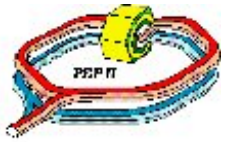


SLAC
NATIONAL ACCELERATOR LABORATORY

Outlook on outreach

3rd Workshop on Data Preservation and Long Term Analysis in HEP

M. Bellis

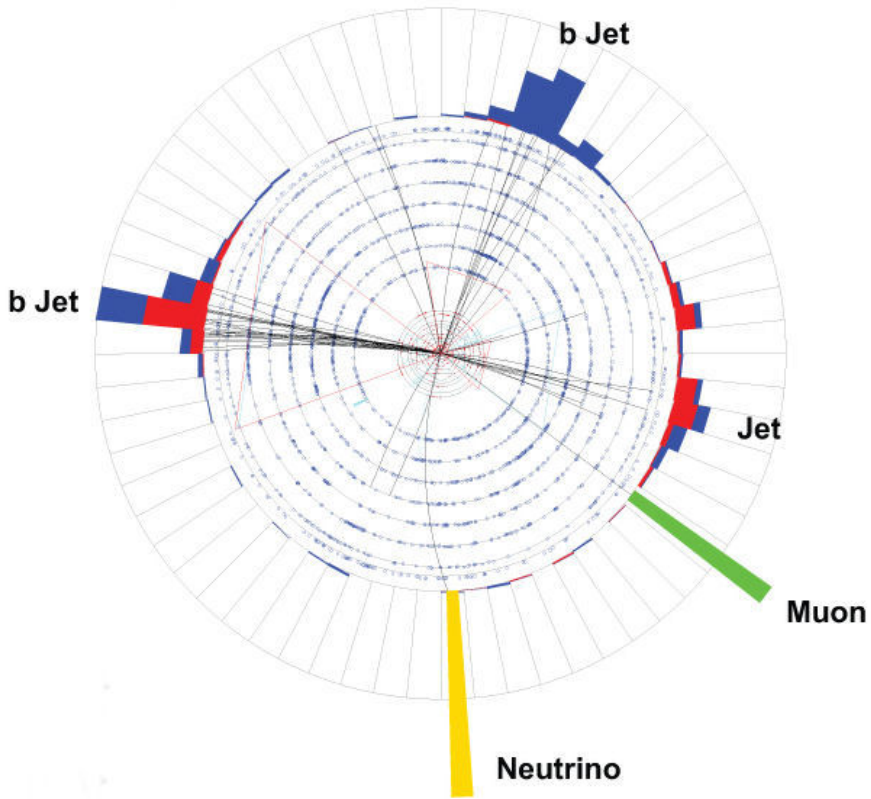
Department of Physics
Stanford University

Dec 8^{th}, 2009

Outline

Motivation

- Particle physics complexity is increasing.
- Difficult to explain to the public.
- Students have gaps in their experience.
- Can HEP data be used to attack these issues?



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- All present different challenges.
- First step, focus on one group.
- Effort in this will naturally filter to other groups.

Physics education

- *CPEP*
- Contemporary Physics Education Project.
- Demos and information.
- Classroom materials.

http://www.cpepweb.org/

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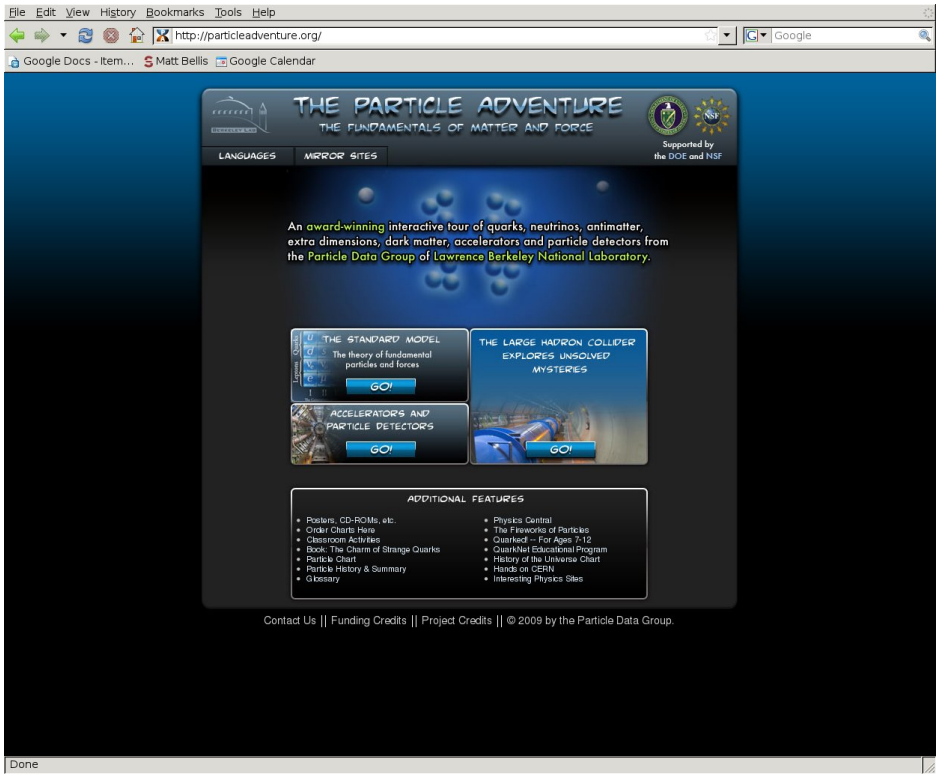

Physics education

- *CPEP*
- Contemporary Physics Education Project.
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- Particle adventure.
- What we're proposing is *complementary* to these projects.

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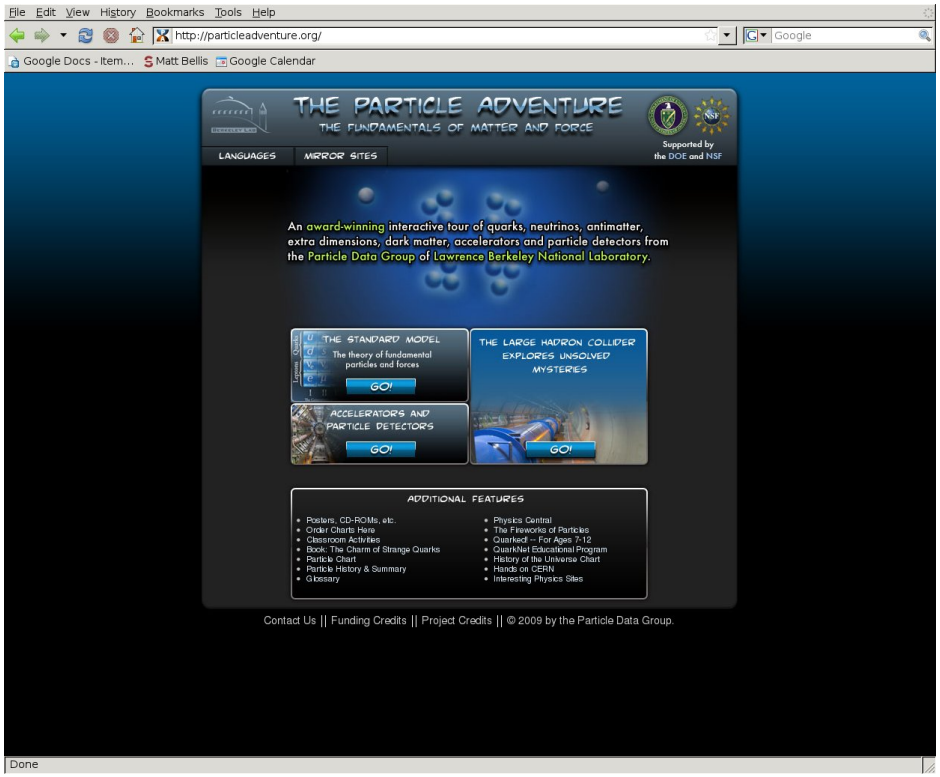

BaBar (HEP?) outreach wiki

https://bbr-lnx-neal.slac.stanford.edu/bbr_outreach_wiki/index.php/Main_Page

- Wiki (Mediawiki)
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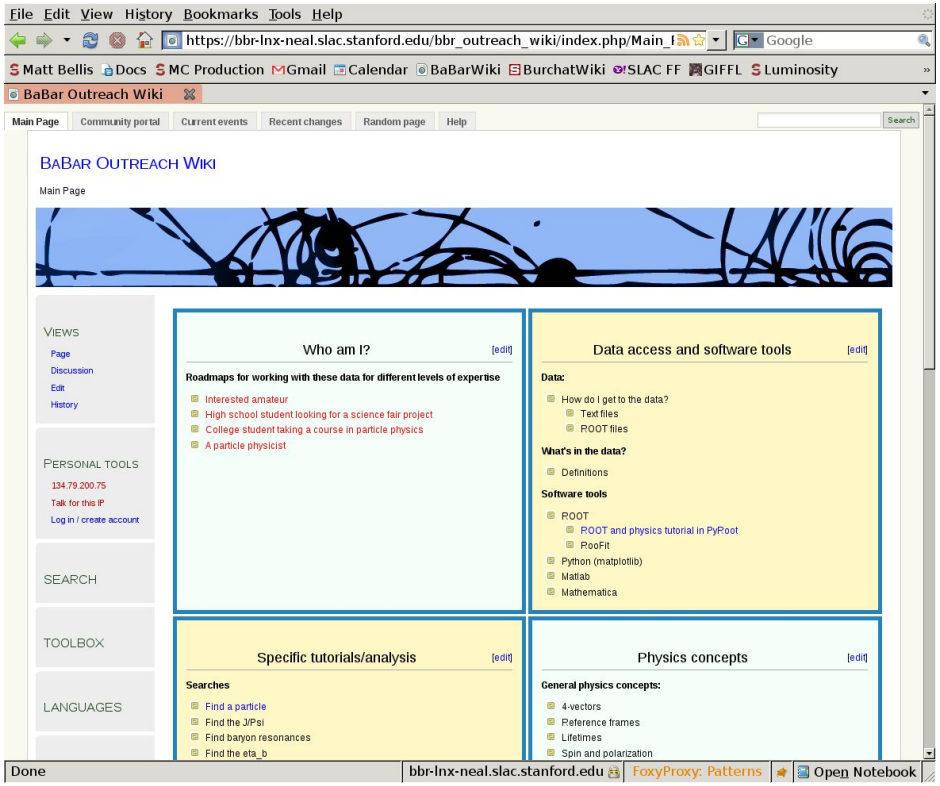

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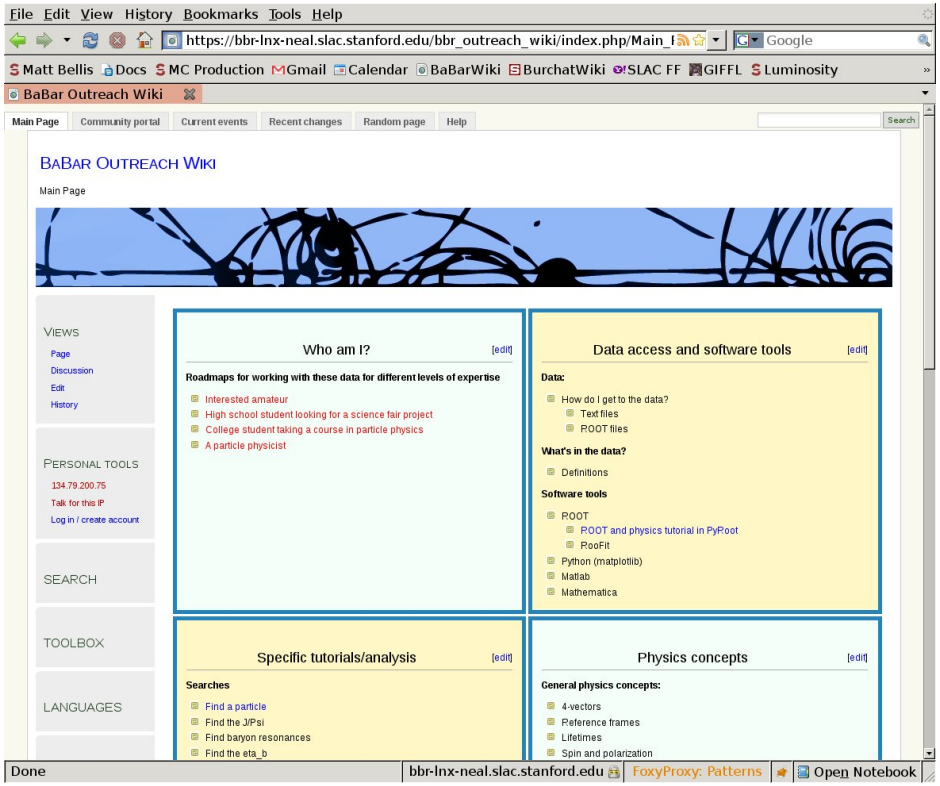

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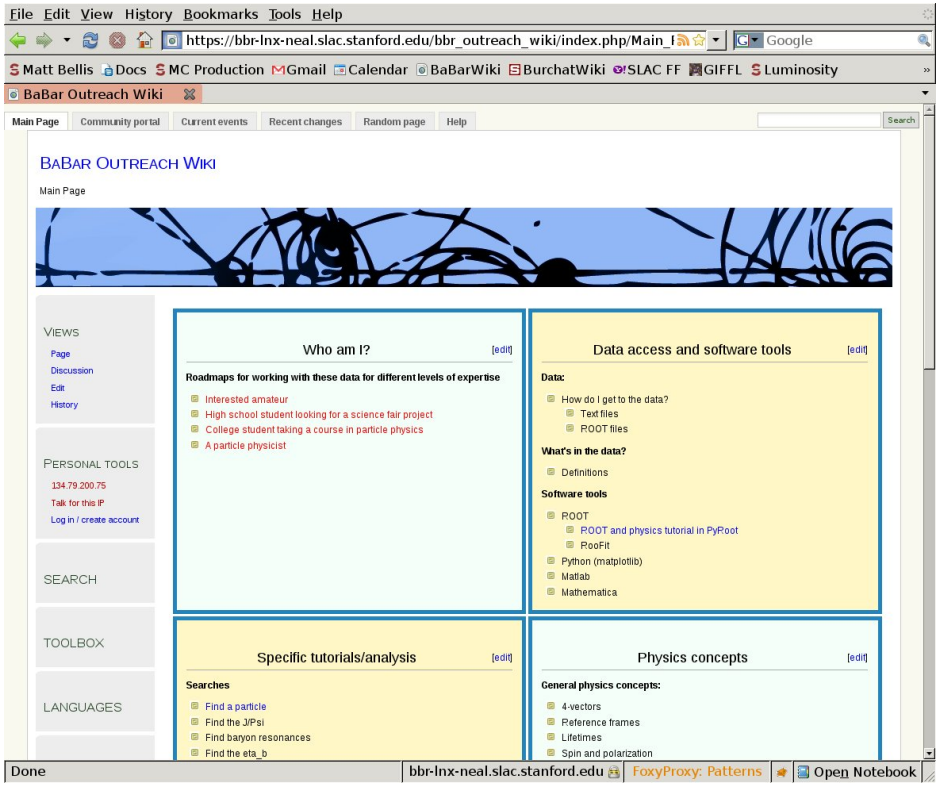

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- Data (samples), tutorials, lectures.
- Try this out in Stanford undergraduate particle physics course.
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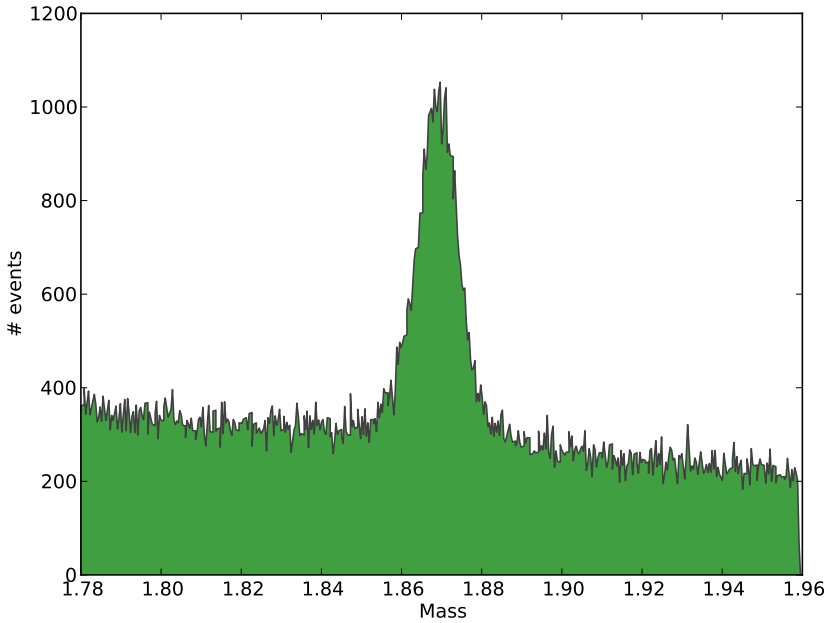
  - Text files
  - Python (matplotlib)
  - http://matplotlib.sourceforge.net/
  - Make mass plots, cut and count, etc.



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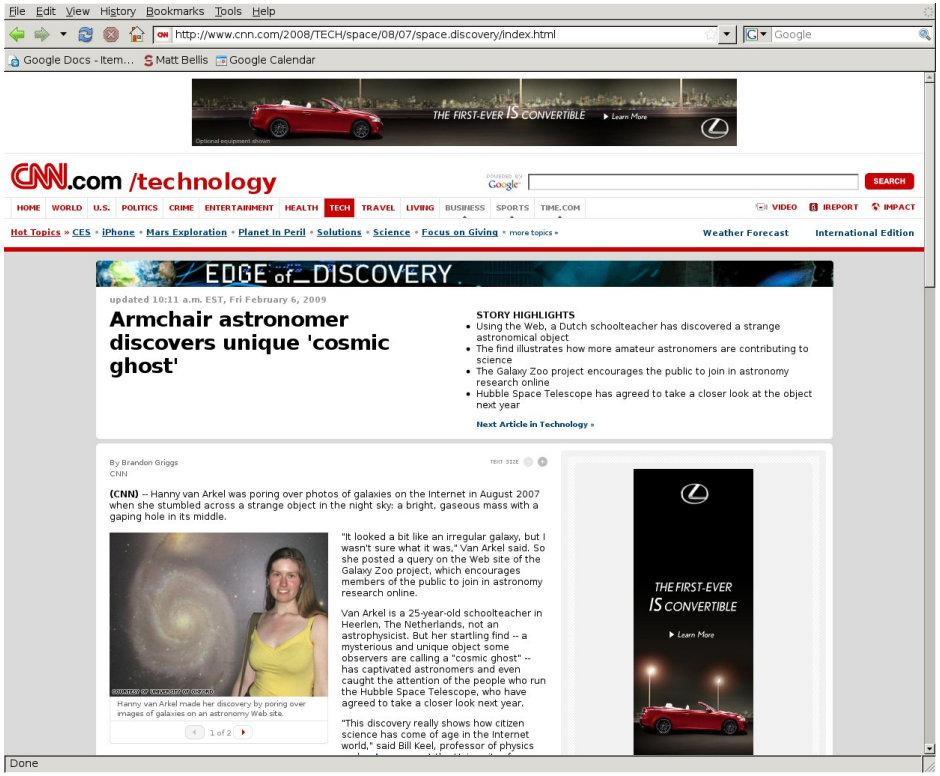

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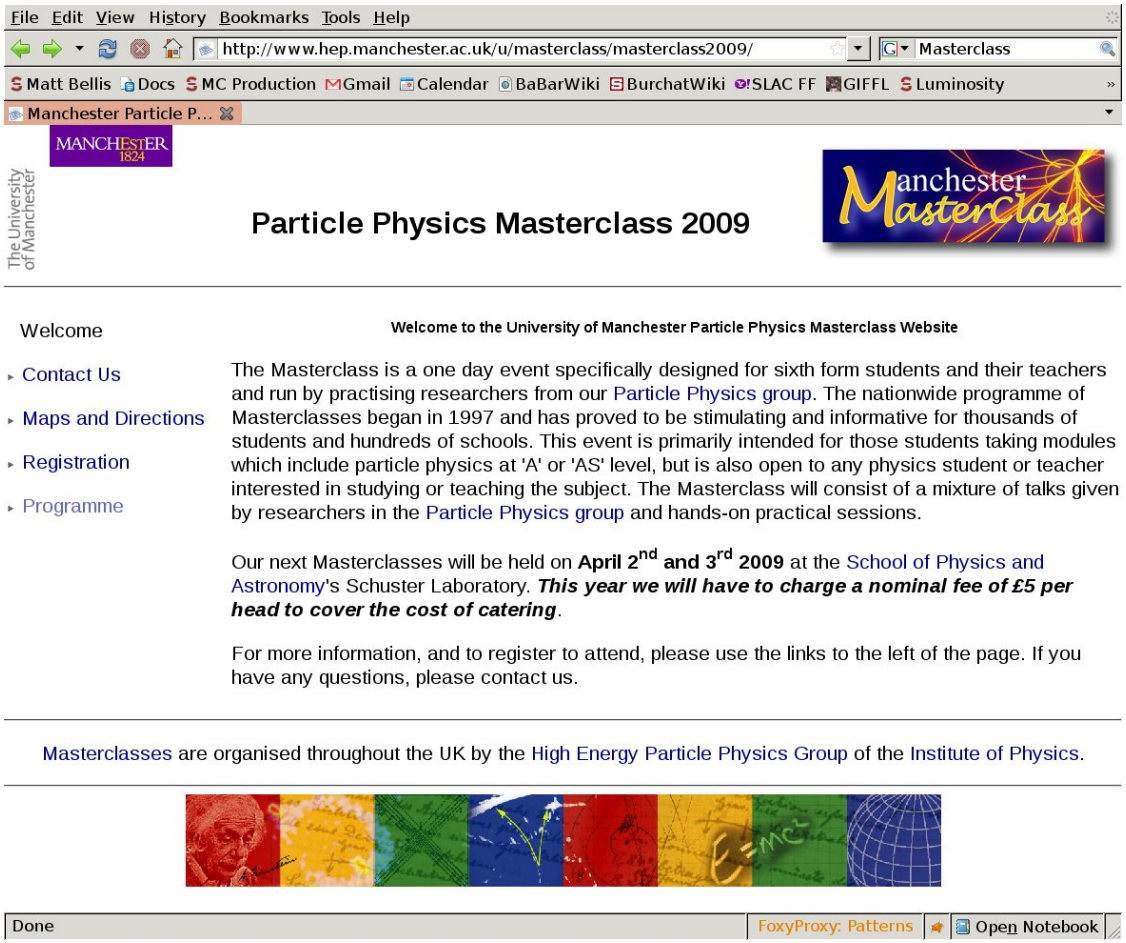
  - Justin Albert (Victoria, BaBar)
  - Homer Neal (SLAC, BaBar)
- Justin set up a CERN group.
  - `pub-interface-HEP-data`
- Galaxy Zoo (Event Zoo) approach may not be the right one for HEP...but that's only *my* opinion.

Other groups

- Masterclass (Manchester)

http://www.hep.manchester.ac.uk/u/masterclass/masterclass2009/



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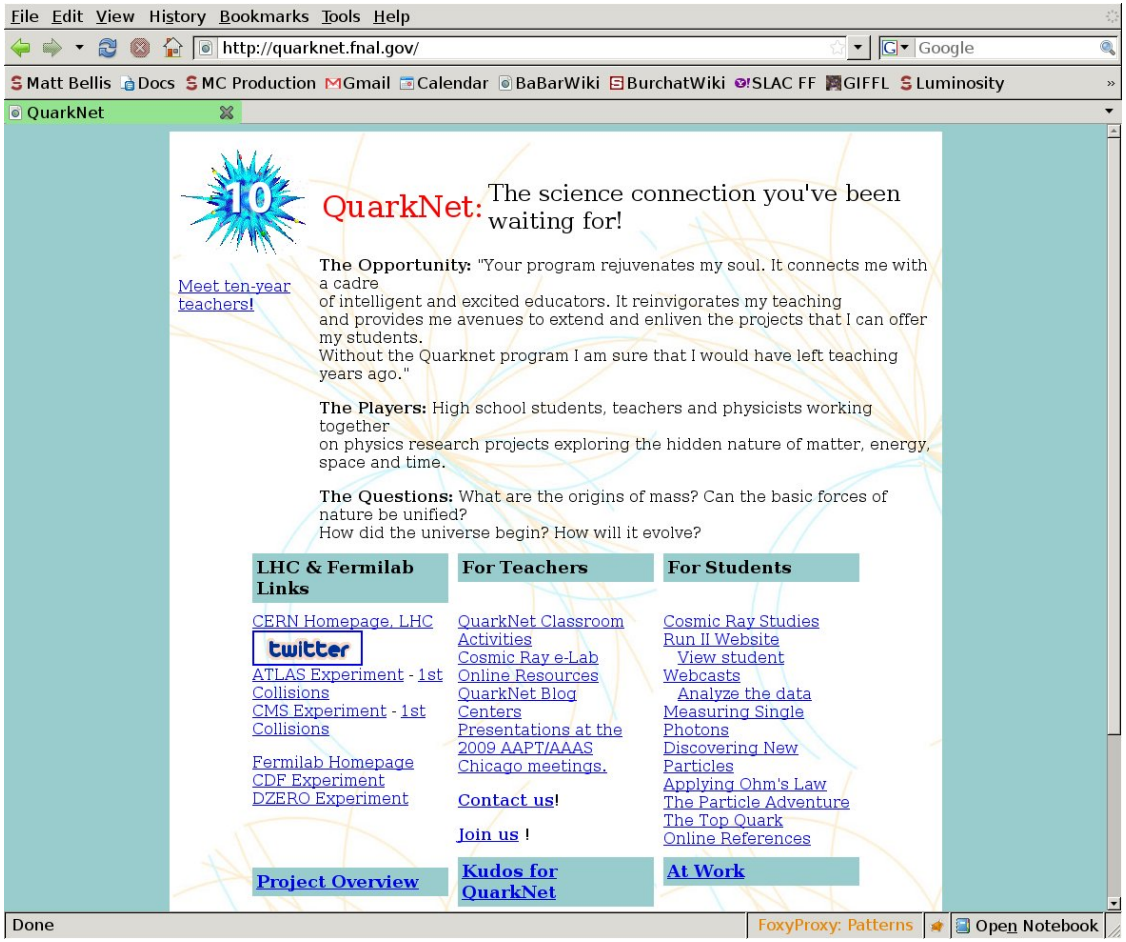
http://quarknet.fnal.gov/



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- I2U2 (NSF/DOE, LIGO, CMS)
- All seem to be targeting grades 6-12.

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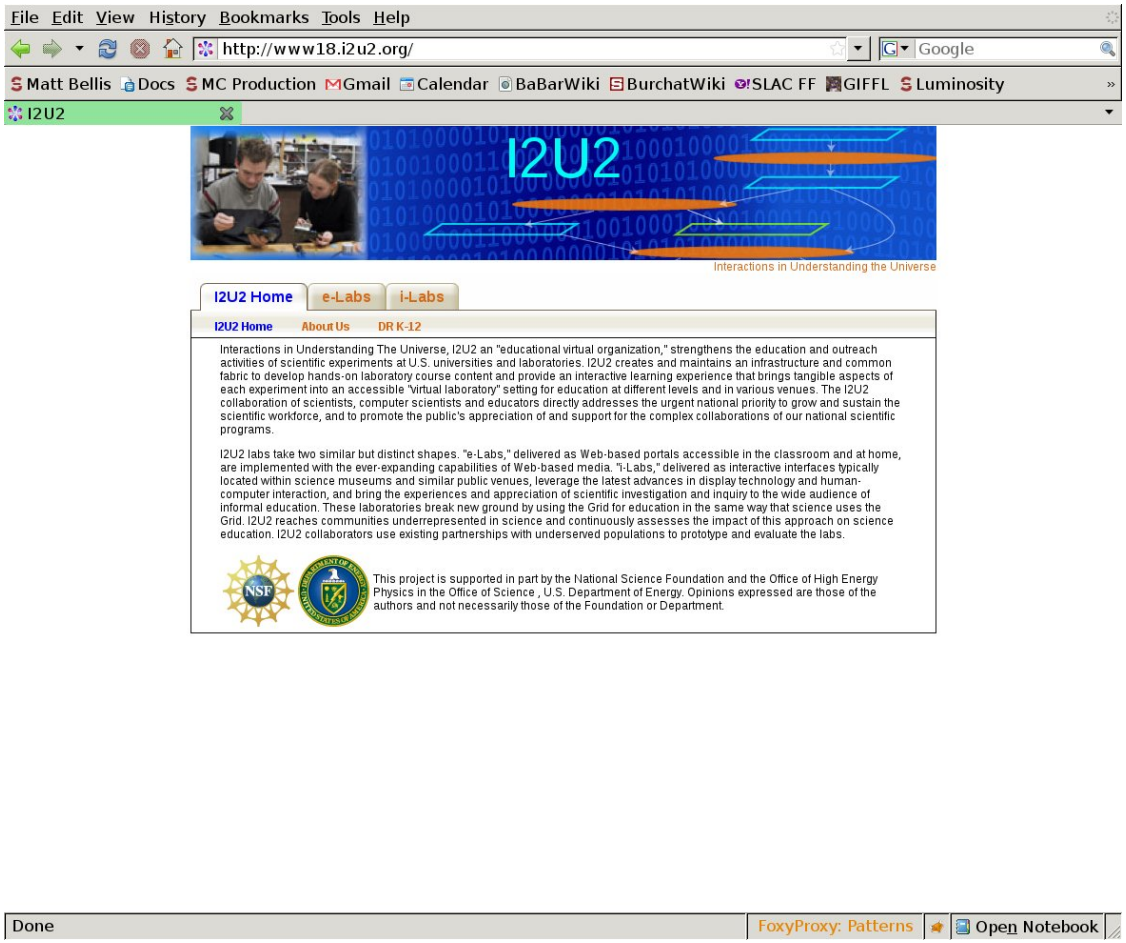
http://www18.i2u2.org/



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  - Viewpoints. (NASA)

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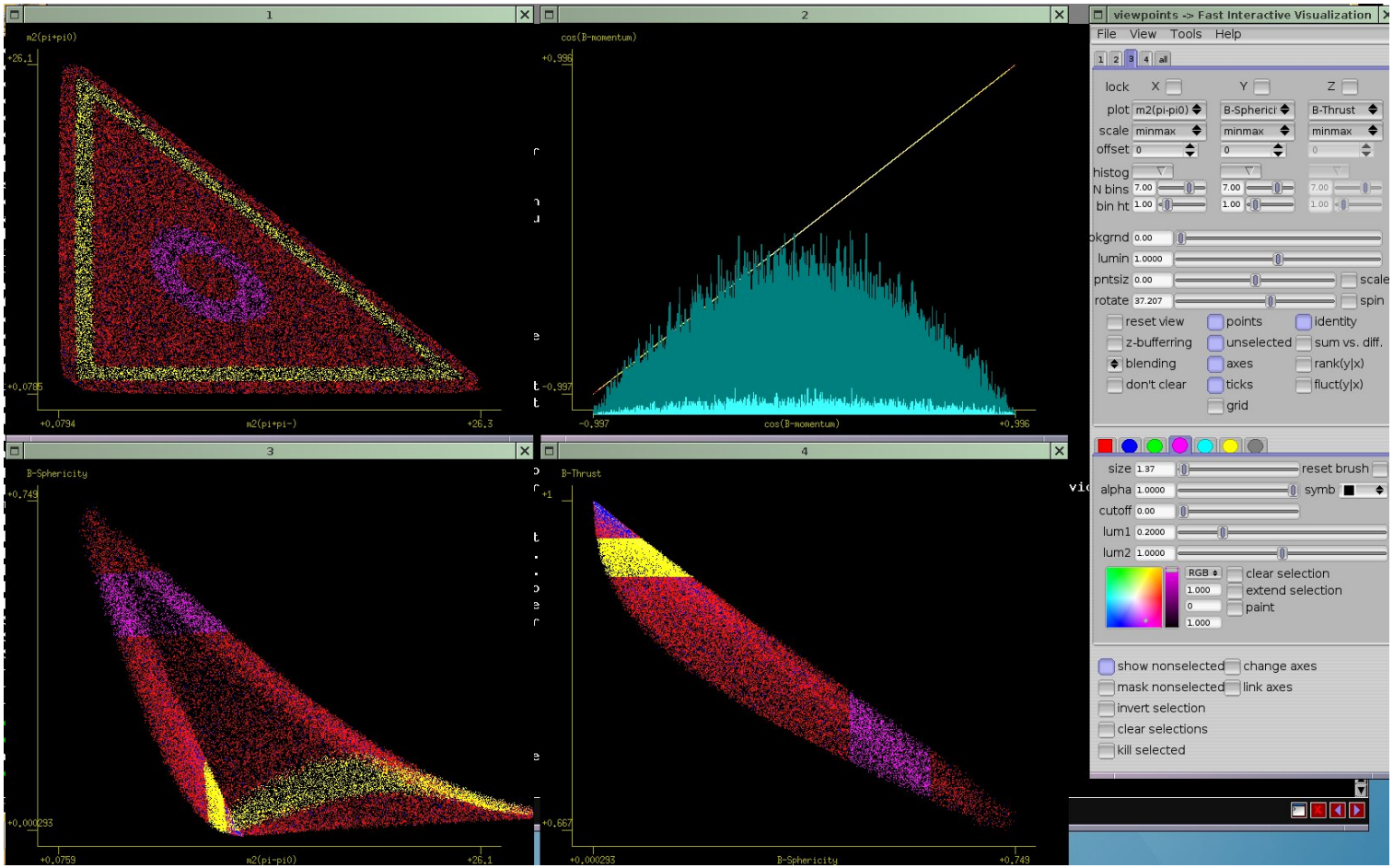
http://astrophysics.arc.nasa.gov/~pgazis/viewpoints.htm
http://www.slac.stanford.edu/~bellis/viewpoints_demo.html



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- File formats.
  - Data for students.
  - Experimenting with LASS data (30+ years old!)
  - Revived by David Aston (SLAC/LASS)
    - http://www.slac.stanford.edu/~bellis/data_formats.html

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  - FITS (Flexible Image Transport System)
    - Used in astro community.
    - Header with information about the image.
    - Many implementations: Fortan, C/C++, Perl, Python, Java, etc.
    - Can even read with gimp or Photoshop.
  - I want a file format that carries its own documentation around with it.

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  - Fixed target SLAC experiment.
  - 11 GeV K^+/K^- beams on hydrogen target.
  - 1977-1978, 1981-1982
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  - David Aston (SLAC) revived the data.
    - " The original format (in fact, still is the format, since the files are just straight bit-copies of the originals) is IBM VBS – "Variable Blocks Spanned" – format, processed with VM/CMS; big-endian with IBM's mainframe floating point format (not IEEE)."

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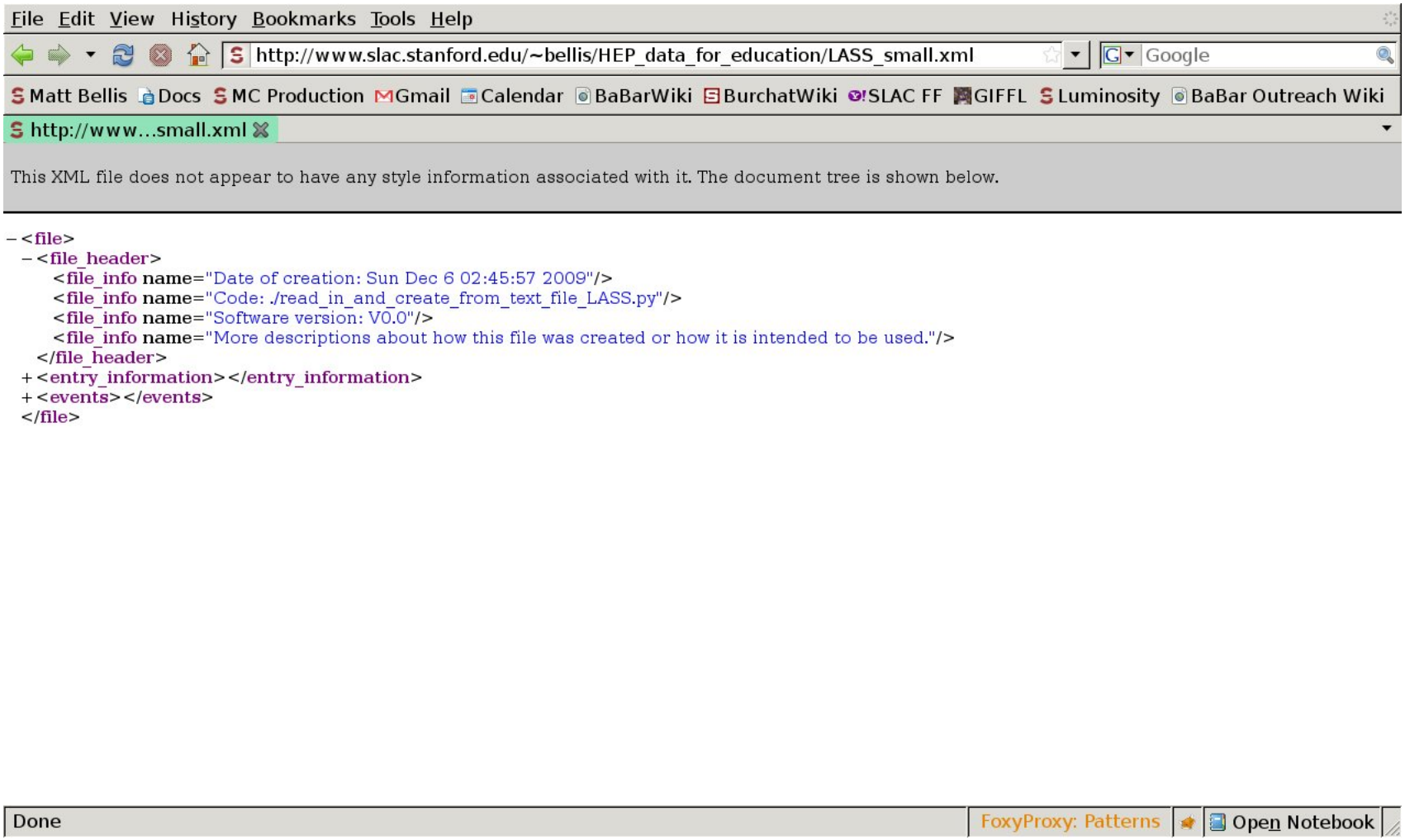
  - David gave me text files...

LASS text files

```
 new EVENT: run event hw & sw triggers    9550      3    18  8E18
 Topology :  1
 Vertices  tracks:  1 5
  Primary vtx: x y z d^2   -0.763999999 -0.40200001  81.5400009  0.0351999998
 Beam charge px py pz :  1 -0.00964925718  0.00366006303  10.9029951
 tracks/charge px py pz :
3  0.00761500327  0.309128046  8.70612812
5  0.133273423 -0.16253081  0.656466305
2  0.0946368724 -0.149057582  0.53865546
-1 -0.0939974785  0.214401409  0.689579844
 Topology :  2
 Vertices  tracks:  2 4
  Primary vtx: x y z d^2   -0.786000013 -0.375999987  80.5699997  0.0177999996
 Beam charge px py pz :  1 -0.00964925718  0.00366006303  10.9029951
 tracks/charge px py pz :
3  0.00738755707  0.309133559  8.70612812
2  0.0962994769 -0.147988901  0.53865546
0  0.037703827  0.0509431213  1.34604621
  Secondary vtx: x y z d^2   -0.858938336 -0.303011149  81.9899979
 0.00257943221
 daughters/charge px py pz :
5  0.13265042 -0.163039669  0.656466305
-1 -0.094946593  0.213982791  0.689579844
  new EVENT: run event hw & sw triggers    9550     91    18  CE1C
 Topology :  1
 Vertices  tracks:  1 5
```

Convert to XML...

LASS XML files



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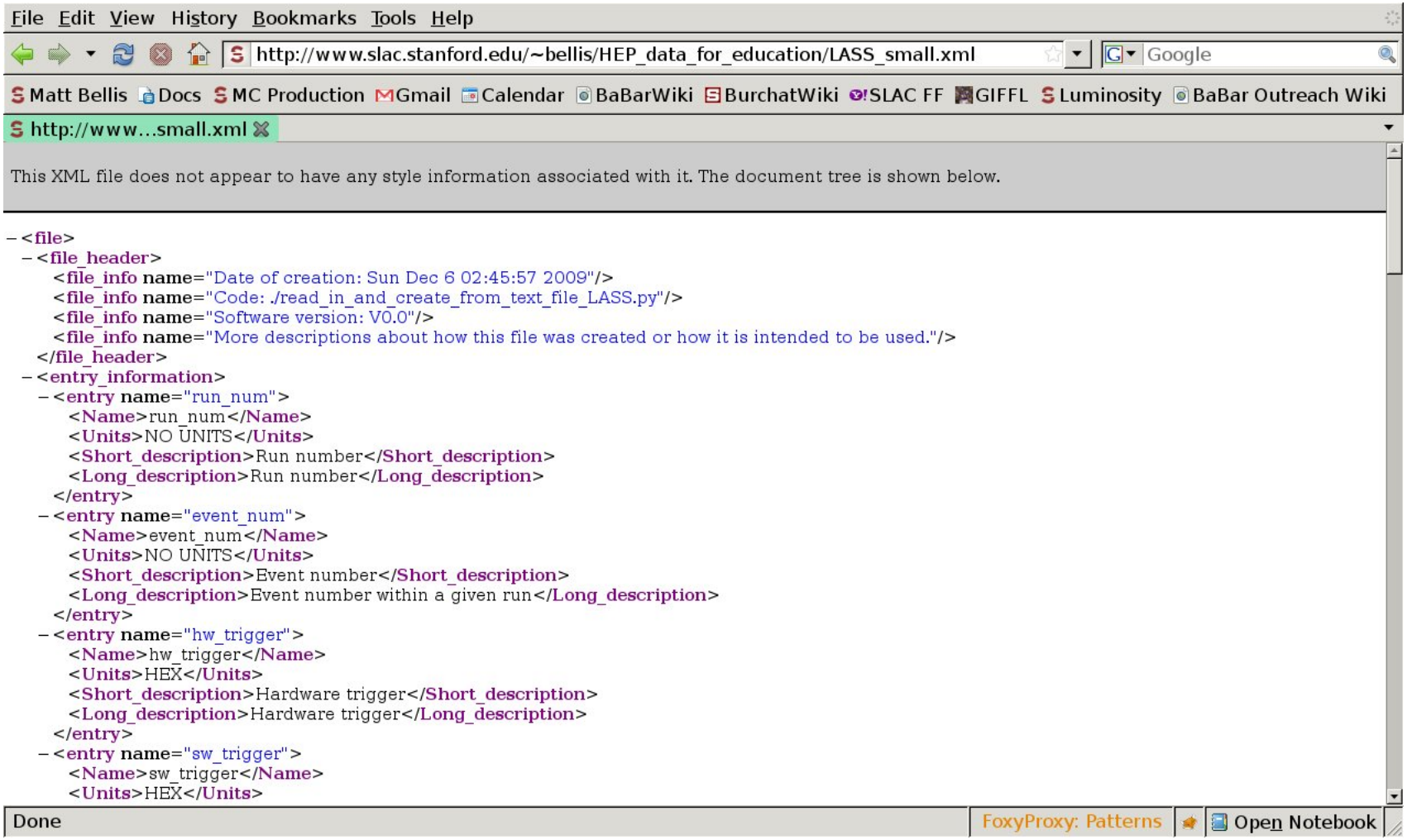

LASS XML files

File Edit View History Bookmarks Tools Help

http://www.slac.stanford.edu/~bellis/HEP_data_for_education/LASS_small.xml

Google

Matt Bellis Docs MC Production Gmail Calendar BaBarWiki BurchatWiki SLAC FF GIFFL Luminosity BaBar Outreach Wiki

http://www...small.xml

```
  </file_header>
 + <entry_information></entry_information>
 - <events>
   - <event>
       <header run_num="9550" event_num="3" hw_trigger="24" sw_trigger="36376"/>
     - <beams>
         <beam beam_tv_map="1100" beam_charge="1" beam_X="-0.00964926" beam_Y="0.00366006" beam_Z="10.90299510"/>
         <beam beam_tv_map="2100" beam_charge="1" beam_X="-0.00964926" beam_Y="0.00366006" beam_Z="10.90299510"/>
       </beams>
     - <vertices>
         <vertex vertex_tv_map="1000" vertex_chi2="0.03520000" vertex_X="-0.76400000" vertex_Y="-0.40200001" vertex_Z="81.54000090"/>
         <vertex vertex_tv_map="2000" vertex_chi2="0.01780000" vertex_X="-0.78600001" vertex_Y="-0.37599999" vertex_Z="80.56999970"/>
         <vertex vertex_tv_map="2100" vertex_chi2="0.00257943" vertex_X="-0.85893834" vertex_Y="-0.30301115" vertex_Z="81.98999790"/>
       </vertices>
     - <vertex_map_info>
         <v_map topology="1" vertex_type="0" num_tracks_with_vertex="4"/>
         <v_map topology="2" vertex_type="0" num_tracks_with_vertex="3"/>
         <v_map topology="2" vertex_type="1" num_tracks_with_vertex="2"/>
       </vertex_map_info>
     - <tracks>
         <track track_info="1000" track_id="3" track_X="0.00761500" track_Y="0.30912805" track_Z="8.70612812"/>
         <track track_info="1000" track_id="5" track_X="0.13327342" track_Y="-0.16253081" track_Z="0.65646631"/>
         <track track_info="1000" track_id="2" track_X="0.09463687" track_Y="-0.14905758" track_Z="0.53865546"/>
         <track track_info="1000" track_id="-1" track_X="-0.09399748" track_Y="0.21440141" track_Z="0.68957984"/>
         <track track_info="2000" track_id="3" track_X="0.00738756" track_Y="0.30913356" track_Z="8.70612812"/>
         <track track_info="2000" track_id="2" track_X="0.09629948" track_Y="-0.14798890" track_Z="0.53865546"/>
         <track track_info="2000" track_id="0" track_X="0.03770383" track_Y="0.05094312" track_Z="1.34604621"/>
         <track track_info="2100" track_id="5" track_X="0.13265042" track_Y="-0.16303967" track_Z="0.65646631"/>
         <track track_info="2100" track_id="-1" track_X="-0.09494659" track_Y="0.21398279" track_Z="0.68957984"/>
       </tracks>
     </event>
   - <event>
       <header run_num="9550" event_num="91" hw_trigger="24" sw_trigger="52764"/>
```

Done FoxyProxy: Patterns Open Notebook

Data formats

- Can we replicate this in ROOT?
- Suggestion from Rene Brun: `GetUserInfo` in TTree.

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- Define my own standard: `TList`'s of TString's

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- Uses `TList` to hold anything derived from `TObject`.
- Define my own standard: `TList`'s of TString's
  - 0^{th} entry: Information about the file.
  - 1^{st} entry: Defines what information is held for each entries.
  - $2^{nd} - n^{th}$ entry: Information about the `TTree` entries.
- Only store `int`'s, `float`'s and arrays of these in the `TTree`.
- Provide PyRoot script to dump information.

LASS ROOT files

```
> ./dump_header_info.py -h
Usage: dump_header_info.py [options]

Options:
  -h, --help            show this help message and exit
  -a, --all             Dump all the information
  -t TREE_NAME, --tree-name=TREE_NAME
                        Name of the TTree object
  -i INFO, --info=INFO  Append these choices for specific information to dump
                        out. Note that only the # of the information is
                        necessary. e.g: -i 0 -i2
```

LASS ROOT files

```
> ./dump_header_info.py LASS_small.root
Information about how this file was generated
Date of creation: Sun Dec  6 02:45:58 2009
Code: ./read_in_and_create_from_text_file_LASS.py
Software version: V0.0
More descriptions about how this file was created or how it is intended to be used.

Description of entries in header
0: Name
1: Units
2: Short description
3: Long description
```

LASS ROOT files

```
> ./dump_header_info.py LASS_small.root -a
Information about how this file was generated
Date of creation: Sun Dec  6 02:45:58 2009
Code: ./read_in_and_create_from_text_file_LASS.py
Software version: V0.0
More descriptions about how this file was created or how it is intended to be used.

Description of entries in header
Name
Units
Short description
Long description

run_num
                Name: run_num
               Units: NO UNITS
   Short description: Run number
    Long description: Run number

event_num
                Name: event_num
               Units: NO UNITS
   Short description: Event number
    Long description: Event number within a given run

hw_trigger
                Name: hw_trigger
               Units: HEX
   Short description: Hardware trigger
    Long description: Hardware trigger
```

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- Still exploring and would welcome suggestions.

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- Could ROOT's file format be separated like FITS?
- Could this become a standard for the community?
- Could require *any function in the analysis chain to return documentation for storage in the data stream.*
- Could require *unit testing models with all functions*.
- Could allow more flexibility to adapt to new languages, hardware, etc.

Near future

- Summary and near future efforts.
  - Education and outreach Wiki.
  - *Not* accessible to outside world...yet.

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  - Set up something that can be maintained by small, distributed core group.

Summary

Thanks for your time

BACKUP SLIDES

University courses

- History of particle physics.
- Repository?

1) Last week we learned about the prediction of a 4th flavour of quarks and the development of the CKM matrix.

Go to the website www.slac.stanford.edu/BaBar_data and download some sample of bulk events.

Look up the primary hadronic decay modes of the D meson.

Find evidence of the D meson.

University courses

- History of particle physics.
- The BaBar dataset contains much of this history,
- Repository?

2) The $\Upsilon(4S)$ is a vector meson and is produced in a polarized state in e^+e^- colliders.

Predict the angular distribution if this state decays to two spin-0 particles.

Go to the website www.slac.stanford.edu/BaBar_data and download the appropriate skimmed sample for this problem.

Reconstruct B mesons in the $J/\psi K$ final state.

Plot the angular distribution. Does this agree with your prediction?

General public/high school students

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- Put the data in people's hands.
- Let people look for new particles.
- New correlations?
- Encourage people to send back their plots.
  - Forum?
  - Plot of the month?
  - Have physicists to comment on the most interesting ones?

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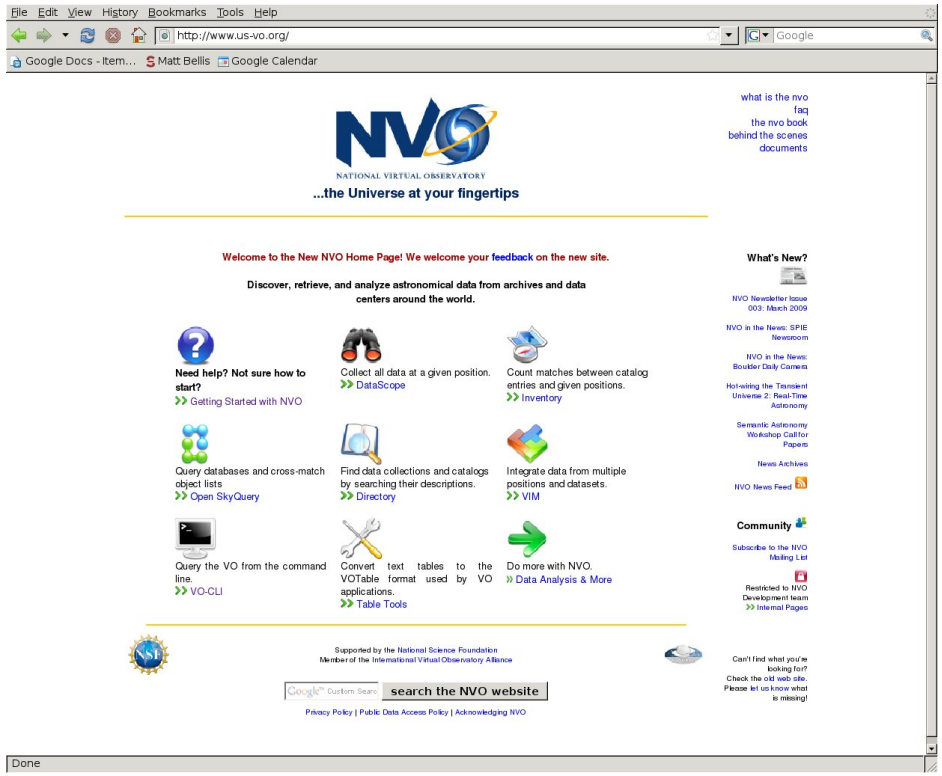
- **Do an analysis start to finish?**
  - Measure branching fractions.
  - Extract spin information.
  - Measure $\sin(2\beta)$
- Needs a well-calibrated dataset (BaBar, others?) and an analysis flow chart,
- **Could you do a publishable analysis in a summer school?**

Physics education

- National Virtual Observatory.
- *Access to real data!*

http:www.us-vo.org



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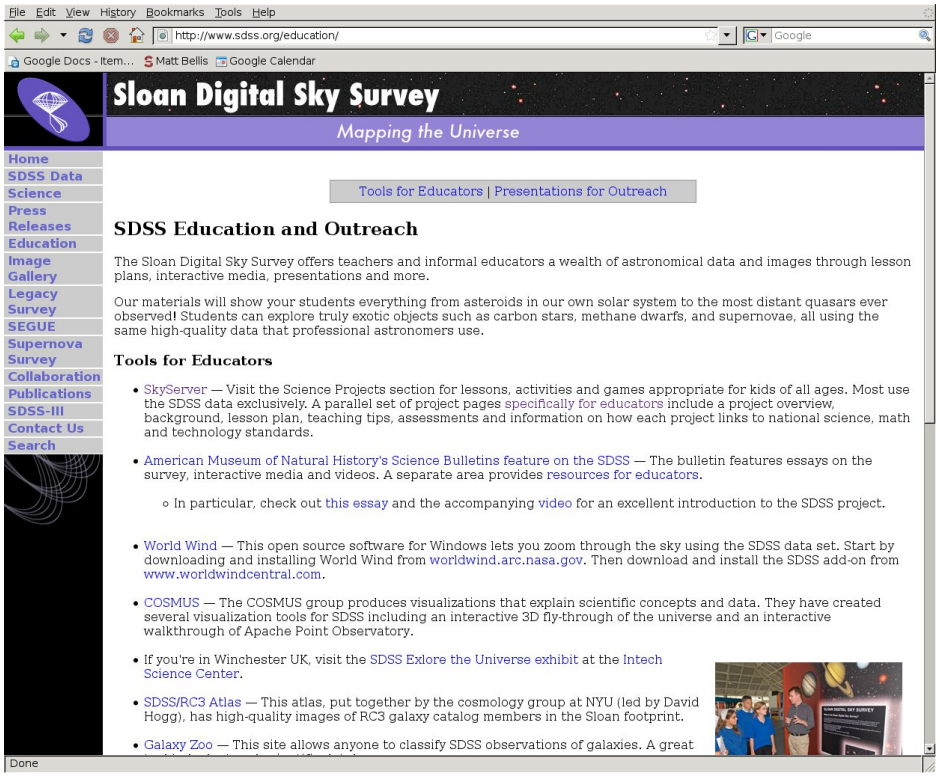

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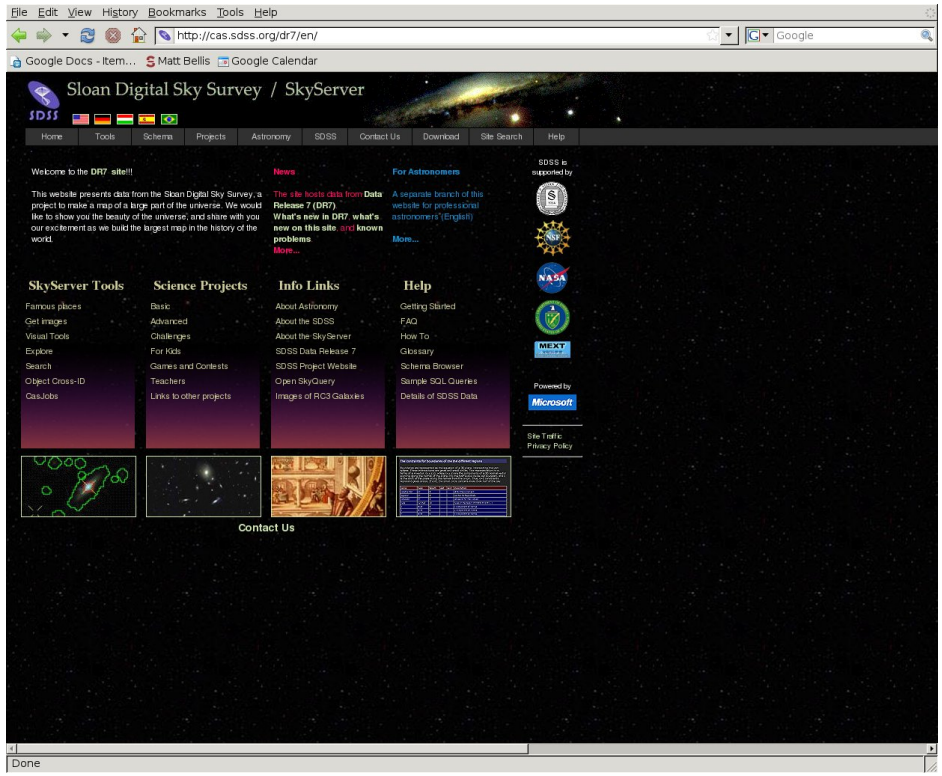

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http://www.lsst.org/lsst/public/outreach