

The Group

- ▶ Group leader
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- ▶ Postdocs
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 - ▶ Christoph Hackstein (final year/with CMS KA)
 - ▶ Luca D'Errico (2nd year/in Durham)
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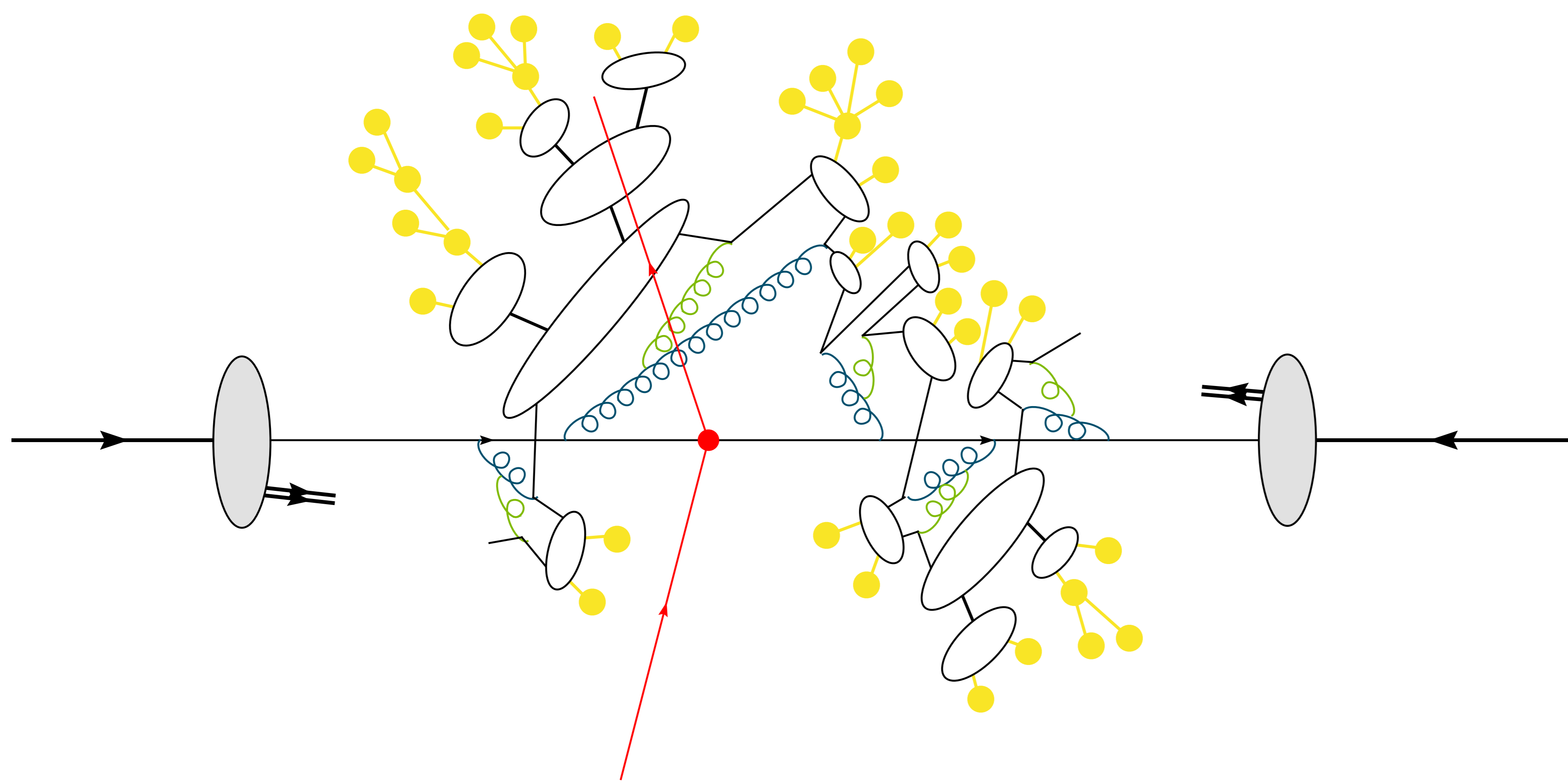
(January 2009)

Topics

Research within Herwig collaboration

- ▶ Development of a parton shower based on Catani–Seymour dipoles.
- ▶ Matching dipole showers with NLO calculations.
- ▶ Colour coherence?
- ▶ Beyond the large N_c limit?
- ▶ Multiple partonic interaction model for the underlying event.
- ▶ Soft interactions.
- ▶ Non-perturbative models.

MC Event Generator



Relevant Publications

- ▶ S. Gieseke, P. Stephens and B. Webber, JHEP **0312** (2003) 045.
- ▶ S. Gieseke, A. Ribon, M. H. Seymour, P. Stephens and B. Webber, JHEP **0402** (2004) 005.
- ▶ S. Gieseke *et al.*, Herwig++ 2.0 β Release Note, hep-ph/0602069.
- ▶ S. Gieseke *et al.*, Herwig++ 2.0 Release Note, hep-ph/0609306.
- ▶ M. Bähr *et al.*, Herwig++ 2.1 Release Note. arXiv:0711.3137.
- ▶ M. Bähr *et al.*, Herwig++ 2.2 Release Note. arXiv:0804.3053.
- ▶ M. Bähr *et al.*, Herwig++ Physics and Manual, Eur. Phys. J. C **58** (2008) 639.
- ▶ M. Bähr *et al.*, Herwig++ 2.3 Release Note. arXiv:0812.0529.
- ▶ M. Bähr, S. Gieseke, Seymour, JHEP **0807** 076.
- ▶ M. Bähr, J.M. Butterworth, M.H. Seymour, JHEP **0901** 065.
- ▶ M. Bähr, J.M. Butterworth, S. Gieseke, M.H. Seymour, 0905.4671.
- ▶ S. Plätzer, S. Gieseke, 0909.5593.
- ▶ S. Gieseke, M. Seymour, A. Siódmok, JHEP **0806** (2008) 001.

Matching Parton Showers with NLO

Master formula for matched observable O :

$$\langle O \rangle_{\text{MC@NLO}} = O(0) \left[B + \bar{V} + \int_0^1 dx \frac{P(x) - A(x)}{x} \right] + \int dx O(x) \frac{R(x) - P(x)}{x}.$$

(B Born, \bar{V} virtual + remainder, R real, A subtraction, P parton shower)

'Custom' parton shower

e.g. with Catani–Seymour subtraction kernels

- ▶ CS subtraction already used in many NLO calculations.

- ▶ $P(x) = A(x)$, so **terms vanish**.

- ▶ $R(x) - A(x)$ already in NLO parton level program.

⇒ (almost) no need to modify NLO calculation!

Simpler in a different way, $P(x) = R(x)$

- ▶ $R(x) - A(x)$ now only needed as integral available in NLO parton level program.

- ▶ No $n+1$ body events.

- ▶ ≥ 1 PS emission from $R(x)$ as splitting kernel → POWHEG.

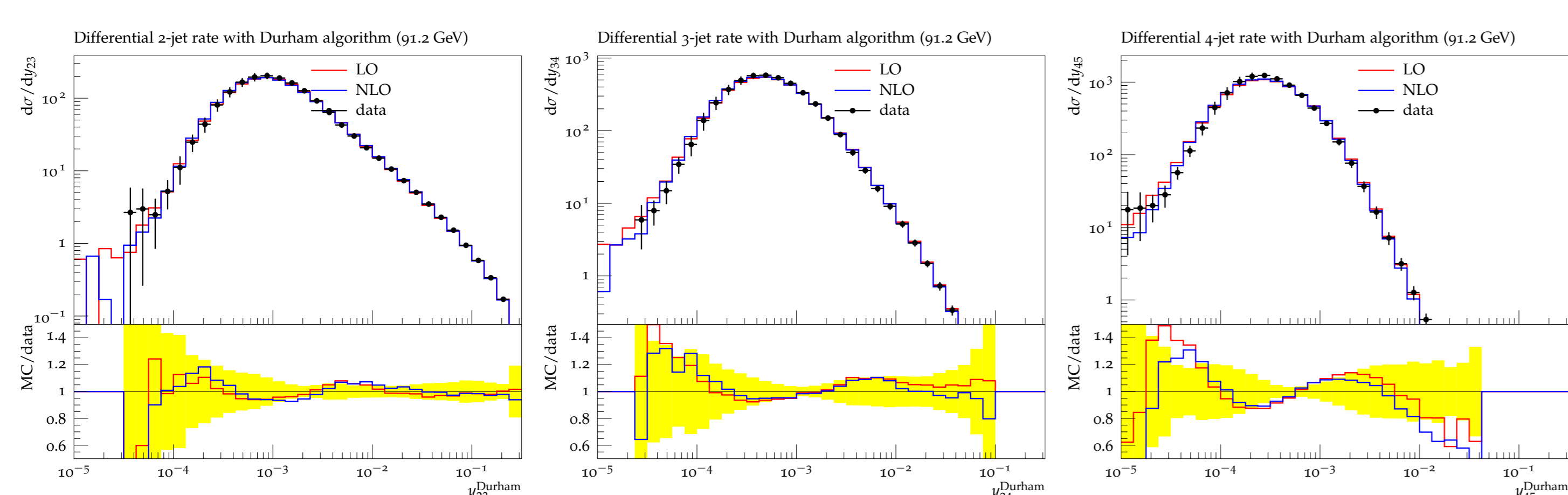
- ▶ Positive weights (terms $\neq 0$ are $\sigma_{\text{NLO}}^{\text{incl}}$).

- ▶ Further emissions from (truncated) standard PS.

Custom CS parton shower → switch between both options.

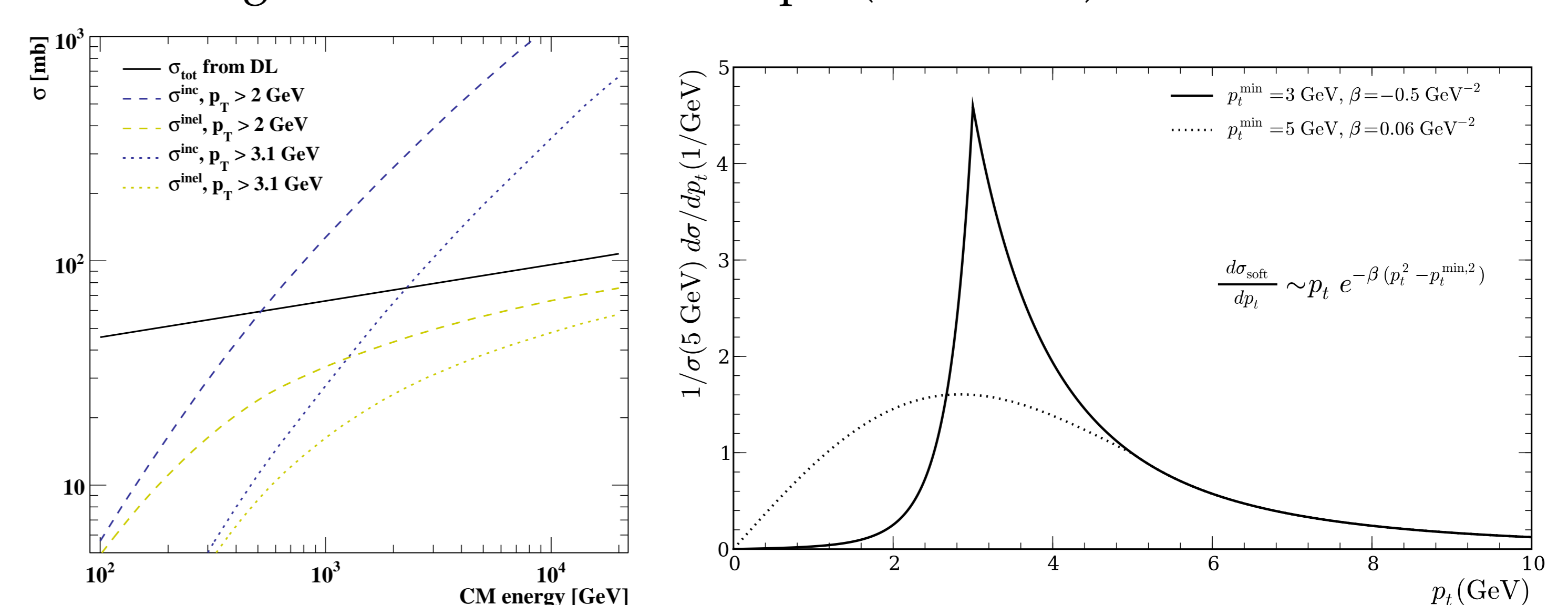
Demonstrated soft coherence for this shower.

Working shower module for Herwig++, first e^+e^- results:



Underlying Event Model

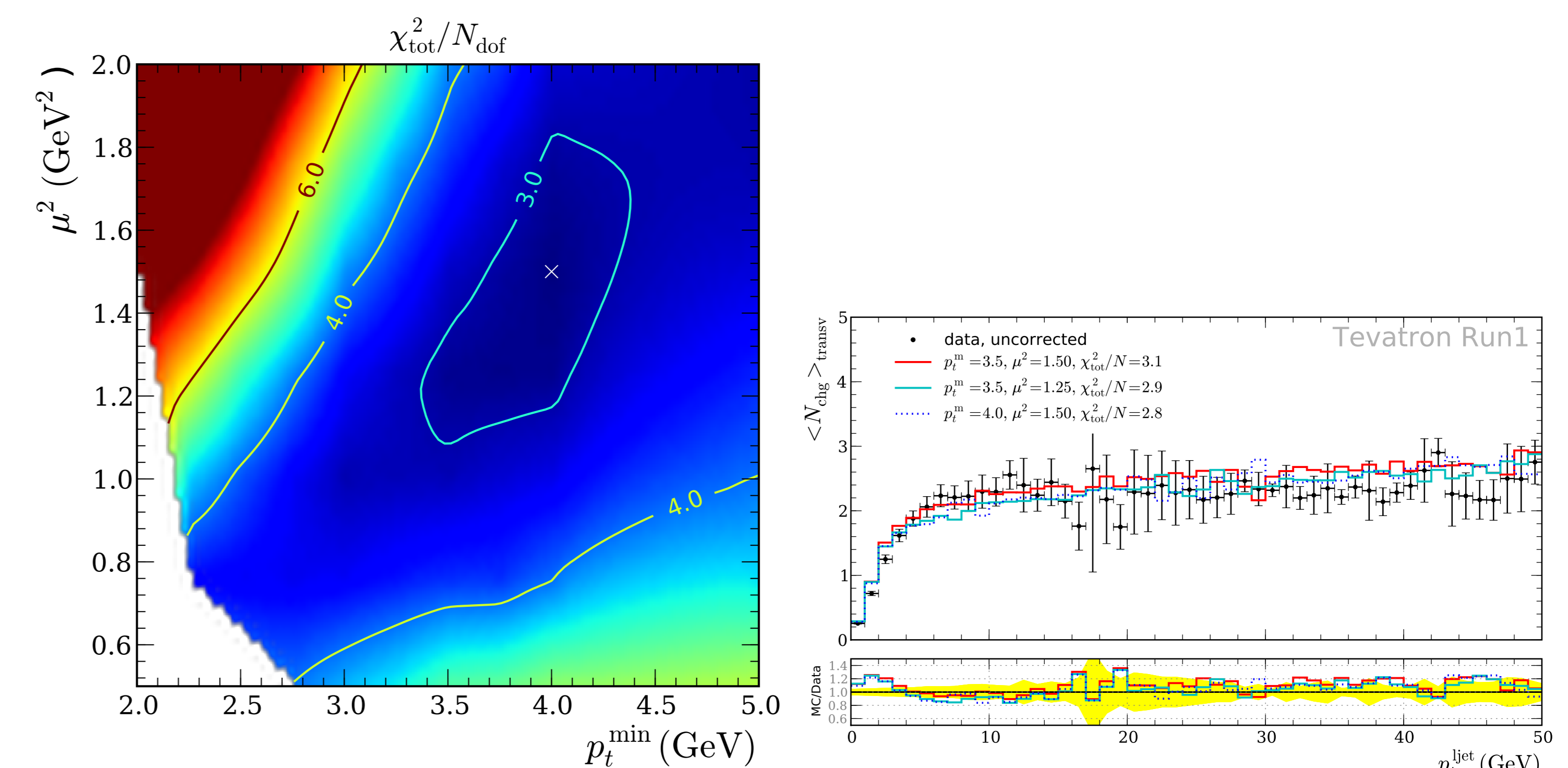
Unitarizing cross sections via multiple (hard+soft) interaction model.



Fit results for Run I underlying event analysis:

χ^2 contours in parameter plane (left)

and MC vs data for a typical UE observable (right).



This is the new default Herwig++ underlying event model.