NLO WG 報告
2002 年

尾高　茂　(KEK)
shigeru.odaka@kek.jp

GR@PPA generators (LO)

S. Tsuno (U. of Tsukuba)

- GR@PPA_4b
  - Official release in Apr. 2002 (version 1.06)

    http://atlas.kek.jp/physics/nlo-wg/grappa.html
  - A paper was submitted to CPC (hep-ph/0204222; KEK Preprint 2002-7).
- GR@PPA_all
  - Many other generators are added.

    $W(\to f\bar{f})b\bar{b}, Wb\bar{b}, Zb\bar{b}, W(\to f\bar{f})c\bar{c}, Wc\bar{c}, Zc\bar{c}, \tau^+\tau^- b\bar{b}, Wb\bar{b}b\bar{b}, t\bar{t}$(6 body)
  - Not well tested yet, especially at the LHC condition.
- Others
  - Generators for W + jets (up to 4 jets) are being developed.

GR@PPA_4b vs PYTHIA

for QCD 4-*b* production

PYTHIA:

QCD 2-jet (MSEL = 1)

Detector:

Active detector in $|\eta| \leq 4.5$

b-quark tag in $|\eta| \leq 2.5$

Event selection:

4 *b*-jets with $E_T \geq 15$ GeV

$\Delta R \geq$ 0.4 for all *b*-jet pairs

$E_T \geq 50$ GeV for leading 2 *b*-jets

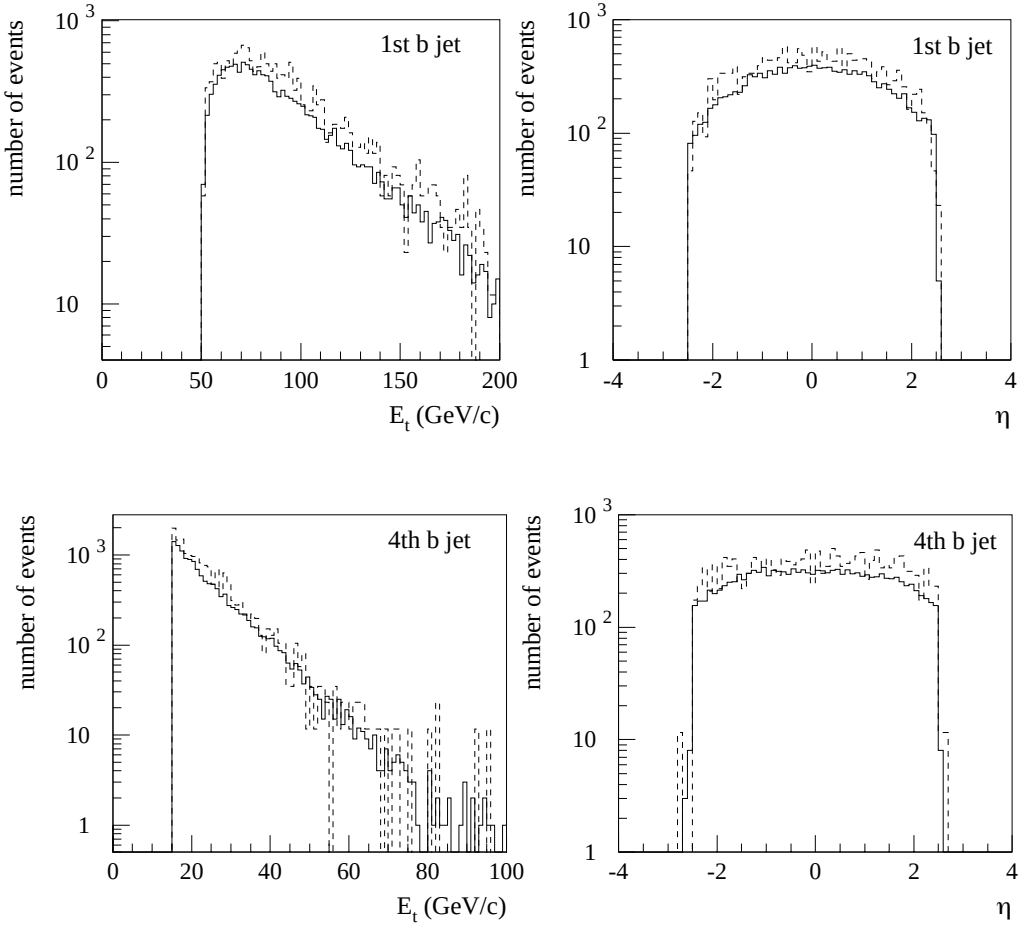
Result:

GR@PPA_4b: (348 ± 3) pb

PYTHIA: (447 ±12) pb

PYTHIA ≈ 1.3 × GR@PPA_4b

solid: GR@PPA_4b, dashed: PYTHIA



Origin of PYTHIA events

$gg \to gg$ ~ 50%

$gb \to gb$ ~ 35%

Additional b's from the final-state PS.

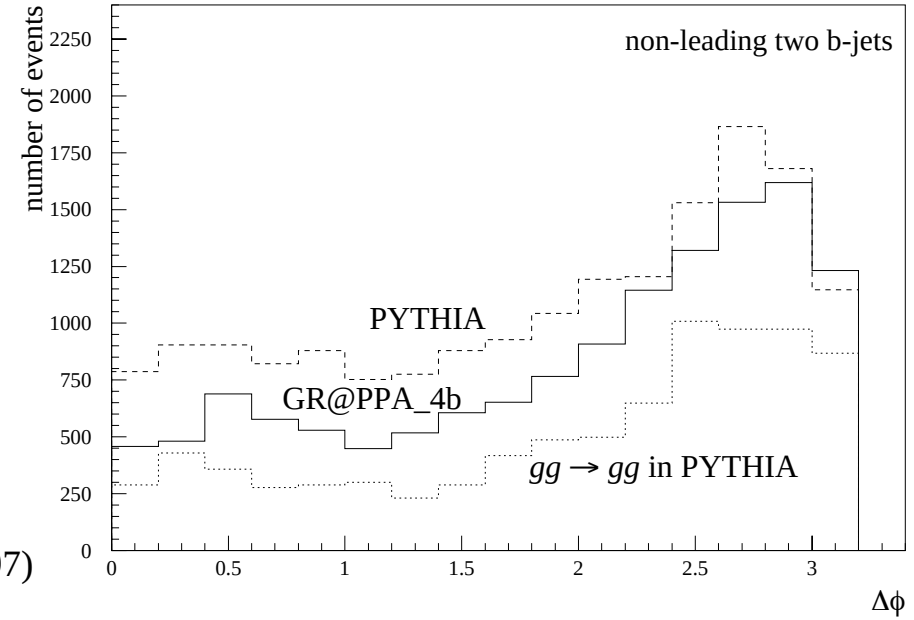
$gg(q\bar{q}) \to b\bar{b} + bb \to bb$ ~ 10%

Additional b's from the initial-state PS.

Consistent with the result in:

Richter-Was and Froidevaux, Z. Phys. C 76, 665 (1997)

and our Feb-2002 result.



Comparable results under a reasonable detection condition, if the QCD 2-jet subset (MSEL = 1) is chosen in PYTHIA.

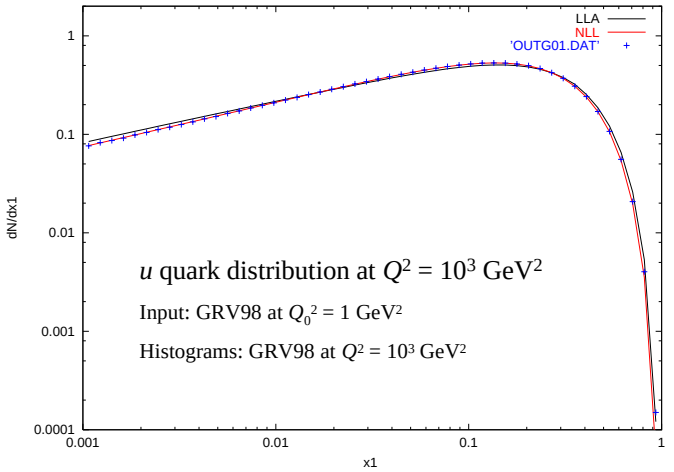
PYTHIA events are dominated by $gg \to gg$ and $gb \to gb$ interactions. The contribution of b-pair producing processes is small (~10%).

Note: PYTHIA ≈ 70×GR@PPA_4b in CPU-time.

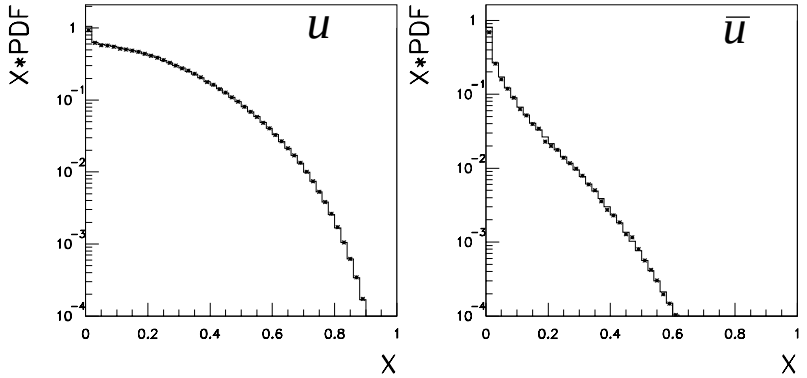
NLL-jet

Monte Carlo implementation (parton shower) of the next-to-leading logarithmic order QCD evolution in the initial state

- NLL-PS
  - All branching functions are ready (Sugiura and Tanaka at Rikkyo U.).
  - A preliminary coding with a temporary kinematics implementation has been tested (Tanaka).
- *X*-deterministic forward evolution PS
  - A new method of the initial-state PS with a forward Q^2 evolution (Y. Kurihara, hep-ph/0207214).
  - The final x is fixed before determining x values at intermediate branches.
  - A good efficiency can be achieved.
  - The idea has been tested for LL evolution.

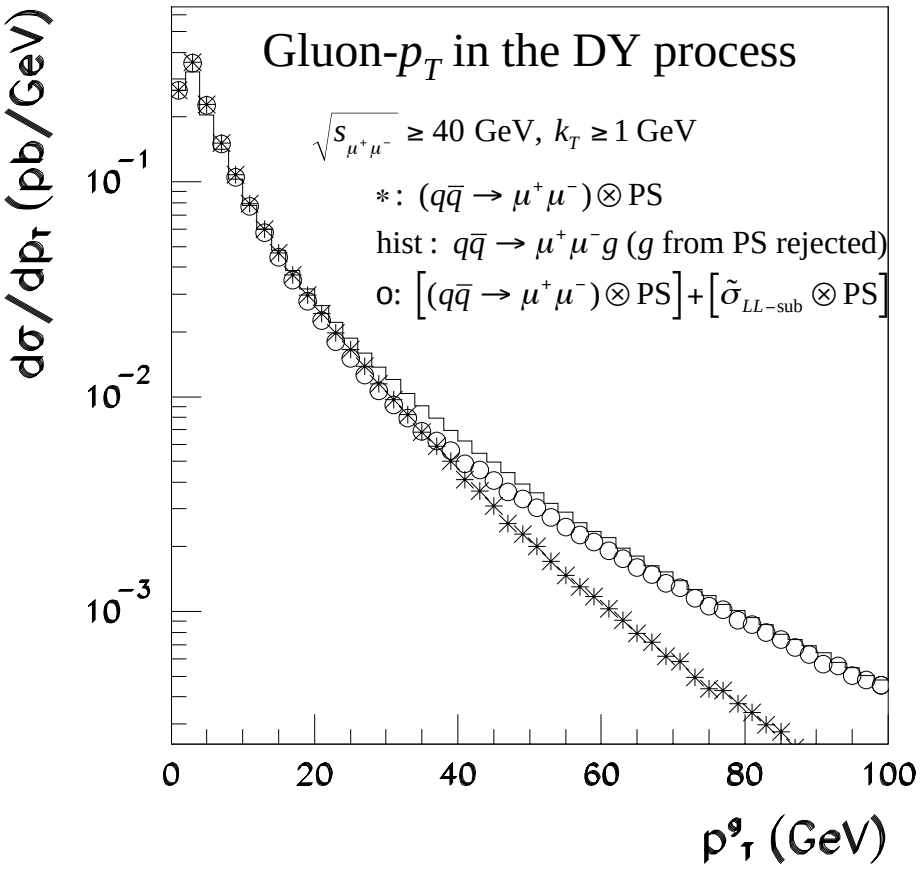


CTEQ5L : $Q_0 = m_b \Rightarrow Q = 100$ GeV



NLO event generator

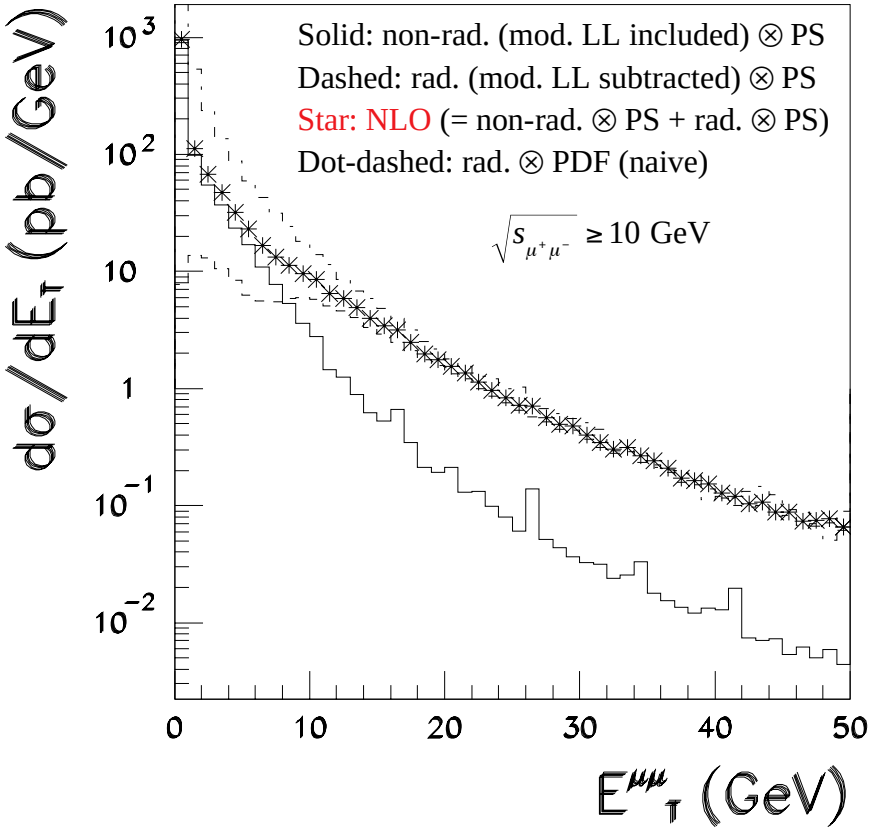
- One-loop corrections (only 3-points yet) are already in the CHANEL library.
- Modified LL-subtraction method to solve the double counting problem in ME and PS.
  - Numerical subtraction of LL terms from ME
  - A maximum p_T of the radiation (= factorisation scale) has to be introduced to reproduce the actual implementation of PS and PDF.
  - Y. Kurihara, hep-ph/0207214.
- Modified BASES/SPRING to handle negative-weight events.
  - The weight of generated events = ±1.
  - The fraction of negative-weight events is very small after the LL subtraction..



NLO Drell-Yan

QED only

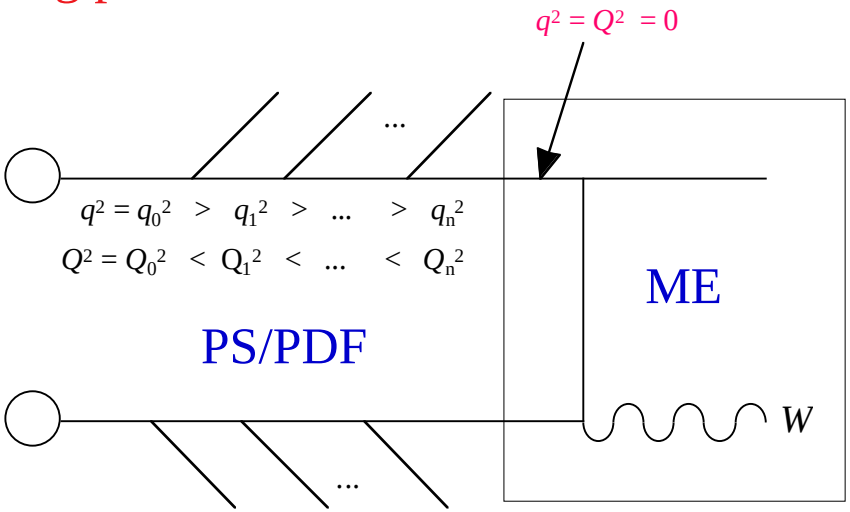
- Test and demonstration of the ideas
  - Kurihara et al., hep/ph-0212216
  - NLO calculation and event generation in the framework of GRACE
  - Numerical modified LL subtraction
  - X-deterministic forward evolution LL-PS
- Smooth transition from a PS-dominated small E_T region to a ME-dominated large E_T region

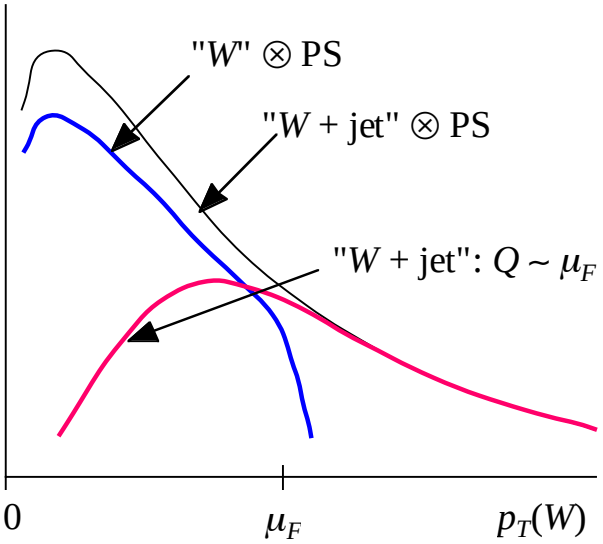


ME-PS matching

double-counting problem

- A serious problem when
  - Colored parton(s) in the final-state of ME, and
  - $E_T(\text{jet}) < \mu_F$
- For example:
  - NLO
  - W/Z + jet(s)
  - t-pair + jet(s)
  - H + jet(s)
- Being seriously discussed at Tevatron
  - “MC Tuning WS”
  - Next meeting on Jan. 14 at Durham (England)
- Various possible solutions have been proposed.





Possible solutions

- (Modified) Log-term subtraction
  - Kurihara, hep-ph/0207214
  - Subtract Log terms from ME, and add non-radiative process + PS, instead
  - Theoretically well defined, but hard to implement in multi-jet cases
  - Perhaps, a similar method in MC@NLO (Frixione and Webber, hep/ph-0204244)
- Hard-PS rejection
  - Mangano at the last “MC Tuning WS” on Nov. 16 @ FNAL
  - Require a matching between ME partons and observed jets -> reject mismatched events
  - Easy to implement, but theoretical basis is not clear
- Extended CKKW method
  - Mrenna at the last “MC Tuning WS” on Nov. 16 @ FNAL
  - CKKW (Catani, Kraus, Kuhn and Webber, hep/ph-0109231) for multi-jet Z decays
  - Generate events of a large jet multiplicity, applying PS with a small μ_F -> merge the jets and correct the event weight using the Sudakov suppression factor
  - Theoretically well defined, but need to generate multi-jet events
- (Simple) phase-space slicing
  - Simple and well defined, but hard to avoid discontinuity

2003 年カレンダー

- 2 月 17 日 - 21 日：ATLAS Week (CERN)
- 5 月 21 日 - 25 日：ATLAS Physics WS (アテネ)
- 5 月 27 日 - 6 月 6 日：Physics at TeV Colliders WS (Les Houches, France)
  - http://wwwlapp.in2p3.fr/conferences/LesHouches/Houches2003/
- 6 月 23 日 - 27 日：ATLAS Week (CERN)
- 7 月 7 日 - 8 月 2 日：LHC Monte Carlo WS (CERN)
  - http://lhc-monte-carlo.web.cern.ch/lhc-monte-carlo/workshop.html
- 9 月 13 日 - 19 日：ATLAS Week (プラハ)