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AACHEN

Particle Physics Theory at the RWTH Aachen

- Staff: Martin Beneke, Werner Bernreuther, Michael Krämer
- Postdocs: Peter Fischer, Sebastian Jäger, Yuichiro Kiyo, Alexander Mück, Christian Schwinn, (Stefan Berge, Tania Robens, Tobias Huber).

+ approx. 10 PhD/Diploma students

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- Theorie Group ist part of the
  - Graduiertenkolleg "Elementarteilchenphysik an der TeV-Skala"
  - SFB TR9 Computergestützte Theoretische Teilchenphysik
    (with Karlsruhe, HU Berlin and NIC/DESY Zeuthen)

Research

- Beneke
  - B-physics: QCD factorization, penguin decays, power corrections,...
  - EFT approach to unstable particle production: expansions in powers of α and Γ/M;
  - Top-production at threshold: third-order Coulomb corrections;
  - SCET, renormalons, ...

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- Krämer
  - Higgs & SUSY particle production: (SUSY)-QCD corrections
  - Gauge boson production: electroweak corrections
  - NLO-QCD calculations with parton showers

Research

- Fischer: quantum gravity with RGE methods
- Jäger: SUSY GUTs and flavour physics
- Kiyo: Top-mass determination
- Mück: 5-D orbifold theories
- Schwinn: new calculation techniques for multi-leg amplitudes

NLO calculations with parton showers (work with Soper and Mrenna)

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  – break down for certain kinematic configurations
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- Aim: Perform NLO calculations with (LL) summation of soft/collinear logarithms and realistic hadronic final states

  $\Rightarrow$ match NLO calculations with parton shower Monte Carlo programs
- Problem of double counting:

  parton showers include part of the short-distance physics already included in NLO calculations

See also work by Frixione, Nason, Webber

NLO calculations with parton showers

- Consider event shape variables in $e^+e^- \to 3$ jets

Examine df_3/dM where f_3 is the fraction of events that have three jets and M is the mass of a jet (Durham algorithm, $y_{cut} = 0.05$)

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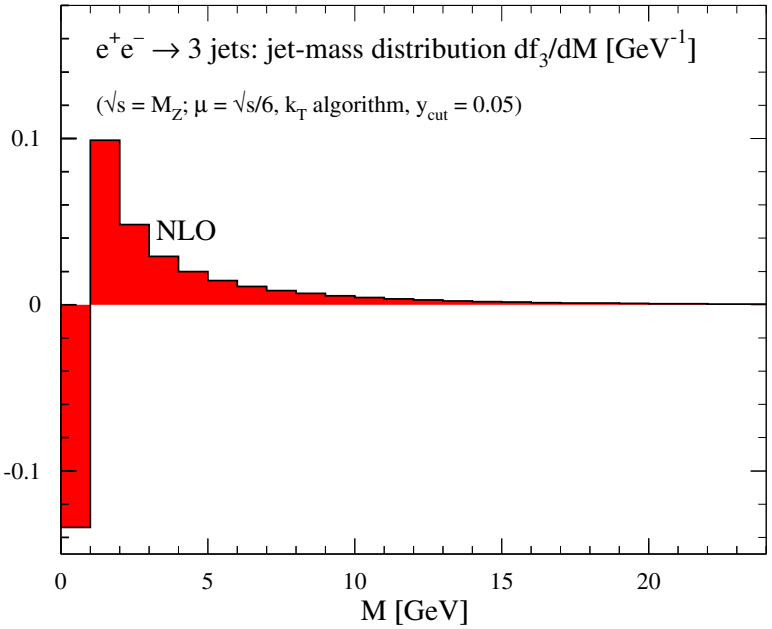
- NLO calculation



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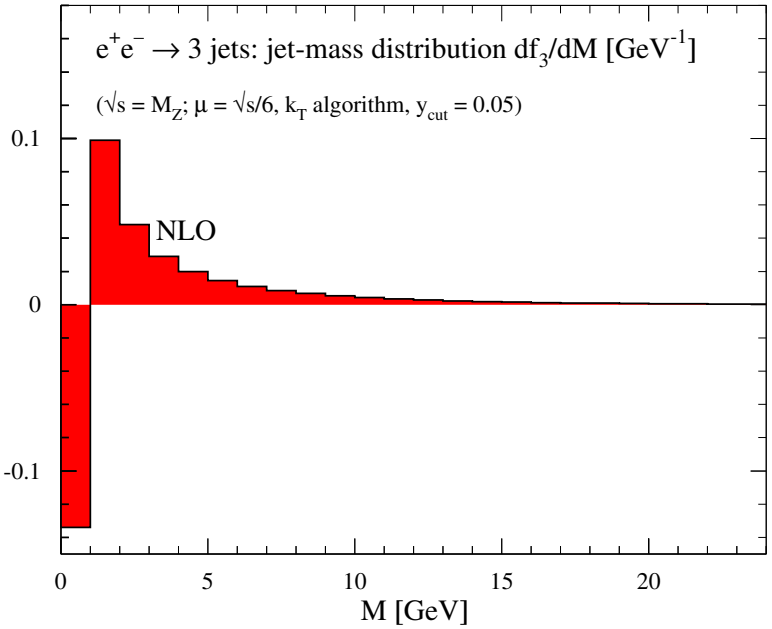

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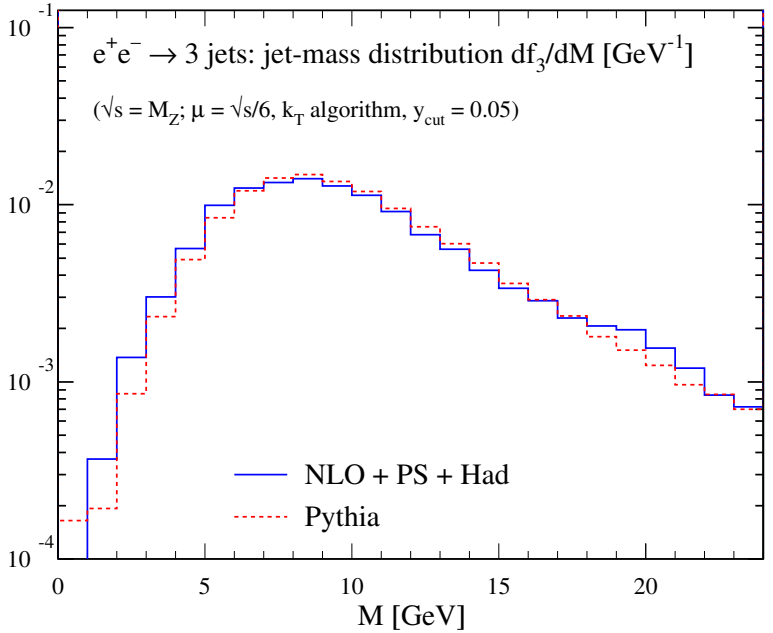
- NLO$\oplus$Pythia



$\Rightarrow$ realistic jet structure for $M \to 0$

$\Rightarrow$ accurate (NLO) prediction for rate