CEDAR: global tuning of MC event generators

JetWeb, HepData, HepML and HepForge

Andy Buckley

Institute for Particle Physics Phenomenology
Durham University, UK

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Outline

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Introduction to CEDAR

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CEDAR: Collaborative e-Science Data Analysis Resource

CEDAR is an e-Science project with several sub-projects:

- JetWeb: global tuning of Monte Carlo generator parameters
- HepData: archival of published experimental data
- HepML: set of XML data formats for data sets and MC config
- HepForge: development environment for HEP software
- HepCode: centralised repository of pheno code/programs

www.cedar.ac.uk

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JetWeb — a system for global MC tuning

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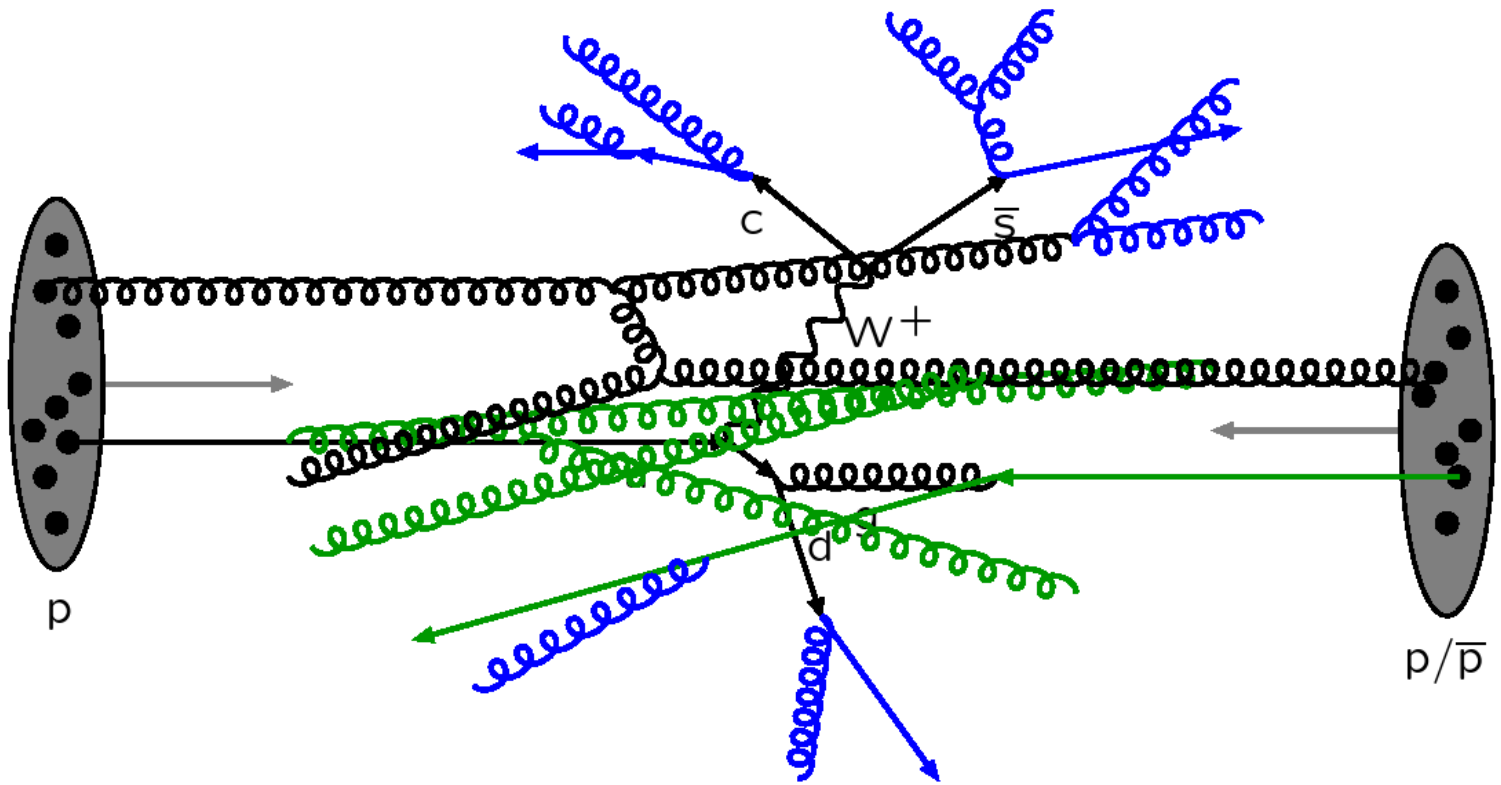
Components of MC event generators



ME, ISR & FSR parton showers, underlying event, hadronisation, decays. . .

Event generators: tuneable parameters

- Parton density functions → MRST/CTEQ...
- Matrix elements (kinematics, phase space, coupling/scale) → order, match to PDF?
- Parton showers and ME matching → which shower?
- Threshold effects in heavy flavour production
- Fragmentation functions
- Hadronisation → string/cluster params, strangeness...
- Underlying event

Large number of params: nonsensical tunings dominate parameter space

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Caveats

There are always caveats, especially in high dimensional problems!

- *Global* tuning to data required — selective tunings are dangerous
- Expect *sets* of reasonable configurations, rather than one "ultimate" tuning
- Any tuning depends on your definition of "best". Both in terms of what phenomenological features a given expt. considers important and in terms of the fitting measure used.

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Introducing JetWeb

JetWeb is a centralised system for global MC tunings

- Written in Java, run on Apache + Tomcat framework
- Database of global data fit qualities for MC models (generator & params)
- Web interface to view fits and plots
- Users can request generation of a particular model if not (sufficient) in db
- Comparisons via a set of routines, each corresponding to a published paper

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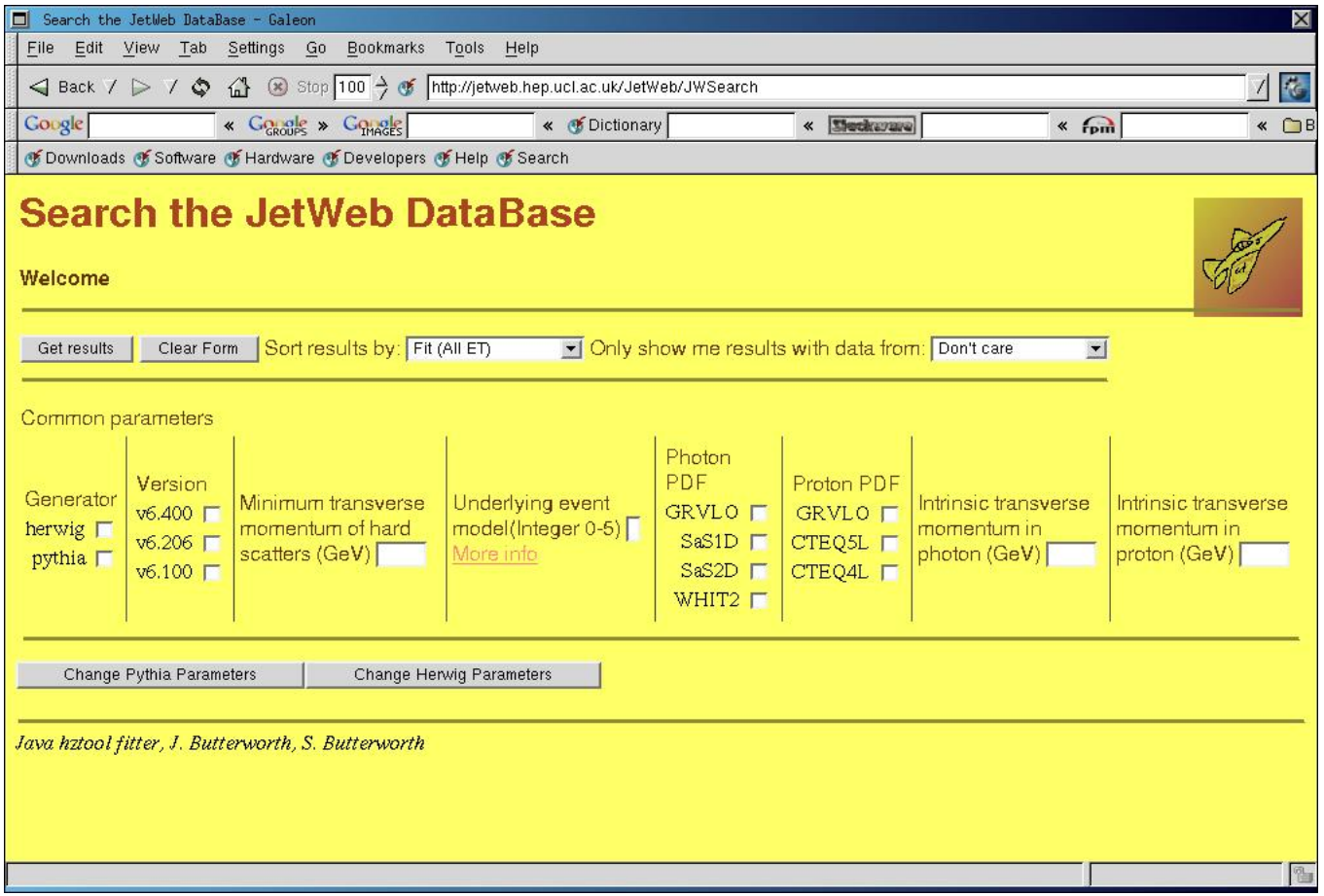
JetWeb in action (1)

Searching

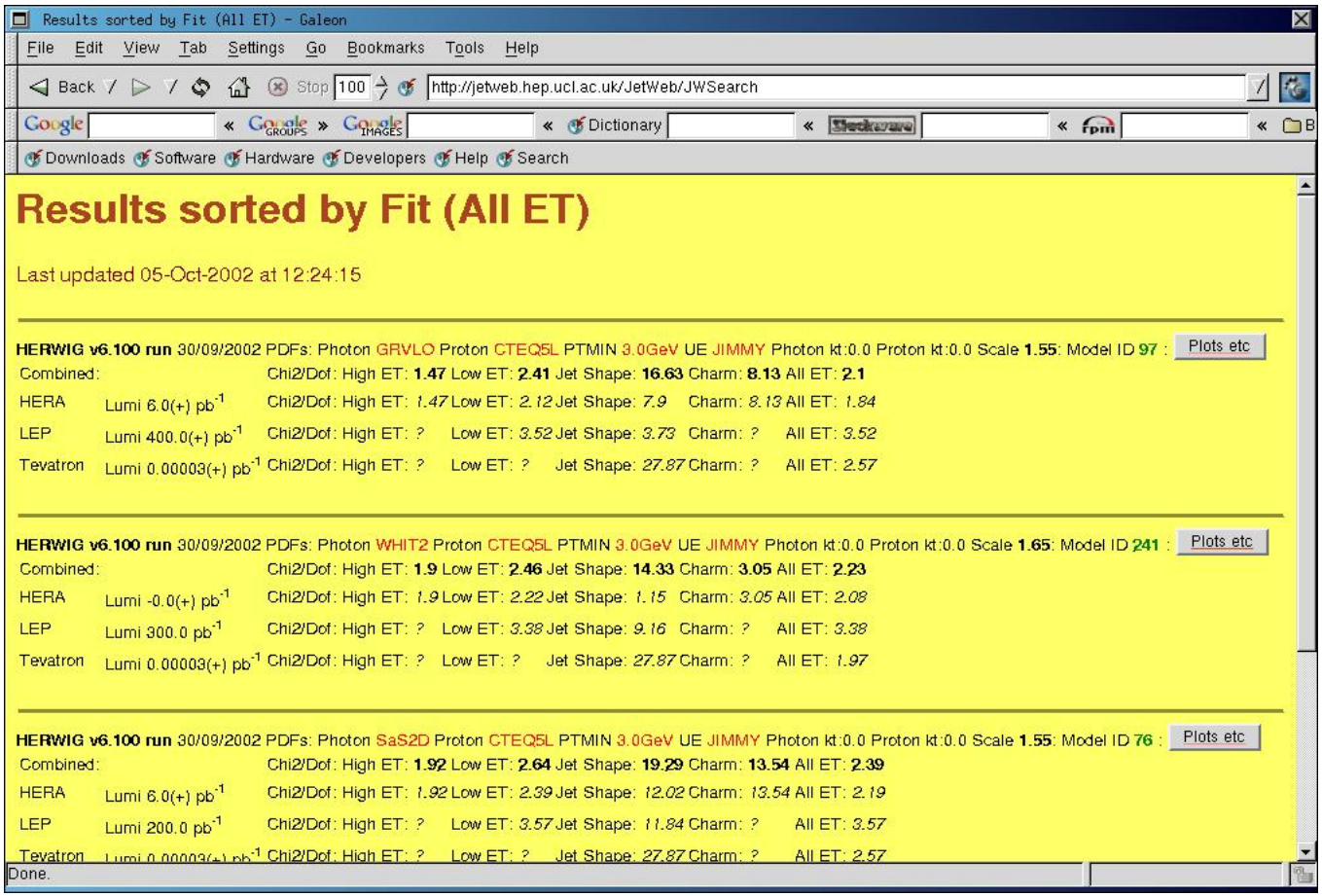
NB. This is the *frozen* copy of JetWeb. . .



JetWeb in action (2)

Fit list

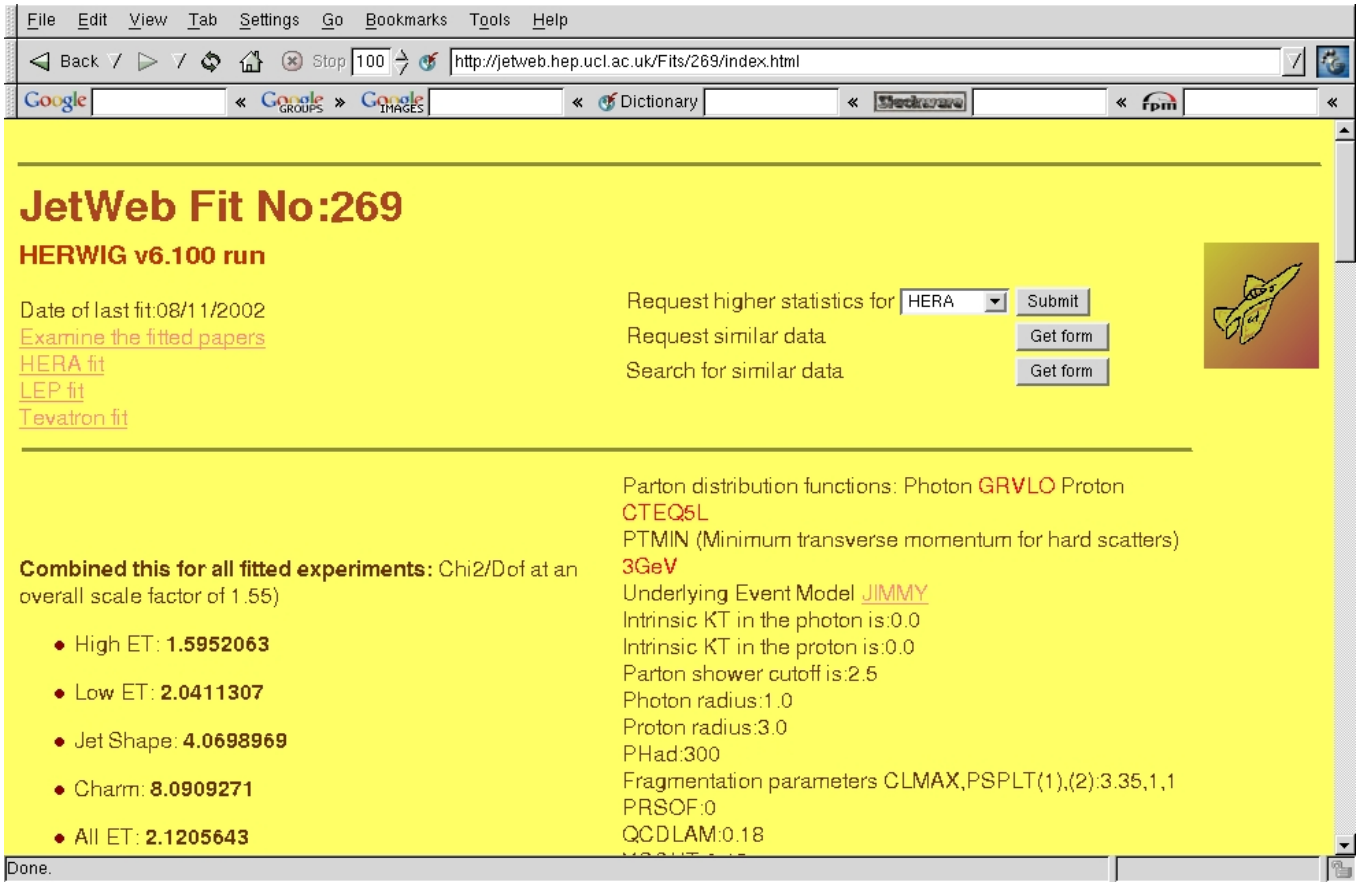
NB. This is the *frozen* copy of JetWeb. . .



JetWeb in action (3)

Fit details

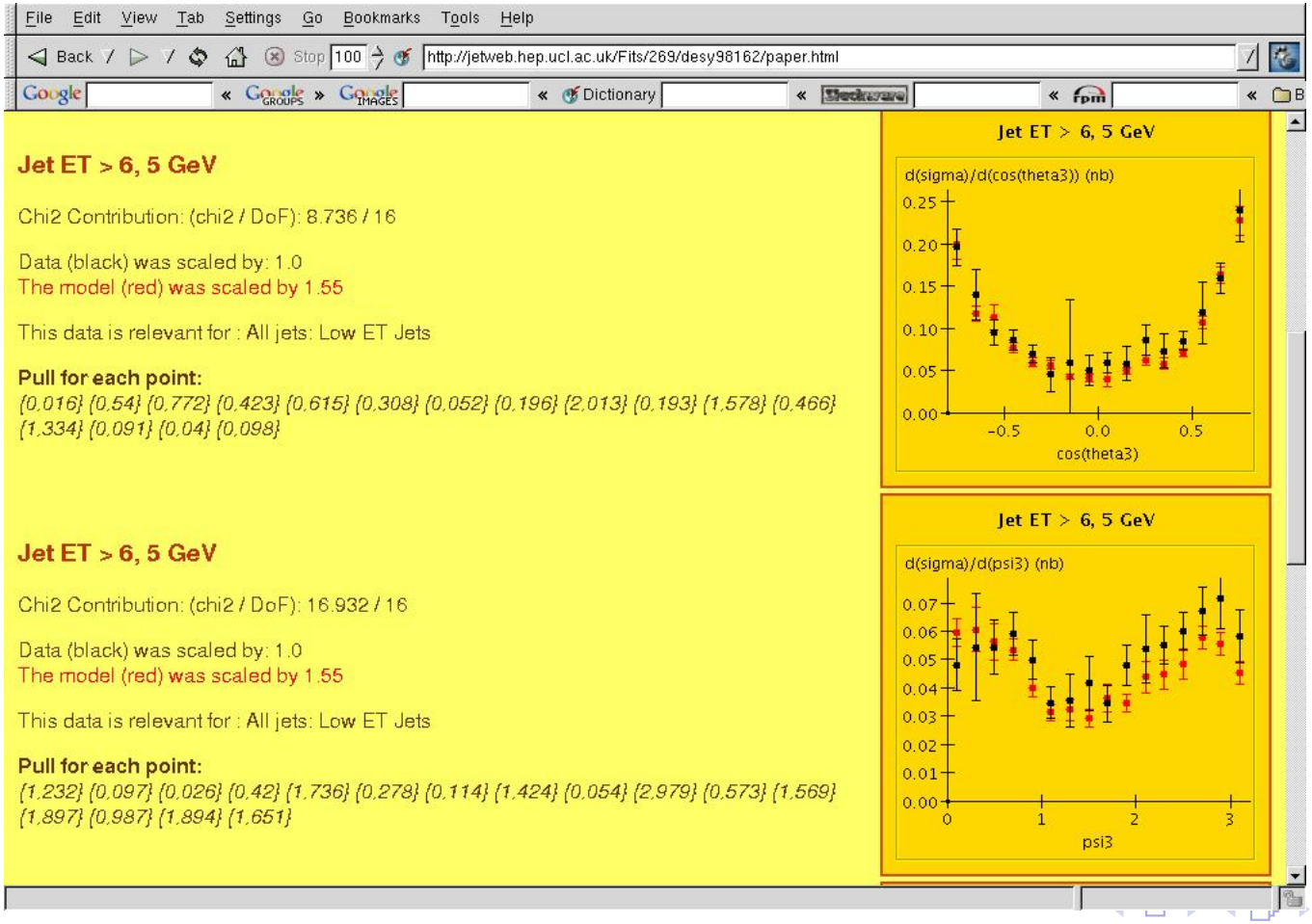
NB. This is the *frozen* copy of JetWeb. . .



JetWeb in action (4)

Paper view

NB. This is the *frozen* copy of JetWeb. . .



HzTool: `http://hepforge.cedar.ac.uk/hztool/`

JetWeb is only the front-end, distribution and comparison system. “Experimental analyses” are done by HzTool

- HzTool is a library of Fortran routines for reproducing observables
- Typically one HzTool routine per paper
- Typically written by paper authors
- Generator independent: generator specifics in HzSteer package
- Rivet: C++ replacement being written by CEDAR: **`http://hepforge.cedar.ac.uk/rivet/`**

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JetWeb enhancements

CEDAR is enhancing JetWeb in several ways:

- Experimental data to be taken from (upgraded) HepData
- Framework re-factor to make model extensions easier
- Plans to use Grid authentication and job distribution
- New histogramming modules using the AIDA interfaces
- (Scanning parameter space, re-weighted fits...)
- First CEDAR version of JetWeb to be available soon

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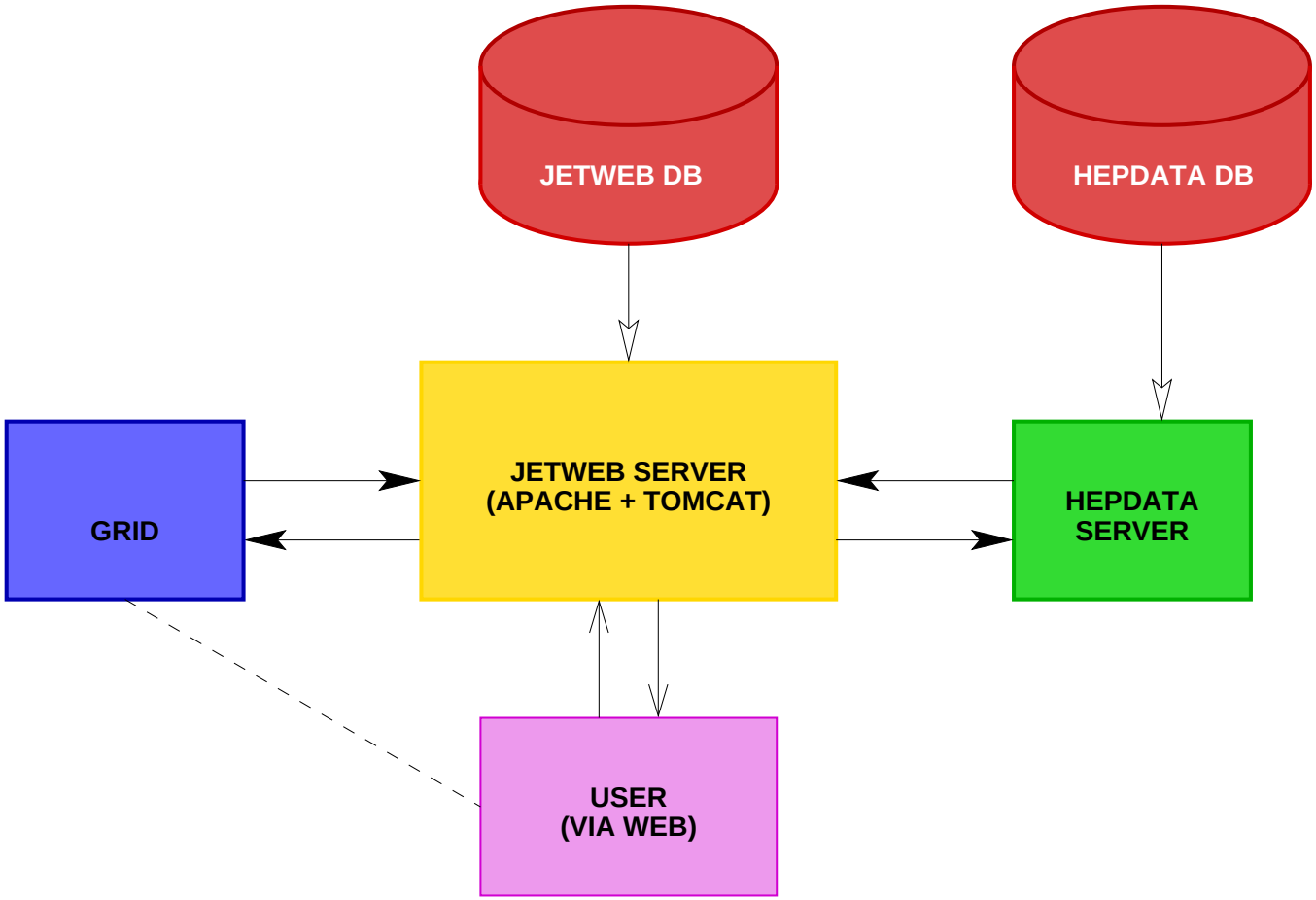
(New) JetWeb behind the scenes



HepData — the HEP reaction database

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Introducing (legacy) HepData

- Searchable ∼30 years' worth of scattering data, PDFs etc.
- Historically stored in hierarchical BDMS database: very inflexible and little modern support
- Data available as text files, PAW kumacs or GIF images
- Legacy db stores pretty much everything as a string
- Adding records requires writing a Fortran routine
- Mirrors to SPIRES, PDG info

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HepData enhancements

- Migration to relational SQL database with Java servlet front-end, sharing object model components with JetWeb
- Database sanitising e.g. axis-level properties, uniform units, measurement classes. . .
- Using “HepML” and AIDA interfaces: XSLT transformations to many data formats possible
- Will use Grid authentication for expts. to submit data directly (modulo sanity checking)

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A brief aside on “HepML”

- XML representation for generator configs and HepData data sets (and more to come?)
- Defined by a set of XML schema docs under the `http://www.cedar.ac.uk/hepml/` namespace
- Will also contain Python API and Java XSLT transformer classes using HD object model
- Intended for use by JetWeb etc., also by external projects (e.g. Professor)
- Will be a common MC generator log/config format (MCnet)
- HepData XML schema version 0.1 (release for comment) very soon: please check it out!
  `http://hepforge.cedar.ac.uk/hepml/`

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HepML fragment (1)

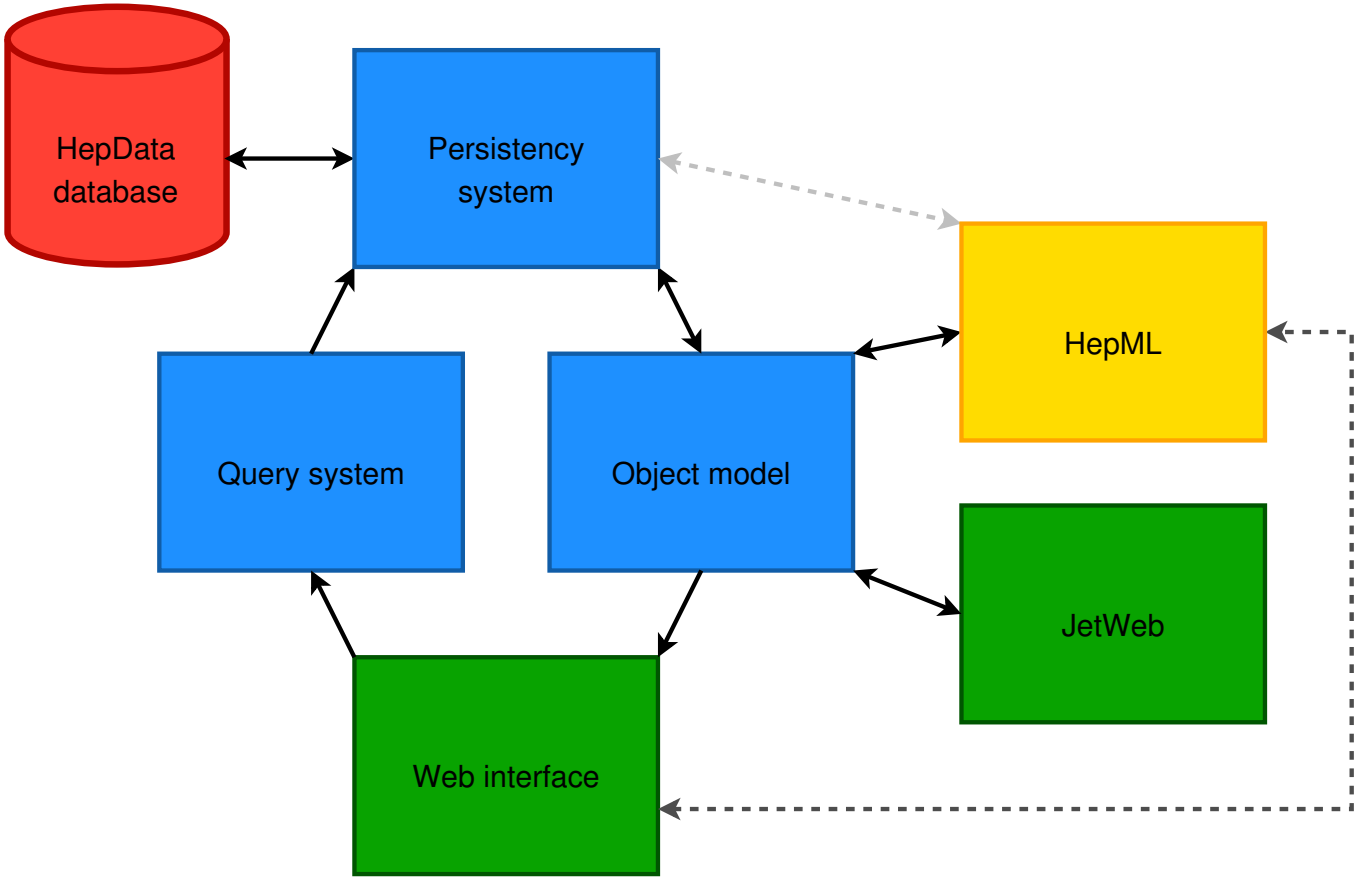
```
<?xml version="1.0" encoding="UTF-8"?>
<hepml xmlns="http://www.cedar.ac.uk/hepml/hepdata/0.1/">
  <data timestamp="2006-04-07 13.09.27">
    <paper irn="3326047" paperId="3552">
      <dataset datasetId="1">
        <comment>
          FITTED, BACKGROUND SUBTRACTED, PEAK OMEGA CROSS SECTION,
          ...
        </comment>
        <property name="RE(Q=MU)" value="E+ E- --&gt; MU+ MU-" />
        <property name="RE(Q=HAD)" value="E+ E- --&gt; PI+ PI0 PI-" />
        <xaxis header="SQRT(S) IN GEV" xaxisId="1">
          <bins>
            <bin pointId="1" value="0.7726" />
            <bin pointId="2" value="0.7776" />
            ...
          </bins>
        </xaxis>

...
```

HepML fragment (2)

```
                                ...
<yaxis header="SIG(Q=HAD) IN MUB" yaxisId="1">
  <points>
    <point pointId="1" value="0.269" />
    <point pointId="2" value="0.74" />
    ...
    <point pointId="7" value="0.065" />
  </points>
  <axiserror norm="percent" source="sys" plus="11.0" minus="11
     description="FROM NUCLEAR ABSORPTION CORRECTION" />
  ...
  <pointerrors norm="abs" source="stat">
    <pointerror plus="0.096" minus="0.096" pointId="1" />
    <pointerror plus="0.192" minus="0.192" pointId="2" />
    ...
    <pointerror plus="0.036" minus="0.036" pointId="7" />
  </pointerrors>
</yaxis>
```

HepData behind the scenes



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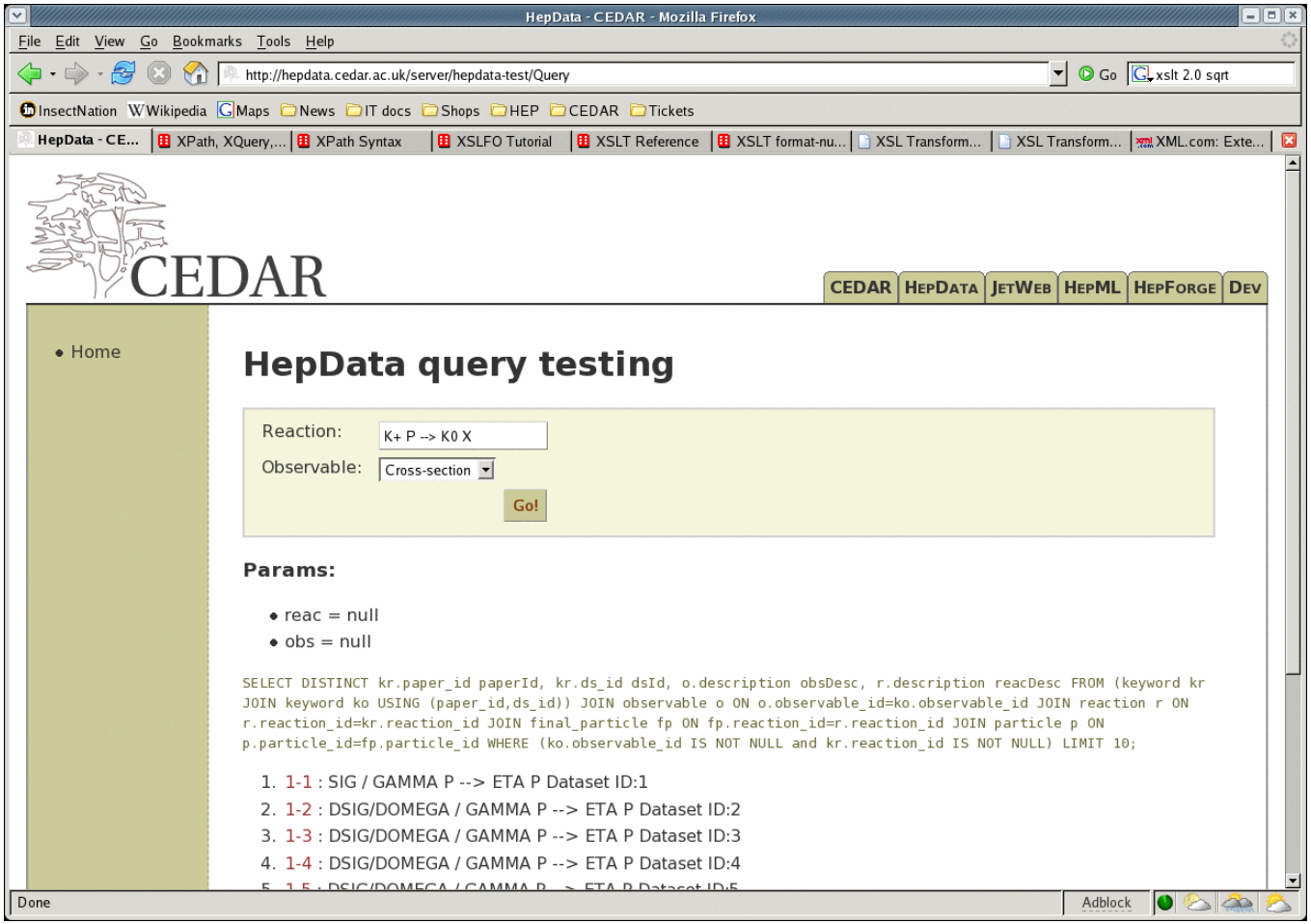
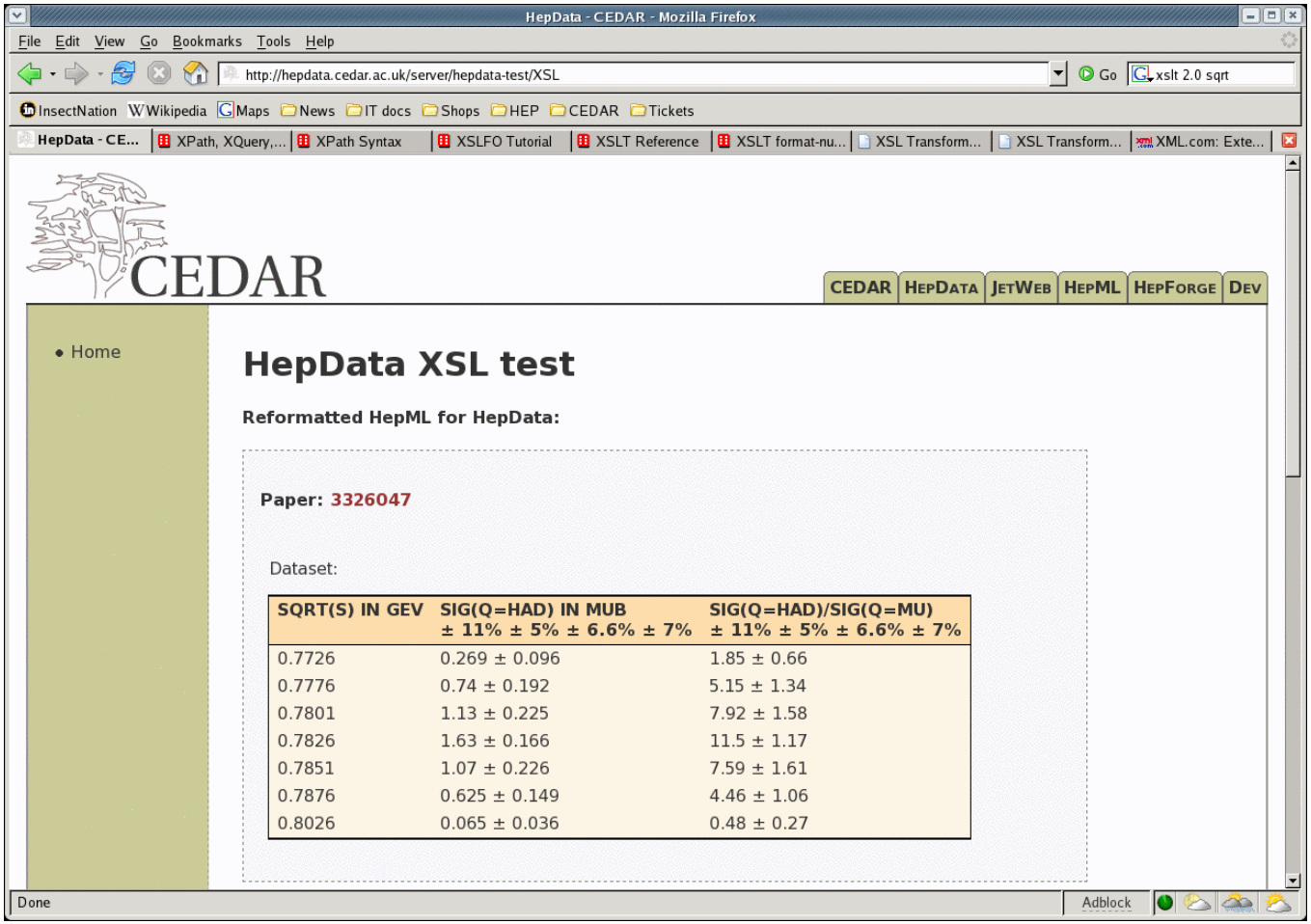
First HepData demos (1)

Query interface (breaking the rules — spot the SQL!)



First HepData demos (2)

HepData $\rightarrow$ HepML $\xrightarrow{XSL}$ HTML



HepForge — a lightweight development environment for HEP

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Software engineering for small HEP projects

- Everyone has written code that might be re-used. . .
- But hard to get managed development started: need to find/install software. . .
- Small projects don't have the resources to do nice things, like:
  - Using standard build/installation systems e.g. autotools, libtool
  - Being independent of execution/build environment e.g. `/cern`!
  - Formal quality control, feedback and bug tracking
  - Version control systems (CVS, Subversion)

HepForge provides many of these features in a powerful, easy-to-use environment.

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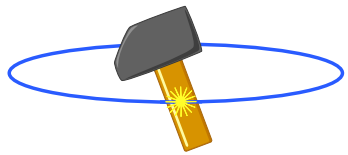
HepForge

- New collaborative development system
- Online at **http://hepforge.cedar.ac.uk**
- Features including:
  - Shell access with full set of dev tools
  - Web space (with several convenient features)
  - CVS and Subversion version control (+ public viewers)
  - Wiki and bug tracker
  - Mailing lists for developers and users
  - Downloads manager
- We've done the "boring bits"!
- Quite a few users: Herwig++, Pythia6, LHAPDF...



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Who should be interested in HepForge?

- Who's it for? Small–medium size projects.
- Stand-alone preferred but not reqd. Aids re-use.
- Intentions to use standard external systems
  Don't re-invent or *break expected behaviour* (UI design)
- Intention to document properly
- General responsible development, essentially

In return, HF provides powerful software management infrastructure with minimum entry level and learning curve

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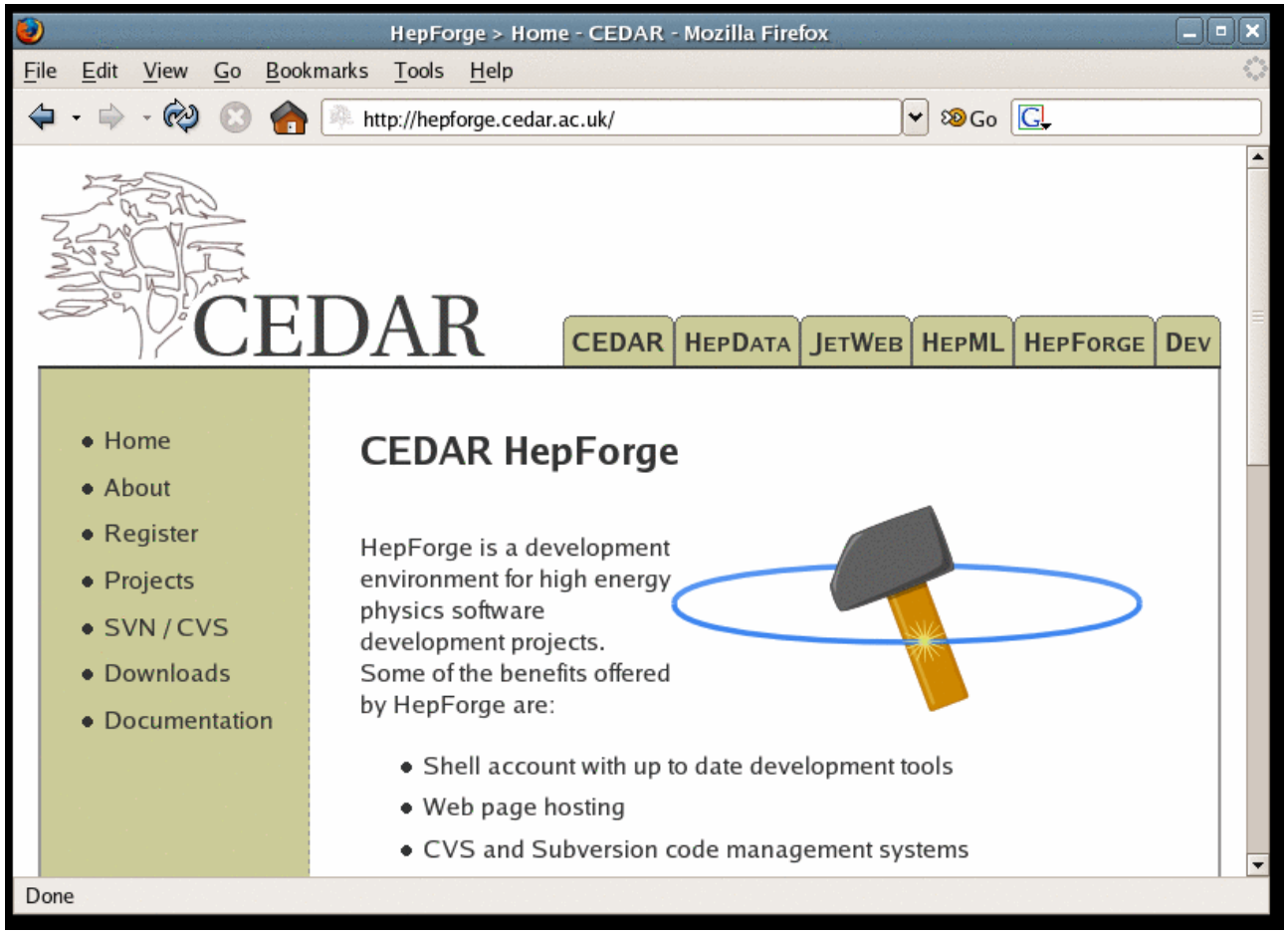
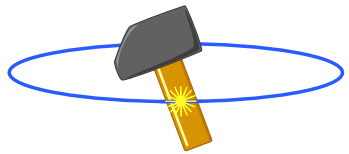
HepForge tour

Home page





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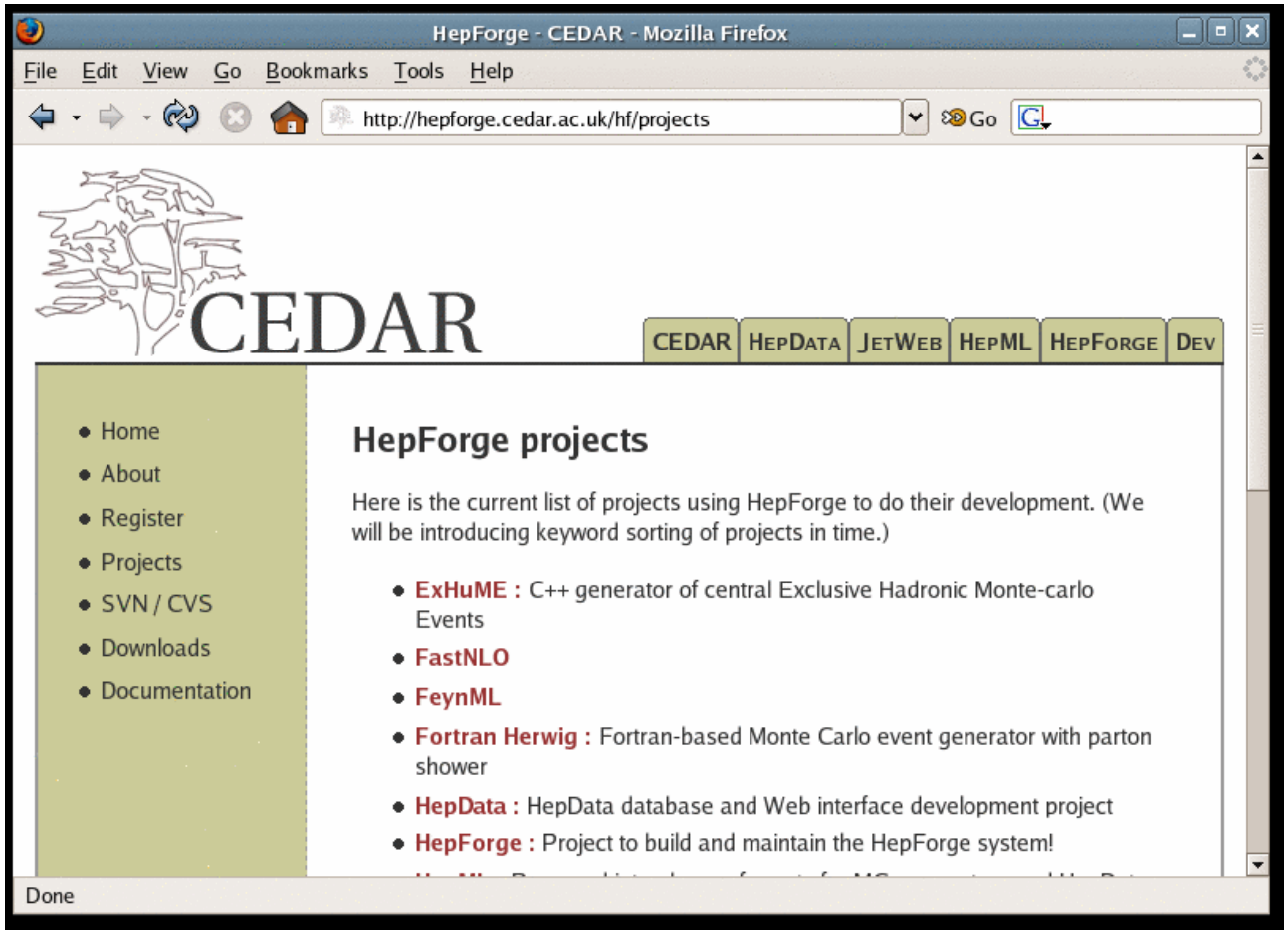
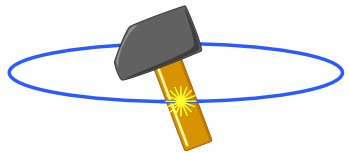
Project list (1)





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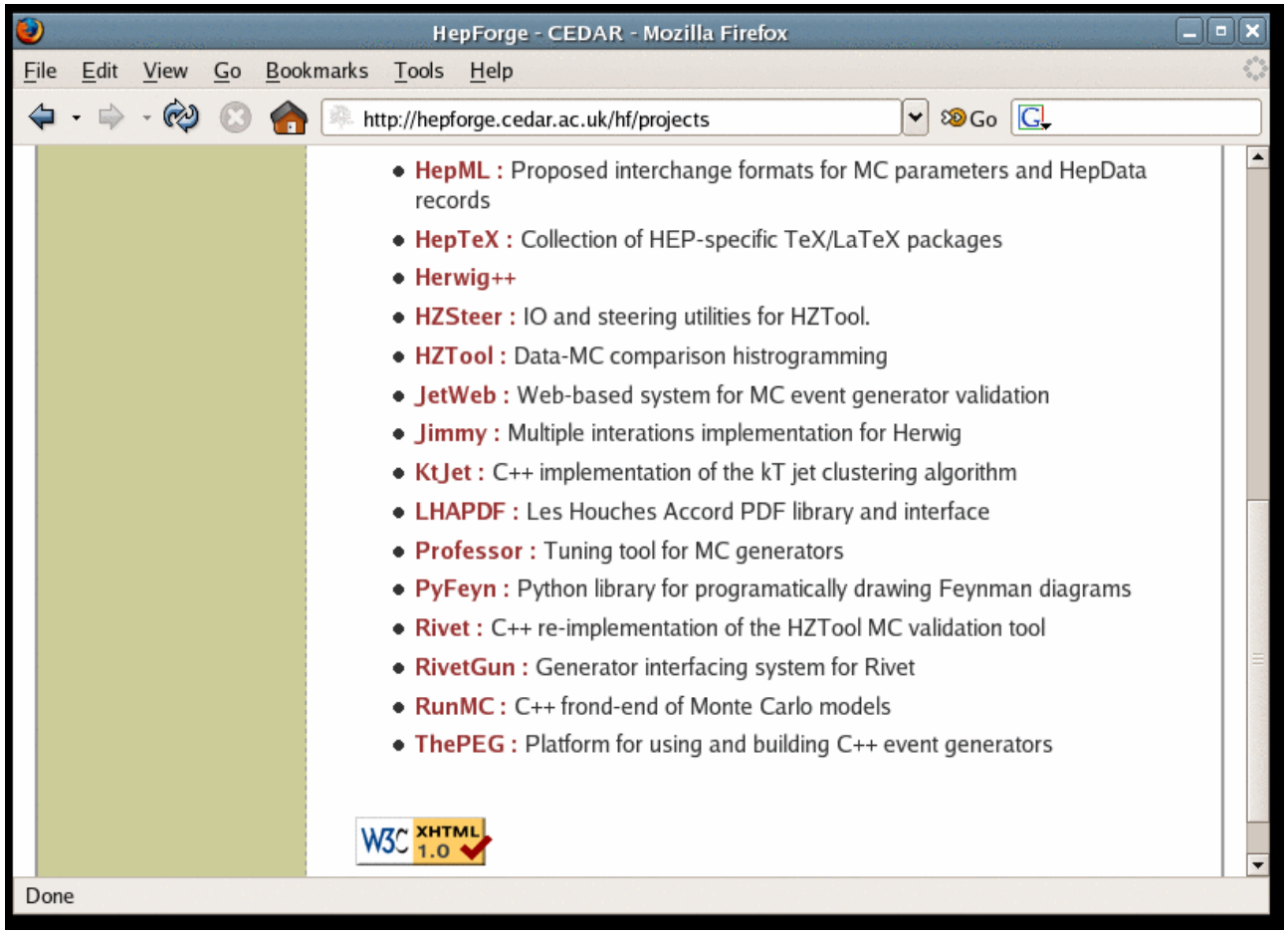
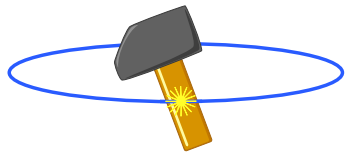
Project list (2)





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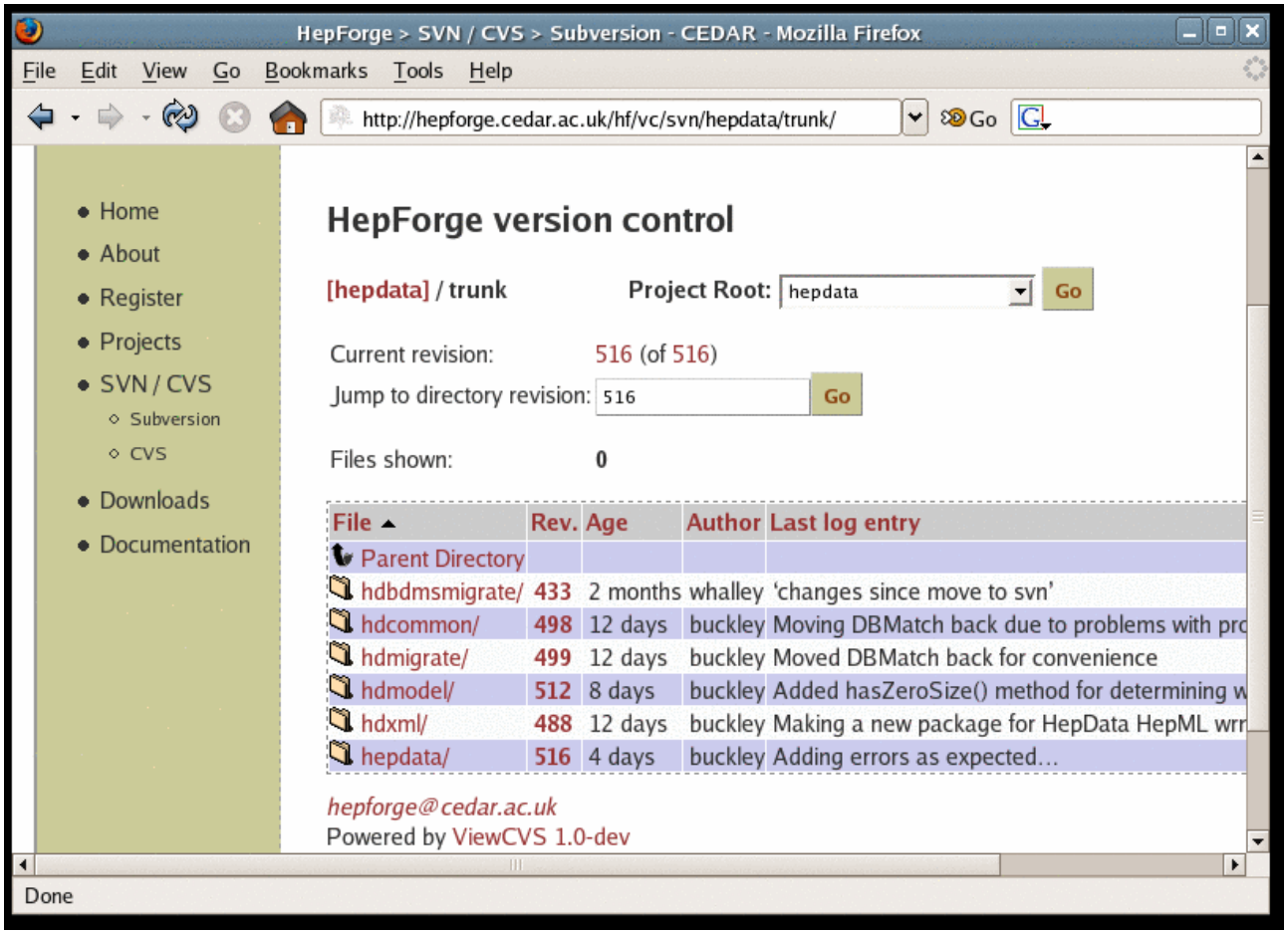
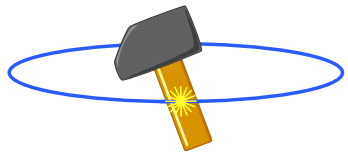
Project VC listing





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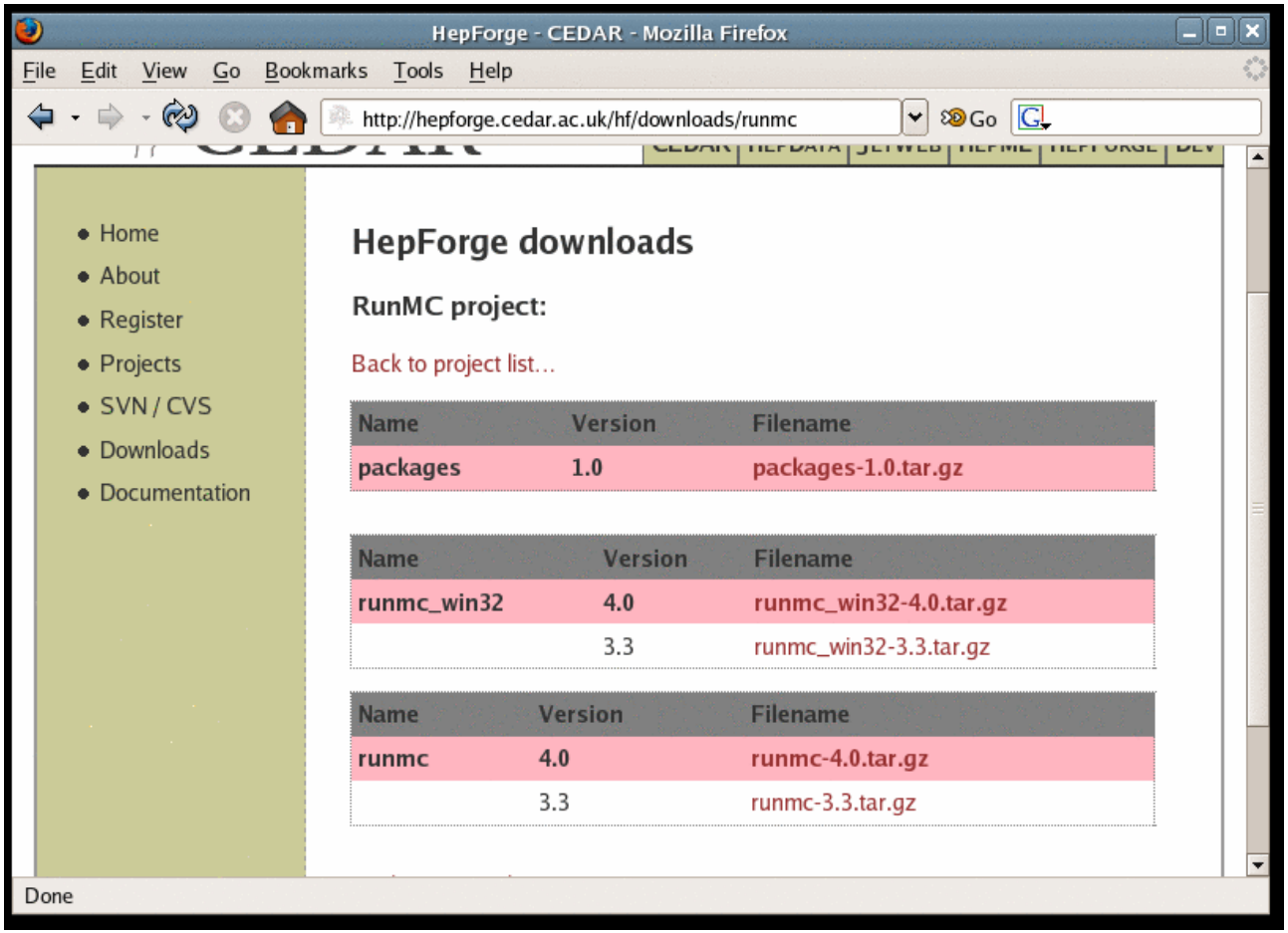
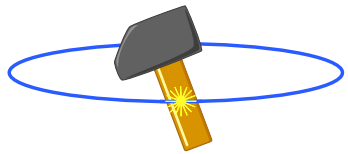
Project downloads listing (also personal copy via SSI)





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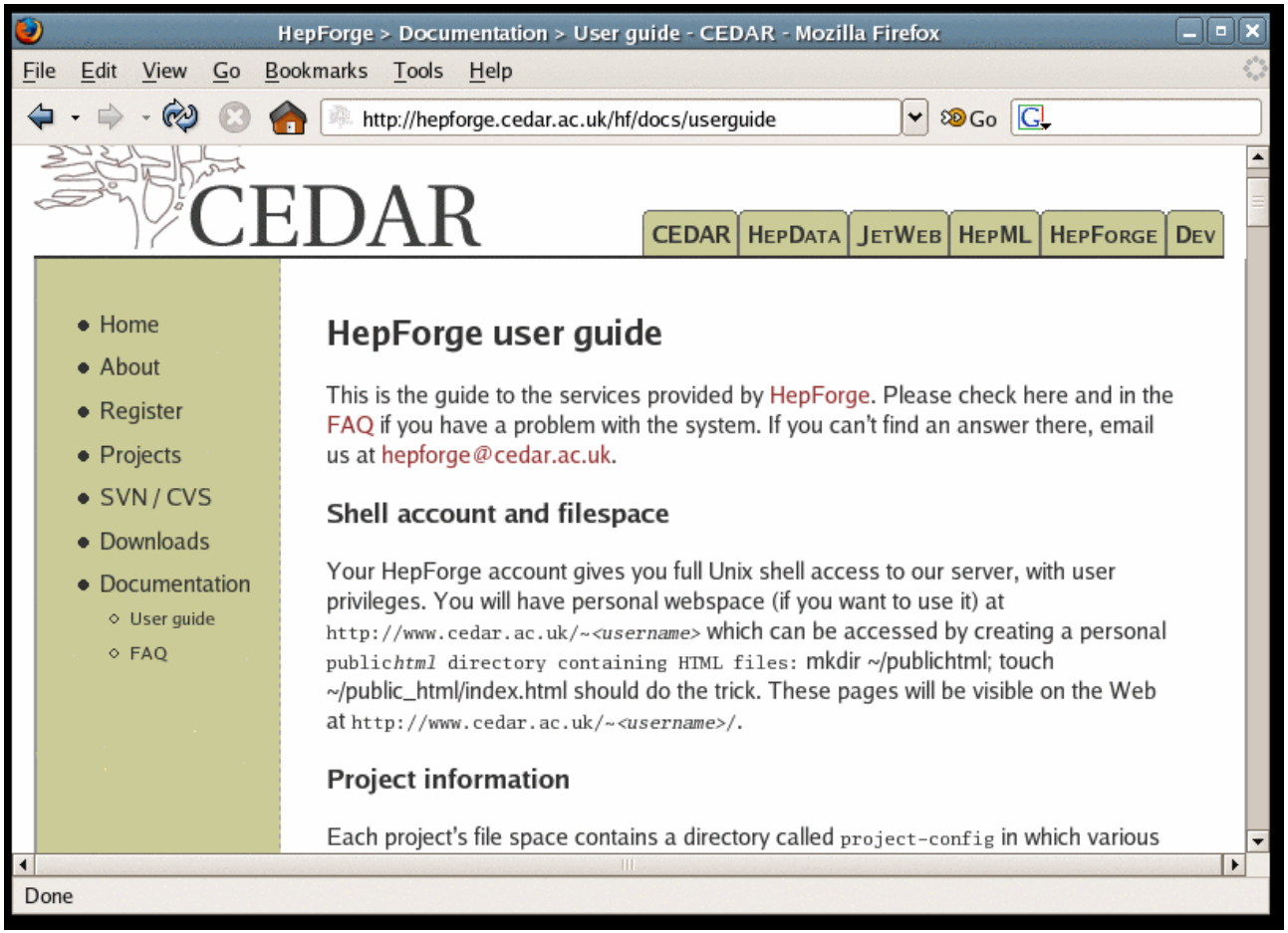
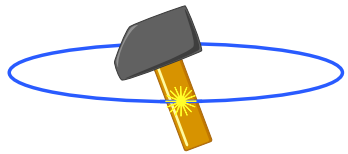
Documentation: user guide (note scrollbar!)





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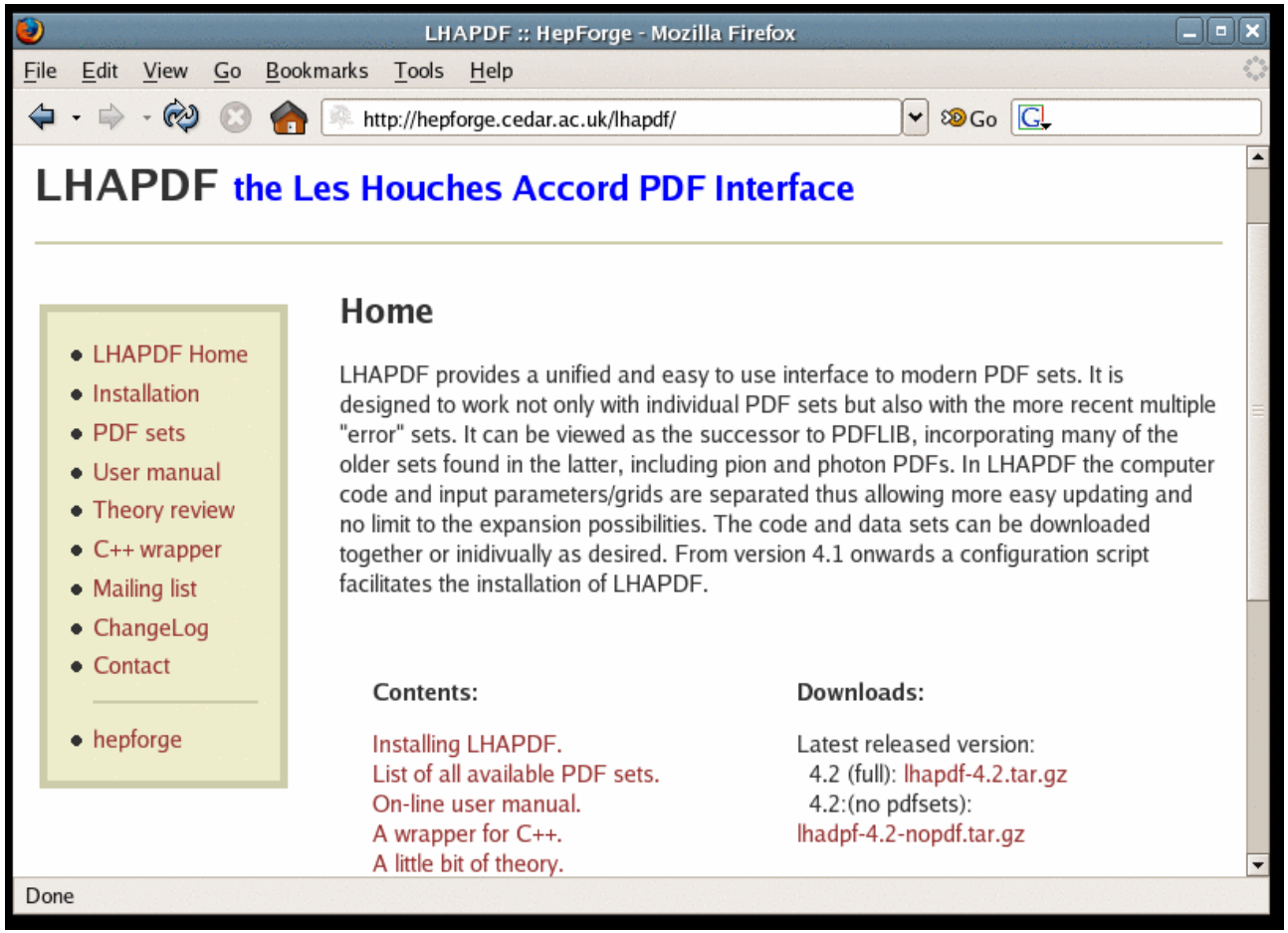
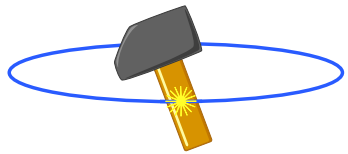
Project Web page: LHAPDF





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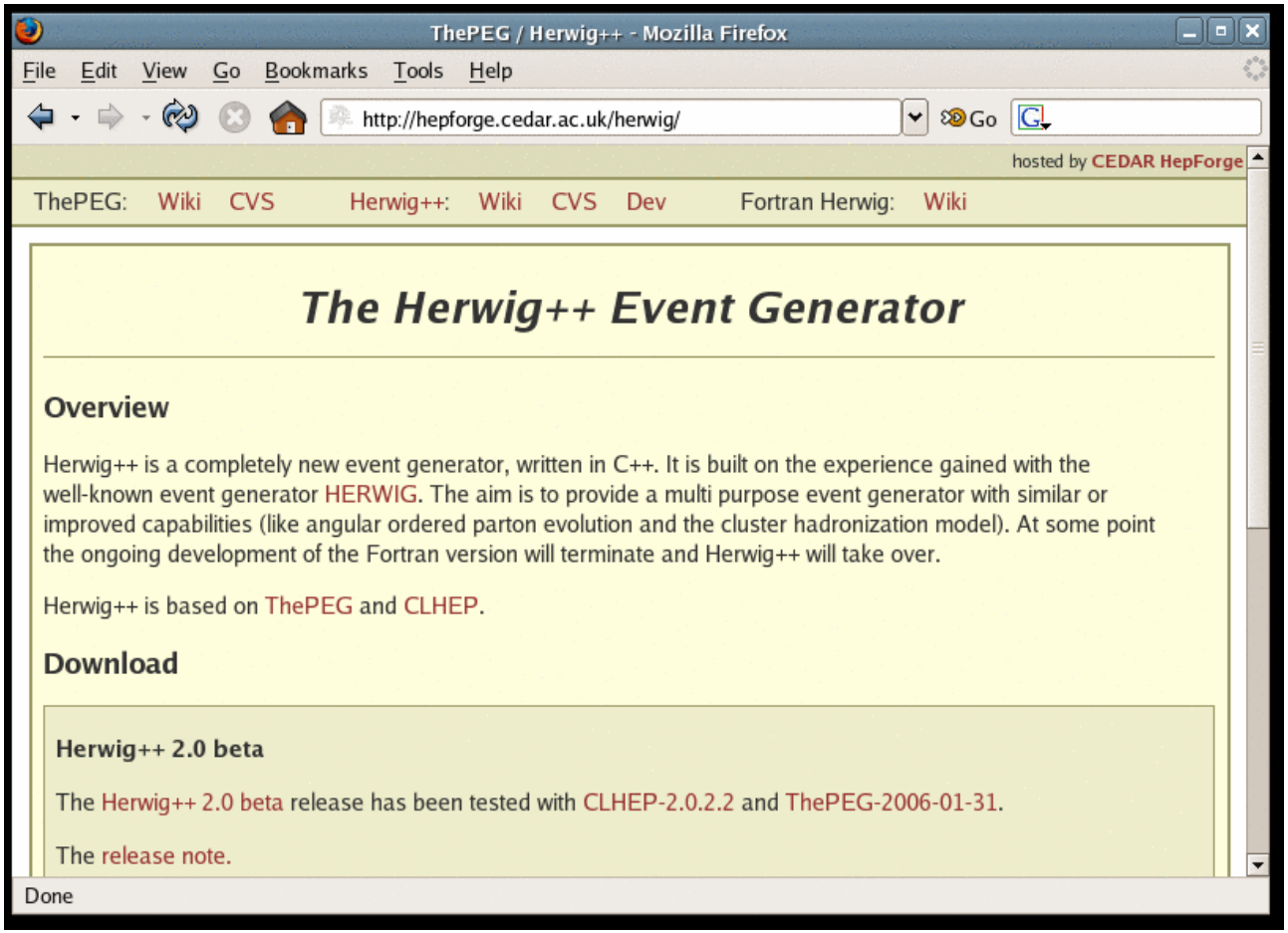
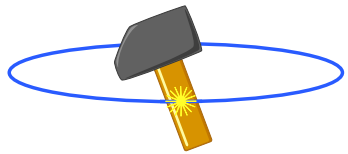
Project Web page: Herwig++





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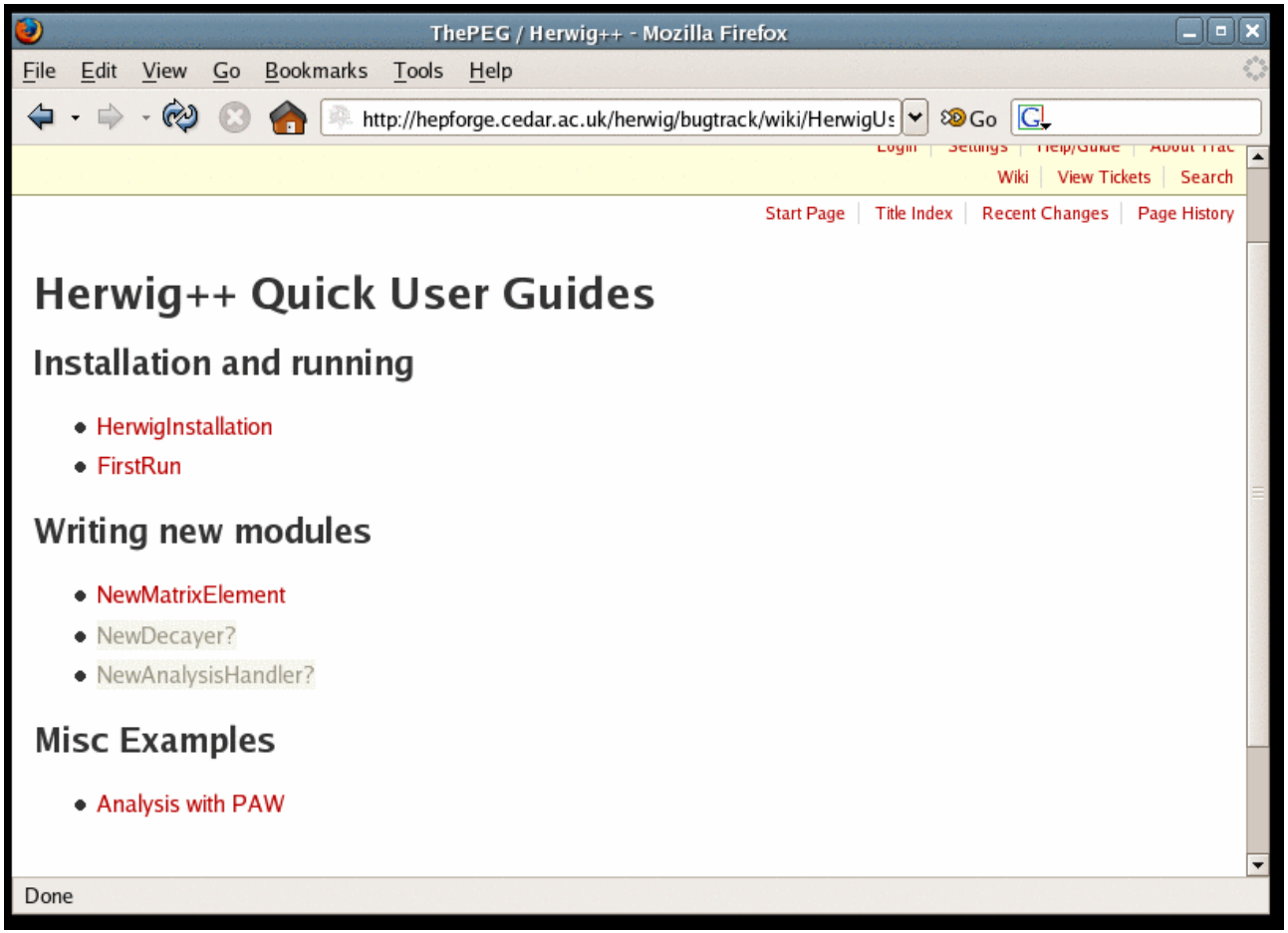
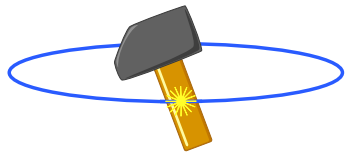
Project wiki





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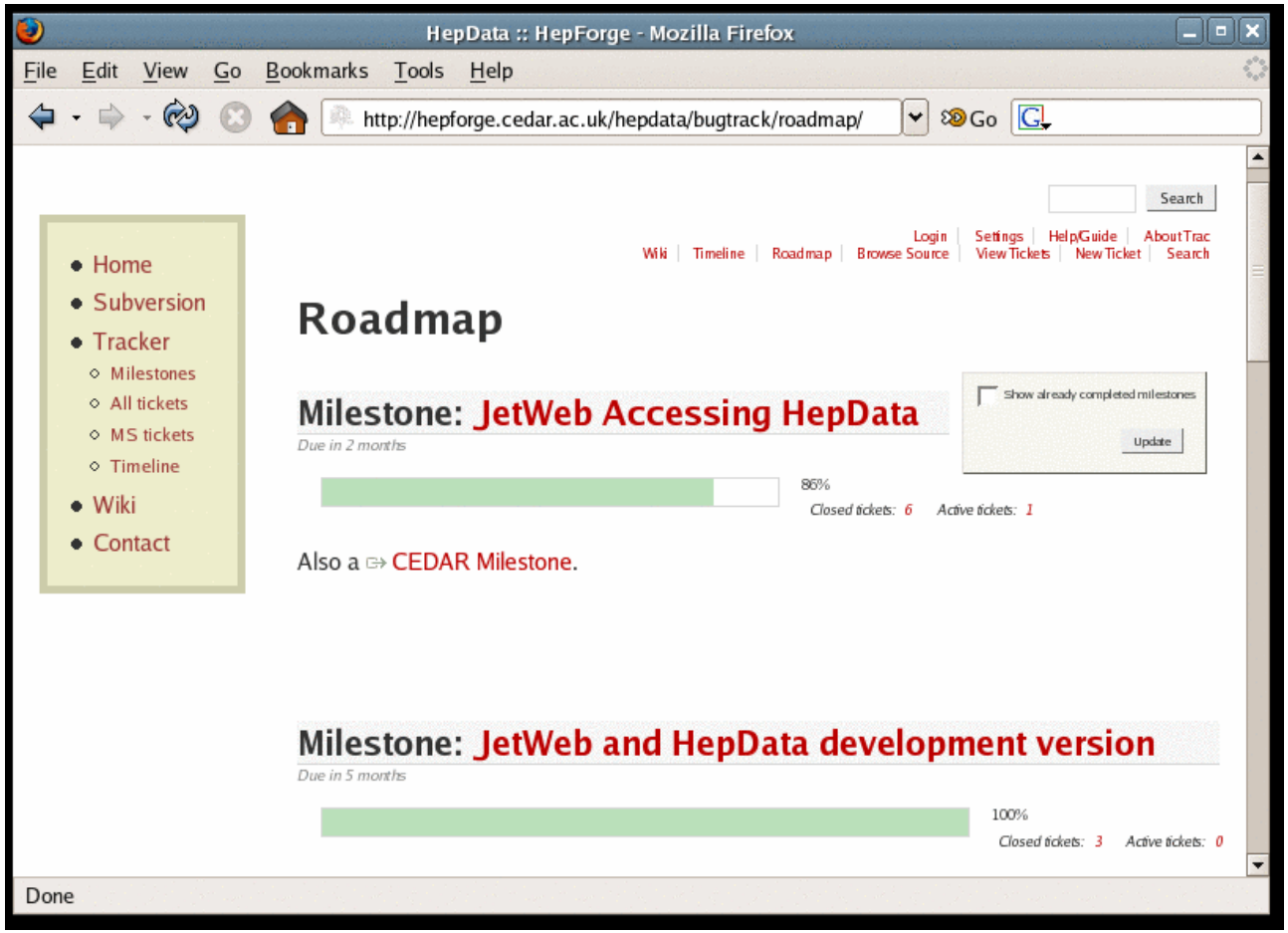
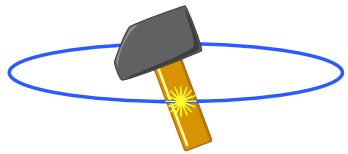
Project bug tracker: milestones





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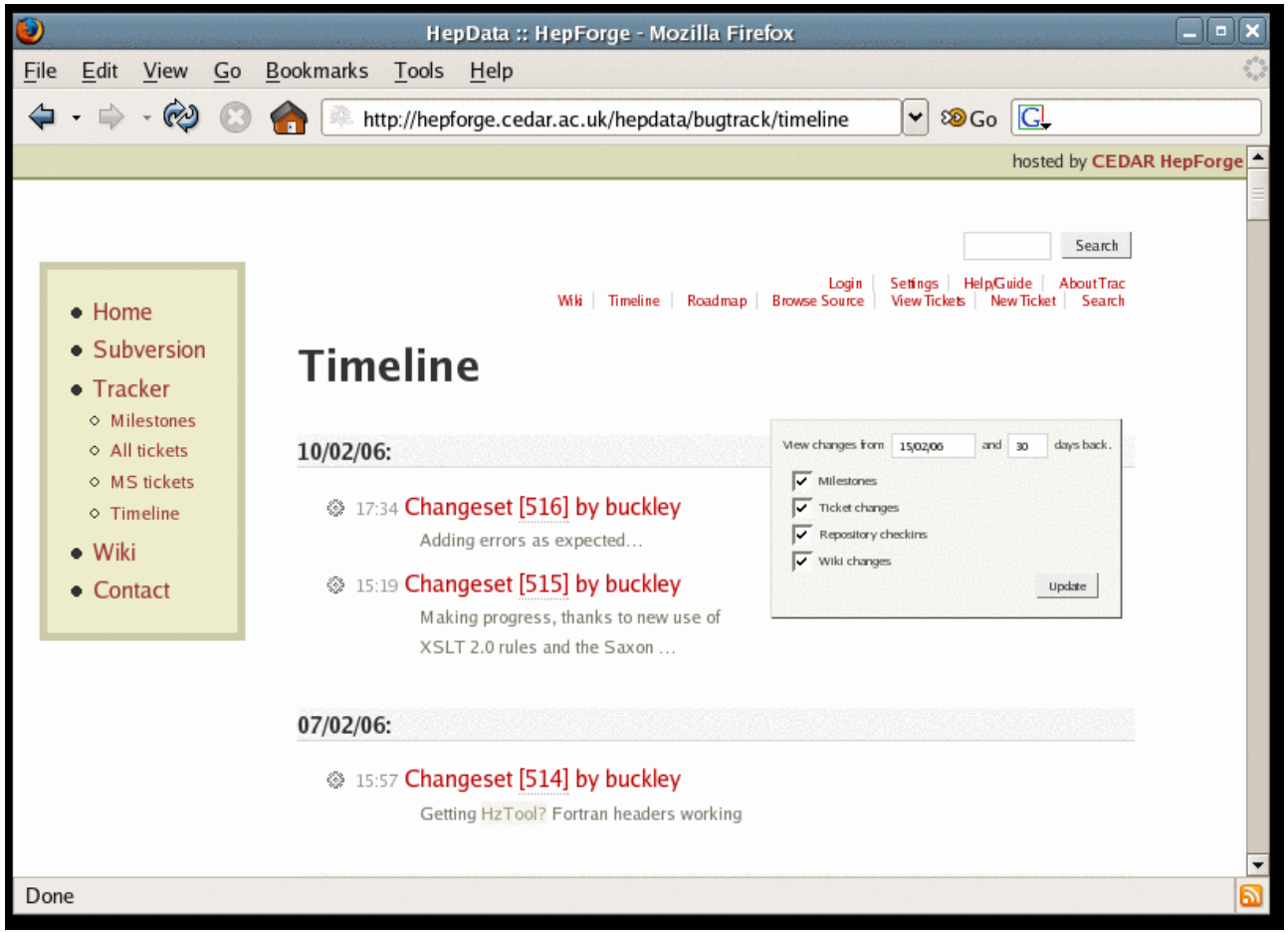
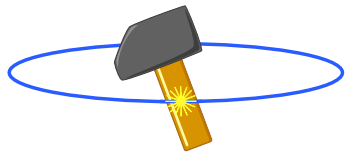
Project timeline (integrated with SVN)





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Project bug listing

HepData :: HepForge - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://hepforge.cedar.ac.uk/hepdata/bugtrack/report/3

Go

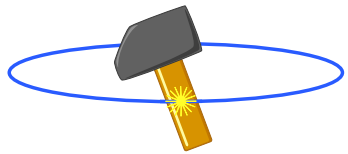
JetWeb Accessing HepData

Ticket	Summary	Component	Version	Type	Owner	Created
#2	Create XSL transformer for data HepML -> HzTool Fortran headers	hepdata	1.0	task	buckley *	01/11/05

Object model and db persistency refactoring

Ticket	Summary	Component	Version	Type	Owner	Created
#42	Refactor the object model / db interaction	model	1.0	task	buckley *	17/01/06
#54	Improve error representation in the object model	model	1.0	task	buckley *	01/02/06
#46	Consider using SQL double for data values	migration	1.0	enhancement	buckley *	21/01/06
#26	Separate HepData model from migration code	hepdata	1.0	defect	buckley *	25/11/05
#53	Use enums for error type	model	1.0	enhancement	buckley *	01/02/06
#56	Separate stat/sys and	model	1.0	enhancement	buckley *	02/02/06

Done



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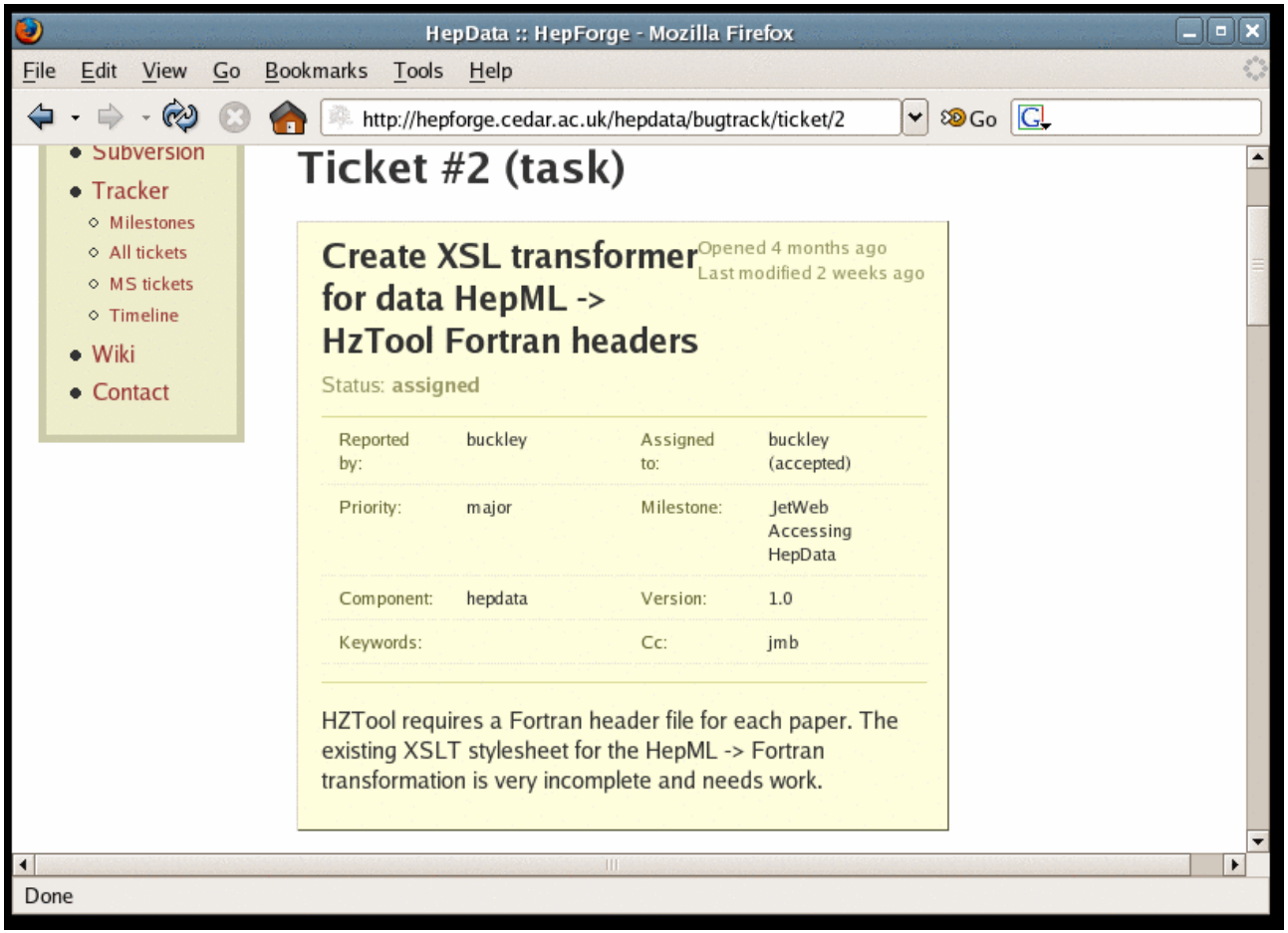
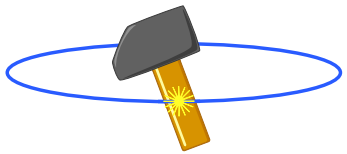
Project bug details (1)





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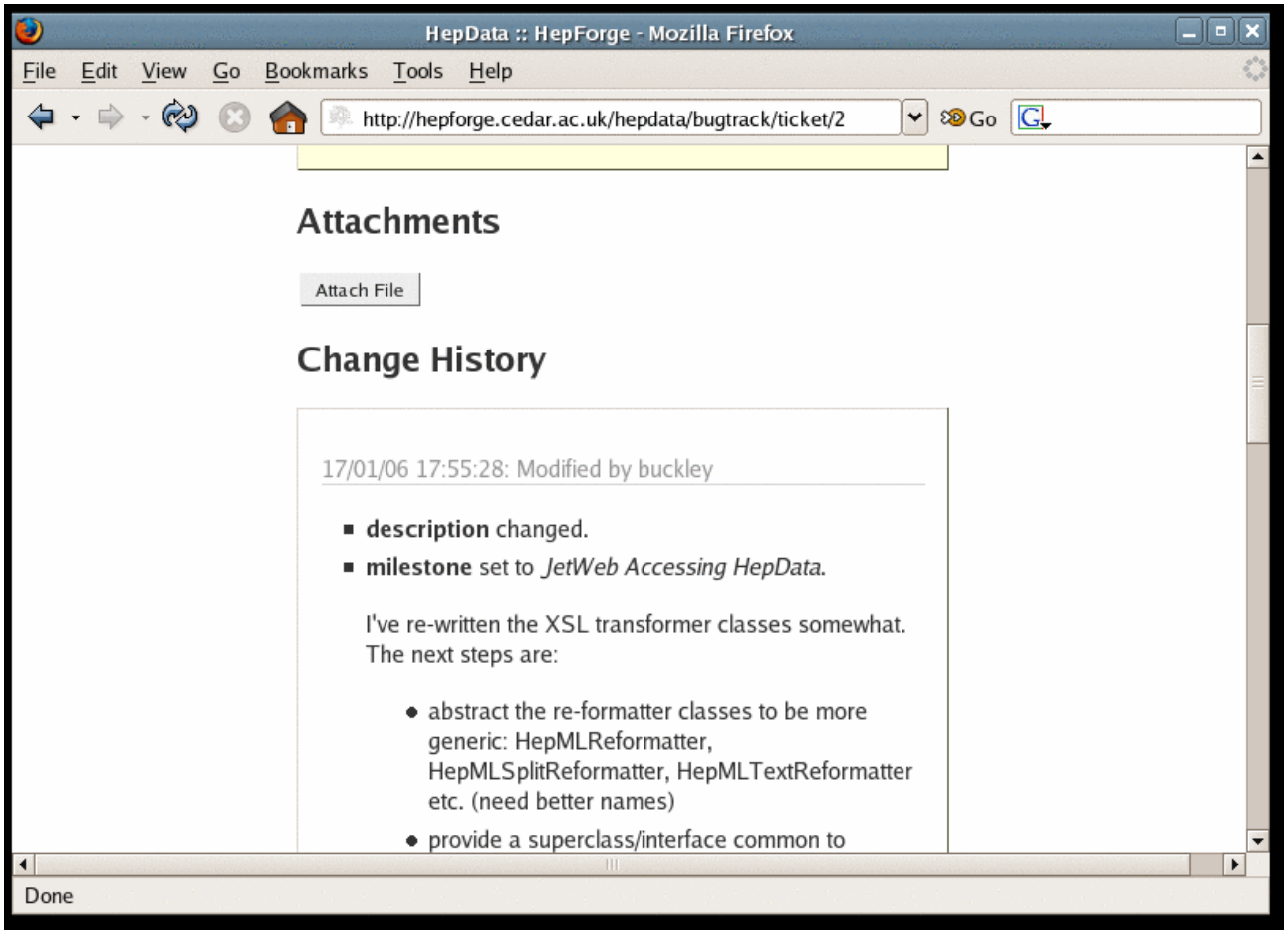
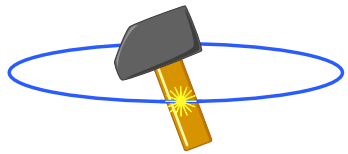
Project bug details (2)





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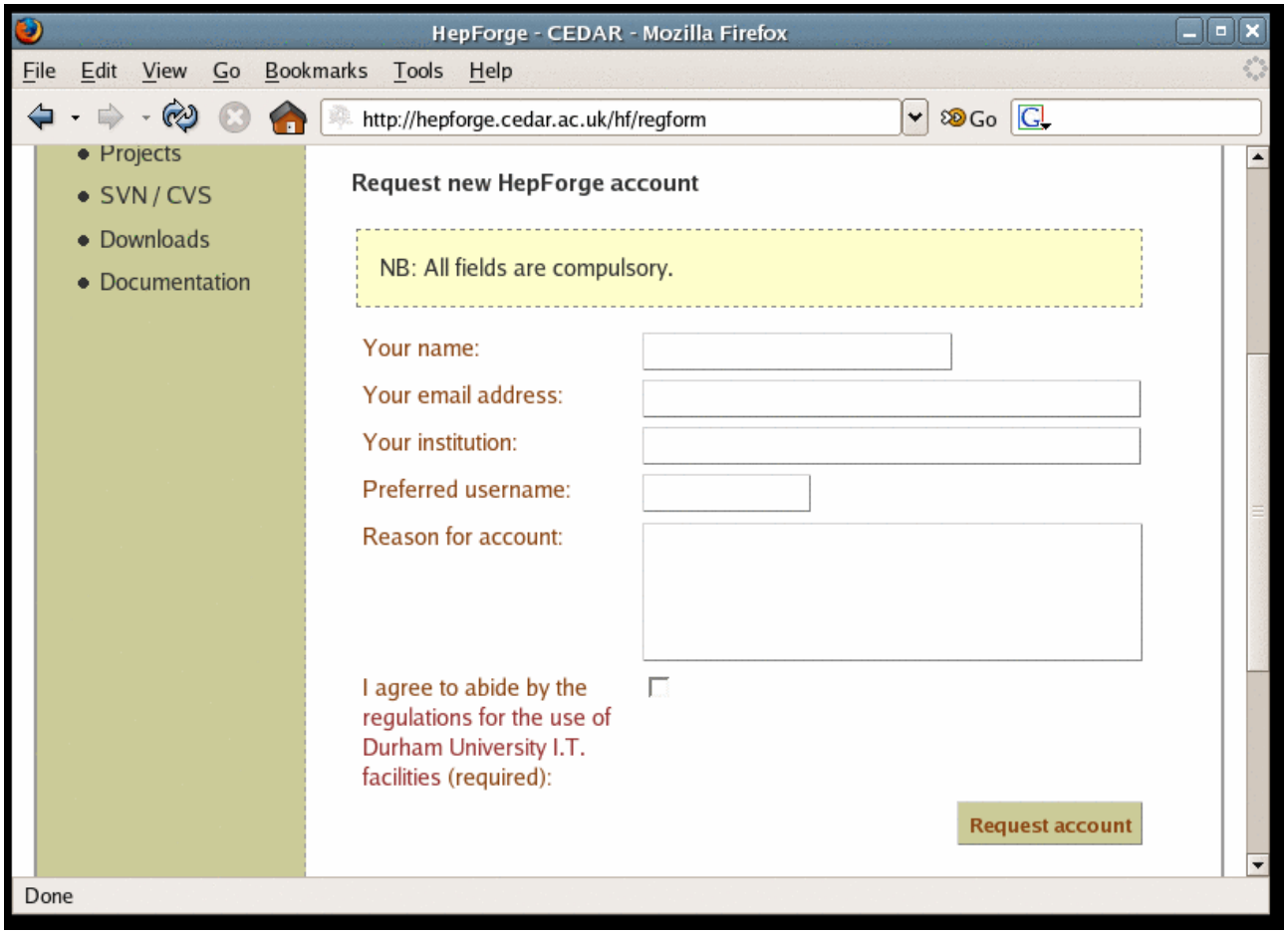
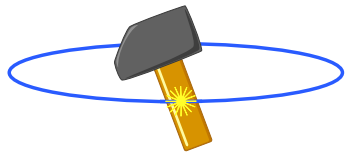
The HepForge registration form! Think about it. . .





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Registration

Please think about using HepForge!

- Current users include: Herwig++, ThePEG, Pythia, LHAPDF, RunMC, FastNLO, Jimmy, KtJet...
- Plus all the CEDAR sub-projects, of course!
- Requirements:
  - has to be for a re-useable HEP project
  - not for processor-intensive use
  - commitment to document and support your project
  - encouraged to use standard build proceduresetc. We can and will help with this!

Visit **`http://hepforge.cedar.ac.uk`** to register

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Summary

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Summary

- CEDAR is primarily a generator tuning system, combining JetWeb and HepData
- Aim is that any expt MC configuration should be "CEDAR-blessed" to be considered trustworthy
- Timescale: must be ready for LHC data

- HepForge is available for HEP software development now!
- Eventually will be used to implement the HepCode system
- Feedback has all been very positive: system is powerful but very easy to use
- Consider HepForge for *your* re-useable HEP code!

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HepForge backend (1)

For the interested...

- Python-based with shell scripts for acc. management
- Various Subversion things, e.g.
  - re-write of CVS: almost complete UI compatability
  - support for symlinks, metadata, dirs, **`mv`**/**`cp`**!
  - anon read access over HTTP; rw dev access over SSH
  - use it! Migration from CVS is easy.
- ViewVC with multi-site hack (also via SSI)

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HepForge backend (2)

For the interested...

- Trac bug tracker and wiki:
  - SQLite backend and SVN integration
  - Moin-compatible wiki
  - excellent tool!
- Web system with post-processing scripts
  - HTML Tidy
  - transparent header and footer handling
- Download manager (personalisable via SSI)

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