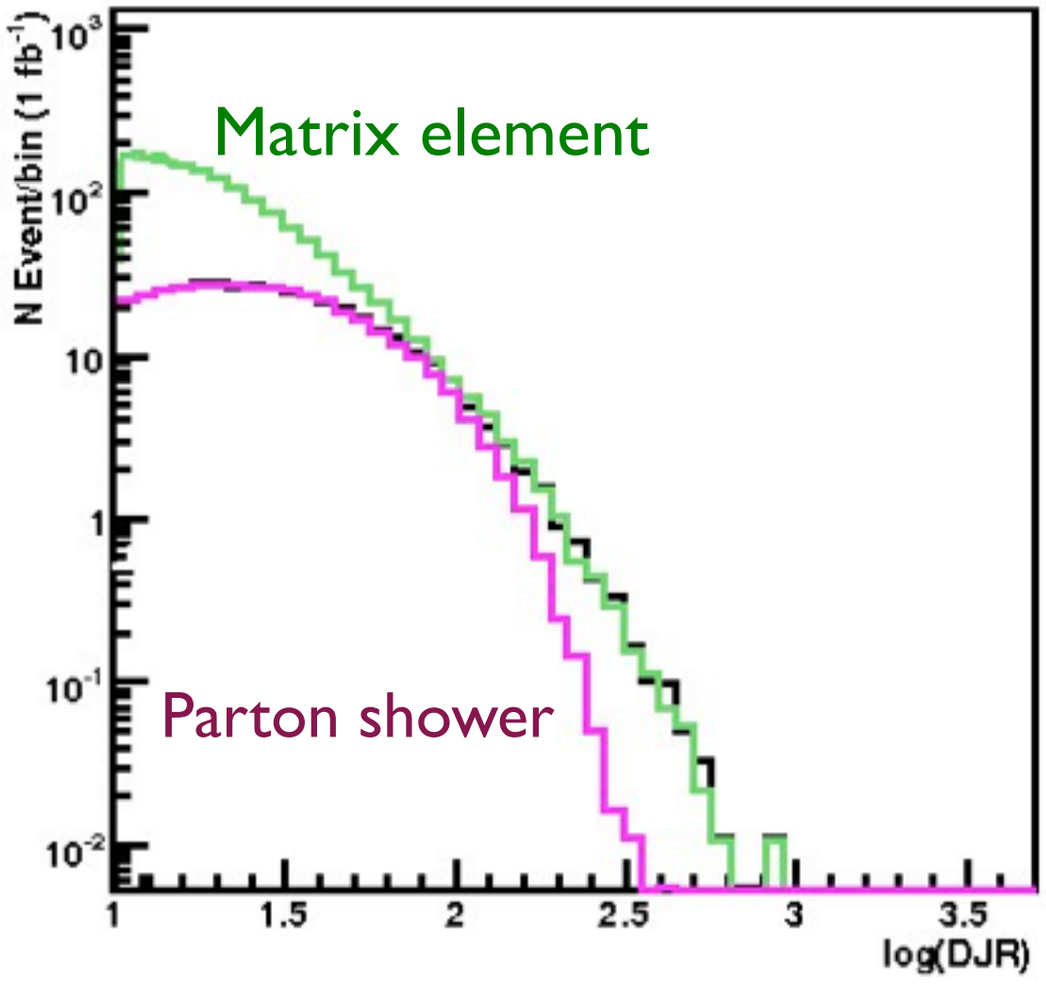
ME ↓



Double counting between ME and PS easily avoided using phase space cut between the two: PS below cutoff, ME above cutoff.

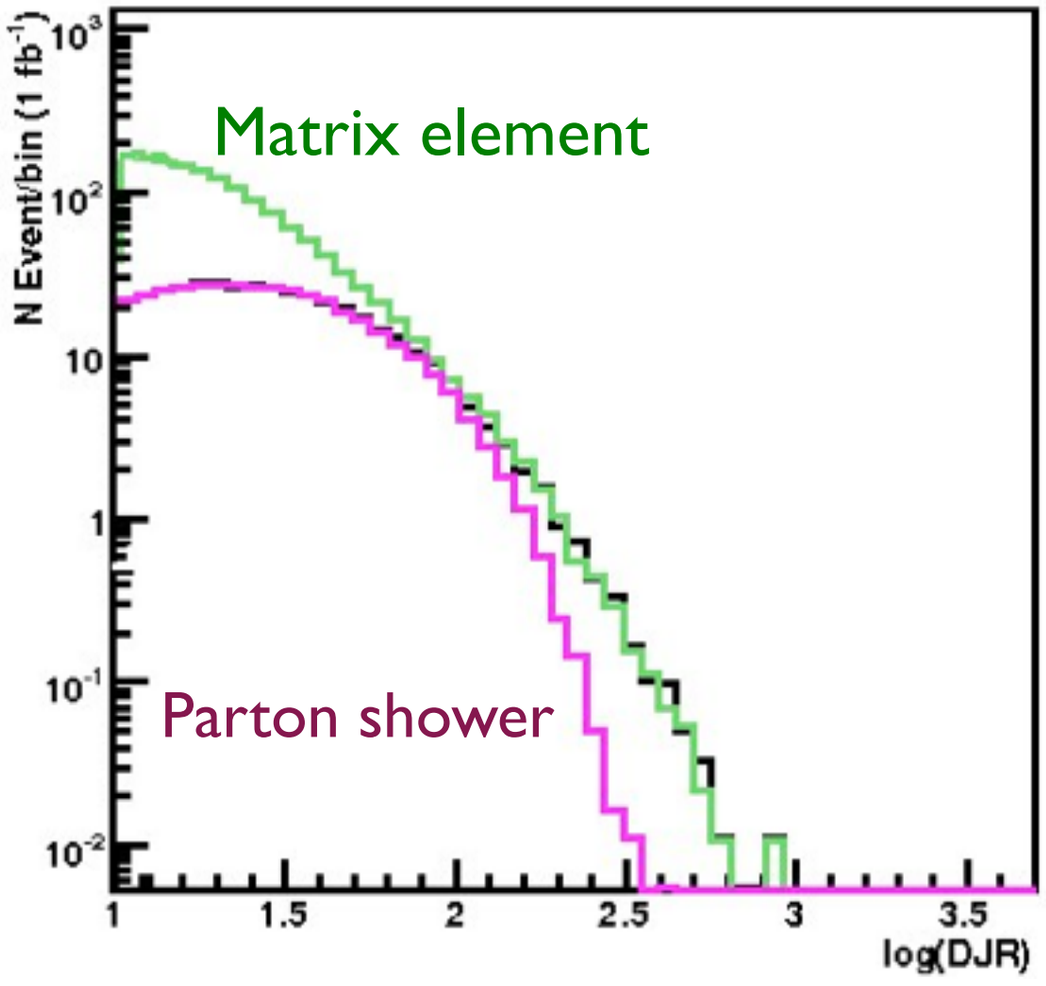
Goal for ME-PS merging/matching



2nd QCD radiation jet in top pair production at the LHC, using MadGraph + Pythia

Goal for ME-PS merging/matching

- Regularization of matrix element divergence



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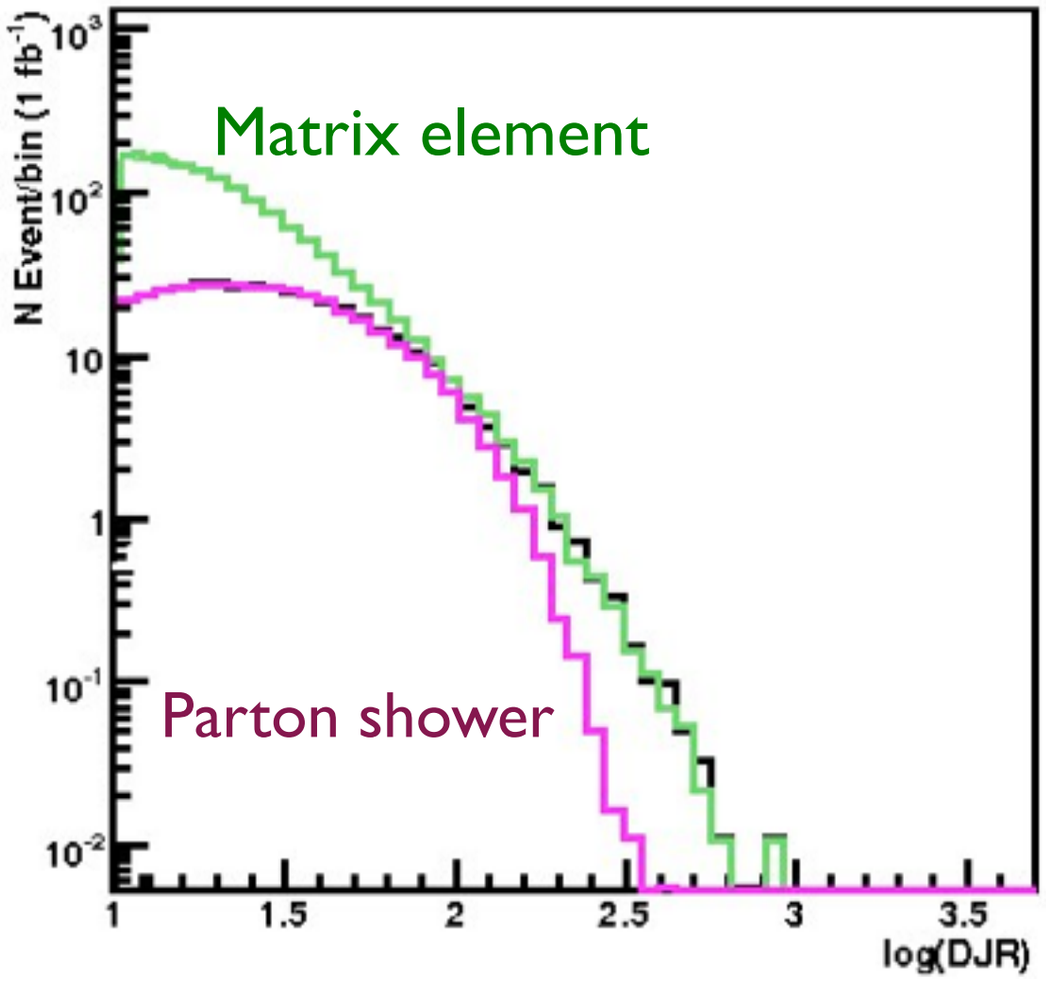

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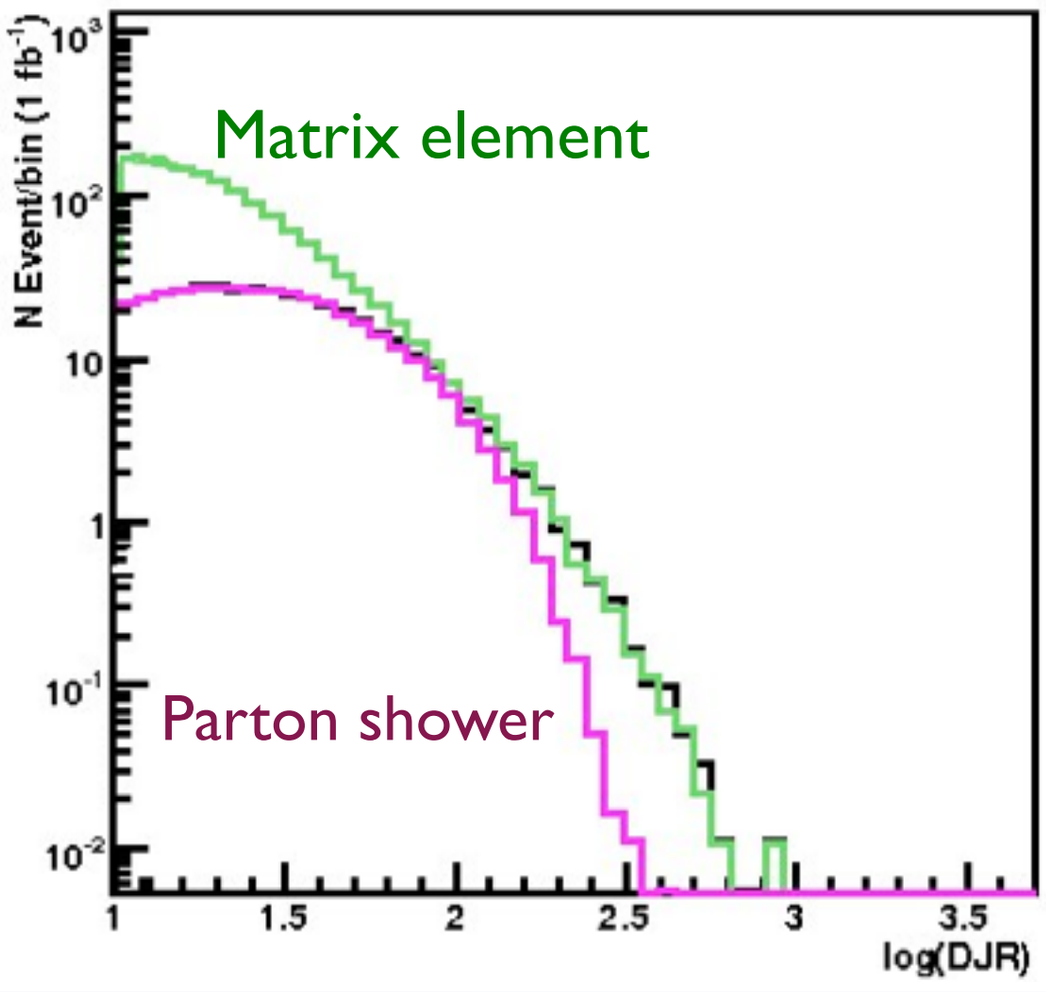
- Regularization of matrix element divergence
- Correction of the parton shower for large momenta
- Smooth jet distributions



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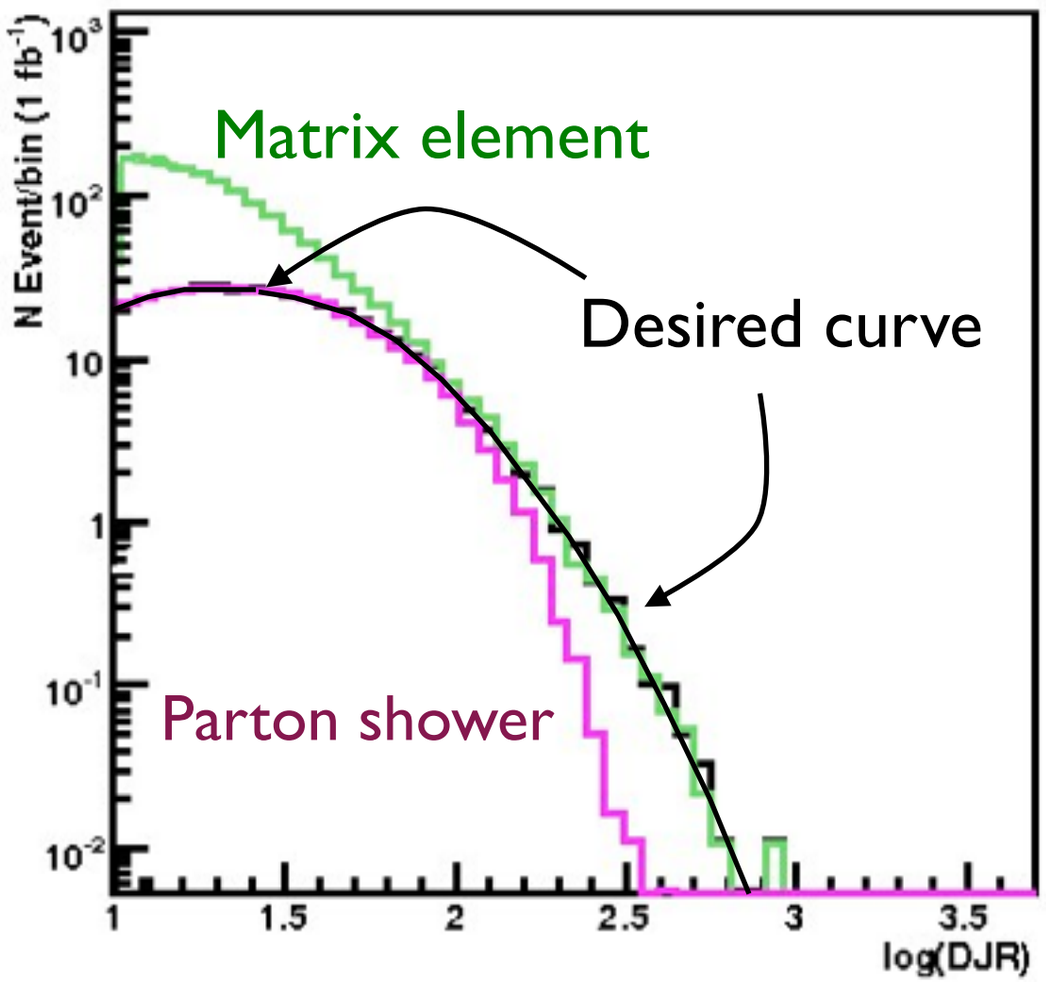

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MLM algorithm in a nutshell

1. Generate ME events (with different parton multiplicities) using parton-level cuts ($p_T^{ME}/\Delta R$ or k_T^{ME})
2. Cluster each event and reweight α_s and PDFs based on the scales in the corresponding clustering vertices
3. Run the parton shower with starting scale $t_0 = m_T$.
4. Check that the number of jets after parton shower is the same as ME partons, and that all jets after parton shower are matched to the ME partons at a scale Q^{match}.
   If yes, keep the event. If no, reject the event. Q^{match} is called the *matching scale*.

How to.

- generate the diagram with
  - ➡ generate
  - ➡ add process
- output
- launch
  - ➡ ask to run pythia
  - ➡ In run_card: put icckw=1
    - ✦ set the value for xqcut
  - ➡ In pythia_card set a value for qcut

- Qcut is the matching scale (the separation between the shower and the matrix element
- xqcut should be strictly lower (by at least 10-15GeV) than qcut