Generator Issues

Peter Richardson
IPPP, Durham University

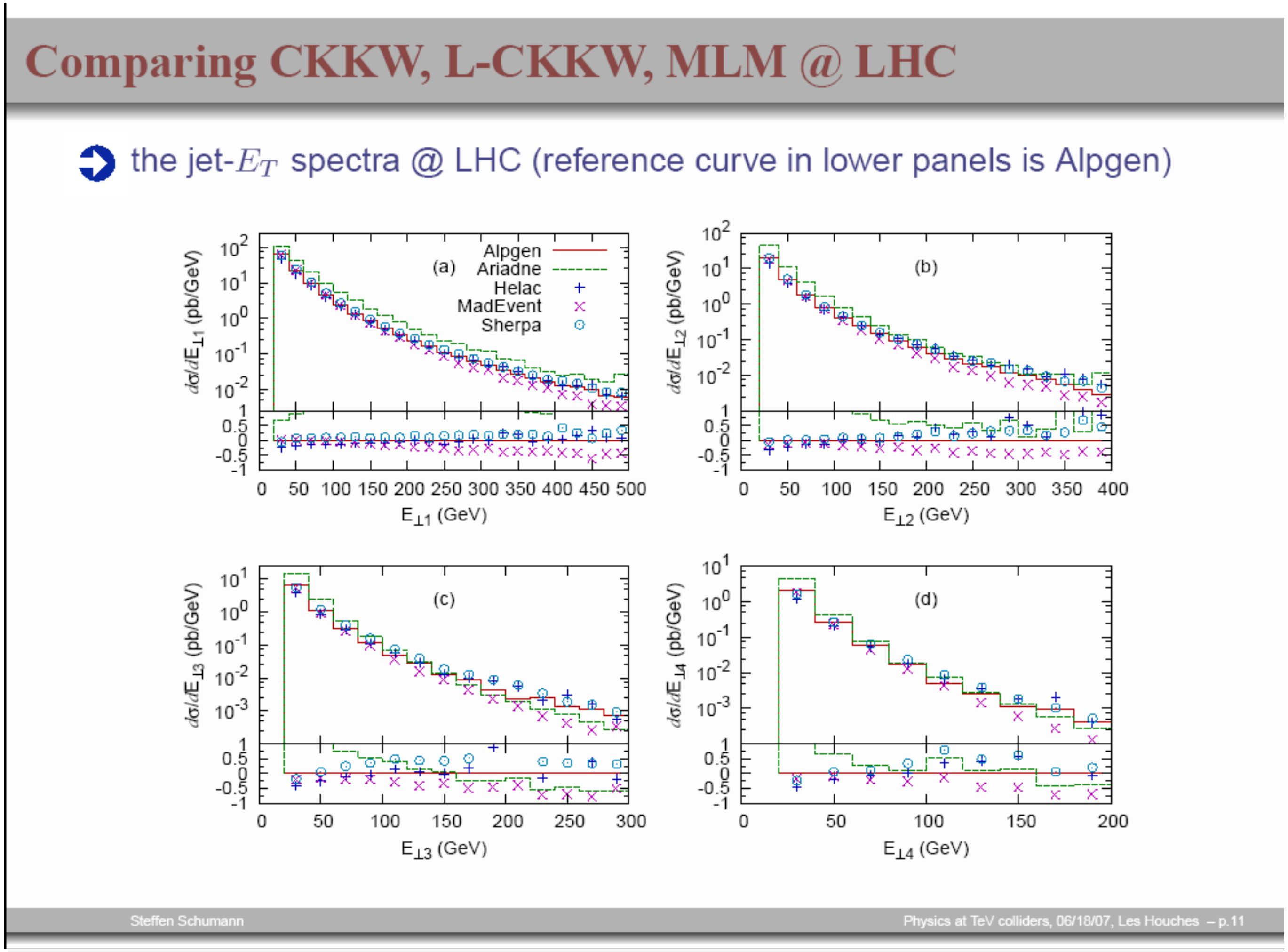
Summary

- Most of the work done by the event generator authors has been in the context of the other groups.
- I'll briefly mention some of this and the more MC specific things.
  - Parton Shower and Matching
  - Underlying Event
  - New Physics

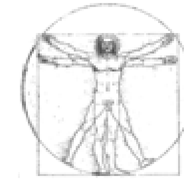
Matching

- So together with the NLM group we had an all day session on matching.
- A number of existing and proposed new approaches were discussed.
- I'll briefly mention them.

Comparing CKKW and MLM Approaches arXiv:0706.2569

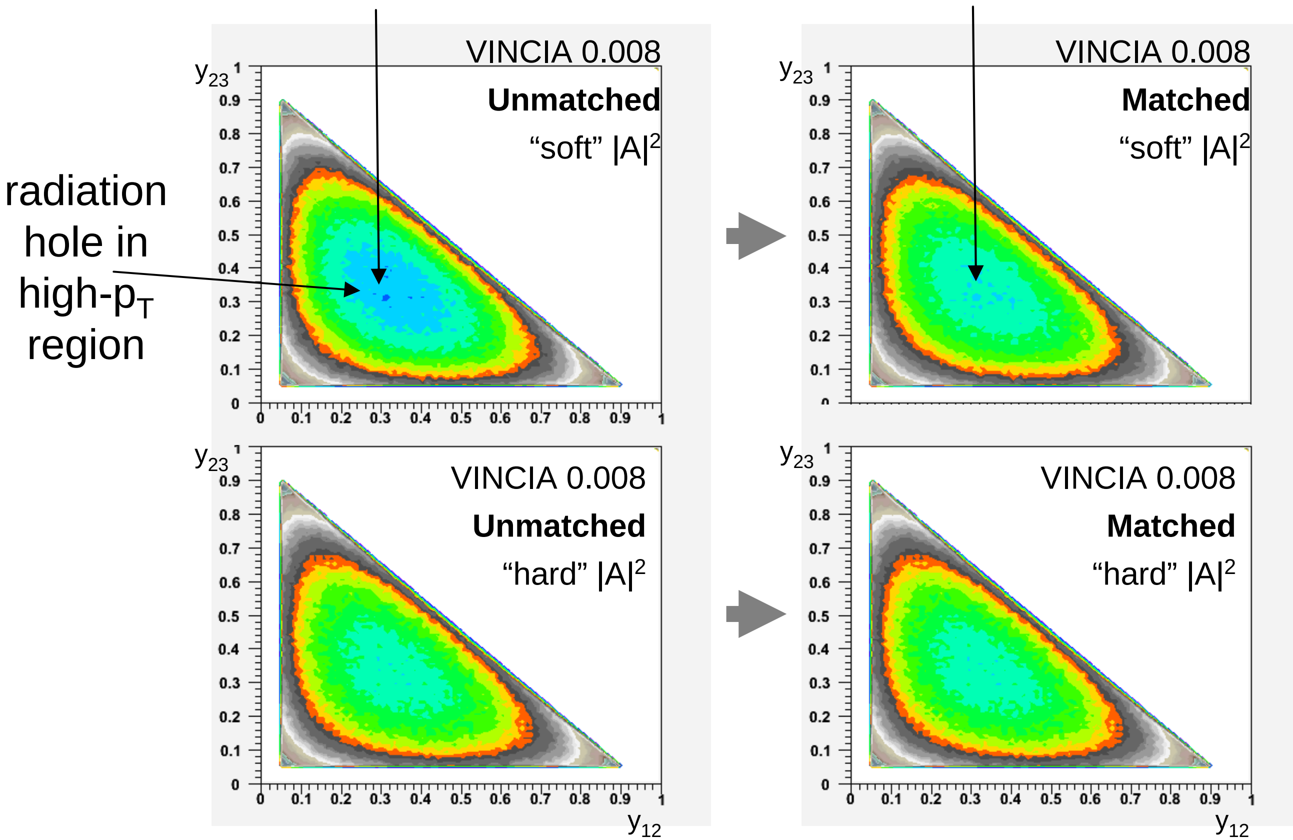


VINCIA Example: H → gg → ggg



Giele, Kosower, PS : FERMILAB-PUB-07-160-T

- First Branching ~ first order in perturbation theory
- Unmatched shower varied from “soft” to “hard” : soft shower has “radiation hole”. Filled in by matching.



Outlook:

Immediate Future:

Paper about gluon shower

Include quarks → Z decays

Automated matching

Then:

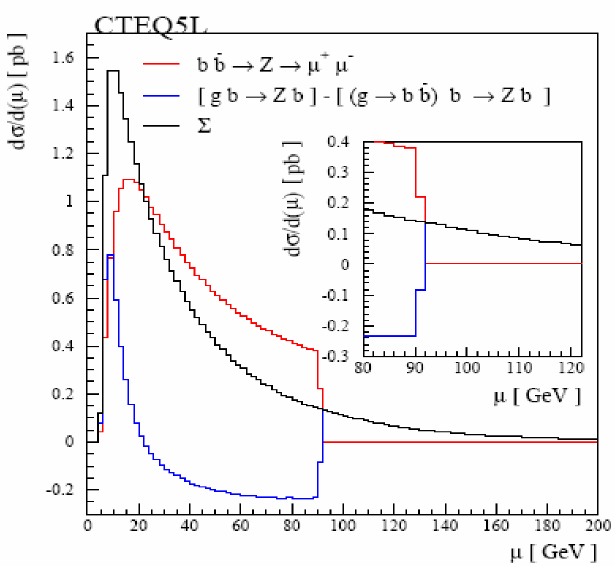
Initial State Radiation

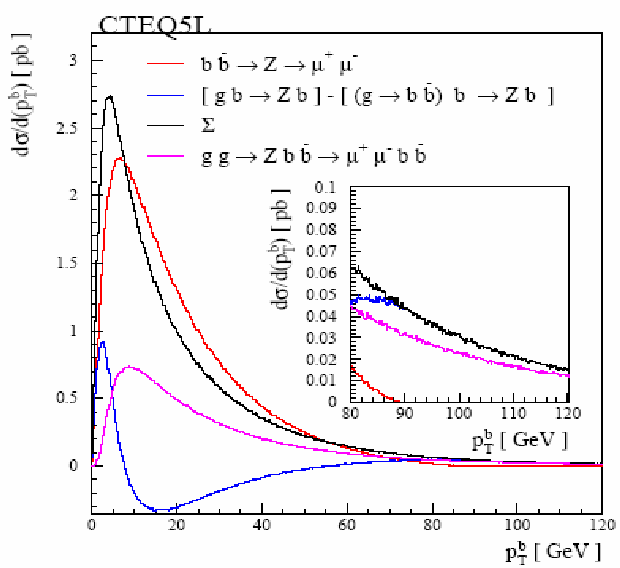
Hadron collider applications

ACOT-style Matching Kersevan

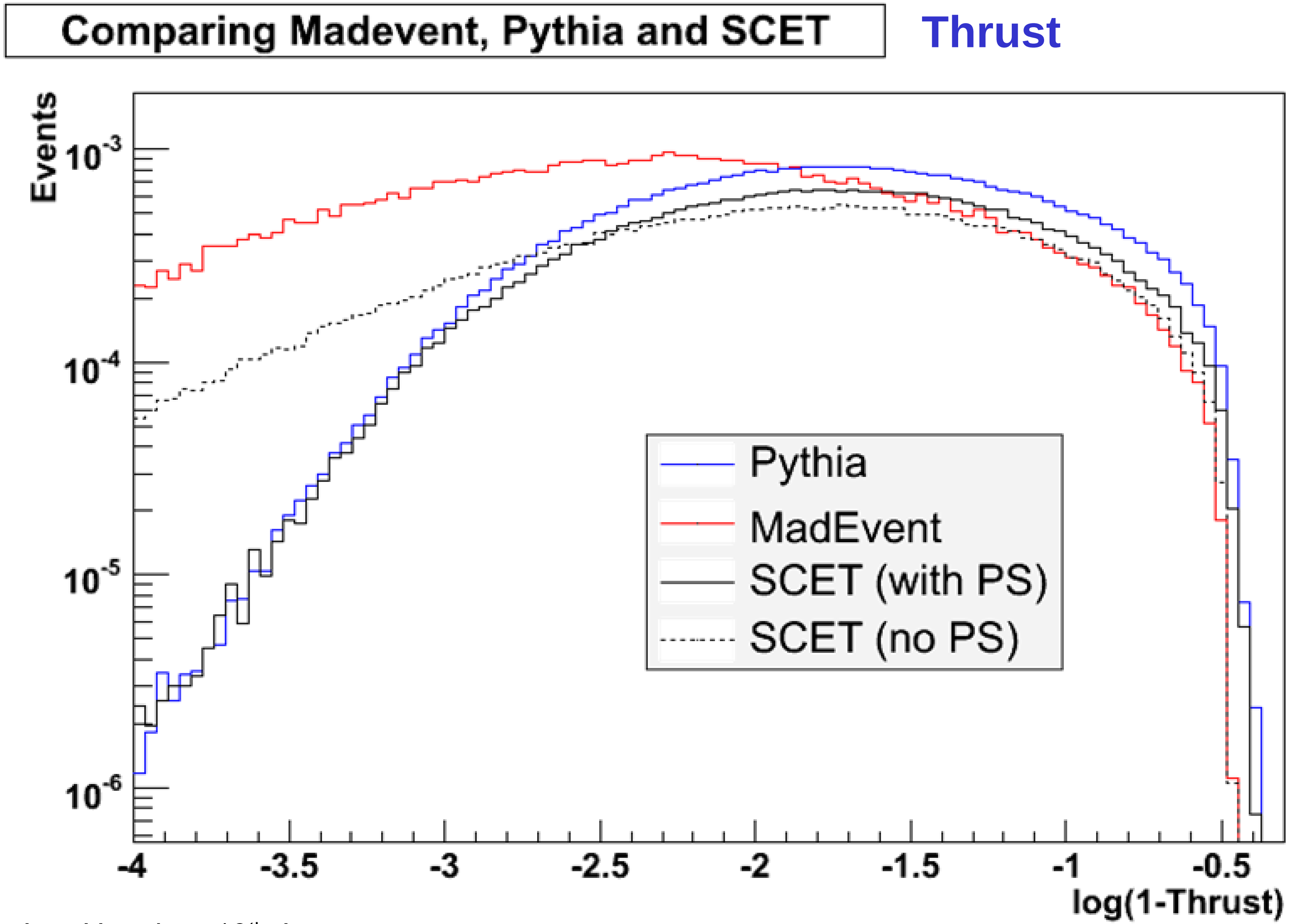
Drell-Yan Z + b production cont'd:

- Note that a smooth continuation in the b-quark virtuality is achieved regardless of the matching point/factorisation scale.
- The p_T distribution is a result of non-trivial contributions in this case.





SCET-Schwartz



Parton Showers with Quantum Coherence- Nagy, Soper

Parton Shower Evolution

Using the factorization properties of the QCD the approximated order by order calculation can be organized according to

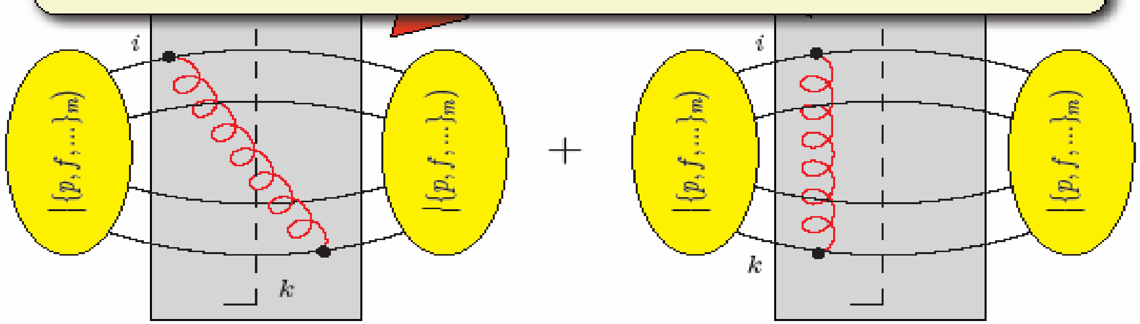
unresolved radiation

$$\mathcal{U}(t,t') = 1 + \int_{t'}^{t} d\tau\, \mathcal{U}(t,\tau)\left[\mathcal{H}_I(\tau) - \mathcal{V}(\tau)\right]$$

resolved radiations

or the differential equation

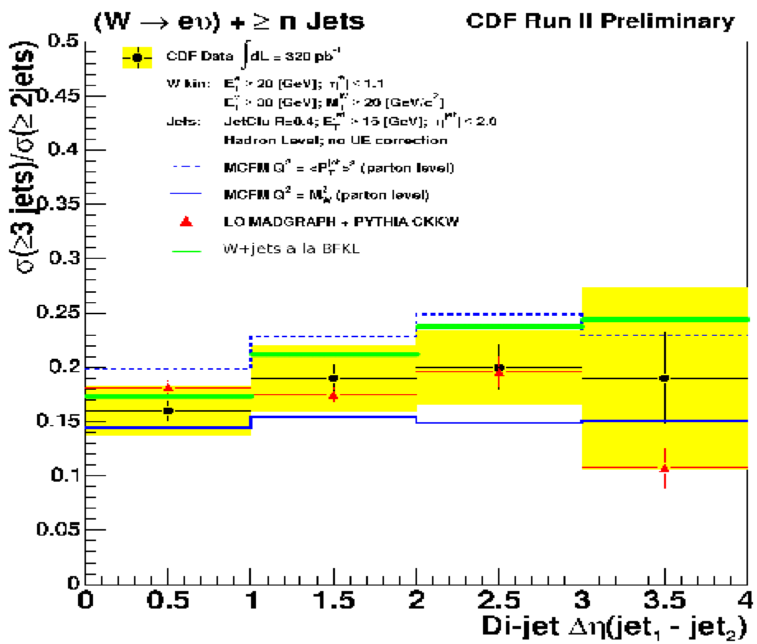
$$\mathcal{U}(t,t') = \mathbb{T}\exp\left(\int_{t'}^{t} d\tau \left[\mathcal{H}_I(\tau) - \mathcal{V}(\tau)\right]\right)$$



BFKL - Andersen

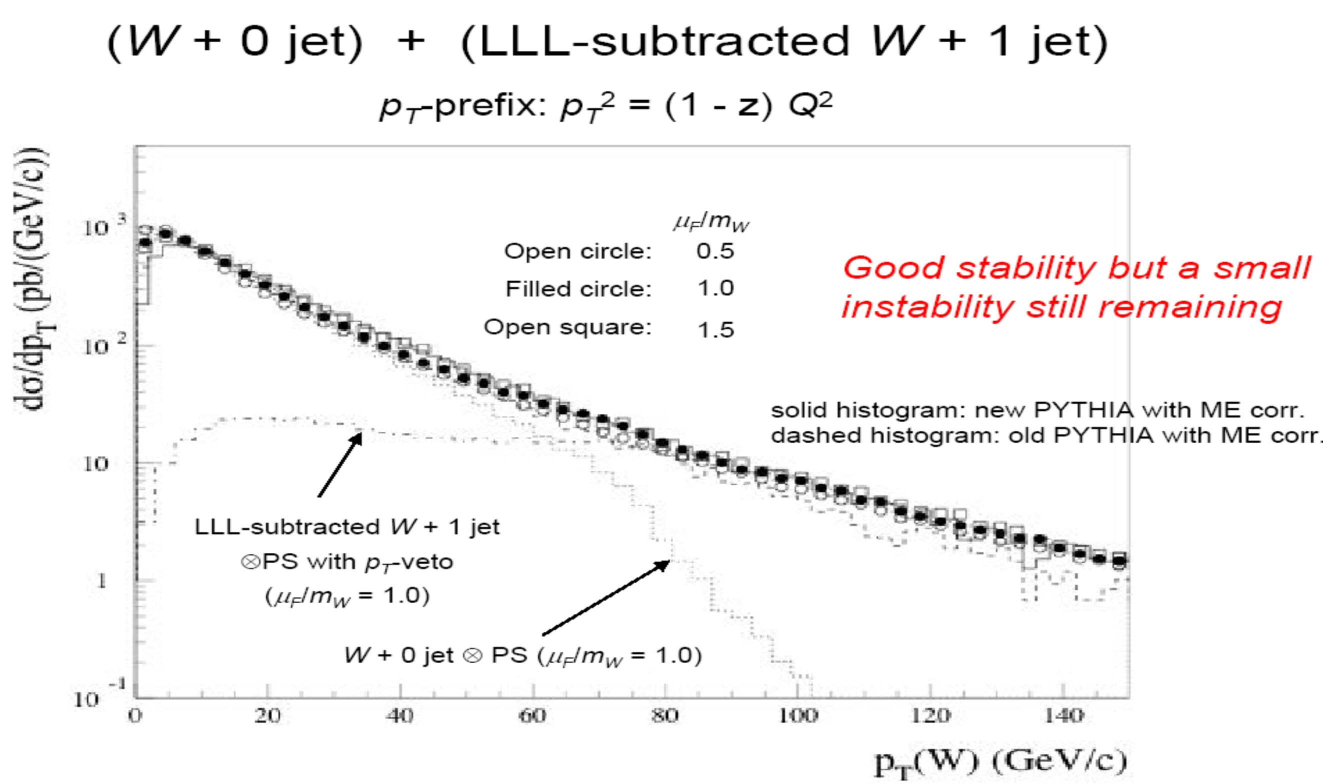
BFKL Multijet Generator — Conclusions

Comparison to Tevatron Data



No adjustable parameters (except scale choice of α_s)

LLL subtraction and PS kinematics - Odaka



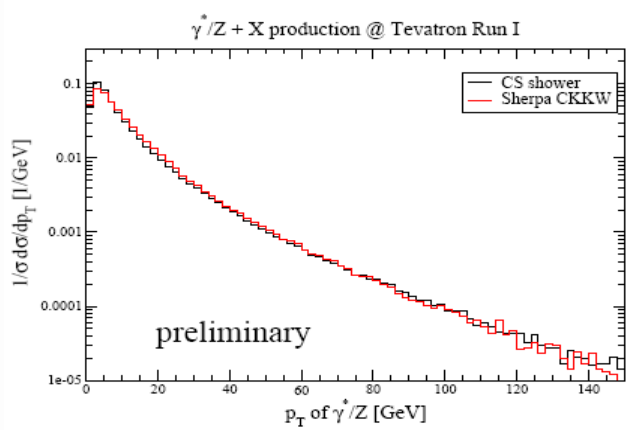
11 - 20 June 2007 Les Houches 2007 15

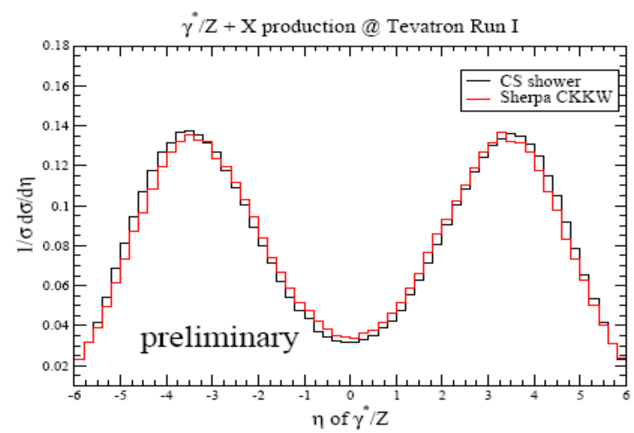
Catani-Seymour based Shower - Schumann

Parton Shower based on Catani-Seymour dipole factorisation

Application: γ^*/Z-production @ Tevatron Run I

- boson p_T and η compared against Sherpa CKKW sample



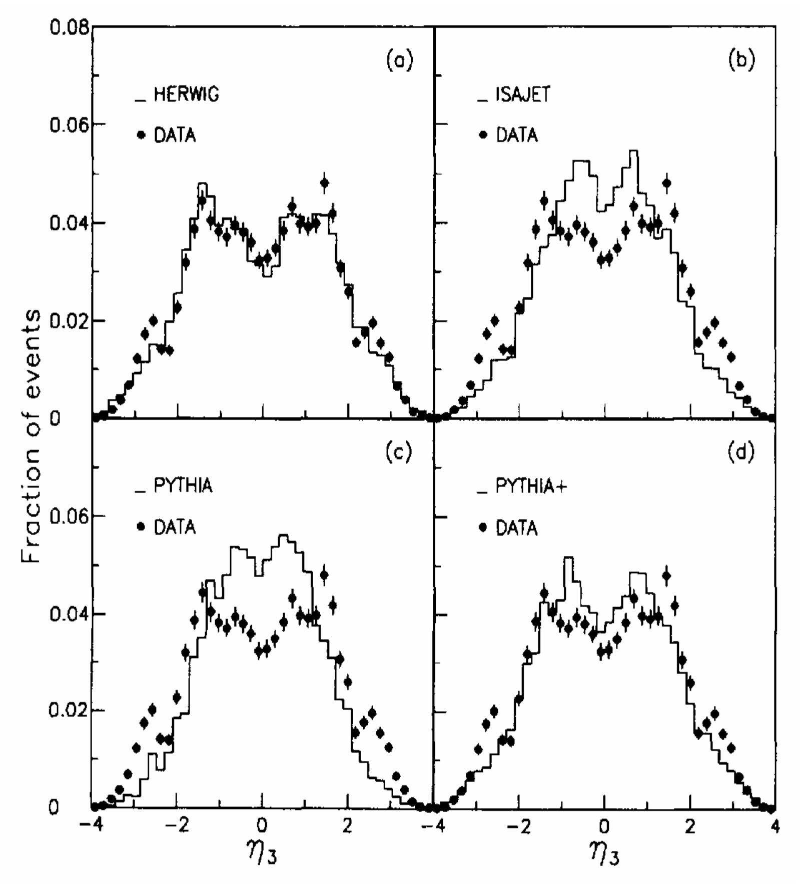


- quite good agreement for the inclusive quantities

Steffen Schumann — Physics at TeV colliders, 06/18/07, Les Houches – p.22

Shower Improvements

- One issue with the new shower algorithms is the extent to which colour coherence effects are included.
- Look at the results with the new generation of shower algorithms.
- Richardson, Schumann, Skands



Underlying Event

- Many useful sessions and discussions.
- A number of projects underway with the SM handles/candles group.

Les Houches Guidebook

- Plan to update the 2003 Les Houches guidebook.
- Include the new generation of simulations.
- Improvements in matching and underlying event modelling

arXiv:hep-ph/0403045 v2 5 Mar 2004

Les Houches Guidebook to Monte Carlo Generators for Hadron Collider Physics

Editors: M.A. Dobbs[1], S. Frixione[2], E. Laenen[3], K. Tollefson[4]

Contributing Authors: H. Baer[5], E. Boos[6], B. Cox[7], M.A. Dobbs[1], R. Engel[8], S. Frixione[2], W. Giele[9], J. Huston[4], S. Ilyin[6], B. Kersevan[10], F. Krauss[11], Y. Kurihara[12], E. Laenen[3], L. Lönnblad[13], F. Maltoni[14], M. Mangano[15], S. Odaka[12], P. Richardson[16], A. Ryd[17], T. Sjöstrand[13], P. Skands[13], Z. Was[18], B.R. Webber[19], D. Zeppenfeld[20]

[1]Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA
[2]INFN, Sezione di Genova, Via Dodecaneso 33, 16146 Genova, Italy
[3]NIKHEF Theory Group, Kruislaan 409, 1098 SJ Amsterdam, The Netherlands
[4]Department of Physics and Astronomy, Michigan State University, East Lansing, MI 48824-1116, USA
[5]Department of Physics, Florida State University, 511 Keen Building, Tallahassee, FL 32306-4350, USA
[6]Moscow State University, Moscow, Russia
[7]Dept of Physics and Astronomy, University of Manchester, Oxford Road, Manchester, M13 9PL, U.K.
[8] Institut für Kernphysik, Forschungszentrum Karlsruhe, Postfach 3640, D - 76021 Karlsruhe, Germany
[9]Fermi National Accelerator Laboratory, Batavia, IL 60510-500, USA
[10]Jozef Stefan Institute, Jamova 39, SI-1000 Ljubljana,Slovenia; Faculty of Mathematics and Physics, University of Ljubljana, Jadranska 19,SI-1000 Ljubljana, Slovenia
[11]Institut für Theoretische Physik, TU Dresden, 01062 Dresden, Germany
[12]KEK, Oho 1-1, Tsukuba, Ibaraki 305-0801, Japan
[13]Department of Theoretical Physics, Lund University, S-223 62 Lund, Sweden
[14]Centro Studi e Ricerche "Enrico Fermi", via Panisperna, 89/A - 00184 Rome, Italy
[15]CERN, CH–1211 Geneva 23, Switzerland
[16]Institute for Particle Physics Phenomenology, University of Durham, DH1 3LE, U.K.
[17]Caltech, 1200 E. California Bl., Pasadena CA 91125, USA
[18]Institute of Nuclear Physics PAS, 31-342 Krakow, ul. Radzikowskiego 152, Poland
[19]Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE, U.K.
[20]Department of Physics, University of Wisconsin, Madison, WI 53706, USA

Abstract

Recently the collider physics community has seen significant advances in the formalisms and implementations of event generators. This review is a primer of the methods commonly used for the simulation of high energy physics events at particle colliders. We provide brief descriptions, references, and links to the specific computer codes which implement the methods. The aim is to provide an overview of the available tools, allowing the reader to ascertain which tool is best for a particular application, but also making clear the limitations of each tool.

Compiled by the Working Group on Quantum ChromoDynamics and the Standard Model for the Workshop "Physics at TeV Colliders", Les Houches, France, May 2003.

May 23, 2006

1

BSM

- One project with the BSM group on off-shell effects.
- Other major issue is SHLA2, useful discussion which should be ready for the proceedings.

hep-ph/07mmnnn
FERMILAB-PUB-07-036-T

SUSY Les Houches Accord 2

B.C. Allanach, C. Balázs, G. Bélanger, F. Boudjema, D. Choudhury, K. Desch, U. Ellwanger, P. Gambino, R. Godbole, J. Guasch, M. Guchait, S. Heinemeyer, C. Hugonie, T. Hurth, S. Kraml, S. Kreiss, J. Lykken, M. Mangano, F. Moortgat, S. Moretti, S. Penaranda, T. Plehn, W. Porod, A. Pukhov, P. Richardson, M. Schumacher, L. Silvestrini, P. Skands, P. Slavich, M. Spira, G. Weiglein, P. Wienemann

List of affiliations.

June 18, 2007

Abstract

The SUSY Les Houches Accord provides a common interface that conveys spectral and decay information between various computer codes used in supersymmetric analysis problems, such as spectrum calculators, decay packages, Monte-Carlo programs, dark matter evaluators, and SUSY fitting programs. Here, we propose extensions of the conventions of the first SUSY Les Houches Accord to include various generalisations: violation of CP, R-parity and flavour as well as the simplest next-to-minimal supersymmetric standard model (NMSSM).

1 Introduction

Supersymmetric extensions of the Standard Model rank among the most promising and well-explored scenarios for New Physics at the TeV scale. Given the long history of supersymmetry and the number of both theorists and experimentalists working in the field, several different conventions for defining supersymmetric theories have been proposed over the years, many of which have come into widespread use. At present, therefore, there is not one unique definition of supersymmetric theories that prevails. Rather, different conventions are adopted by different groups for different applications. In principle, this is not a problem. As long as everything is clearly and completely defined, a translation can always be made between two sets of conventions, call them A and B.

However, the proliferation of conventions does have some disadvantages. Results obtained by different authors or computer codes are not always directly comparable. Hence, if author/code A wishes to use the results of author/code B in a calculation, a consistency check of all the relevant conventions and any necessary translations must first be made – a tedious and error-prone task.

To deal with this problem, and to create a more transparent situation for non-experts, the original SUSY Les Houches Accord (SLHA1) was proposed [1]. This accord uniquely defines a set of conventions for supersymmetric models together with a common interface between codes. The most essential fact is not what the conventions are in detail (they largely

1

Summary

- There have been a lot of useful discussions and hopefully a lot of projects started here will produce useful results.