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)

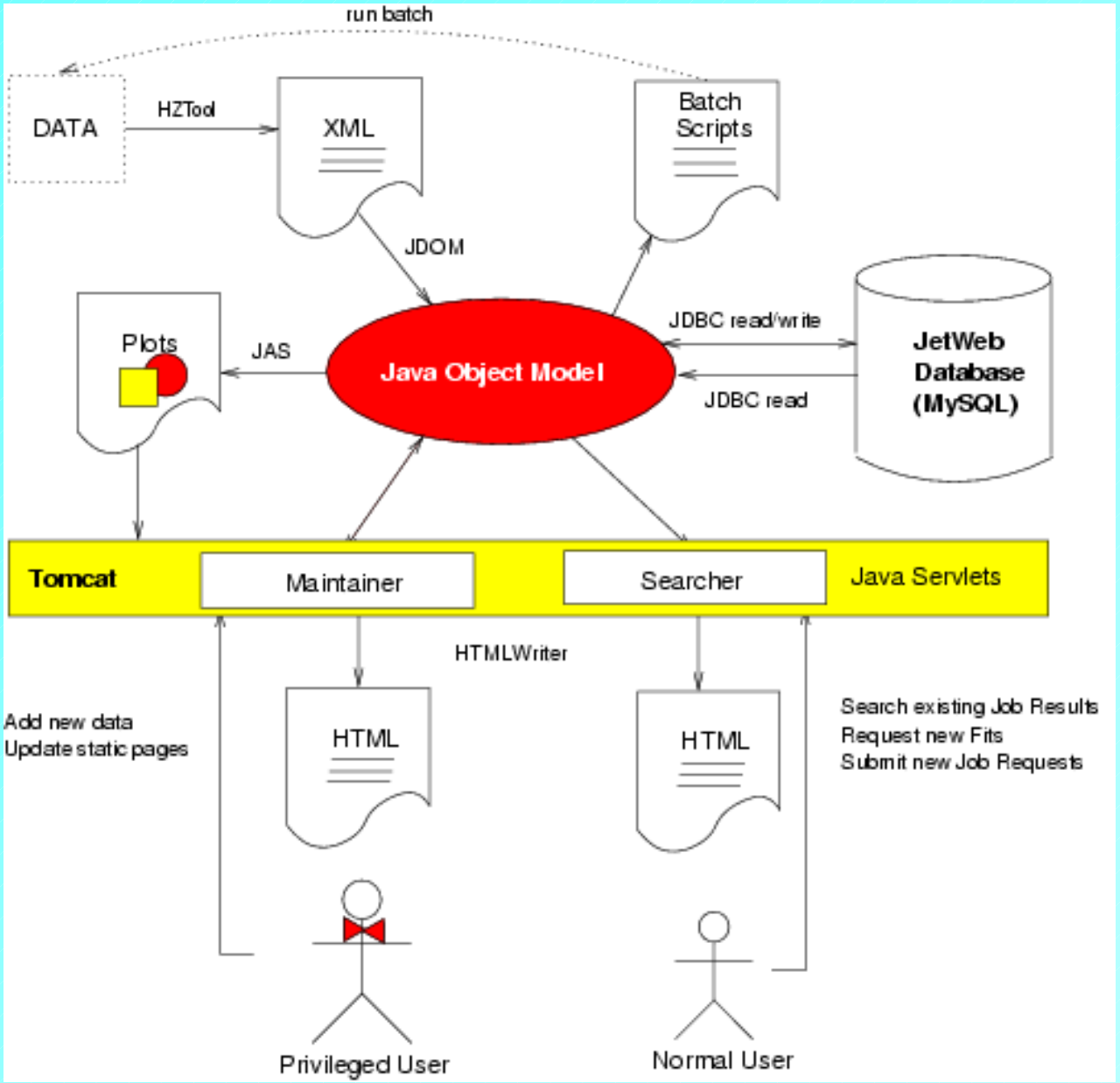
JetWeb

- 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

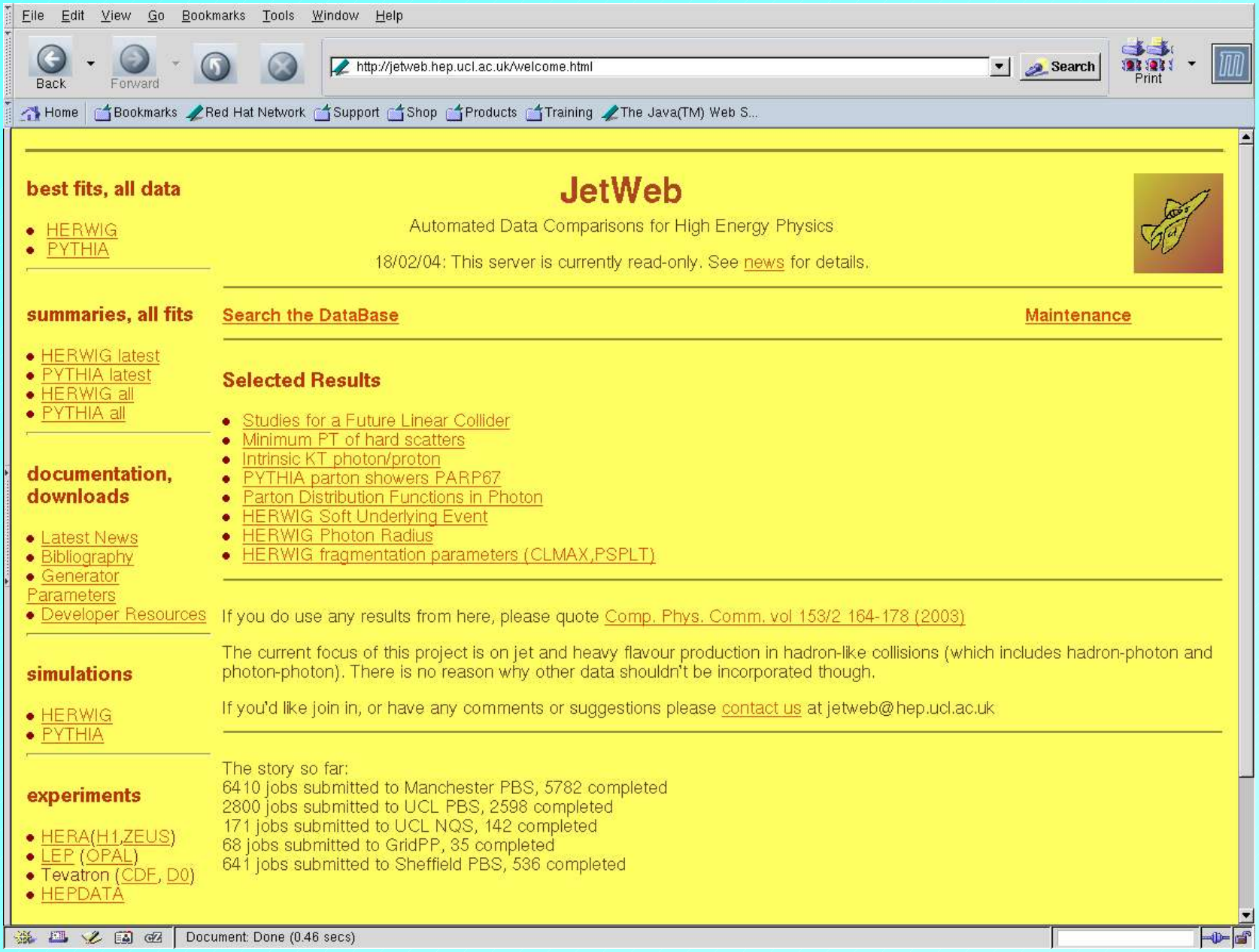
JetWeb: behind the scenes

- 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

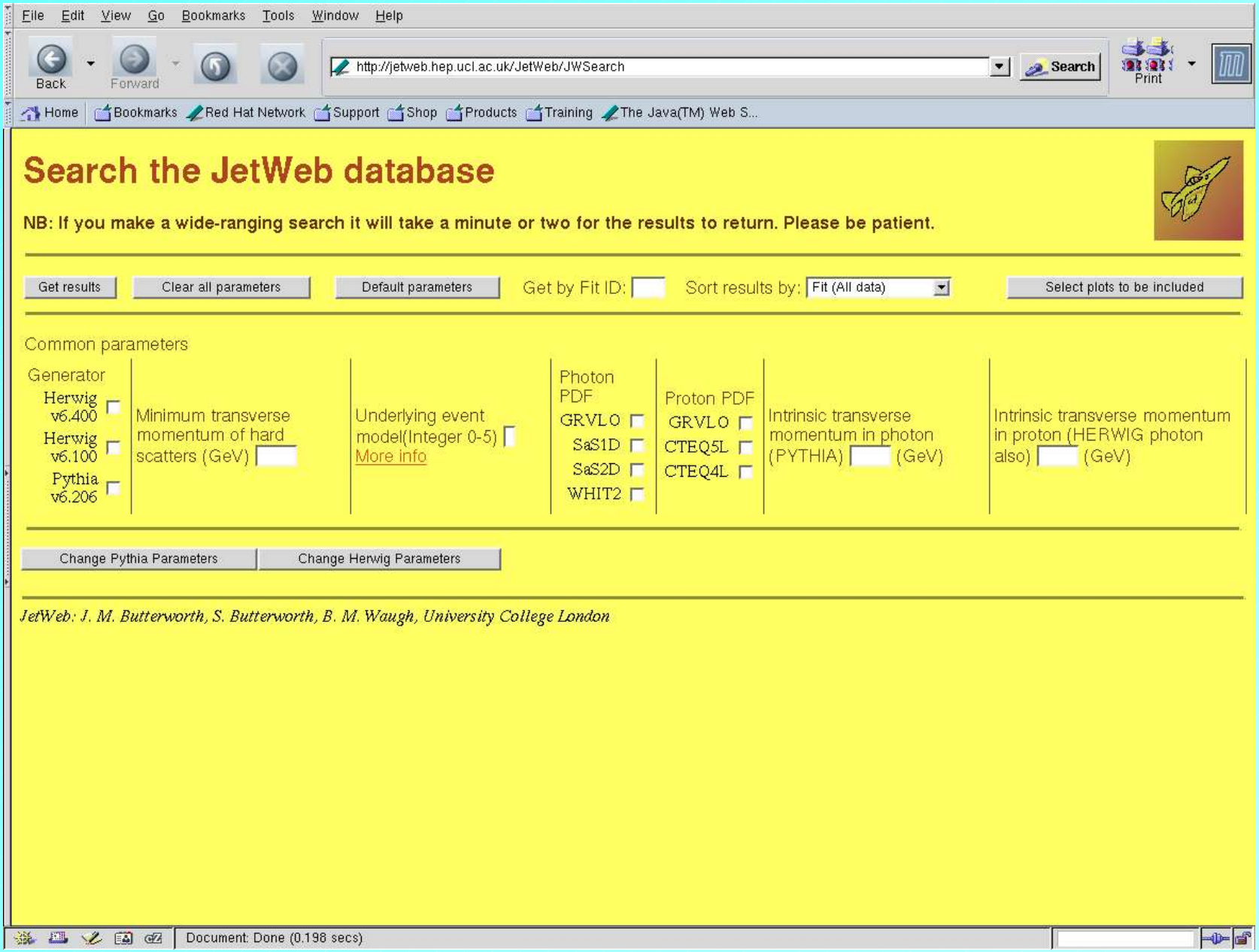
JetWeb: components



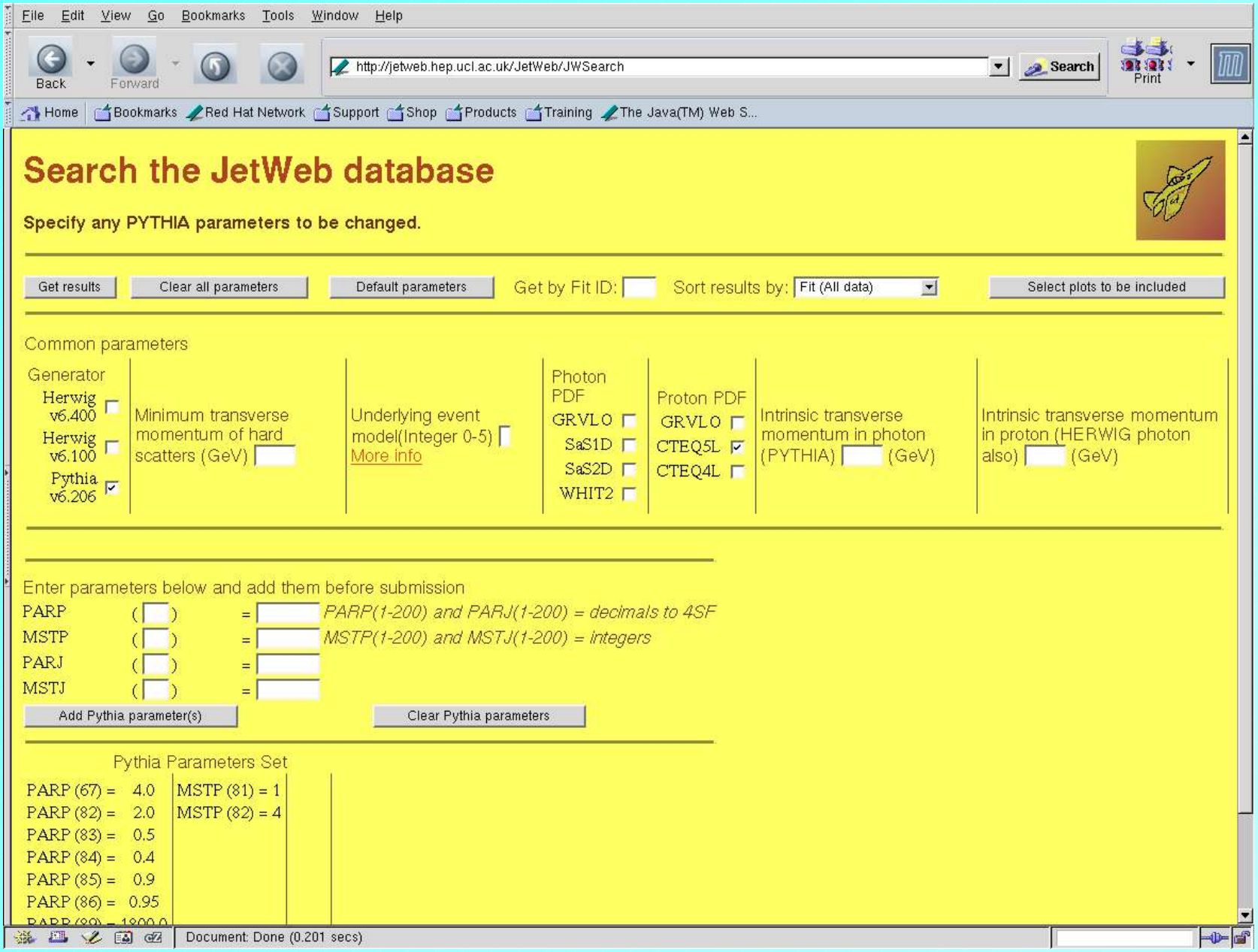
JetWeb home page



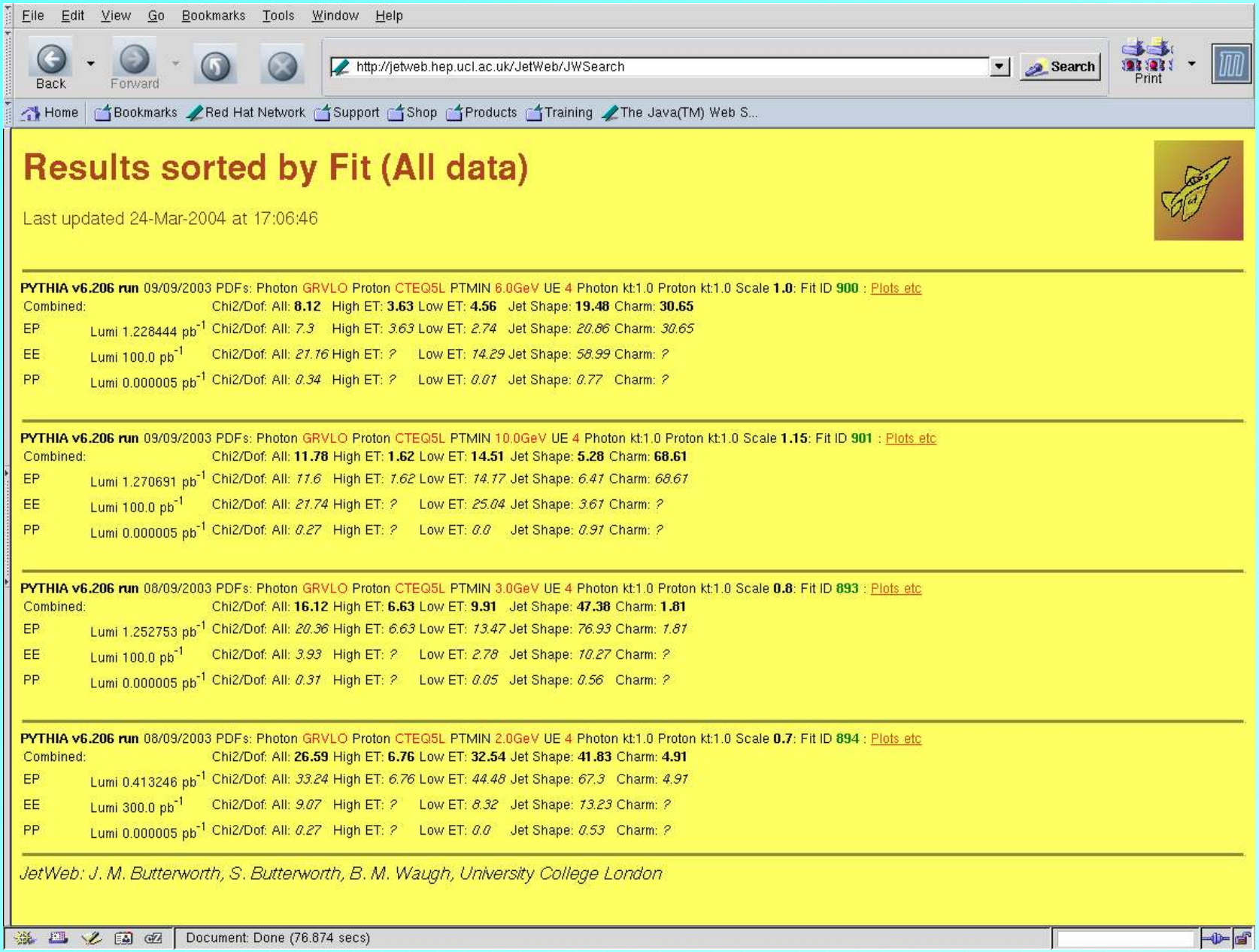
JetWeb search form



JetWeb search form (2)



JetWeb search results



JetWeb fit

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http://jetweb.hep.ucl.ac.uk/Fits/900/index.html

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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 EP Submit
Request similar data Get form
Search for similar data Get form
Maintenance Get form
Compare to fit : OK
Show non-default parameters OK

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				
128.5931438	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.
[illegible]	[illegible]	Dijet Angular Distributions in Resolved and Direct Photoproduction at	ZEUS	Physics Letters B [illegible]

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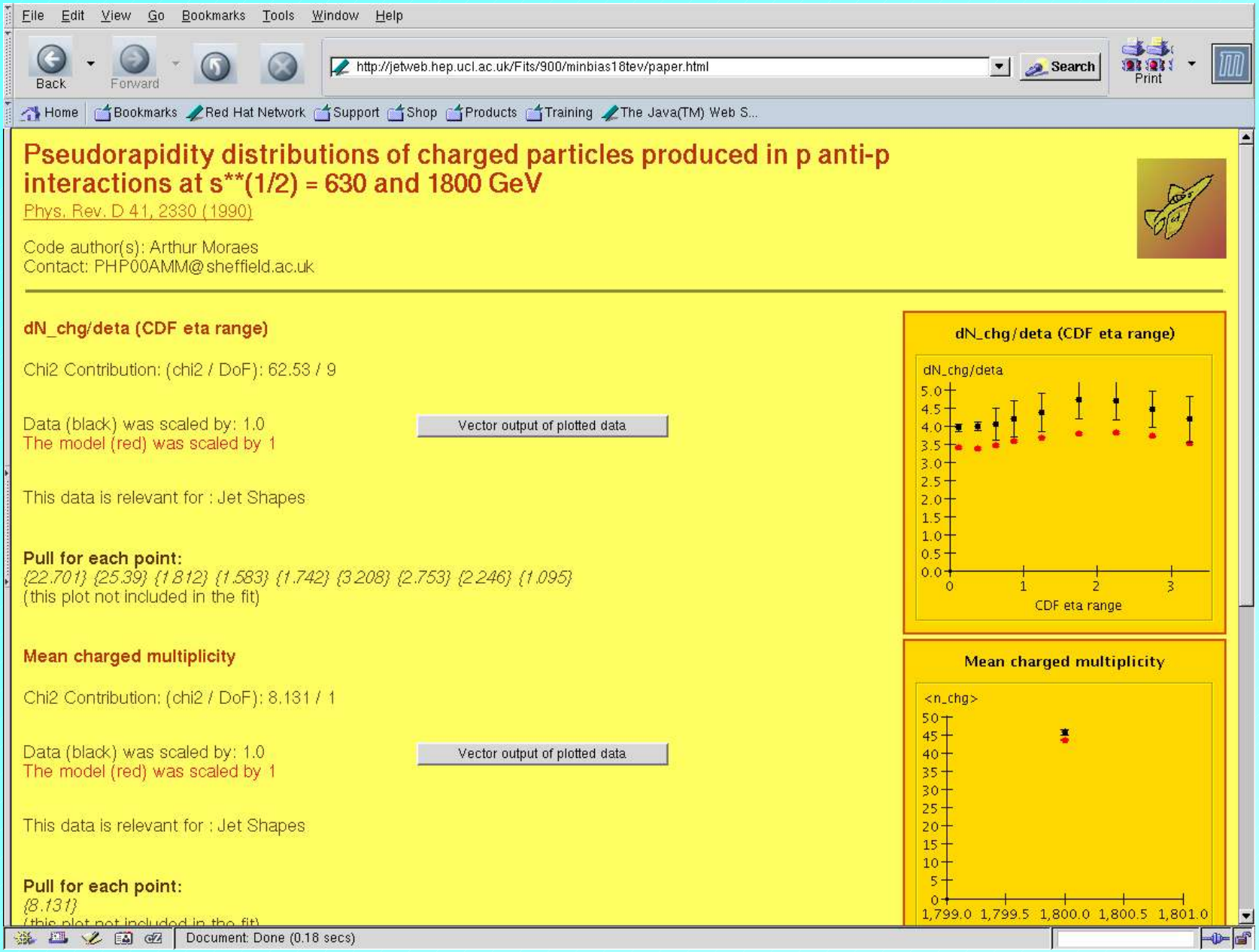
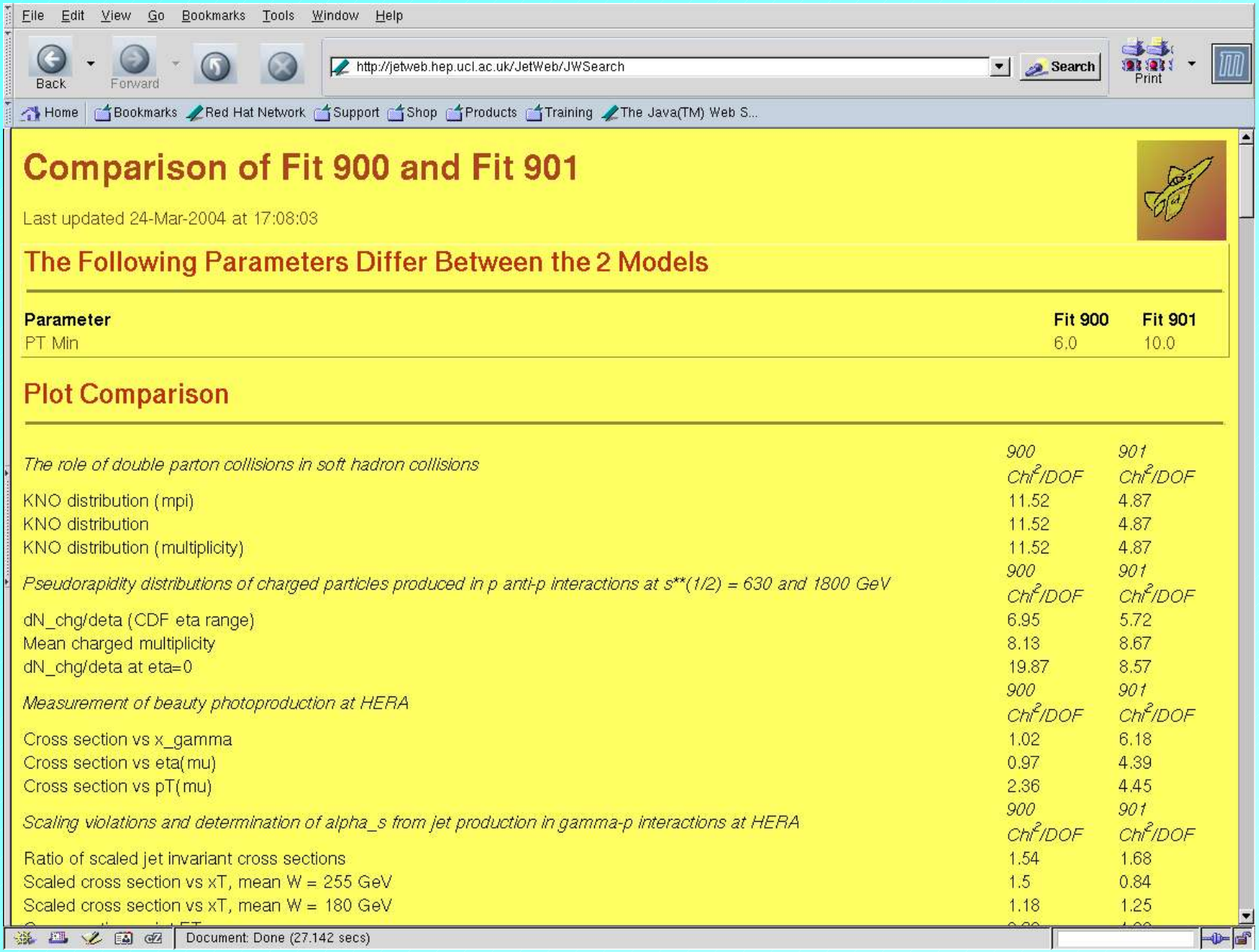
JetWeb plots



JetWeb compare fits



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
The role of double parton collisions in soft hadron collisions	*Chi^2/DOF*	*Chi^2/DOF*
KNO distribution (mpi)	11.52	4.87
KNO distribution	11.52	4.87
KNO distribution (multiplicity)	11.52	4.87
*Pseudorapidity distributions of charged particles produced in p anti-p interactions at s**(1/2) = 630 and 1800 GeV*	*900 Chi^2/DOF*	*901 Chi^2/DOF*
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
Measurement of beauty photoproduction at HERA	*900 Chi^2/DOF*	*901 Chi^2/DOF*
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
Scaling violations and determination of alpha_s from jet production in gamma-p interactions at HERA	*900 Chi^2/DOF*	*901 Chi^2/DOF*
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

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. ptmin 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!