

HzTool, JetWeb and CEDAR

Tools for validating and tuning MC models

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Workshop on ‘HERA and the LHC’

Working group 5: MC Tools

CERN, 2004-03-27

HzTool, JetWeb, CEDAR

- Physics goals
- Available tools: status and plans
 - HzTool
 - JetWeb
 - HEPDATA
- The next step: CEDAR
- References

Physics goals

- Test, validate, tune and compare MC models (inc. NLO)
- Make best use of existing data
 - tuning to one data set can spoil agreement with others
 - different measurements may be sensitive to same effects
 - want to use many different distributions simultaneously
- Non-trivial task since measurements
 - from variety of colliding beams
 - different regions of phase space
 - many complex observables

HzTool

- Product of HERA “ Future Physics” workshop, with contributions from many authors
- Reproduce experimental distributions
- Produce comparable plots from MC events
- Library of Fortran routines
 - typically one per paper
 - generally written by paper authors
- Use event data from HEPEVT common block
 - (almost) independent of generator used

HzTool: status

- Many new analysis routines since first release
 - HERA, Tevatron, LEP, SPS
- Were two (known) active versions: JetWeb and Hannes Jung
- Now merged in JetWeb repository
- Interfaces to Cascade and RapGap as well as Pythia and Herwig
- Some extra analysis routines
- Soon working with Herwig 6.505 (with Jimmy)

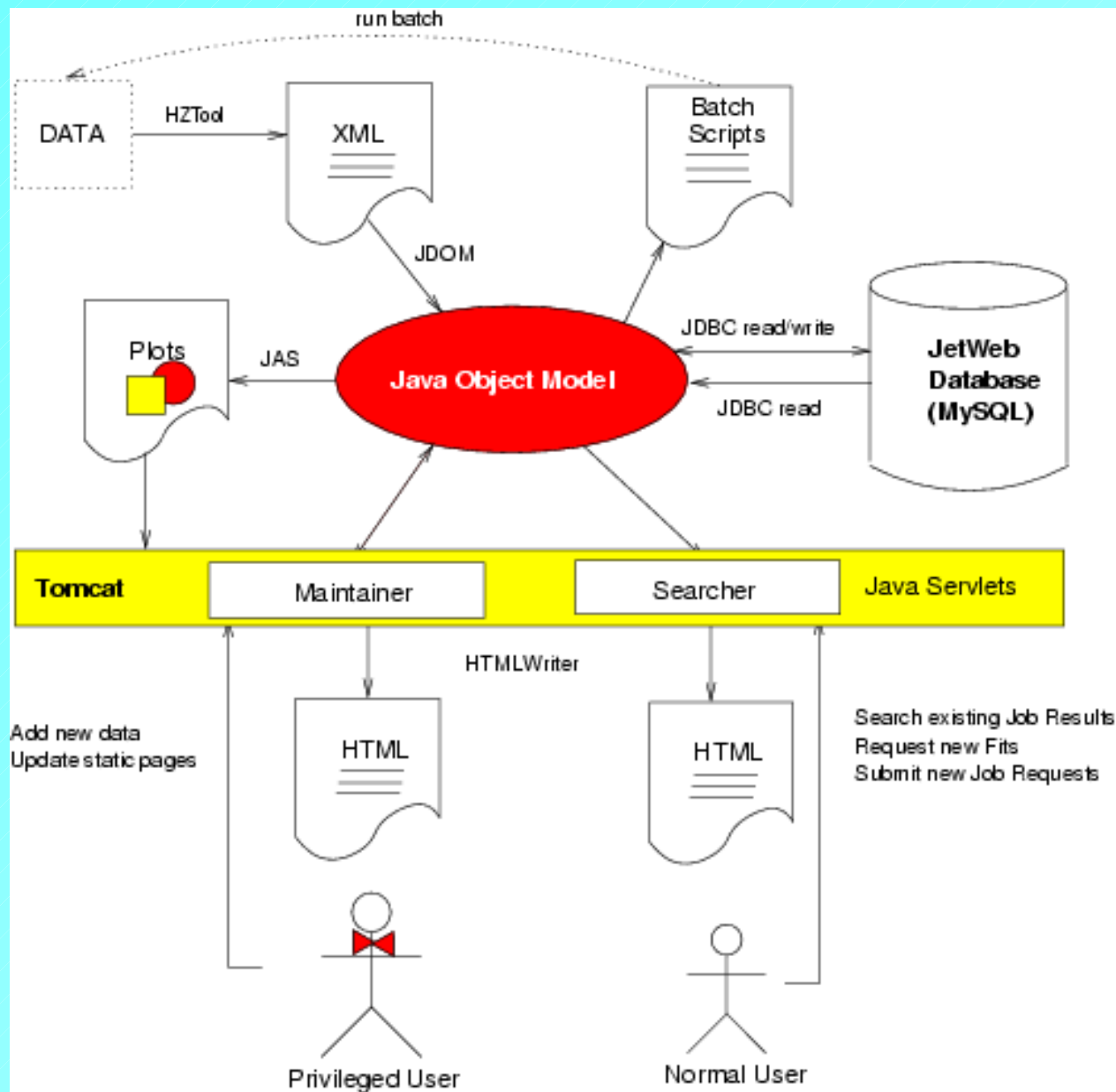
JetWeb

- Developed at UCL
- Database of data and MC plots
- Fits (varying normalization) between different MC models and selected data
- Web interface:
 - find fits using required model
 - submit request for MC if model not in database
- Currently limited to a few MC generators and PDFs
- Need to extend this to make it more useful

JetWeb: behind the scenes

- Java object model:
 - data: papers, plots, data points
 - MC: models, logfiles etc.
 - fits
- Java servlets running in Tomcat servlet container within Apache web server
- Data stored in MySQL relational database
- Plots produced using JAS (Java Analysis Studio)
- Data input via XML (using subset of JAS plotML)
- Writes job scripts to run MC on batch farm or grid

JetWeb: components



JetWeb home page

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best fits, all data

- [HERWIG](#)
- [PYTHIA](#)

summaries, all fits

- [HERWIG latest](#)
- [PYTHIA latest](#)
- [HERWIG all](#)
- [PYTHIA all](#)

documentation, downloads

- [Latest News](#)
- [Bibliography](#)
- [Generator Parameters](#)
- [Developer Resources](#)

simulations

- [HERWIG](#)
- [PYTHIA](#)

experiments

- [HERA\(H1,ZEUS\)](#)
- [LEP\(OPAL\)](#)
- [Tevatron\(CDF, D0\)](#)
- [HEPDATA](#)

JetWeb

Automated Data Comparisons for High Energy Physics

18/02/04: This server is currently read-only. See [news](#) for details.

[Maintenance](#)

Search the DataBase

Selected Results

- [Studies for a Future Linear Collider](#)
- [Minimum PT of hard scatters](#)
- [Intrinsic KT photon/proton](#)
- [PYTHIA parton showers PARP67](#)
- [Parton Distribution Functions in Photon](#)
- [HERWIG Soft Underlying Event](#)
- [HERWIG Photon Radius](#)
- [HERWIG fragmentation parameters \(CLMAX,PSPLT\)](#)

If you do use any results from here, please quote [Comp. Phys. Comm. vol 153/2 164-178 \(2003\)](#)

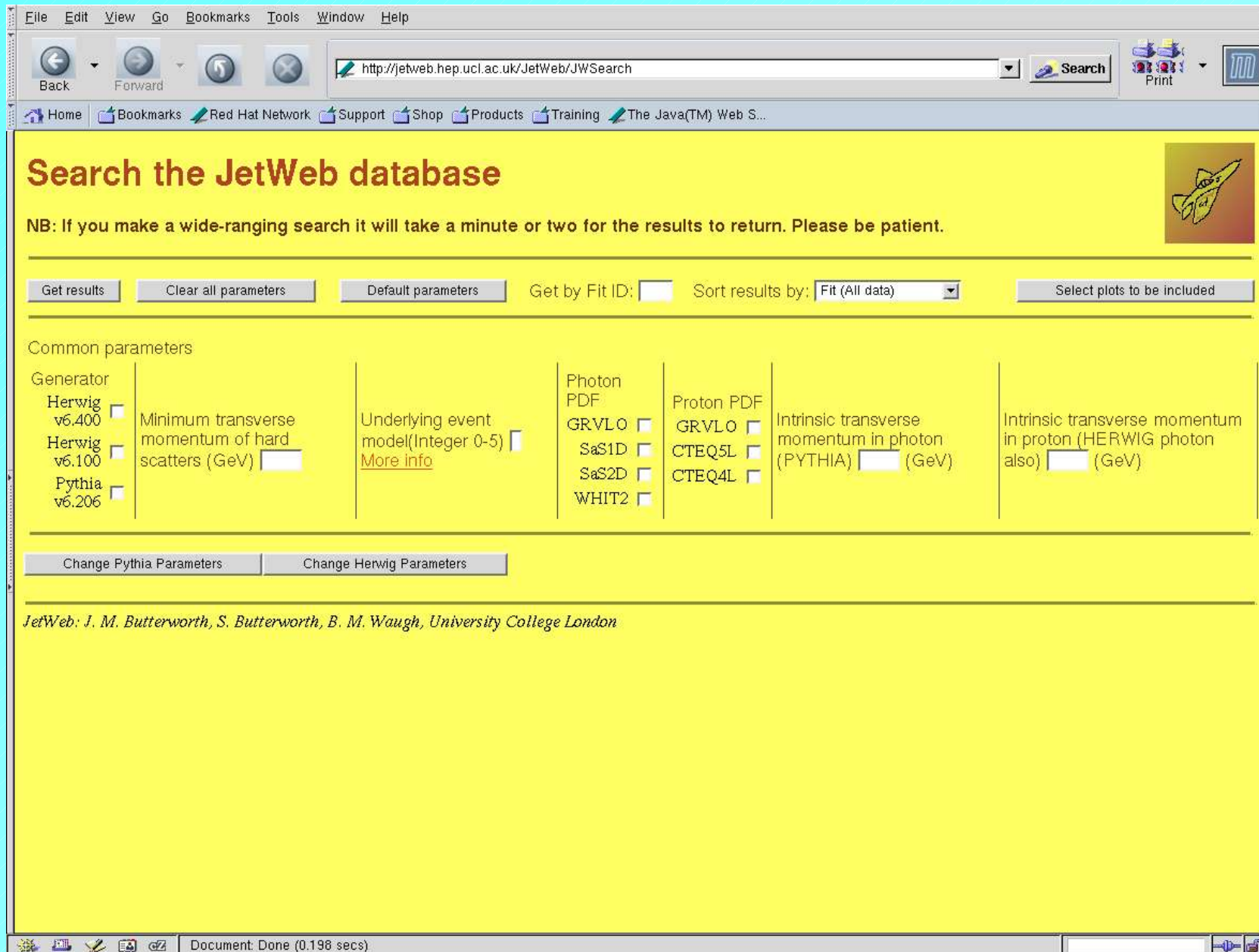
The current focus of this project is on jet and heavy flavour production in hadron-like collisions (which includes hadron-photon and photon-photon). There is no reason why other data shouldn't be incorporated though.

If you'd like join in, or have any comments or suggestions please [contact us](#) at jetweb@hep.ucl.ac.uk

The story so far:
6410 jobs submitted to Manchester PBS, 5782 completed
2800 jobs submitted to UCL PBS, 2598 completed
171 jobs submitted to UCL NQS, 142 completed
68 jobs submitted to GridPP, 35 completed
641 jobs submitted to Sheffield PBS, 536 completed

Document: Done (0.46 secs)

JetWeb search form




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Search the JetWeb database



NB: If you make a wide-ranging search it will take a minute or two for the results to return. Please be patient.

Get results Clear all parameters Default parameters Get by Fit ID: Sort results by: Fit (All data) Select plots to be included

Common parameters

Generator	Photon PDF	Proton PDF	Intrinsic transverse momentum in photon (PYTHIA) <input type="text"/> (GeV)	Intrinsic transverse momentum in proton (HERWIG photon also) <input type="text"/> (GeV)
Herwig v6.400 <input type="checkbox"/>	GRVLO <input type="checkbox"/>	GRVLO <input type="checkbox"/>		
Herwig v6.100 <input type="checkbox"/>	SaS1D <input type="checkbox"/>	CTEQ5L <input type="checkbox"/>		
Pythia v6.206 <input type="checkbox"/>	SaS2D <input type="checkbox"/>	CTEQ4L <input type="checkbox"/>		
Minimum transverse momentum of hard scatters (GeV) <input type="text"/>	Underlying event model(Integer 0-5) <input type="text"/>	WHIT2 <input type="checkbox"/>		

[More info](#)

Change Pythia Parameters Change Herwig Parameters

JetWeb: J. M. Butterworth, S. Butterworth, B. M. Waugh, University College London

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JetWeb search form (2)

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Specify any PYTHIA parameters to be changed.

Get results Clear all parameters Default parameters Get by Fit ID: Sort results by: Fit (All data) Select plots to be included

Common parameters

Generator	Photon PDF	Proton PDF	Intrinsic transverse momentum in photon (PYTHIA) <input type="text"/> (GeV)	Intrinsic transverse momentum in proton (HERWIG photon also) <input type="text"/> (GeV)
Herwig v6.400 <input type="checkbox"/>	GRVLO <input type="checkbox"/>	GRVLO <input type="checkbox"/>		
Herwig v6.100 <input type="checkbox"/>	SaS1D <input type="checkbox"/>	CTEQ5L <input checked="" type="checkbox"/>		
Pythia v6.206 <input checked="" type="checkbox"/>	SaS2D <input type="checkbox"/>	CTEQ4L <input type="checkbox"/>		
Minimum transverse momentum of hard scatters (GeV) <input type="text"/>	WHIT2 <input type="checkbox"/>			
Underlying event model(Integer 0-5) <input type="text"/>				

Enter parameters below and add them before submission

PARP () = *PARP(1-200) and PARJ(1-200) = decimals to 4SF*

MSTP () = *MSTP(1-200) and MSTJ(1-200) = integers*

PARJ () =

MSTJ () =

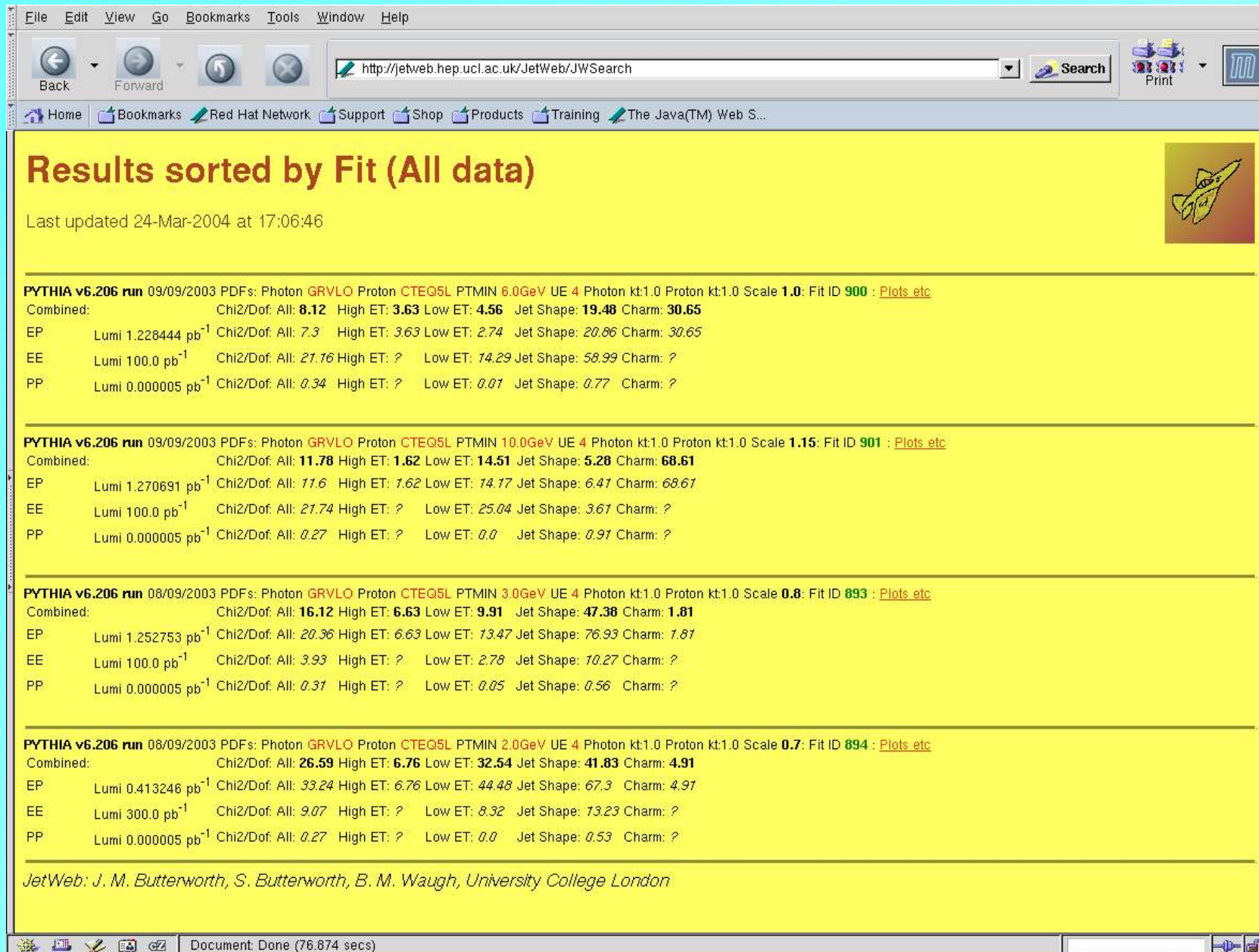
Add Pythia parameter(s) Clear Pythia parameters

Pythia Parameters Set

PARP (67) = 4.0	MSTP (81) = 1
PARP (82) = 2.0	MSTP (82) = 4
PARP (83) = 0.5	
PARP (84) = 0.4	
PARP (85) = 0.9	
PARP (86) = 0.95	
PARP (89) = 1.0000	

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Results sorted by Fit (All data)

Last updated 24-Mar-2004 at 17:06:46

PYTHIA v6.206 run 09/09/2003 PDFs: Photon GRVLO Proton CTEQ5L PTMIN 6.0GeV UE 4 Photon kt:1.0 Proton kt:1.0 Scale 1.0: Fit ID 900 : [Plots etc](#)

Combined: Chi2/Dof: All: **8.12** High ET: **3.63** Low ET: **4.56** Jet Shape: **19.48** Charm: **30.65**

EP Lumi 1.228444 pb⁻¹ Chi2/Dof: All: 7.3 High ET: 3.63 Low ET: 2.74 Jet Shape: 20.86 Charm: 30.65

EE Lumi 100.0 pb⁻¹ Chi2/Dof: All: 21.76 High ET: ? Low ET: 14.29 Jet Shape: 58.99 Charm: ?

PP Lumi 0.000005 pb⁻¹ Chi2/Dof: All: 0.34 High ET: ? Low ET: 0.01 Jet Shape: 0.77 Charm: ?

PYTHIA v6.206 run 09/09/2003 PDFs: Photon GRVLO Proton CTEQ5L PTMIN 10.0GeV UE 4 Photon kt:1.0 Proton kt:1.0 Scale 1.15: Fit ID 901 : [Plots etc](#)

Combined: Chi2/Dof: All: **11.78** High ET: **1.62** Low ET: **14.51** Jet Shape: **5.28** Charm: **68.61**

EP Lumi 1.270691 pb⁻¹ Chi2/Dof: All: 11.6 High ET: 1.62 Low ET: 14.17 Jet Shape: 6.41 Charm: 68.61

EE Lumi 100.0 pb⁻¹ Chi2/Dof: All: 21.74 High ET: ? Low ET: 25.04 Jet Shape: 3.61 Charm: ?

PP Lumi 0.000005 pb⁻¹ Chi2/Dof: All: 0.27 High ET: ? Low ET: 0.0 Jet Shape: 0.91 Charm: ?

PYTHIA v6.206 run 08/09/2003 PDFs: Photon GRVLO Proton CTEQ5L PTMIN 3.0GeV UE 4 Photon kt:1.0 Proton kt:1.0 Scale 0.8: Fit ID 893 : [Plots etc](#)

Combined: Chi2/Dof: All: **16.12** High ET: **6.63** Low ET: **9.91** Jet Shape: **47.38** Charm: **1.81**

EP Lumi 1.252753 pb⁻¹ Chi2/Dof: All: 20.36 High ET: 6.63 Low ET: 13.47 Jet Shape: 76.93 Charm: 1.81

EE Lumi 100.0 pb⁻¹ Chi2/Dof: All: 3.93 High ET: ? Low ET: 2.78 Jet Shape: 10.27 Charm: ?

PP Lumi 0.000005 pb⁻¹ Chi2/Dof: All: 0.31 High ET: ? Low ET: 0.05 Jet Shape: 0.56 Charm: ?

PYTHIA v6.206 run 08/09/2003 PDFs: Photon GRVLO Proton CTEQ5L PTMIN 2.0GeV UE 4 Photon kt:1.0 Proton kt:1.0 Scale 0.7: Fit ID 894 : [Plots etc](#)

Combined: Chi2/Dof: All: **26.59** High ET: **6.76** Low ET: **32.54** Jet Shape: **41.83** Charm: **4.91**

EP Lumi 0.413246 pb⁻¹ Chi2/Dof: All: 33.24 High ET: 6.76 Low ET: 44.48 Jet Shape: 67.3 Charm: 4.91

EE Lumi 300.0 pb⁻¹ Chi2/Dof: All: 9.07 High ET: ? Low ET: 8.32 Jet Shape: 13.23 Charm: ?

PP Lumi 0.000005 pb⁻¹ Chi2/Dof: All: 0.27 High ET: ? Low ET: 0.0 Jet Shape: 0.53 Charm: ?

JetWeb: J. M. Butterworth, S. Butterworth, B. M. Waugh, University College London

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JetWeb fit

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JetWeb Fit No:900

PYTHIA v6.206 run . Model ID:665. Normalisation determined using default high ET data.

Date of last fit:09/09/2003
[Examine the fitted papers](#)
[EP fit](#)
[EE fit](#)
[PP fit](#)

Request higher statistics for
Request similar data
Search for similar data
Maintenance
Compare to fit
Show non-default parameters



Combined this for all fitted experiments: Chi2/Dof at an overall scale factor of 1)

- All: **8.1193922**
- High ET: **3.628825**
- Low ET: **4.5565687**
- Jet Shape: **19.4838957**
- Charm: **30.6476535**

Parton distribution functions: Photon GRVLO Proton CTEQ5L
PTMIN (Minimum transverse momentum for hard scatters) 6GeV
Underlying Event Model 4
Intrinsic KT in the photon is:1.0
Intrinsic KT in the proton is:1.0
See [here](#) for a complete list of PYTHIA parameters for this job.

fitted papers:

Chi2 Total	Per Dof	Title	Experiment	Reference
lepton-proton data				
128.5981438	2.7955031	Inclusive Jet Differential Cross Sections in Photoproduction at HERA	ZEUS	Physics Letters B 342 (1995) 417-432
28.2997158	1.8866477	Dijet Cross Sections in Photoproduction at HERA	ZEUS	Physics Letters B 348 (1995) 665-680
435.137461	36.2614551	Rapidity Gaps between Jets in Photoproduction at HERA	ZEUS	Physics Letters B 369 (1996) 55-68.
84.0354341	2.7108205	Jets and Energy Flow in Photon-Proton Collisions at HERA	H1	Z. Phys. C70 (1996) 17.
69.499749	2.9994496	Dijet Angular Distributions in Resolved and Direct Photoproduction at	ZEUS	Physics Letters B 394 (1996) 404-419

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JetWeb plots

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Pseudorapidity distributions of charged particles produced in p anti-p interactions at $s^{1/2} = 630$ and 1800 GeV

Phys. Rev. D 41, 2330 (1990)

Code author(s): Arthur Moraes
Contact: PHP00AMM@sheffield.ac.uk



dN_chg/deta (CDF eta range)

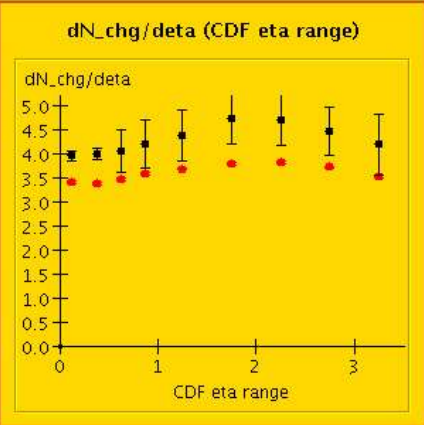
Chi2 Contribution: (chi2 / DoF): 62.53 / 9

Data (black) was scaled by: 1.0
The model (red) was scaled by 1

Vector output of plotted data

This data is relevant for : Jet Shapes

Pull for each point:
{22.701} {25.39} {1.812} {1.583} {1.742} {3.208} {2.753} {2.246} {1.095}
(this plot not included in the fit)



Mean charged multiplicity

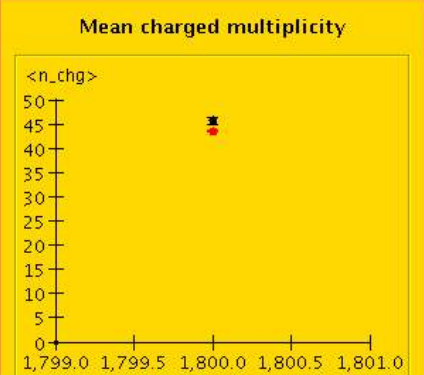
Chi2 Contribution: (chi2 / DoF): 8.131 / 1

Data (black) was scaled by: 1.0
The model (red) was scaled by 1

Vector output of plotted data

This data is relevant for : Jet Shapes

Pull for each point:
{8.131}
(this plot not included in the fit)



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JetWeb compare fits

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Comparison of Fit 900 and Fit 901

Last updated 24-Mar-2004 at 17:08:03



The Following Parameters Differ Between the 2 Models

Parameter	Fit 900	Fit 901
PT Min	6.0	10.0

Plot Comparison

	900	901
<i>The role of double parton collisions in soft hadron collisions</i>	<i>Chi²/DOF</i>	<i>Chi²/DOF</i>
KNO distribution (mpi)	11.52	4.87
KNO distribution	11.52	4.87
KNO distribution (multiplicity)	11.52	4.87
<i>Pseudorapidity distributions of charged particles produced in p anti-p interactions at s**(1/2) = 630 and 1800 GeV</i>	<i>900</i>	<i>901</i>
	<i>Chi²/DOF</i>	<i>Chi²/DOF</i>
dN_chg/deta (CDF eta range)	6.95	5.72
Mean charged multiplicity	8.13	8.67
dN_chg/deta at eta=0	19.87	8.57
<i>Measurement of beauty photoproduction at HERA</i>	<i>900</i>	<i>901</i>
	<i>Chi²/DOF</i>	<i>Chi²/DOF</i>
Cross section vs x_gamma	1.02	6.18
Cross section vs eta(mu)	0.97	4.39
Cross section vs pT(mu)	2.36	4.45
<i>Scaling violations and determination of alpha_s from jet production in gamma-p interactions at HERA</i>	<i>900</i>	<i>901</i>
	<i>Chi²/DOF</i>	<i>Chi²/DOF</i>
Ratio of scaled jet invariant cross sections	1.54	1.68
Scaled cross section vs xT, mean W = 255 GeV	1.5	0.84
Scaled cross section vs xT, mean W = 180 GeV	1.18	1.25

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JetWeb: status and ongoing work

- Database frozen: can search but not submit jobs
- Existing framework not flexible enough
- Need to “factor out” generator-specific details
- Need to combine different runs into appropriate models
 - minimum bias, high- p_t jets, beauty production
 - some parameters vary between run types
 - e.g. p_{tmin} must be large for jets, 0 for min bias
- Use list of “irrelevant parameters” for each run type
 - already used for ee, ep, pp runs
 - extend to different run types
 - must be done for each generator

HEPDATA

- Durham HEP Databases
 - reaction data
 - parton distribution functions
 - also literature, names, experiments...
- Very comprehensive!
- Reaction data provided as “flat” text files
- Good for humans, but not for automated tools
- A relational database (RDB) would be better

CEDAR

- Combined E-science Data Analysis Resource
- Collaboration between UCL (JetWeb) and Durham (HEPDATA)
 - UCL: J M Butterworth, S Butterworth, B M Waugh
 - Durham: W J Stirling, M R Whalley, A N Other
- Funded from PPARC e-Science budget 2004–08
 - first full release in time for LHC start-up
- Three areas:
 - Reaction data: start with HEPDATA
 - Model validation: start with JetWeb
 - Code repository

CEDAR: Reaction data

- Migrate HEPDATA to a relational database (work started)
- Enable direct input of data by collaborations using Grid authentication tools
- Define standard XML format for data exchange
- Access via Web and Grid tools

CEDAR: Model validation

- Make JetWeb more modular, using object-oriented design principles
- Extend to more models (currently still two Herwig versions + one Pythia)
- Access HEPDATA directly rather than maintaining separate database
- Replace HzTool with OO framework

CEDAR: Code repository

- Model validation requires well defined versioning of generators, PDF fitting codes, jet algorithms...
- Propose to establish repository with Web and Grid access
- Can obtain JetWeb-validated version here
- Could be used as official version by authors

References

- HzTool
 - <http://www.desy.de/~carli/hztool.html>
 - <http://jetweb.hep.ucl.ac.uk/Doc/cvs.html>
 - J Bromley et al., Future Physics at HERA, vol 1, pp 611-612
- JetWeb
 - <http://jetweb.hep.ucl.ac.uk/>
 - J M Butterworth & S Butterworth, Comp. Phys. Commun. 152 (2003) 164-178
- HEPDATA
 - <http://www-spires.dur.ac.uk/hepdata/>
- CEDAR
 - nothing yet!