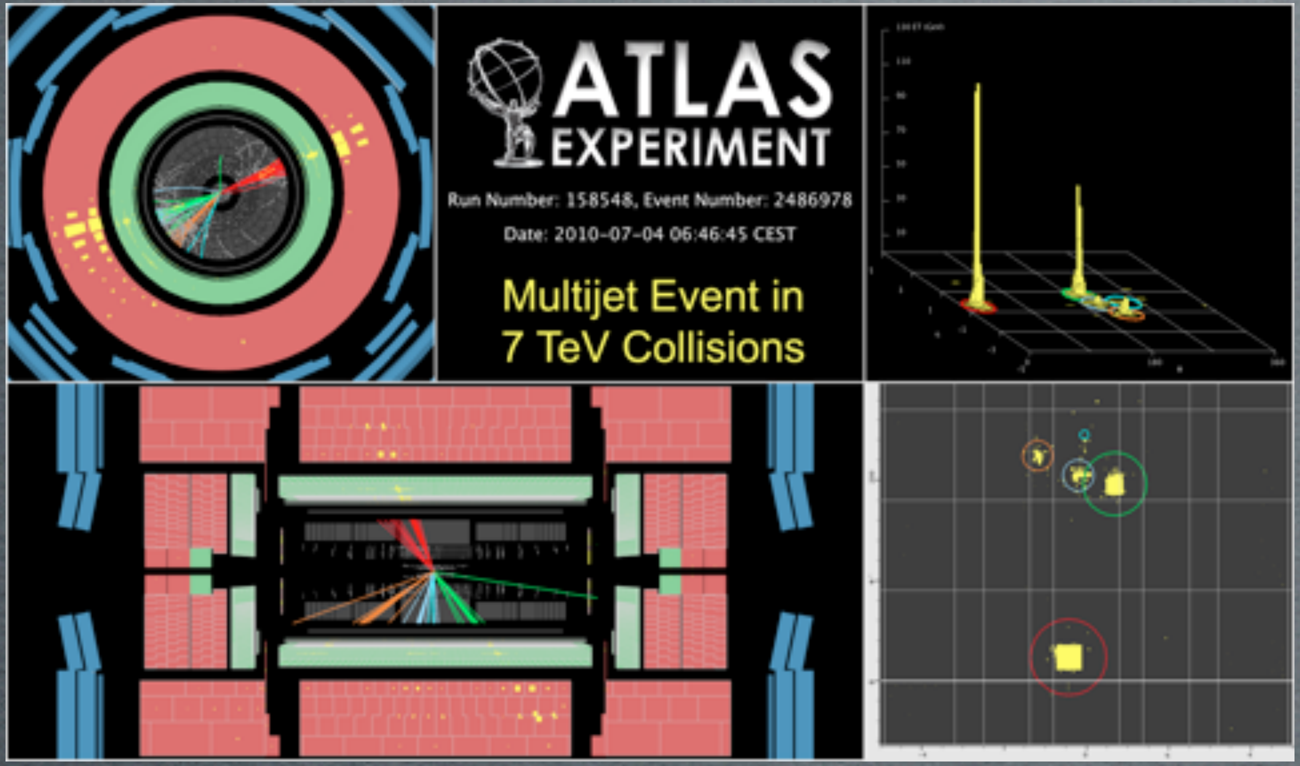
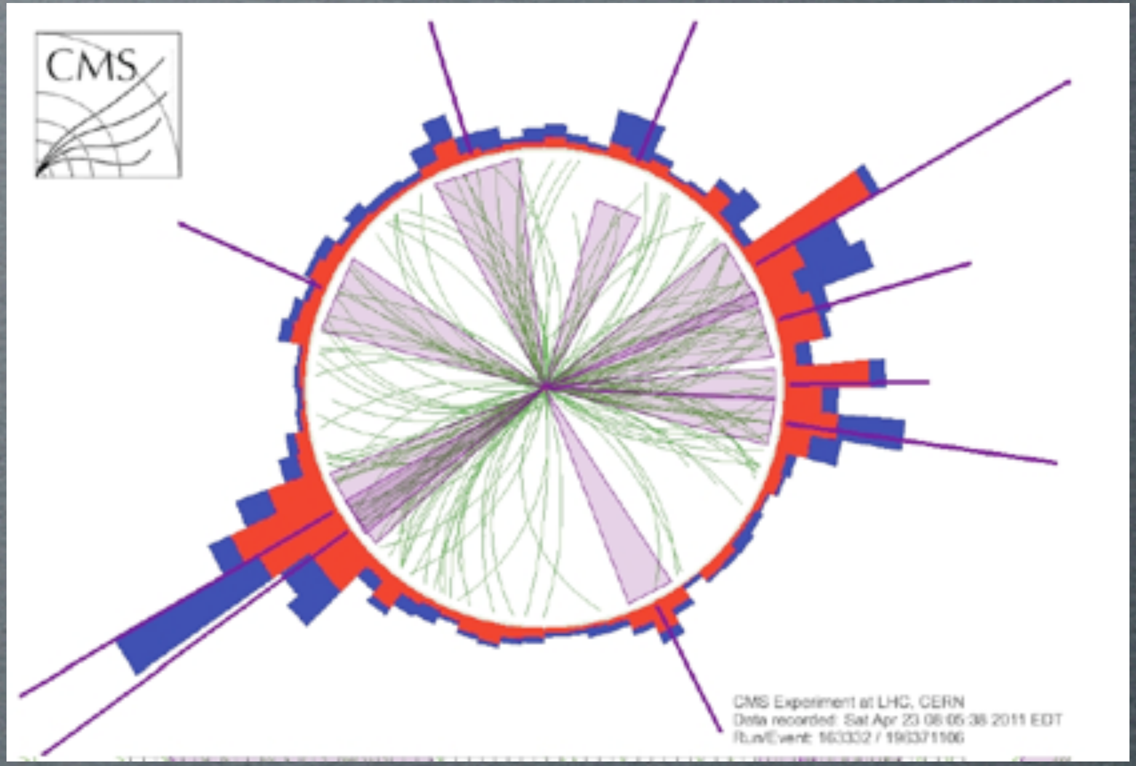
HFS SUMMARY

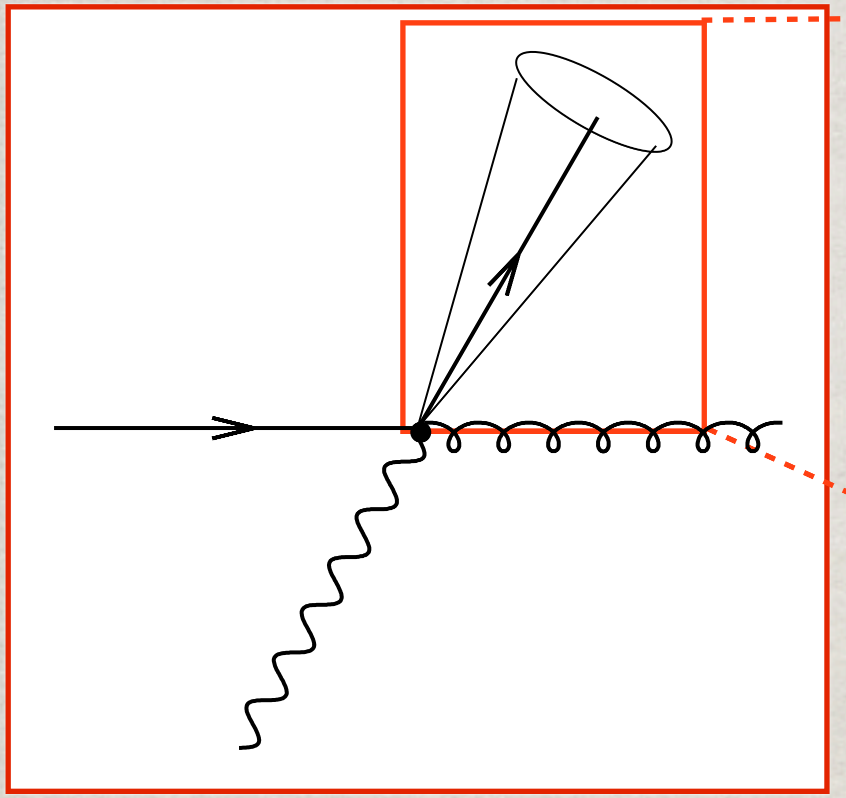




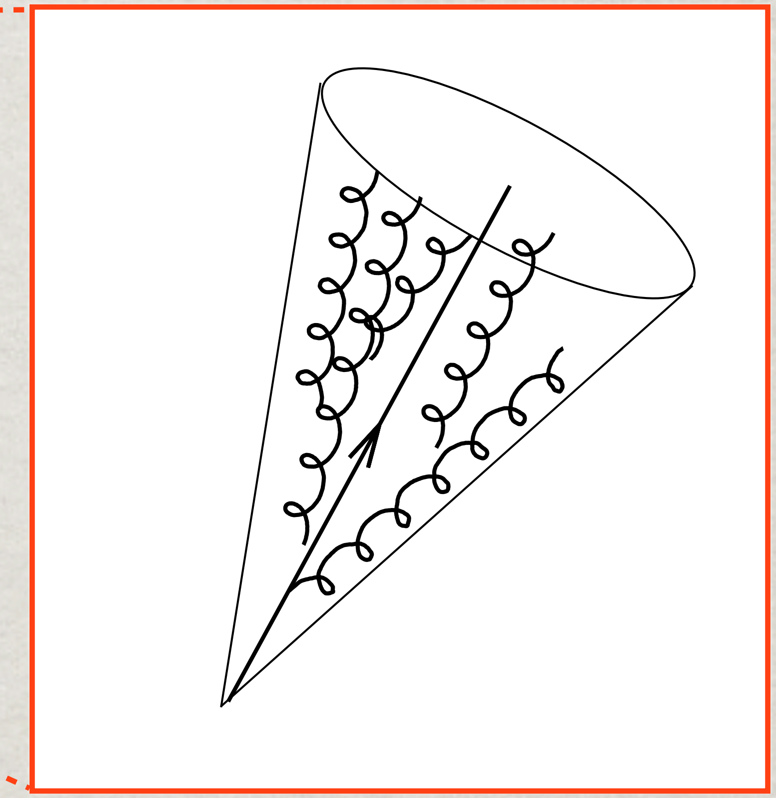
THEORY

DIS 2013 WORKSHOP - MARSEILLE

Towards a theory of jets



Use of jets
[J. Rojo]



Fixed-order calculations
[D. Maitre, F. Campanario]

Resummations
[D. Kang, C. Marquet, Y. Delenda]

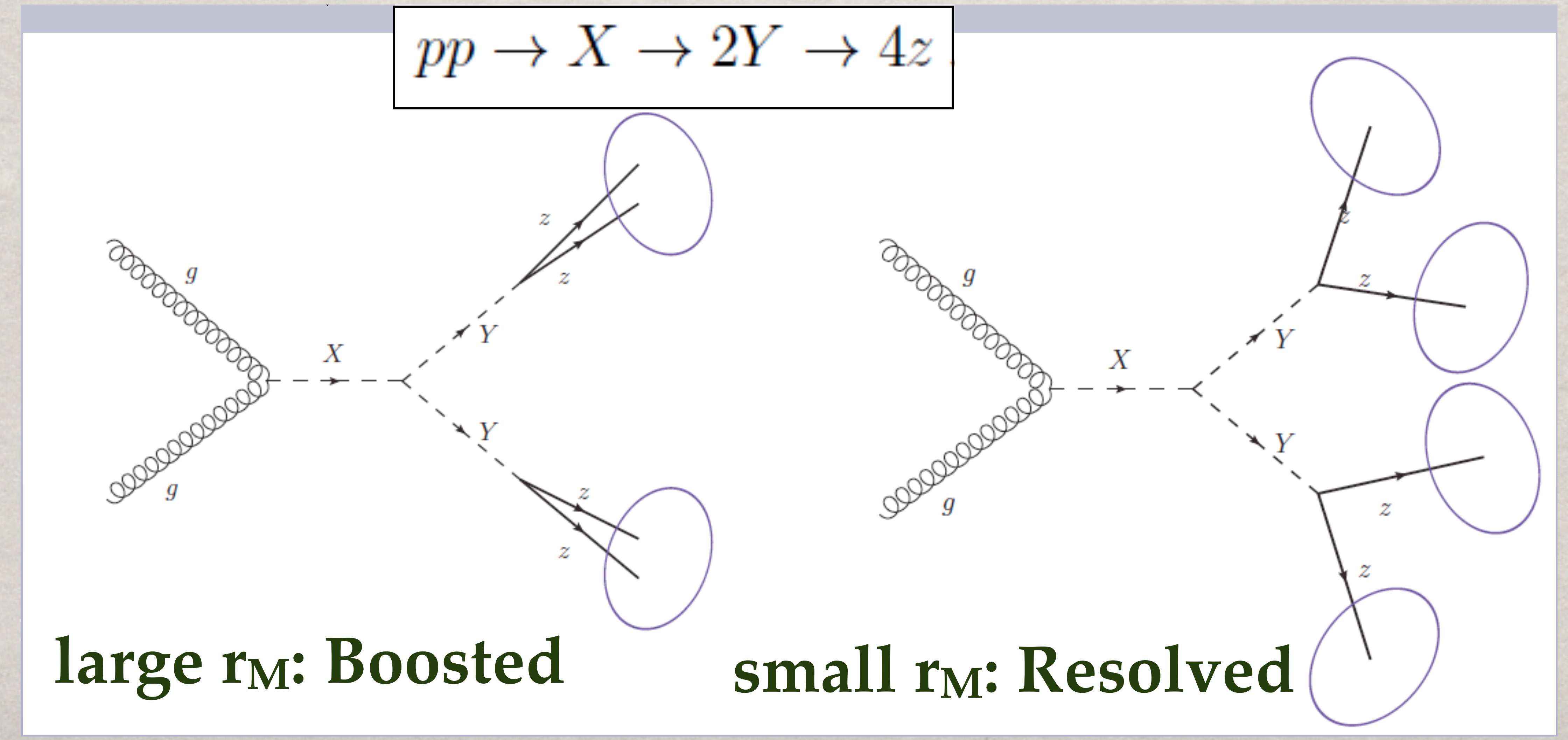
Parton shower Monte-Carlo
[S. Plätzer, M. Ritzmann, S.Dooling, M. Sjodahl]

BFKL inspired Monte-Carlo
[H. Jung, J. Andersen, G. Chachamis]

Using jets for discovery

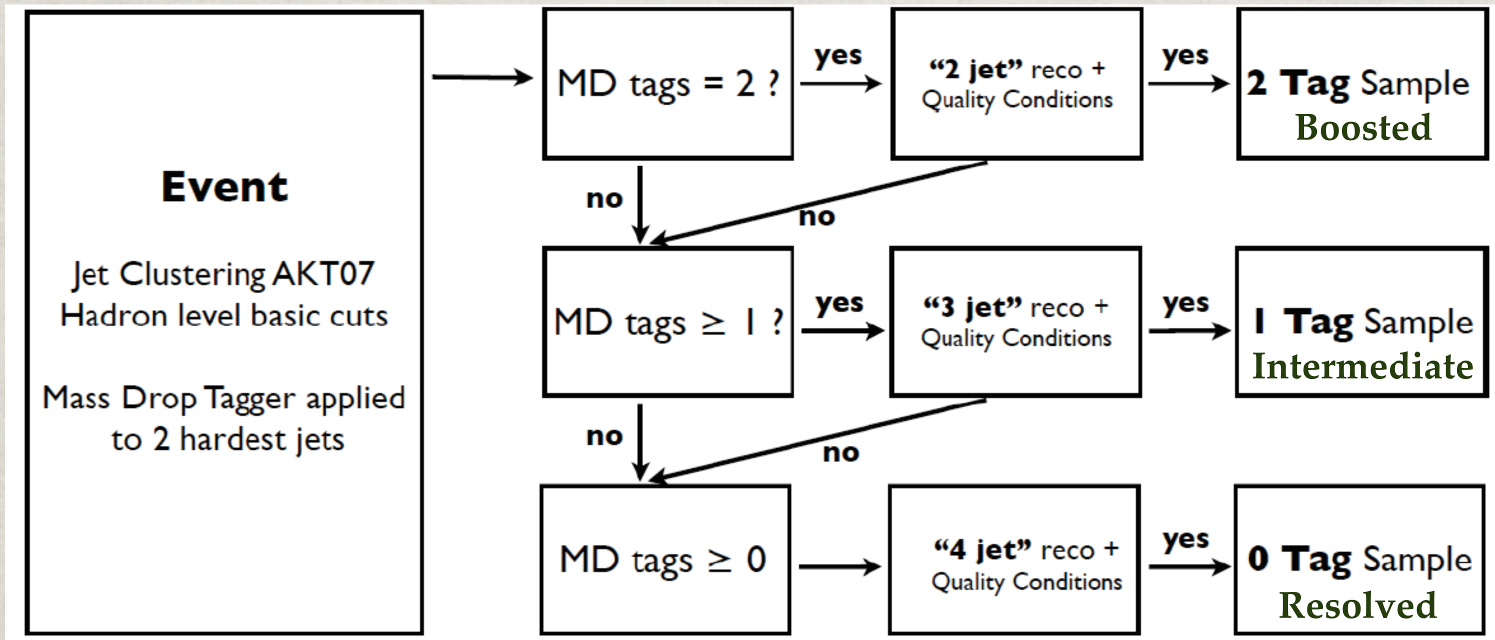
- Jets are very useful for tagging heavy resonances
- Example: heavy resonance X decaying into lighter resonance Y
- Analysis strategy depends on the value of the ratio $r_M = M_X/(2M_Y)$
- Since we do not know r_M, it would be nice to interpolate smoothly between boosted and resolved regimes

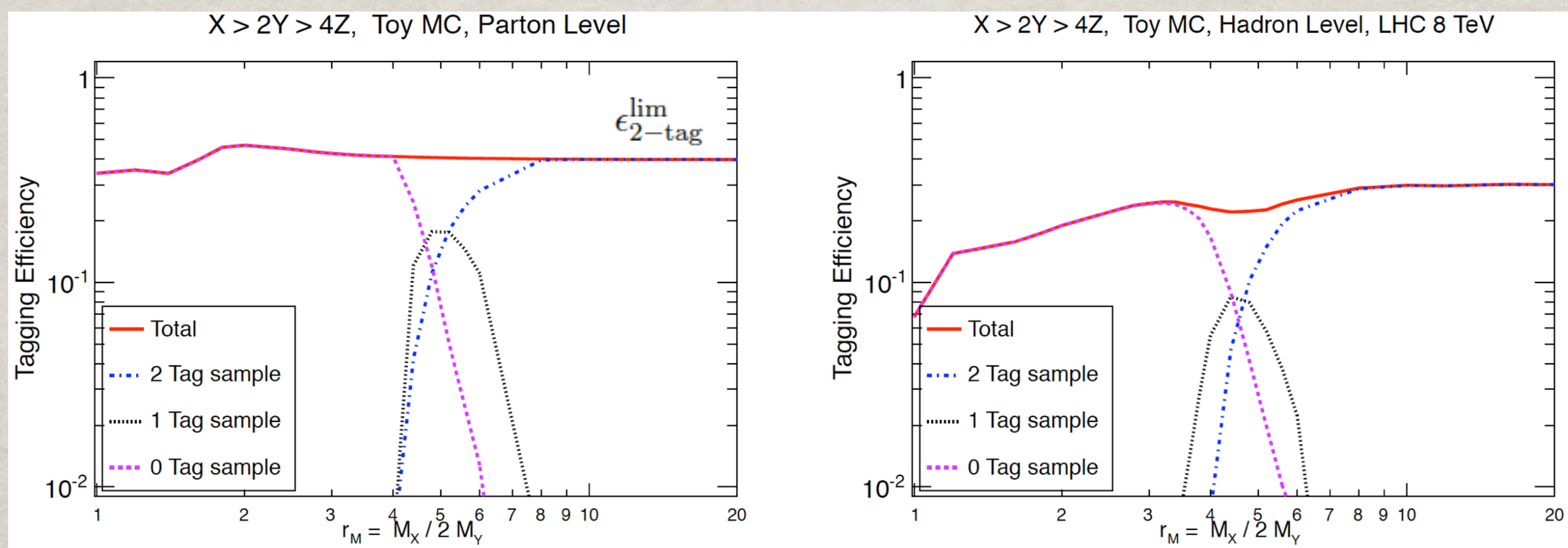
[Juan Rojo]



Scale invariant tagging

- Strategy: use the number of mass-drop tags to decide the search analysis to be performed [Juan Rojo]



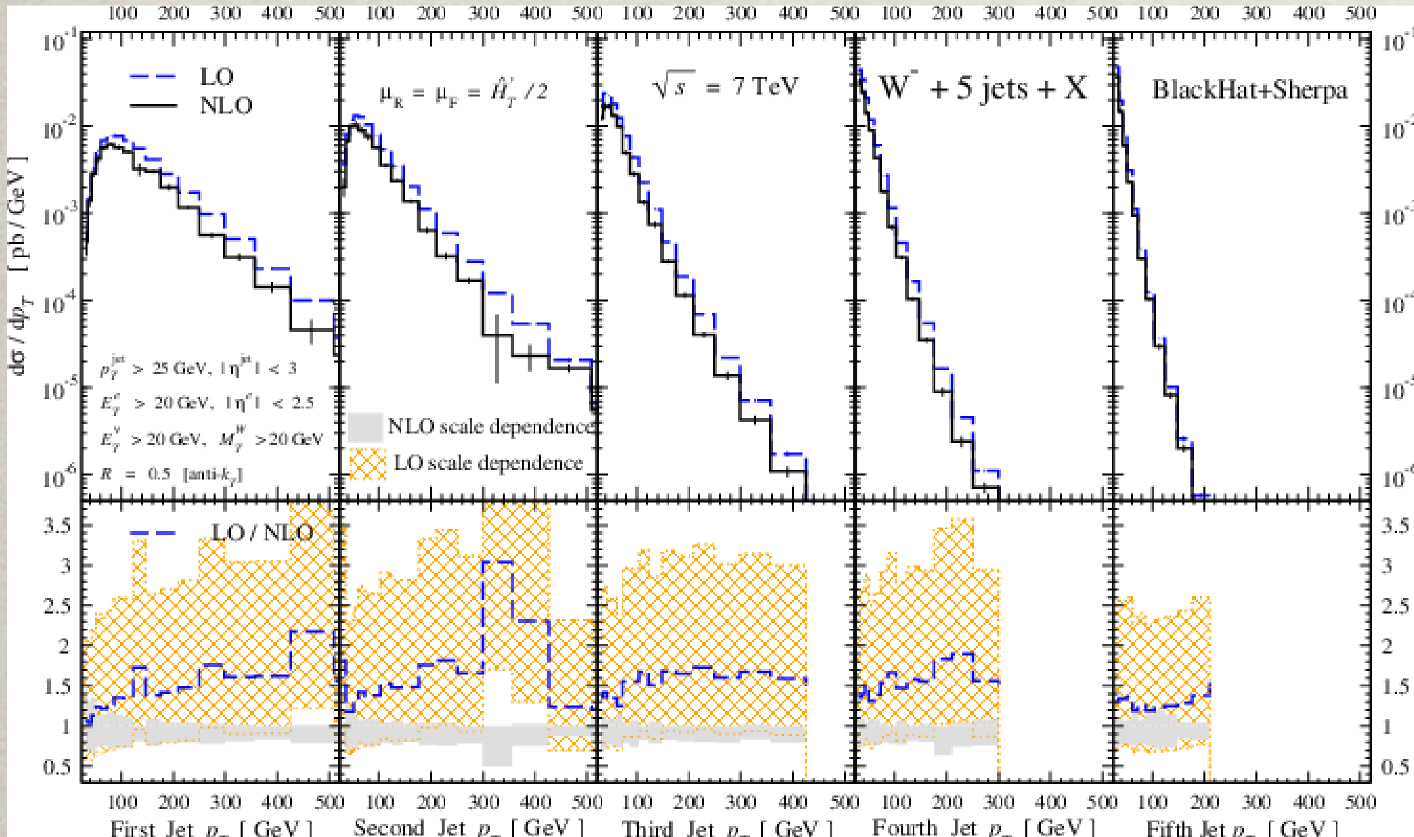


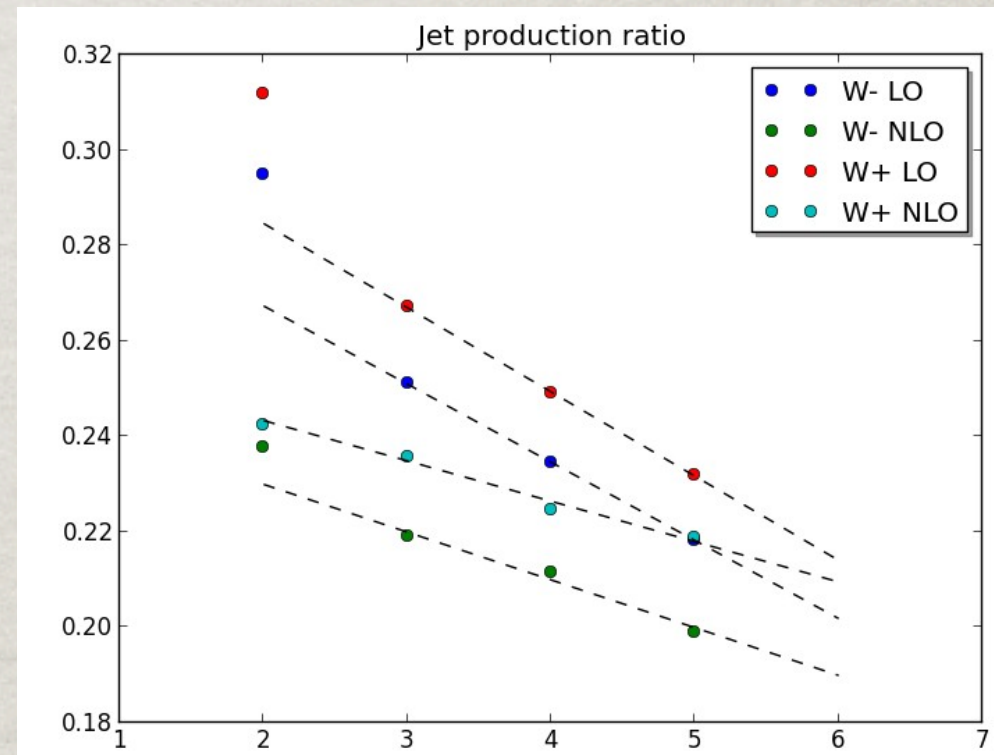
- Smooth and stable tagging efficiency independently of r_M

Multijet calculations

- The impressive progress in the automation of one-loop calculation has reached $2 \to 6$ processes (W+5jets) with BLACKHAT+SHERPA

[Daniel Maitre]





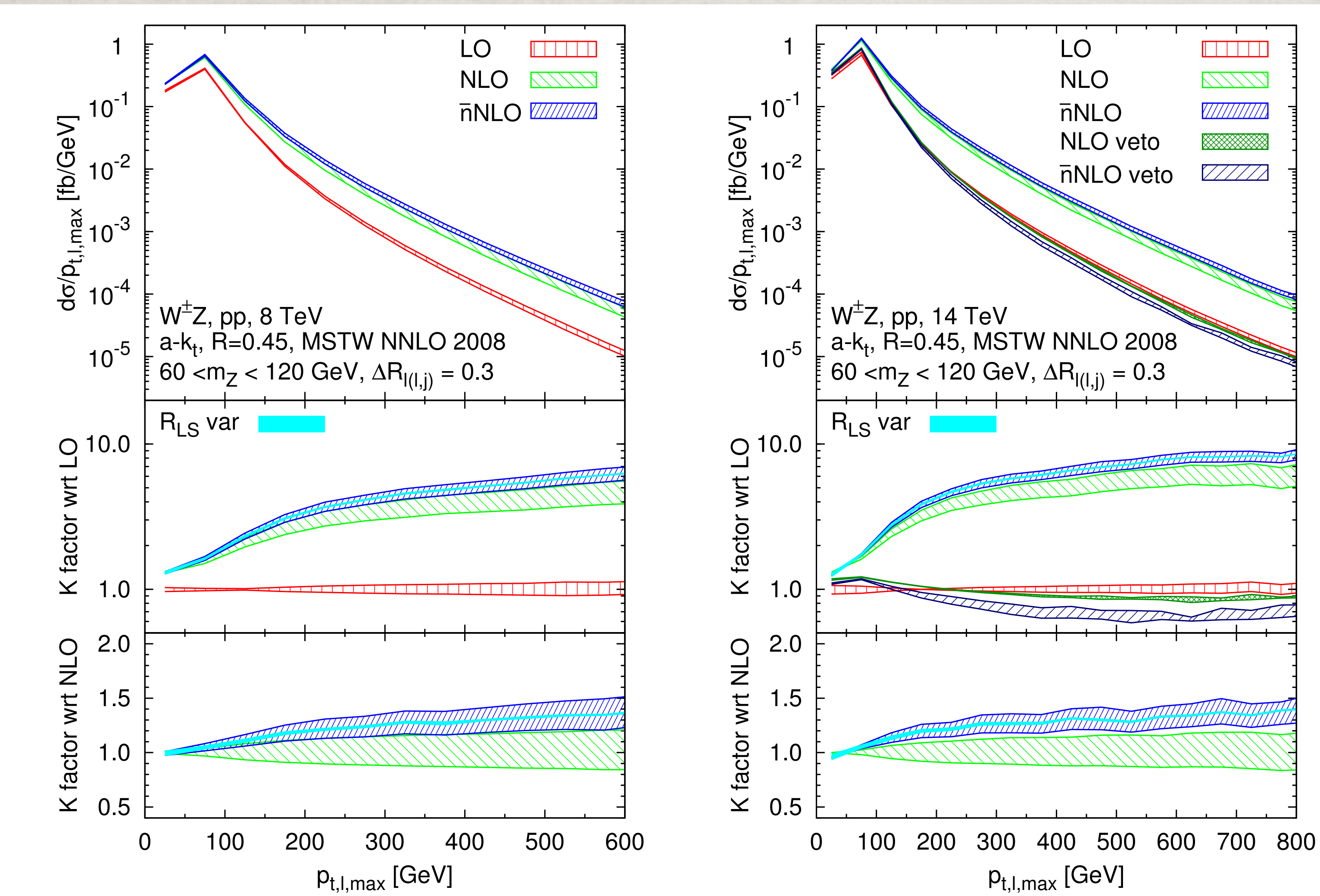
- Evidence for staircase scaling $\Rightarrow$ extrapolate to W+6 jets

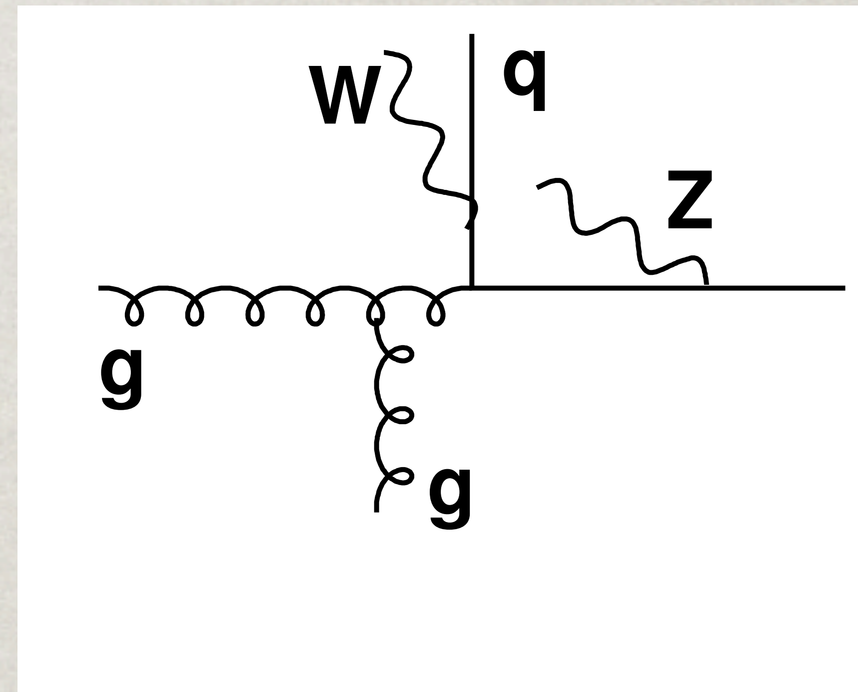
- W− : 0.15 ± 0.01 pb
- W+ : 0.30 ± 0.03 pb

Beyond NLO: large K-factors

- Multiple boson production suffers from large K-factors from the opening of new channels

[Francisco Campanario]





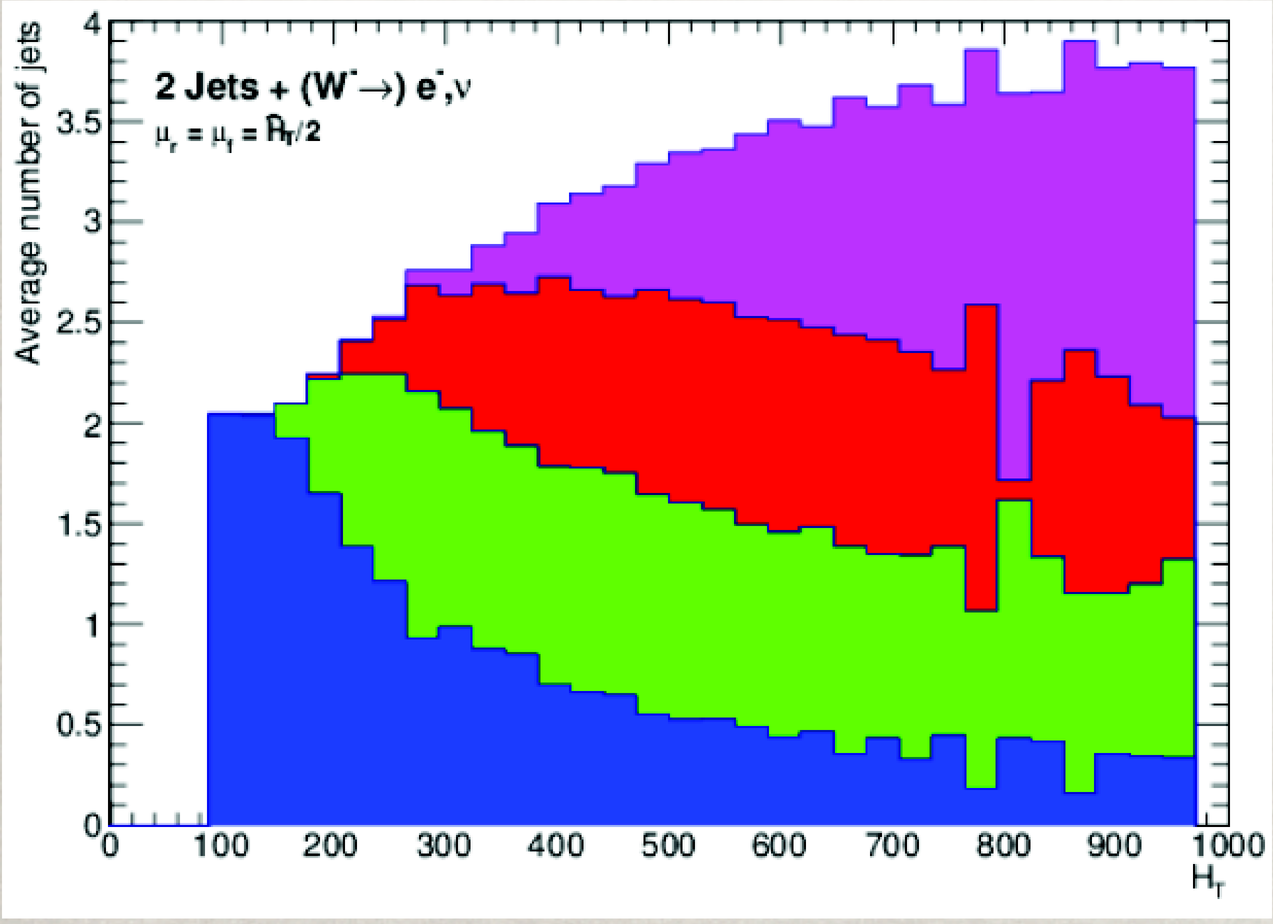
$$\alpha_{EW}^2\,\alpha_s^2\,\ln^2\frac{p_T}{M_W}\,\ln^2\frac{p_T}{M_Z}$$

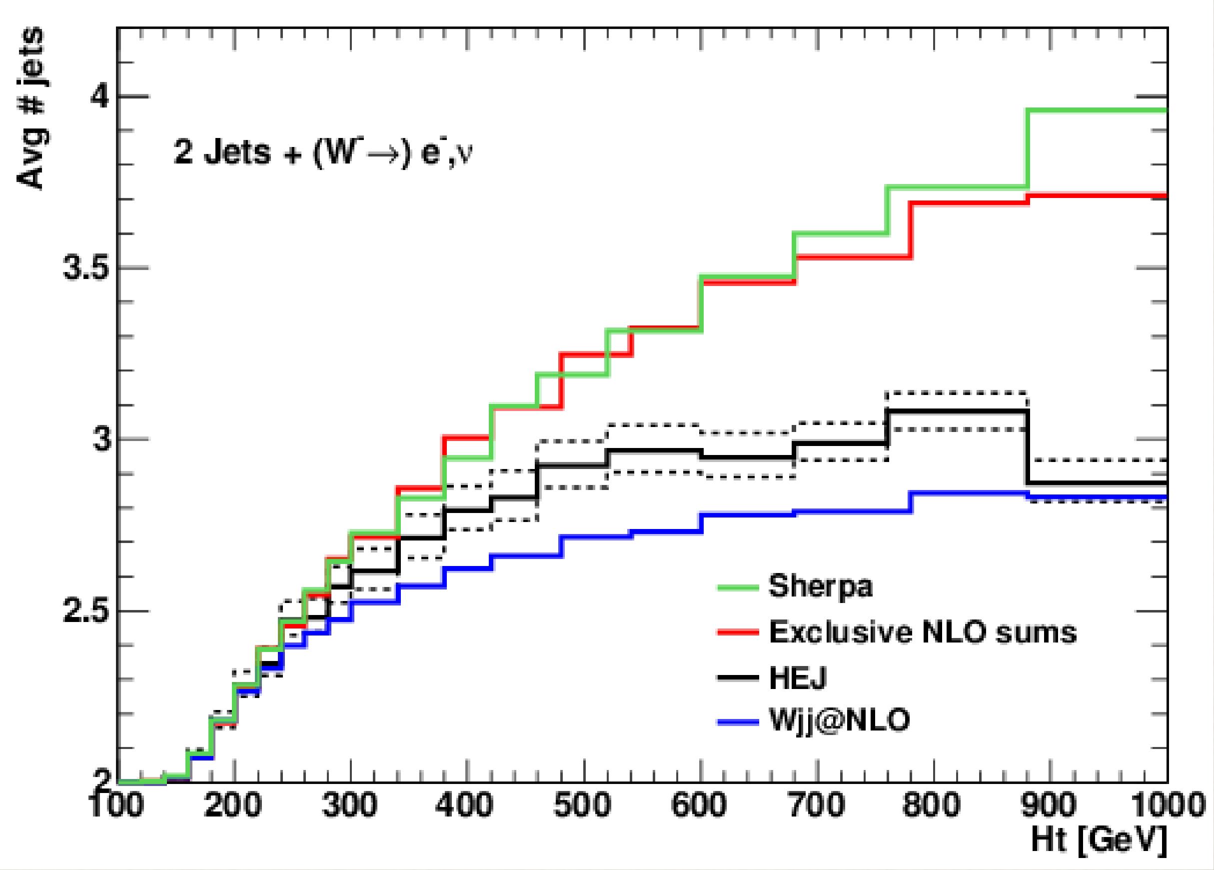
- Reliable higher order predictions for WZ production in the presence of large K-factors can be obtained with the program LoopSim, which reliably simulates higher order contributions

Exclusive sums

- There are variables, like the total transverse energy H_T, which get contribution from higher and higher jet multiplicities

[Daniel Maitre]





- There are various procedures to merge different jet multiplicities at NLO, although evaluation of uncertainties need more investigation

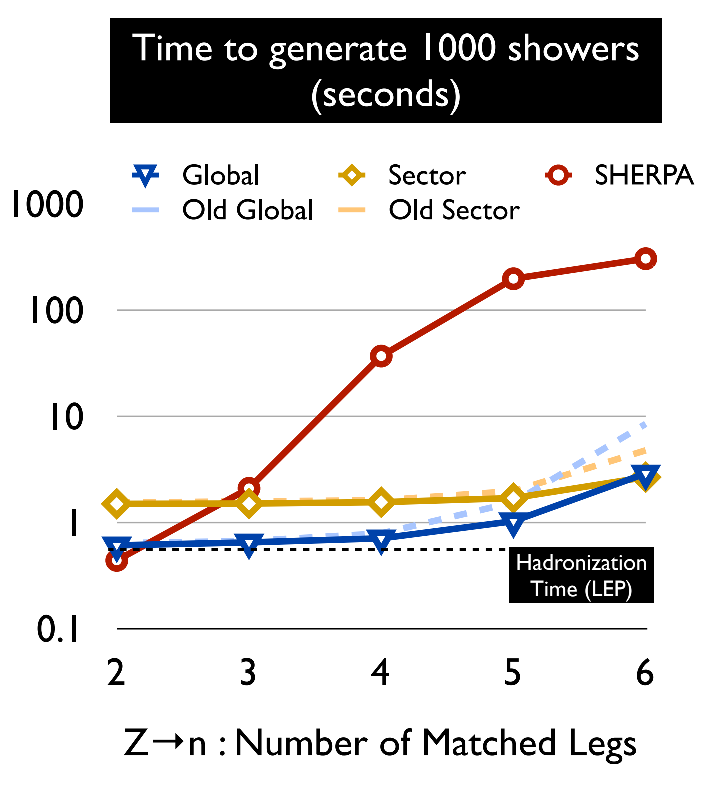
- The average number of jets as a function of H_T provides a good validation of different approaches to multi-jet production

Merging PS+ME

- A way to reliably generate exclusive samples is to merge exact matrix elements and parton showers

LO and NLO matching: progress in VINCIA [Mathias Ritzmann]

- extension to hh collisions
- faster LO ME+PS merging



General procedure for ME+PS merging beyond NLO [Simon Plätzer]

$$
\mathrm{d}\sigma_\rho^{(0)}(\phi_{N-1}, q_{N-1})\Delta_{N-2}(q_{N-1}|\cdots|q_0) +
$$

$$
\int_\rho^{q_{N-1}} \mathrm{d}q_N \left(\frac{\mathrm{d}\sigma_\rho^{(0)}(\phi_N, q_N)}{\mathrm{d}q_N} - \frac{\mathrm{d}\phi_N}{\mathrm{d}\phi_{N-1}\mathrm{d}q_N} P_\rho(\phi_{N-1}, q_N)\mathrm{d}\sigma_\rho^{(0)}(\phi_{N-1}, q_{N-1}) \right) \times
$$

$$
\Delta_{N-1}(q_N|\cdots|q_0)
$$

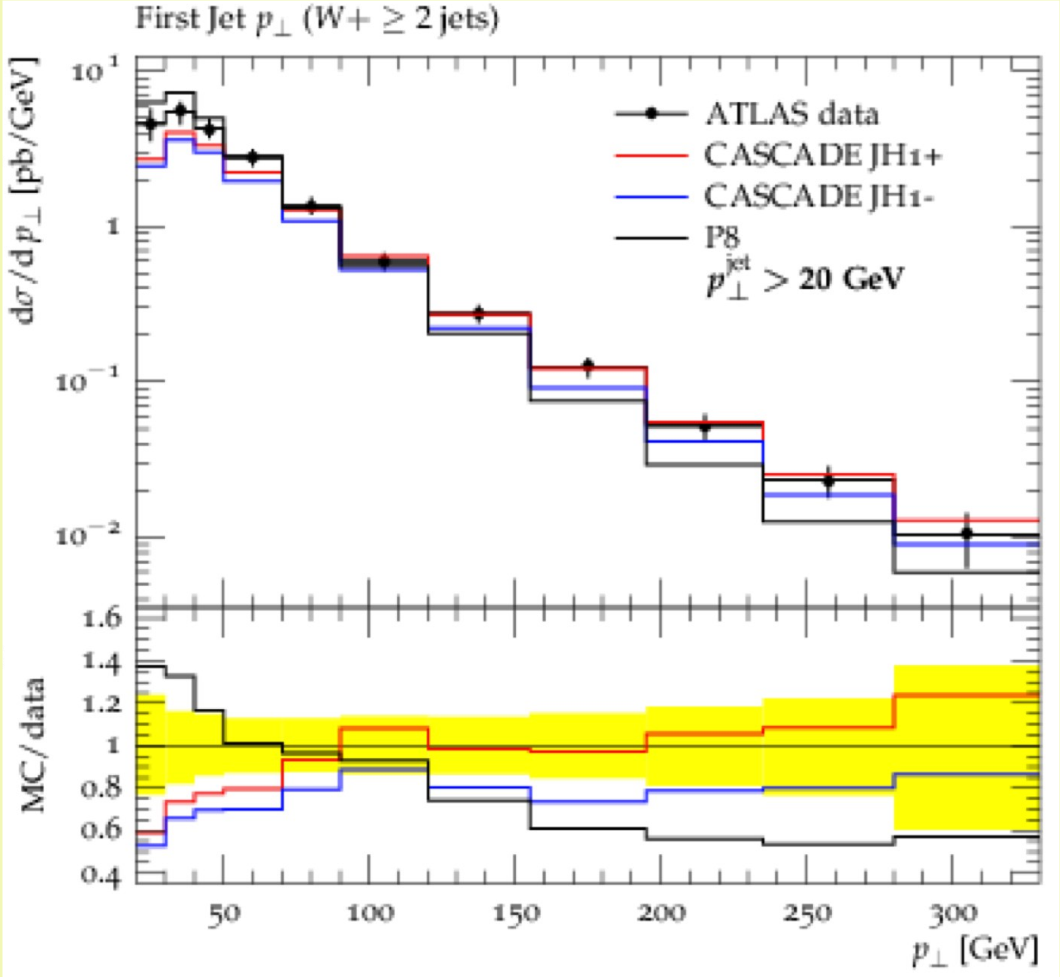
Caveat: improved (NNLL) parton shower kernel needed

BFKL inspired Monte Carlo

- An orthogonal approach to multi-jet production is offered by BFKL inspired Monte-Carlo generators, like CASCADE or HEJ

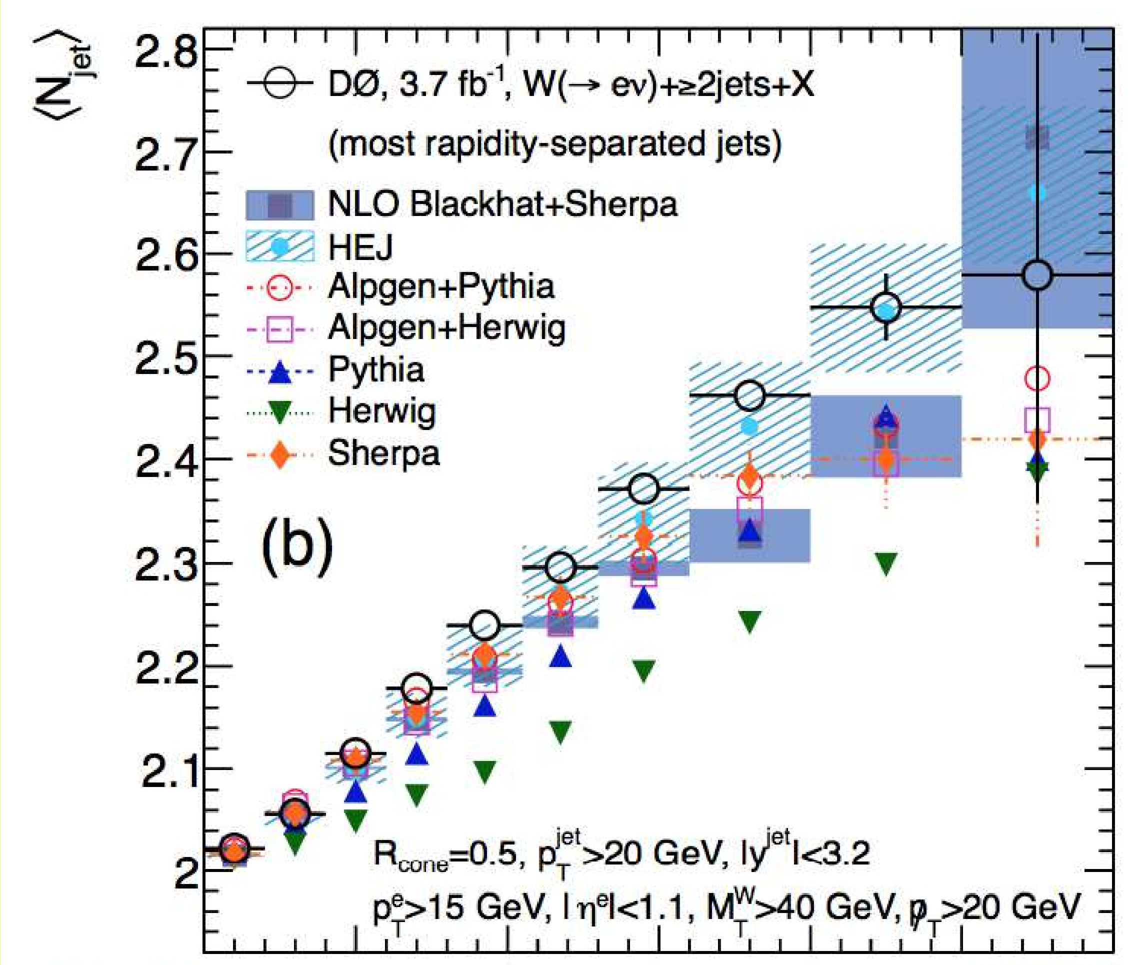
- CASCADE, based on CCFM equation, offers today a reasonable description of events with a high jet multiplicity

[Hannes Jung]



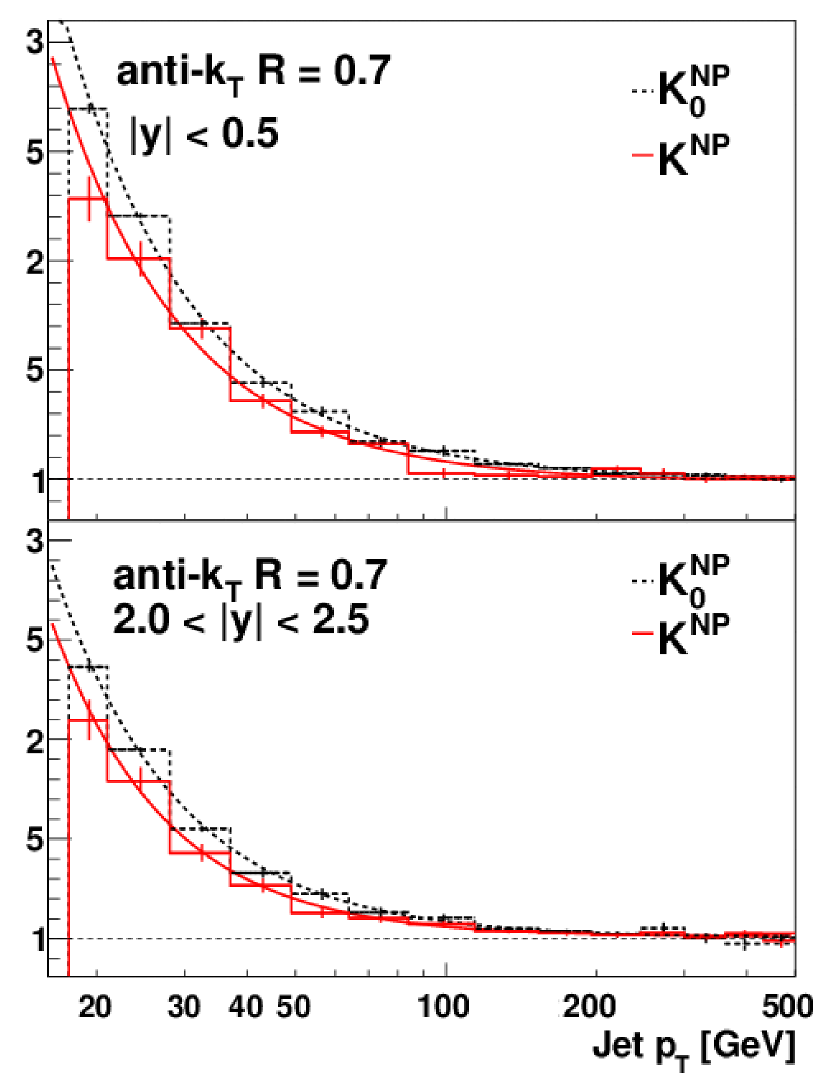
- HEJ, based on approximate matrix elements in the Regge-limit $t \ll s$, is appropriate for describing widely separated jets

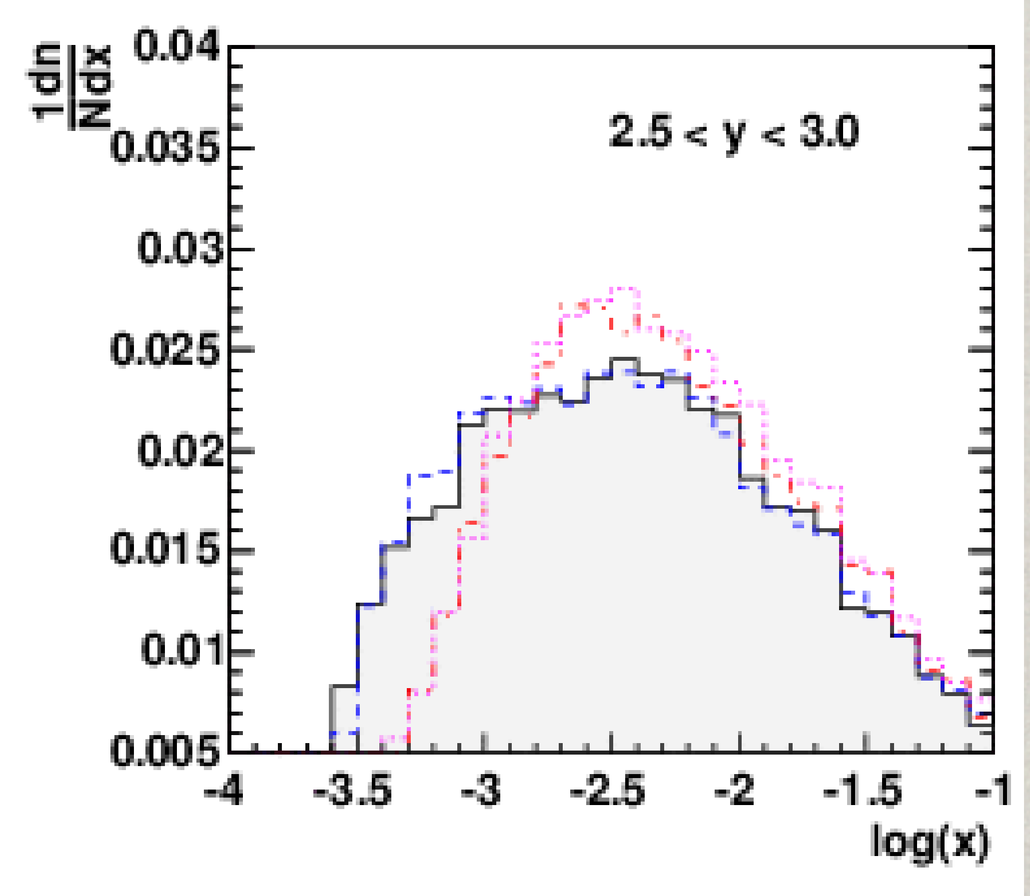
[Jeppe Andersen]



Caveats in the use of MC

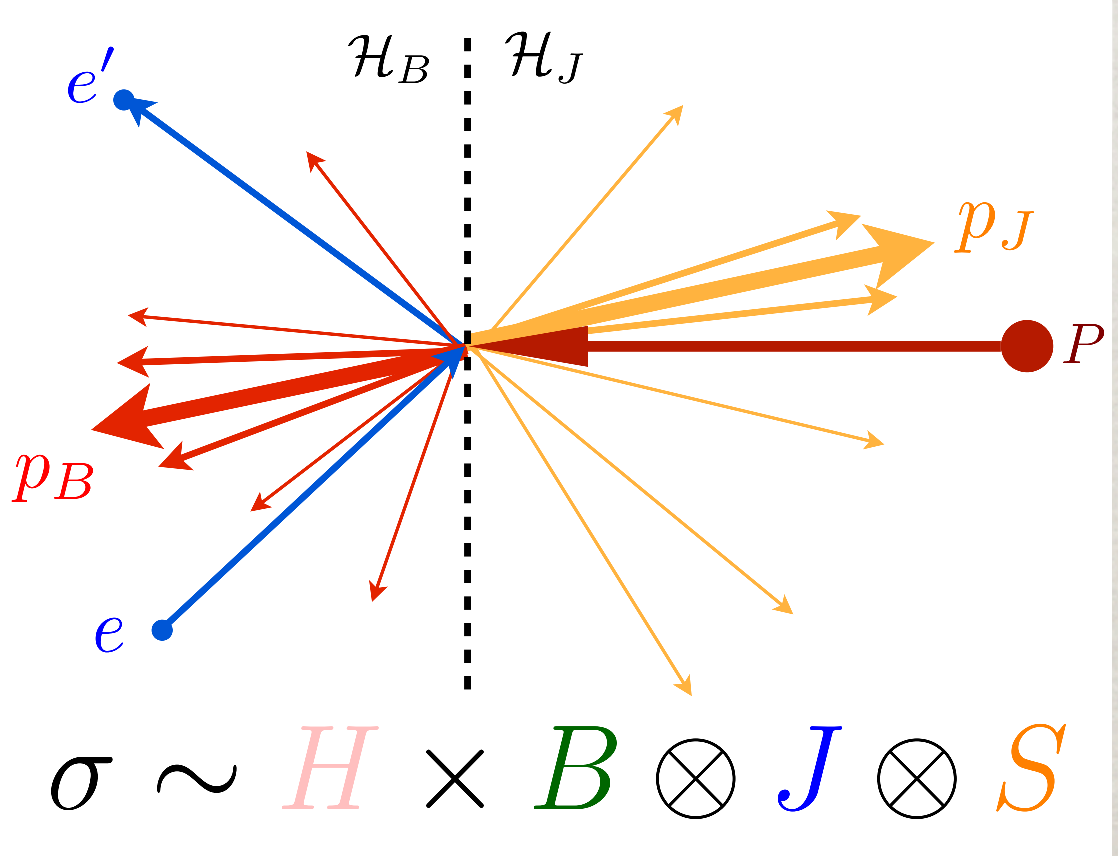
- Concluding remark on parton shower Monte Carlo: care must be taken when using them to supplement NLO calculations with NP effects
- Example of inclusive jet: parton shower can alter in a significant way the characteristics of the hard events we are interested in [Samantha Dooling]

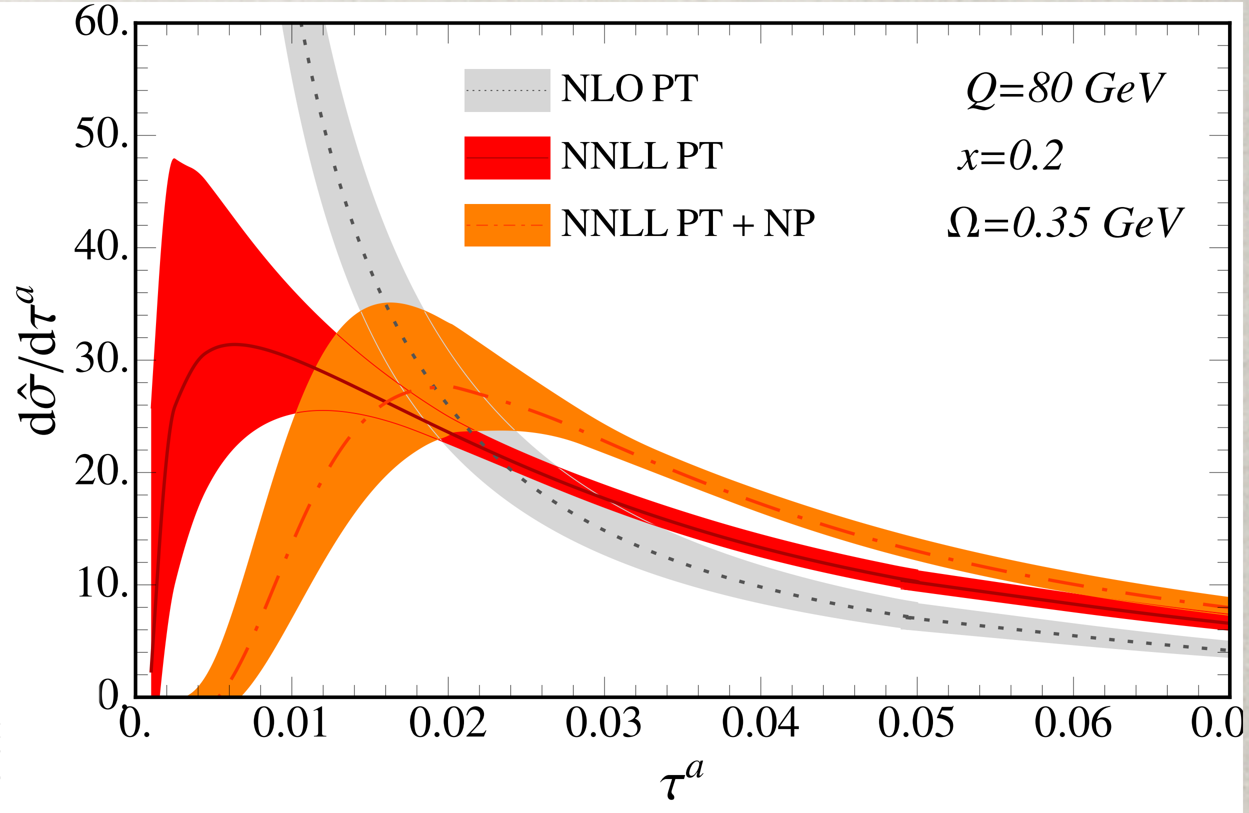




Progress in resummation (I)

- Soft-collinear effective theory is a powerful way to account sistematically for large logarithms in global observables
- The 1-jettiness (in three variants) can be used for precision studies in DIS, since it can be resummed to NNLL accuracy [Daekyoung Kang]





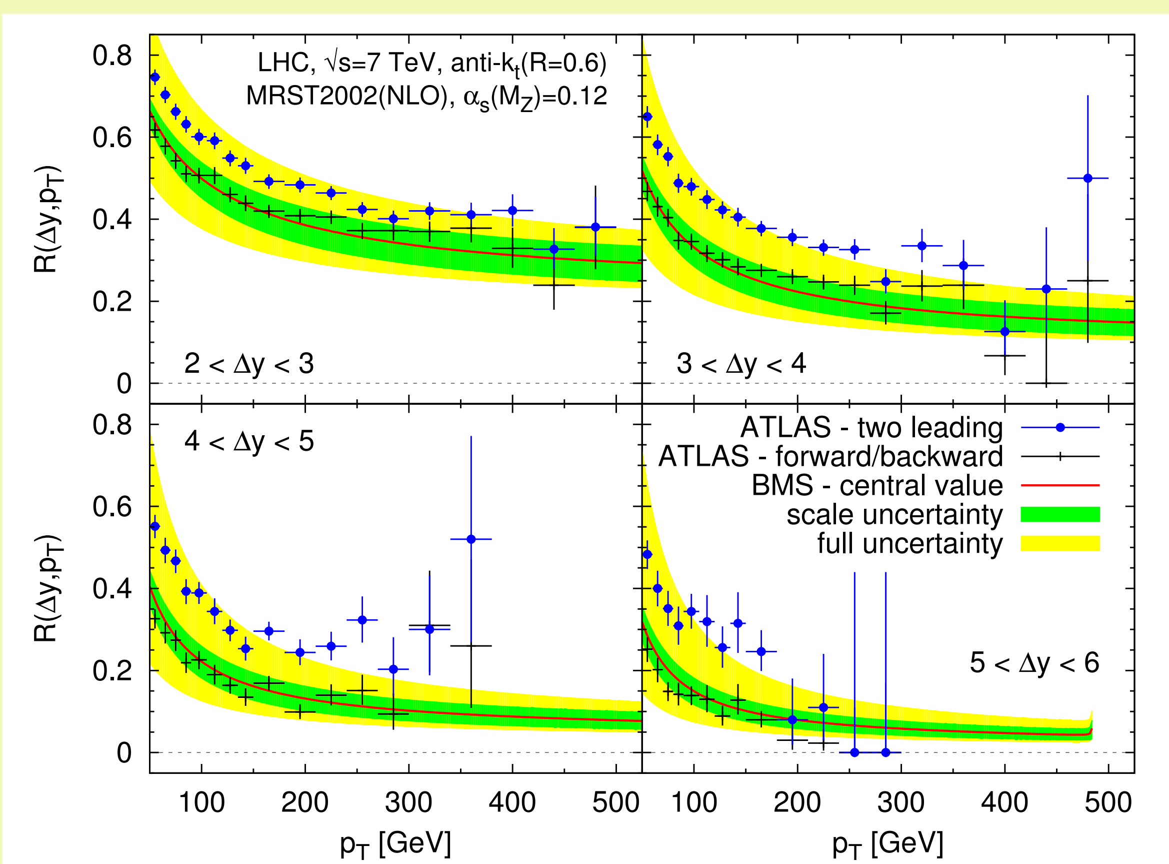
- Note: variant b of 1-jettiness could be measured with existing data, since it's just one minus current hemisphere thrust normalised to Q

Progress in resummation (II)

- Realistic experimental setups involve non-global observable, like the case of gap fraction in dijet events (the fraction of events with no extra jets above a threshold $Q_0 \leq p_{\rm t,jet}$)
- For $Q_0 \ll p_{\rm t,jet}$, resummation of $\alpha_s^n \ln^n(Q_0/p_{\rm t,jet})$ is needed

- For anti-kt jets, NLL resummation with BMS equation gives a good description of ATLAS data

[Cyrille Marquet]



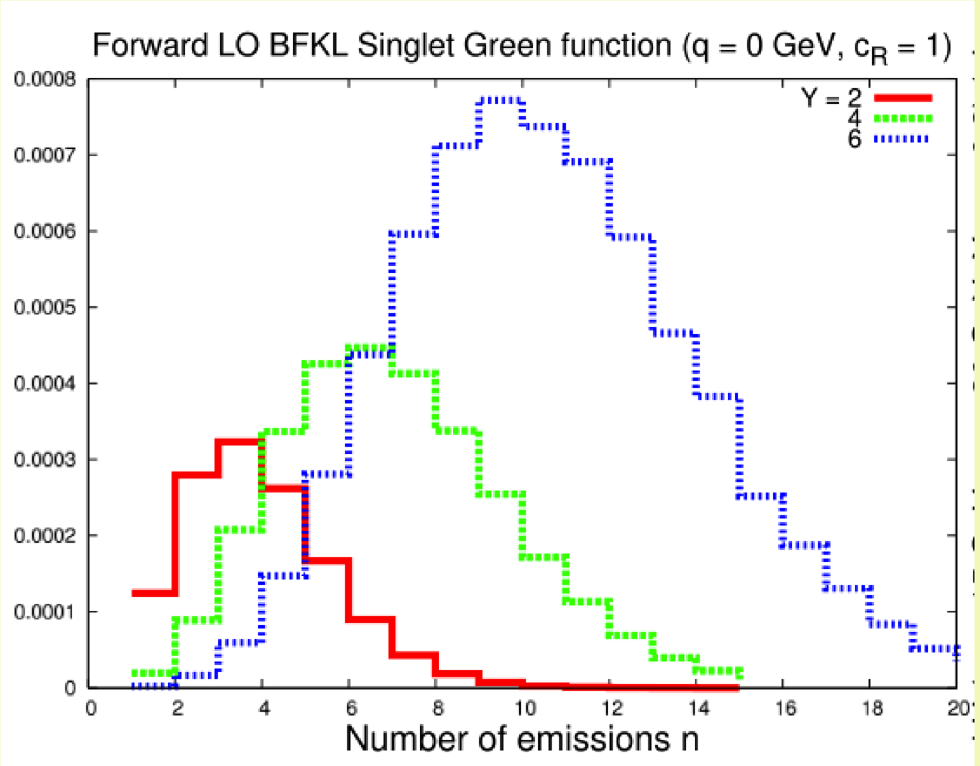
- For kt and C/A jets, new clustering logarithms appear, which show intriguing exponential structure
- The correction induced by large logarithms is reduced (7%) for kt with respect to anti-kt jets (50%)
- Clustering logarithms can play a role in boosted object searches, where C/A algorithm is used

[Yazid Delenda]

Formal developments

- Monte Carlo solution of BFKL, BKP and BDS equations

  [Grigorios Chachamis]



- General method to decompose a multi-gluon amplitude into an orthogonal colour basis

  [Malin Sjodahl]

Case	Vectors $N_c = 3$	Vectors, general case
4 gluons	8	9
6 gluons	145	265
8 gluons	3 598	14 833
10 gluons	107 160	1 334 961

- Computer implementation in ColorFull and ColorMath packages

- Such theoretical developments are mature enough to be applied to realistic phenomenological studies in multijet production

Conclusions

- During this conference, we have been updated on an impressive progress in understanding the physics of multi-jet events

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Thanks to all the speakers