MC - Tools Working Group

Summary, part 2

Thomas Kluge, DESY

with Paolo Bartalini, Stefan Gieseke and Frank Krauss

NNLO Upgrade of QCDNUM

Michiel Botje
NIKHEF
PO Box 41882 1009DB Amsterdam

Presented at the HERALHC workshop, DESY, March 12-17, 2007

What is QCDNUM

- QCDNUM is a Fortran program that performs numerical DGLAP evolution of parton densities on a discrete grid in x and μ^2
- QCDNUM provides
  - Evolution of α_s
  - Evolution of unpolarized parton densities
  - Calculation of the structure functions F_2, F_L and xF_3
  - Possibility to independently vary the renormalization and factorization scales

NNLO Upgrade of QCDNUM

What is new in QCDNUM17

- Fully NNLO
- Automatic separation of PDFs into singlet and non-singlet distributions
- Quadratic spline interpolation
- New very fast evolution algorithm on multiple equidistant grids
- Two alternative definitions of F_L

☺ Gain in speed by factor of 4 with quadratic interpolation because the number of grid points can be reduced from 200 to 100….

NNLO Upgrade of QCDNUM

To Summarize…

- QCDNUM17 is basically OK but might still need a bit of shakedown
- Factorization scale dependence and alternative F_L will soon be implemented
- You can get the current Beta release and write-up from

`http://www.nikhef.nl/~h24/qcdnum`

Useful tool in HERA and LHC context, NNLO for structure fnct

Jets can be included via fastNLO (want calculations at NNLO!)

Strong connection/overlap with PDF working group

Report on DPEMC generator

Oldřich Kepka

DAPNIA-SPP, CEA Saclay
Charles University, Prague
oldrich.kepka@cea.fr

14.03.2007, HERA-LHC workshop, DESY

- What is DPEMC?
- QCD inclusive and exclusive models
- Survival probability correction
- QED $\gamma\gamma$ models
- Conclusion

Report on DPEMC Generator

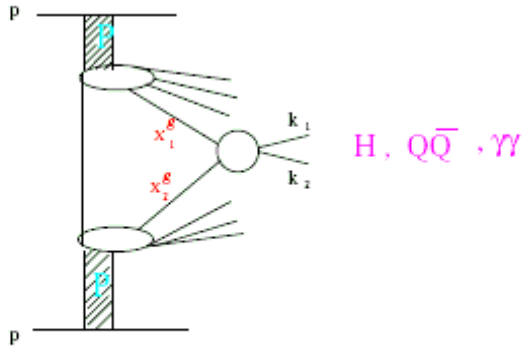
- Purpose: have a convenient interface containing many models to perform various analysis of Tevatron, and LHC diff. data
- It is a flexible interface to study:
  SD, DPE processes, exclusive χ_c, χ_b and $\gamma\gamma$ interactions between protons or heavy nuclei
- Production of dijets, dileptons, WW, Z, diphotons, SUSY particles ...
- Interfaced with ATLAS full simulation ATHENA
- New version v2.8 is about to be published in the Comput.Phys.Commun.
- Download: *http://boonekam.home.ch/boonekam/dpemc.htm*

- Authors: M. Boonekamp et al.

Report on DPEMC Generator

QCD inclusive

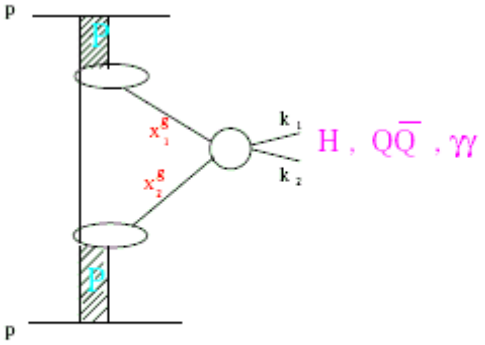
- "Factorized model" (FM)
  exchange of perturbative pomerons (Reggeons)
  factorization brake-up only up to the survival probability factor
  (code adopted from POMWIG)
- Bialas-Landshoff inclusive model (BL inc, BPR model, Saclay model)
  non-perturbative approach, inclusive extention of BL exclusive model



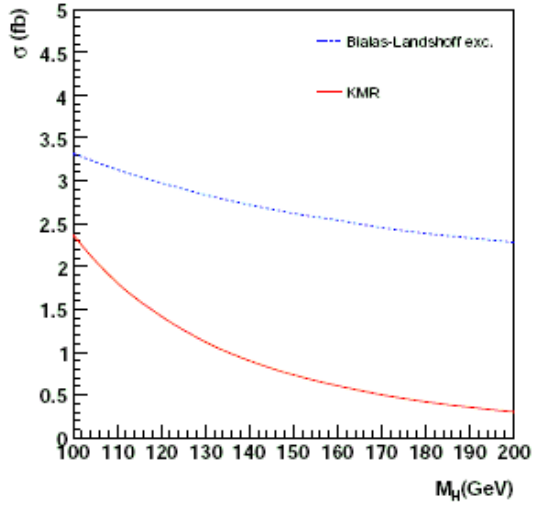
"Inclusive"

QCD exclusive DPE

- Bialas-Landshoff exclusive model (BL exc)
  exchange of two non-perturbative gluons
- Khoze, Martin, Ryskin model (KMR)
  exchange of two gluons directly coupled to the protons



"Exclusive "



Pythia Tuning for LHCb

Kenneth Lessnoff

Kenneth.lessnoff@cern.ch

University of BRISTOL

PYTHIA tuning for LHCb

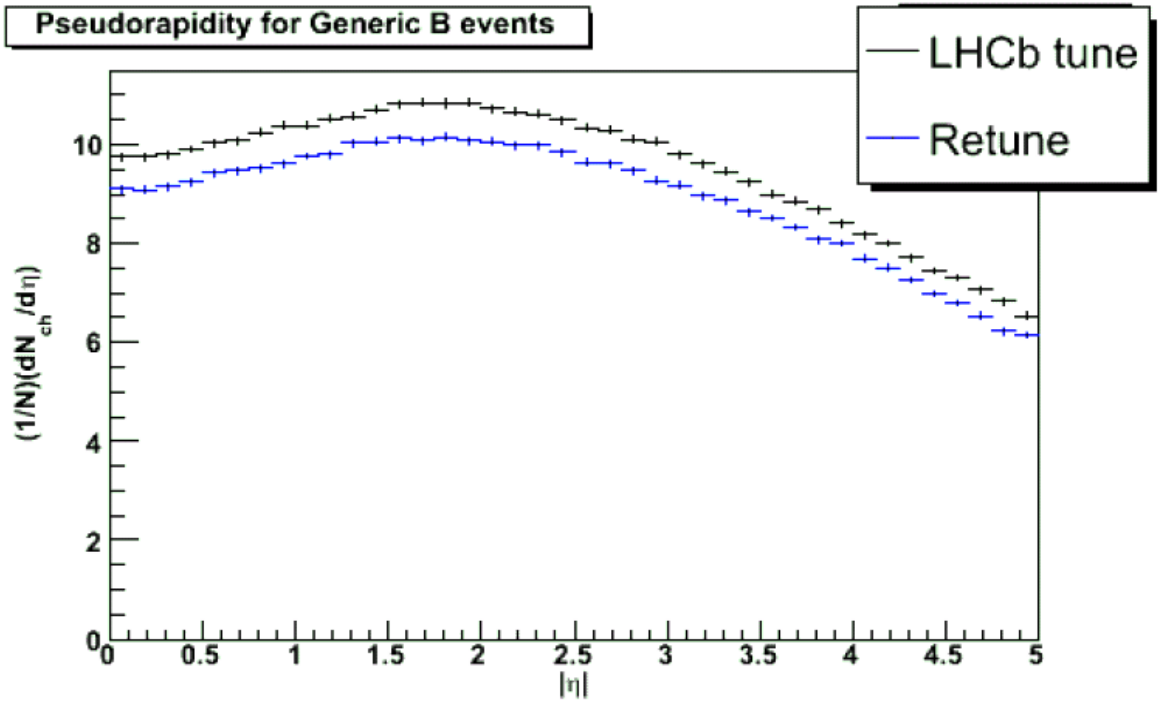
- Retune Pythia for the use of LHCb
- Requires the inclusion of excited B meson states.
- After retuning to fit LEP data, it is necessary to retune to fit data from hadron hadron collisions.

Tune / Data	LHCb	Parj(11)=0.7 Parj(12)=0.4 Parj(13)=0.78	Parj(11)=0.1 Parj(12)=0.2 Parj(13)=0.76	Parj(11)=0.9 Parj(12)=0.4 Parj(13)=0.75	Parj(11)=0.6 Parj(12)=0.3 Parj(13)=0.76	Parj(11)=1.0 Parj(12)=1.0 Parj(13)=0.79	Parj(11)=0.3 Parj(12)=0.8 Parj(13)=0.78	Parj(11)=0.5 Parj(12)=0.4 Parj(13)=0.79
K*	**9.70686**	**0.581911**	6.30127	0.700179	2.09931	55.3692	34.6064	**0.604811**
ω	**21.2486**	21.2159	**0.190781**	54.5138	24.3161	45.7763	1.53477	**3.03835**
φ	**5.59246**	1.0689	8.15106	**0.769361**	2.96809	44.4911	14.5653	**1.35154**
ρ	**2.16063**	1.2169	20.1401	4.75999	**1.05774**	5.82269	9.17321	**2.42266**
D*	**3.35683**	2.71016	3.51176	3.15332	3.1297	**2.04131**	2.79938	**2.62796**
N_{ch}	**1.11694**	0.806028	0.645477	2.87359	0.79549	5.41735	**0.142706**	**0.152342**
All	**43.1823**	27.5998	38.9404	66.7702	34.3664	158.918	62.8218	**10.1977**

Parameter	Old value	New Value
PARJ(11)	0.5	0.5
PARJ(12)	0.6	0.4
PARJ(13)	0.75	0.79
PARJ(14)	0.162	0
PARJ(17)	0.09	0.131

PYTHIA tuning for LHCb

- Retuning gives a lower multiplicity, but $\langle dN_{ch}/d\eta \rangle|_{\eta<0.25}$ is still within the errors of the predicted value.



Several suggestions in discussion, e.g. which parameters to tune etc.

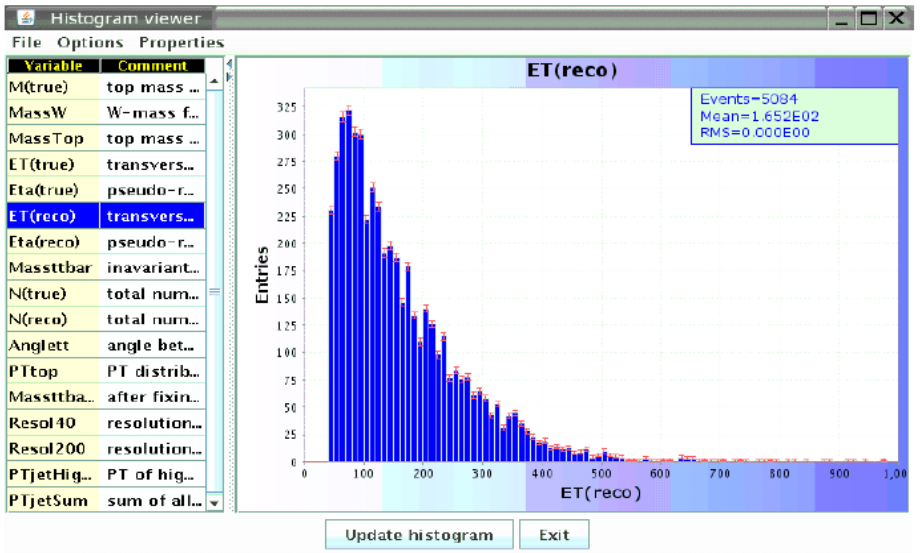
RunMC status

S.Chekanov (ANL/DESY)

HERA-LHC workshop
March 2007, DESY

Update on the RunMC Project

- C++/ROOT framework for running FORTRAN Monte Carlo (MC) model:
  - ✓ PYTHIA, HERWIG, ARIADNE, CASCADE, LEPTO,
  - ✓ AROMA, RAPGAP, PHOJET
- Can be used for MC validations, tuning, comparisons, calculations of correction factors etc.
- New 4.2β version of RunMC is available:
- http://projects.hepforge.org/runmc/news.html



Update on the RunMC Project

Progress since May 2006 -I

- Code was modified i order to compile RunMC using modern compilers
- Removed dependence on CERNLIB
  - ✓ CERNLIB not supported for gfortran + gcc4.1
  - ✓ but many MC models still use CERNLIB functions
- Stand-alone version of CERNLIB-lite is (CERNIBlite.tgz, 1.7Mb, tgz):
  - ✓ http://www.desy.de/~chekanov/cernlib/
- Now RunMC uses LHAPDF (Les Houches Accord PDF Interface)
- New feature: a JAVA histogram browser:
  - ✓ Before RunMC could monitor only up to 8 histograms
  - ✓ Now all histograms can be viewed during event generation

Status of HZTool

J.M Butterworth, H. Jung, E.L. Nurse, B.M. Waugh

HZTOOL

A Library for Data – Simulation Comparisons at High Energy Colliders (version 4.2)

Last update: March 11, 2007

Editors

J. M. Butterworth[1], H. Jung[2], , E. L. Nurse[1], B. M. Waugh[1]

Contributing Authors

A. Ahmed[1], D. Beneckenstein[6], F. Botterweck[21], I. Borozan[1], N. Brook[4], J. Bromley[14], A. Buniatian[2], T. Carli[16], A. Cholewa[2], B. E. Cox[19], T. Ebert[8], J. Elmsheuser[17], G. Flucke[18], G. Grindhammer[9], O. Gutsche[5], C. Gwenlan[20], M. Hansson[3], M. E. Hayes[1], E. A. Heaphy[1], D. Jansen[12], A.W. Jung[2], D. Kant[7], G. Knies[2], A. Knutsson[3], B. Koblitz, M. Kuhlen[9], K. Krastev[2], D. Krüker, S. Lausberg[6], V. Lendermann[6], K. Lohwasser[2], L. Lönnblad[3], A. von Manteuffel[18], Ll. Marti[2], P. van Mechelen[10], R. Mohr[9], A. Moraes[14], G. Nellen[9], C. O'Dea[1], K. Peters[19], R. Pöschl[2], K. Sedlak[10] R. Selle, S. Söldner-Rembold[19], K. Rabbertz[16], H. Rick[16], M. Riveline[11], F.-P. Schilling[2], T. Schörner[18], A. Solano[13], C. Targett-Adams[1], R. J. Taylor[1], C. Tesch , P. Thompson , A. Valkarova[15], T. Wengler[19], A. Werner Jung, M. Wing[1]

Status of HZTool

New subroutines

- Tevatron Underlying Event - hzh0404004 (Emily Nurse)
- ZEUS
  - D* jets - hzh0507089.F (Sarah Boutle)
- H1
  - inclusive Photoproduction (Daniel Beneckenstein)
  - fwd jets (A.Knutsson)
  - dijets in gammap (K. Krastev)
  - D* +jets in gammap (Ll.Marti/G.Flucke)
  - dijets in low q2 (K.Sedlak)
  - event shapes (A. Knutsson)
  - prompt photons (M. Hansson)
  - F2D3 (R. Polifka) is almost ready

  - HZSteer interfaces added to read Les Houches files from Alpgen and fragment with Pythia or Herwig.

LUND
UNIVERSITY

RIVET

Current status and future plans

Leif Lönnblad

Department of Theoretical Physics
Lund University

HERA/LHC workshop
DESY 07.03.14

Status of Rivet

RIVET

- A C++-replacement for HZTOOL
- Includes analysis routines for comparison of event generators to measurements in HEPDATA
- Only for data corrected to particle level.
- Also includes utilities: jet finders, thrust calculations, . . .
- Should be completely generator-independent

RIVETGUN

- The functionality of HZSTEER
- Common interface to any Fortran or C++ event generator.
- Steered from HEPML setup files
- Produces HEPMC event objects which are sent to RIVET for analysis.

Status of Rivet

The RIVET/RIVETGUN team

Andy Buckley, Jon Butterworth, Andrew Ilott, Leif Lönnblad, James Monk, Lars Sonnenschein, David Voong, Ben Waugh, ...

http://projects.hepforge.org/rivet

Current Status

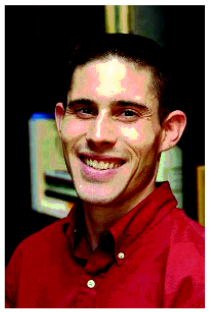
- A beta version will be ready before the MCnet Monte Carlo school in Durham in April.
- Proper documentation is being written

Vista as a tool for generator tuning

Stephen Mrenna
CD/FNAL

HERALHC

The MIT High-Pt group:


Bruce Knuteson


Conor Henderson


Ray Culbertson


Georgios Choudalakis

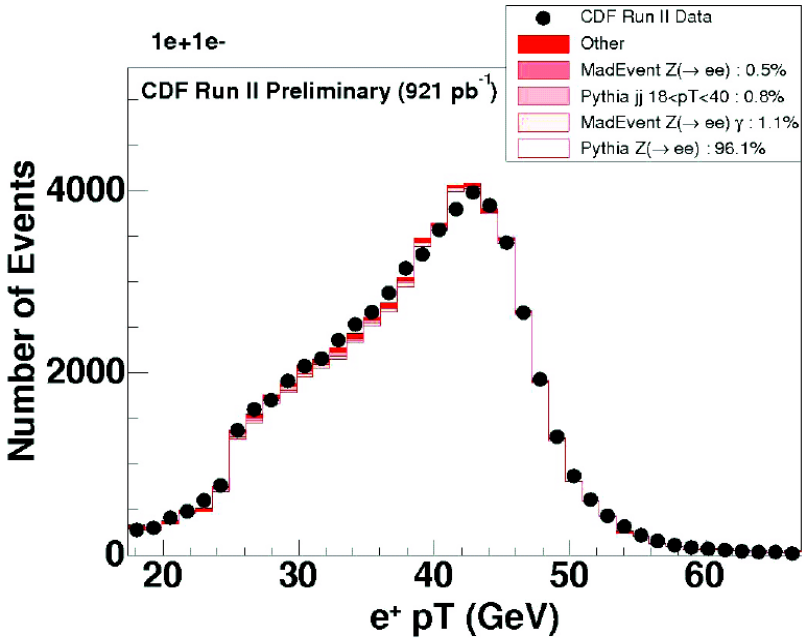
Vista as a Tool for Generator Tuning

How do we address the question:

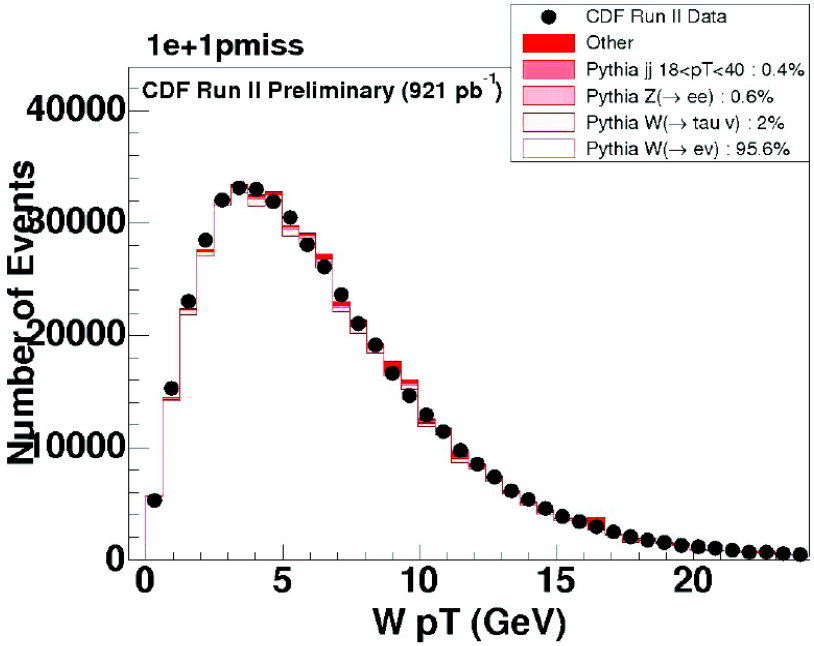
Do we understand the entirety of high-pT (collider) data?

Vista comparison

~15,000 plots of kinematic distributions



dominated by Z→ee



dominated by W→eν

Vista as a Tool for Generator Tuning

$$\chi^2_k(\vec{s}) = \frac{(\mathrm{Data}[k] - \mathrm{SM}[k])^2}{\delta\mathrm{SM}[k]^2 + \sqrt{\mathrm{SM}[k]}^2}$$

SM = Integrated Luminosity ×
{σ_{LO} x k-factors} ×
{ID and misID probabilities} ×
{Trigger Efficiencies}

There are no systematic uncertainties on the procedure ?

Vista takes a different approach to the question of systematic uncertainties.

Finds values for the correction factors that allow the data to be described by the Standard Model.

The correction factors themselves are systematic shifts

Discussion

What is better: Vista or HZTool/Rivet?

- **Vista** looks in many (high p_t) channels on detector level

- Reiterate and „debug“ the experiment

- Overlooked something? Test hypothesis quickly

- Want to give detector level to outside world early?

- **HZTool/Rivet** use published data on particle level

- Store full knowledge (e.g. on correlated systematics) once and for all

Want both!

Alternative to ROOT for data analysis

jHepWork
a java-based analysis framework

S.Chekanov (DESY/ANL)

HERA-LHC workshop
March 2007
DESY

Status of jHepWork

- **Main programing language is Jython**
  - object-oriented, multiplatform
  - similar to other high-level languages (MatLab, Maple, S-plus)
  - shorter programs than in C++/JAVA (factor of 2)
- **Faster programming, less bugs**

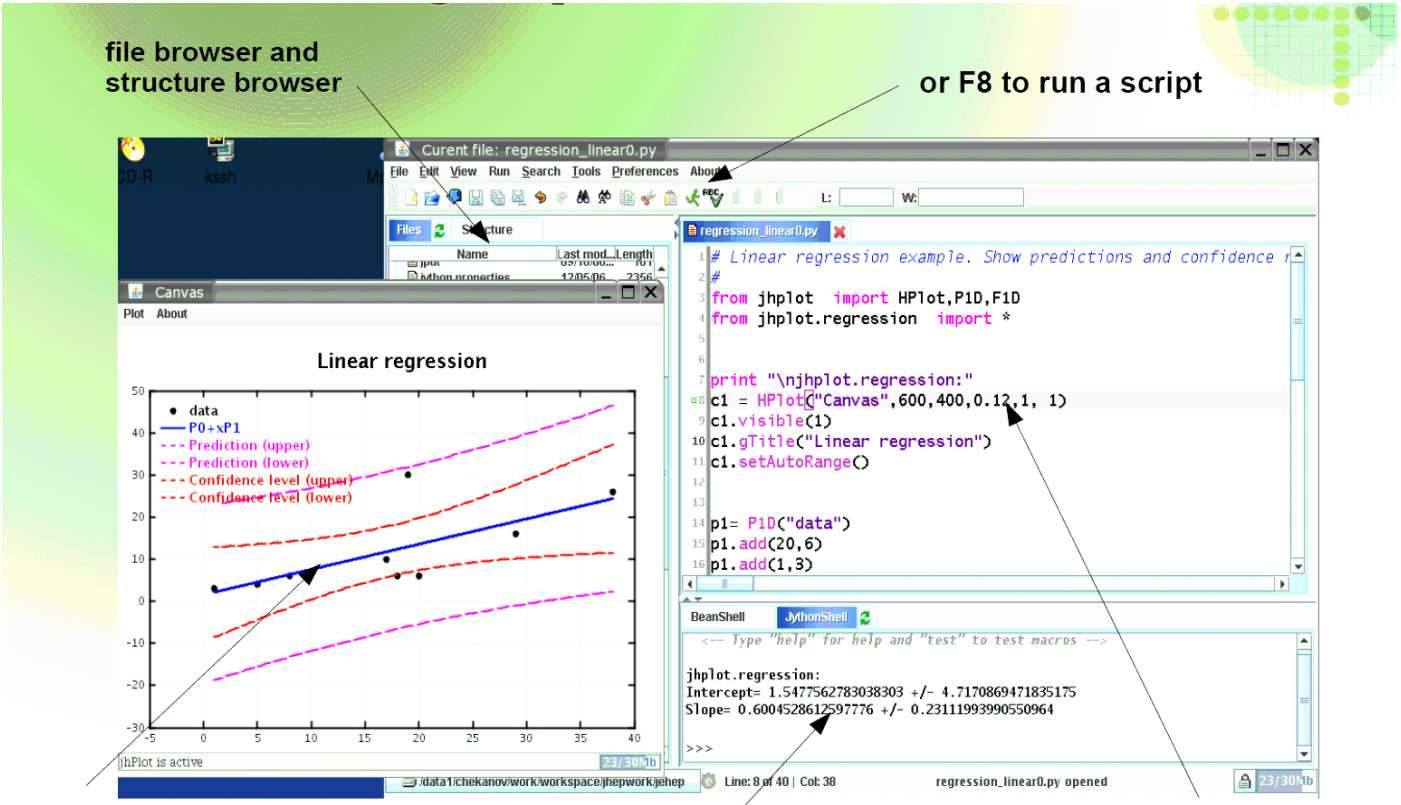
Advantages compared to JAS

- More powerful graphics than in JAS
  - output plots are very close “publishable” standard.
  - statements are more similar to ROOT. 3D graphics

Advantages compared to ROOT

- Multiplatform. No installation. No compilation. Access to JAVA/Jython
- Java reflection technology looks inside a Java object at runtime

Status of jHepWork



S.Chekanov: jHepWork

- **jHepWork version 1.1:**
  - **http://projects.hepforge.org/jhepwork/**
  - **Online manual with description of ~200 methods**

Please answer those questions in the WG summaries

- do we have the tools to understand the underlying event and multiple parton interactions ?

➔ Is PYTHIA MI/Jimmy the final answer to MI and underlying events ? Do we understand MI enough to just tune MCs ? Are further investigations also from HERA needed ?

New HERA measurements underway

CDF: PYTHIA 6.4, not straightforward to use in DIS

- do we have the necessary measurements and informations to obtain best tuned Monte Carlo event generators

➔ Tuning of MCs. Are data available in computer usable form (Hztool, Rivet) ? Which pdfs to use in MC generators (LO,NLO, Msbar, DIS, ... uPDFs) ?

- do we have all needed MC generators ready and do we have the tools ready for tuning when the first LHC data arrive ?

Rivet around the corner, HZTool established (more LEP needed?)

Vista for first data to arrive (yet to demonstrate...)