Computing Upgrade and Production

Juerg Beringer, Piotr Zyla
Physics Division
Lawrence Berkeley National Laboratory

Cecilia Aragon, Igor Gaponenko
Computational Research Division
Lawrence Berkeley National Laboratory

Contents

1. **Role of Search Engines**
2. Production of the *Review of Particle Physics* with the existing system
3. Why we need the computing upgrade
4. Requirements for the upgraded system
5. Computing upgrade project plan

Presented by Juerg Beringer (JBeringer@lbl.gov)

Different Goals

- **PDG and Search Engines have very different goals**
- **Search engines (e.g. Google) produce a list of articles on a given topic, such as "pion mass"**
  - 2,700,000 hits in Google (top entry from Wikipedia)
  - 114,000 hits in Google Scholar (top entry is theory paper)
  - 240 papers in SPIRES
- **PDG aims to evaluate the available data in order to give an authoritative answer endorsed by the experts in the field**
  - For example, gives single, citable, world average value for pion mass, together with detailed information how it was obtained

“Pion Mass”

pion mass - Google Search - Mozilla Firefox

Web Images Maps News Shopping Gmail more ▼ Sign in

Google pion mass Search Advanced Search Preferences

Web Results **1** - **10** of about **2,760,000** for **pion mass**. (**0.27** seconds)

Pion — **Mass**: Π: 139.57018(35) MeV/c2 π: 134.9766(6) MeV/c2
According to http://en.wikipedia.org/wiki/**Pion**

Pion - Wikipedia, the free encyclopedia
If their constituent quarks were massless (making chiral symmetry exact), the Goldstone theorem would predict that the **pions** should have zero **mass**. ...
en.wikipedia.org/wiki/**Pion** - 52k - Cached - Similar pages

Pion Mass Measurement
Research programmes at the Space Research Centre, University of Leicester.
www.src.le.ac.uk/projects/**pion_mass**/ - 11k - Cached - Similar pages

[0710.0691] **Pion mass** difference from vacuum polarization
Abstract: We calculate the electromagnetic contribution to the **pion mass** difference, $\Delta m^2_\pi=m^2_{\pi^+}-m^2_{\pi^0}$, in the chiral limit through ...
arxiv.org/abs/0710.0691 - 7k - Cached - Similar pages

On the two-loop contributions to the **pion mass**
We derive a simplified representation for the **pion mass** to two loops in three-flavour chiral perturbation theory. For this purpose, we first determine the ...
www.iop.org/EJ/abstract/1126-6708/2007/09/065 - Similar pages
by R Kaiser - 2007 - Related articles - All 8 versions

Physics Letters B : On the determination of the **pion** effective ...
He) reaction, have been used by several groups to derive the **pion** effective **mass** in nuclear matter. We show that these binding energies are fully consistent ...
linkinghub.elsevier.com/retrieve/pii/S0370269398006558 - Similar pages
by E Friedman - 1998 - Cited by 12 - Related articles - All 5 versions

Pion-mass dependence of three-nucleon observables
The **pion-mass** dependence of input quantities in our "pionless" EFT is obtained from a recent chiral EFT calculation. To the order we work at, ...
cat.inist.fr/?aModele=afficheN&cpsidt=18908618 - Similar pages
by HW HAMMER - 2007 - Related articles - All 7 versions

Citebase - The **pion mass** in finite volume
We determine the relative **pion mass** shift Mπ(L)/Mπ-1 due to the finite spatial extent L of the box by means of two-flavor chiral perturbation theory and the ...
www.citebase.org/abstract?id=oai%3AarXiv.org%3Ahep-lat%2F0311023 - 13k -
Cached - Similar pages

[PDF] Volume dependence of the **pion mass**
File Format: PDF/Adobe Acrobat - View as HTML

PDGLive Particle Summary - Mozilla Firefox

http://pdglive.lbl.gov/popupblockdata.brl?nodein=S008M&inscript=

PDG particle data group Live

HOME: pdgLive | Summary Tables | Reviews, Tables, Plots | Particle Listings

from the 2008 Review of Particle Physics.
Please use this **CITATION**: C. Amsler *et al.* (Particle Data Group), Phys. Lett. **B667**, 1 (2008)

$\pi^\pm$ MASS

The most accurate charged pion mass measurements are based upon x-ray wavelength measurements for transitions in π^--mesonic atoms. The observed line is the blend of three components, corresponding to different K-shell occupancies. JECKELMANN 1994 revisits the occupancy question, with the conclusion that two sets of occupancy ratios, resulting in two different pion masses (Solutions A and B), are equally probable. We choose the higher Solution B since only this solution is consistent with a positive mass-squared for the muon neutrino, given the precise muon momentum measurements now available (DAUM 1991, ASSAMAGAN 1994, and ASSAMAGAN 1996) for the decay of pions at rest. Earlier mass determinations with pi-mesonic atoms may have used incorrect K-shell screening corrections.

Measurements with an error of >0.005 MeV have been omitted from this Listing.

back to $\pi^\pm$

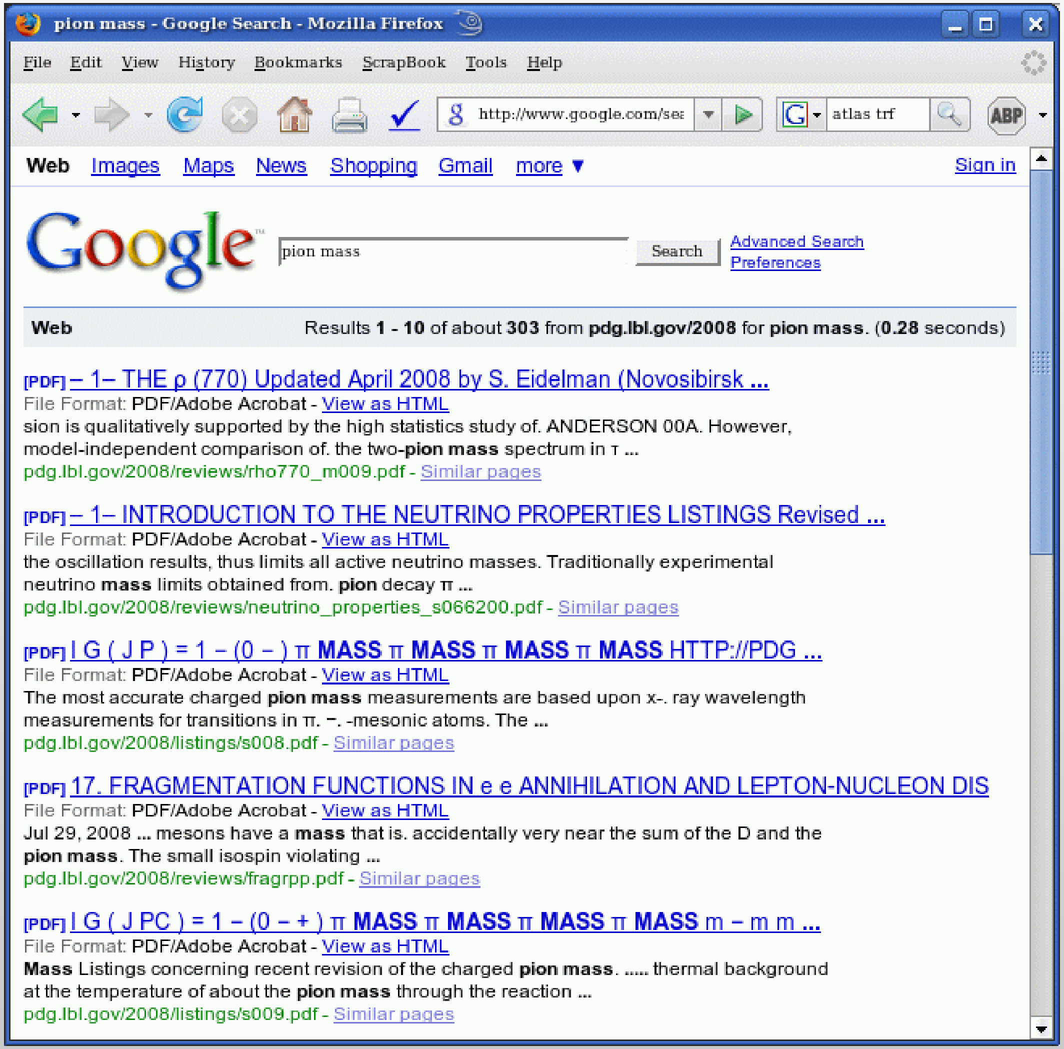
$\pi^\pm$ MASS References History since 1958

VALUE (MeV)		DOCUMENT ID	TECN	CHG	COMMENT
139.57018 ± 0.00035	OUR FIT				Error includes scale factor of 1.2.
139.57018 ± 0.00035	OUR AVERAGE				Error includes scale factor of 1.2.
139.57071 ± 0.00053	1	LENZ 98	CNTR	–	pionic N2-atoms gas target
139.56995 ± 0.00035	2	JECKELMANN 94	CNTR	–	π^- atom, Soln. B
* * * We do not use the following data for averages, fits, limits, *etc.* * * *					
139.57022 ± 0.00014	3	ASSAMAGAN 96	SPEC	+	$\pi^+ \to \mu^+ \nu_\mu$
139.56782 ± 0.00037	4	JECKELMANN 94	CNTR	–	π^- atom, Soln. A
139.56996 ± 0.00067	5	DAUM 91	SPEC	+	$\pi^+ \to \mu^+ \nu$
139.56752 ± 0.00037	6	JECKELMANN 86B	CNTR	–	Mesonic atoms
139.5704 ± 0.0011	5	ABELA 84	SPEC	+	See DAUM 1991
139.5664 ± 0.0009	7	LU 80	CNTR	–	Mesonic atoms
139.5686 ± 0.0020		CARTER 76	CNTR	–	Mesonic atoms
139.5660 ± 0.0024	7, 8	MARUSHENKO 76	CNTR	–	Mesonic atoms

1 LENZ 1998 result does not suffer K-electron configuration uncertainties as does JECKELMANN 1994.
2 JECKELMANN 1994 Solution B (dominant 2-electron K-shell occupancy), chosen for consistency with positive $m^2_{\nu_\mu}$.
3 ASSAMAGAN 1996 measures the μ^+ momentum p_μ in $\pi^+ \to \mu^+ \nu_\mu$ decay at rest to be 29.79200 ± 0.00011 MeV/c. Combined with the μ^+ mass and the assumption $m_{\nu_\mu} = 0$, this gives the π^+ mass above; if $m_{\nu_\mu} > 0$, m_{π^+} given above is a lower limit. Combined instead with m_μ and (assuming *CPT*) the π^- mass of JECKELMANN 1994, p_μ gives an upper limit on m_{ν_μ} (see the ν_μ).
4 JECKELMANN 1994 Solution A (small 2-electron K-shell occupancy) in combination with either the DAUM 1991 or ASSAMAGAN 1994 pion decay muon momentum measurement yields a significantly negative $m^2_{\nu_\mu}$. It is accordingly not used in our fits.
5 The DAUM 1991 value includes the ABELA 1984 result. The value is based on a measurement of the μ^+ momentum for π^+ decay at rest, p_μ = 29.79179 ± 0.00053 MeV, uses m_μ = 105.658389 ± 0.000034 MeV, and assumes that $m_{\nu_\mu} = 0$. The last assumption means that in fact the value is a lower limit.
6 JECKELMANN 1986B gives m_π/m_e = 273.12677(71). We use m_e = 0.51099906(15) MeV from COHEN 1987. The authors note that two solutions for the probability distribution of K-shell occupancy fit equally well, and use other data to choose the lower of the two possible $\pi^\pm$ masses.
7 These values are scaled with a new wavelength-energy conversion factor $V\lambda = 1.23984244(37) \times 10^{-6}$ eV m from COHEN 1987. The LU 1980 screening correction relies upon a theoretical calculation of inner-shell refilling rates.
8 This MARUSHENKO 1976 value used at the authors' request to use the accepted set of calibration γ energies. Error increased from 0.0017 MeV

Google and PDG

- **Google indexes PDG web pages**
  – Google searches find PDG pages
- **PDG uses Google to search within PDG pages**
  – Result of "pion mass" search initiated from search box on PDG web page



Difficult to Parse

- **Current PDG pages difficult to interpret for search engines**
  - Lots of Greek symbols and equations
  - Information specific to HEP context
  - Investigate how to help search engines better “understand” PDG web pages

- **HEP searches often difficult in ASCII**
  - Try searching for
    - “Mass of Λ_c^+“
    - “$\mathrm{BF}(B_s^0 \to J/\Psi(1S)\Phi)$“
  - LaTeX syntax may work, but need to guess exact LaTeX expression used in article

SPIRES and PDG

- **SPIRES, and its successor INSPIRE (under construction), provide a comprehensive HEP Literature database**
  - Similar to a search engine, but focussed on HEP literature
  - Again, can provide list of available data, but evaluation must be done by user
- **Cross-linking between pdgLive and SPIRES**
  - pdgLive provides reference information and pointers to full citation entries using SPIRES
  - SPIRES provides links from an article to data in pdgLive

Conclusions

- **Search engines and PDG have different goals**
- **PDG provides an authoritative evaluation of HEP data**
  - Due to nature of data (lots of math and Greek) difficult to parse by Google and similar search engines
- **We need to provide a specialized online tool such as pdgLive that allows efficient browsing and searching of PDG data**
  - Cannot be done by a general-purpose search engine

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3. Why do we need the computing upgrade
4. Requirements for the upgraded system
5. Upgrade project plan

Presented by Piotr Zyla (PAZyla@lbl.gov)

Major RPP production tasks

- Literature search
- Encodings
- Verifications
- Reviews
- Monitoring progress
- Web/Book production
- Errata

Encoding process

Receive encoding instructions (lots of emails)

- Convert instructions to encoding input

Enter into database using single-user editor system

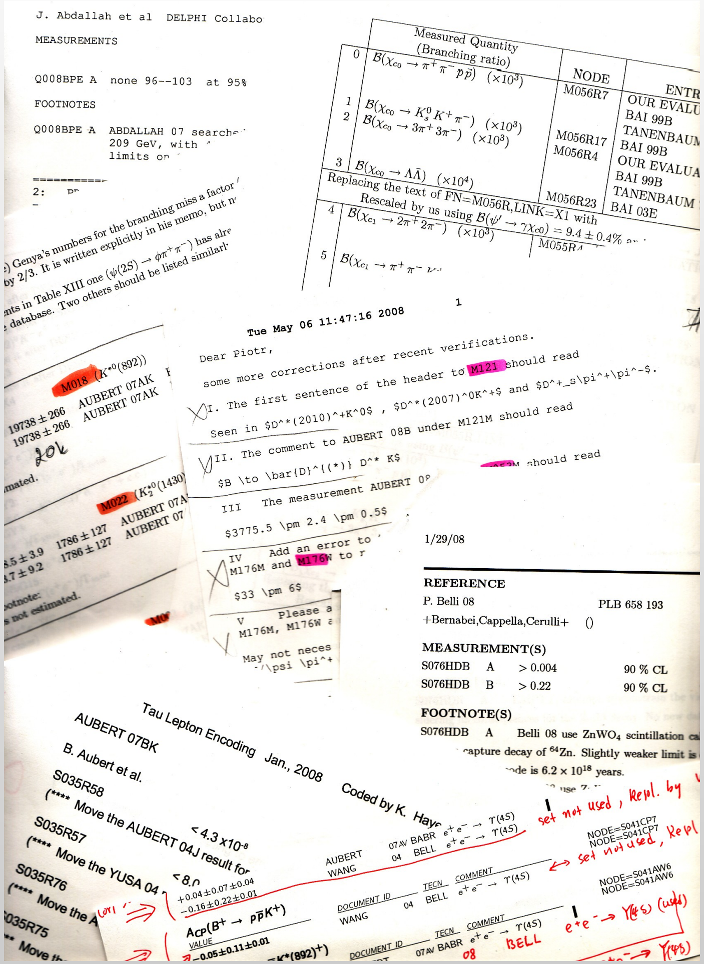
- New particles, decay modes, nodes, measurements, footnotes

Evaluate data and create listings

- Fits, averages, create ideograms, etc.

Iterate output with encoders (lots of emails)

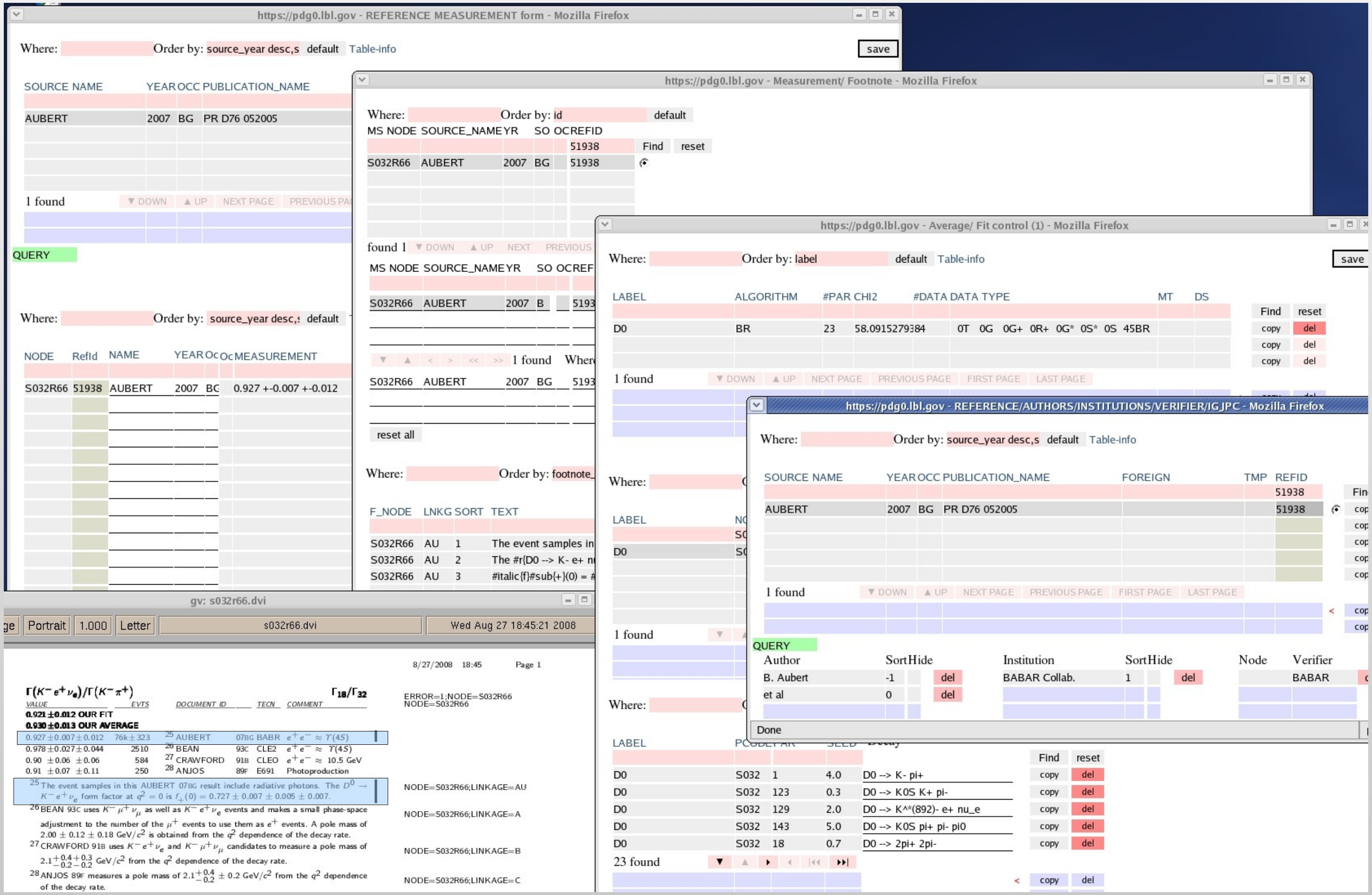
- Post listings; communicate; iterate corrections and adjustments



Samples of encoding instructions

Editor interface to database

Requires detailed knowledge about database structure and conventions (PDG macros) to insert/modify data

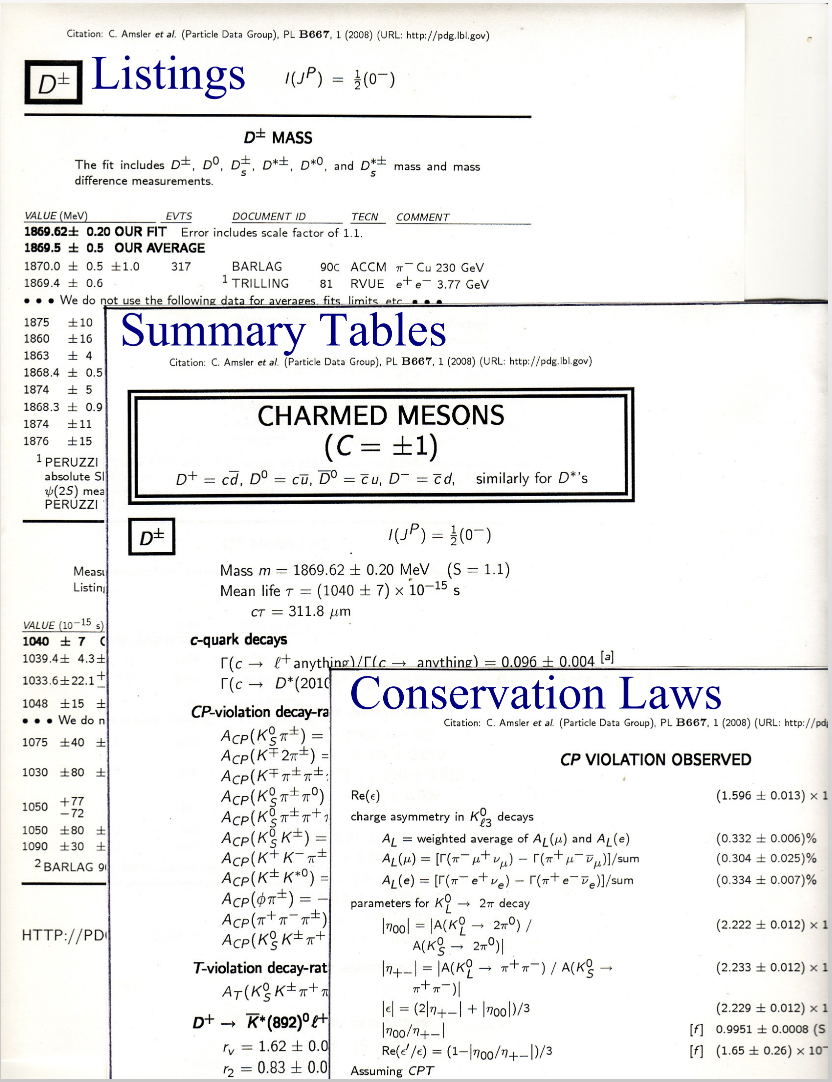


Encodings (cont.)

BERKELEY LAB

Encodings provide:

- Listings
- Summary Tables
- Conservation Laws



P. Zyla – September 2008

Reviews production

- **Make review files available to authors**
  - Adopt all reviews to local plain TeX processing
  - Create individual tar archives
  - Post the archives for download
- **Process modified/new reviews and post for refereeing**
  - Convert new/revised reviews from LaTeX, MS-Word, RevTeX, etc. to TeX macro package for PDG (TeXsis)
- **Iterate corrections and modifications**

Not supported by database or programs

Editor major-tasks list

***** Major RPP production tasks**

- Literature search;
+ Arrange with literature searchers new literature search;
+ Input literature search into database;
+ Assign papers if multiple encoders per particle;
Allow customized choice for one of the B-meson encoders;
+ Create lists for encoders and overseers;
+ Post new literature assignments on web;
+ Verify all links point to papers in SPIRES or are available on journal online pages;
+ Notify SPIRES about RPP papers not in their database;

- Encodings:
+ Encode reference details,
+ Prepare instructions for encoding: replace TEX and references with PDG macros, etc.;
+ Add new particle, decay mode, and/or new node if needed;
+ Encode measurement, comment, footnote;
+ Create new fits, add nodes to existing fits if needed;
+ Perform fits, averages, create ideograms etc.;
+ View encoding in the printed form;
+ Adjust column sizes, if needed;
+ Create new particle listing;
+ Post new listing for checking;
+ Inform encoder/overseer the listing ready for checking;
+ Iterate corrections and adjustments;
+ Periodically create and post Summary Tables and Conservation Laws;
+ Rearrange/update existing measurements;

- Verifications;
+ Prepare verificatons per paper;
+ Prepare verificatons per experiment;
+ Convert to pdf;
+ Create verifications web pages;
+ Post and check;
+ Email requests for verifies;
+ Update encodings if changes/corrections suggested by verifiers;

- Reviews;
+ Adopt all reviews to local plain TEX processing
+ Create individual tar archives;
+ Post the archives for download;
+ Process modified/new reviews and post for refereeing;
+ Convert new/revised reviews from LaTEX, MS-World, RevTEX, etc. to RPP TEXsis;
+ Iterate corrections and modifications;

- **Monitoring progress;**
+ Establishing status of papers for encodings;
+ Communicating outstanding papers to overseers;
+ Checking status of reviews;

- **Book production:**
+ Perform final:
fits;
averages;
momenta calculation (pdecay program);
other calculations, e.g. decay times (fincom program);
create ideograms;
+ Prepare:
history plots;
abstract;
authors list;
consultants list and other parts of introduction;
highlights of the edition;
illustrative key;
list of abbreviations (abbrev program);
summary tables for each sections: bosons, leptons, etc.;
tabular summary of mesons and baryons;
tests of conservation laws (conlaw program);
individual reviews;
listings with ideograms and data driven reviews;
contents: main and per section;
compose index;
setup color figures section;
+ Pagination (manual formating);
+ Quality control;
+ Posting of materials for the publisher;
+ Communications with the publisher;
+ Mailing lists;

- Web edition of RPP;
+ Prepare in the web form:
history plots;
abstract;
authors list;
consultants list and other parts of introduction;
highlights of the edition;
summary tables for each sections: bosons, leptons, etc.;
tabular summary of mesons and baryons;
tests of conservation laws;
individual reviews;
listings with ideograms;
+ Create the particles and reviews contents pages;
+ Prepare list of figures in reviews for download;
+ Quality control;

- Booklet production;
+ Reviews;
adopt all reviews to local plain TEX processing in the booklet format;
create individual tar archives;
post the archives for download;
iterate corrections and modifications;
+ Prepare in the booklet form:
authors list;
summary tables for each sections: bosons, leptons, etc.;
tests of conservation laws;
individual reviews;
inside/outside front and back covers;
+ Quality control;
+ Posting of materials for the publisher;
+ Communications with the publisher;
+ Mailing lists;

- Post production tasks:
+ Tag entries as published;
+ Archive fit average values and units;
+ Tag/archive production environment, database, source files;
+ Revert checked to not-checked publication flags;

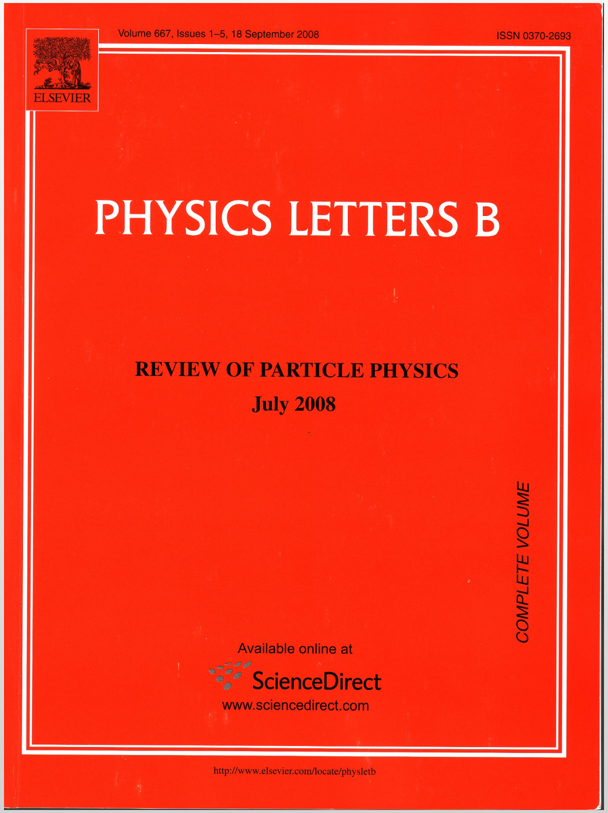
- Errata;
For listings or summary tables:
+ Check where the entry is listed in the listings, summary tables
in RPP book, booklet, and web posted files;
+ Identify the main database entry to be modified;
+ Establish if the entry propagates onto other values;
+ Correct entry in the production and pdgLive databases;
+ Prepare corrected files for posting;
+ Replace the affected files;
+ Add an entry to errata file;
For a review
+ Check where the entry appears in RPP book, booklet, and web posted files;
+ Correct the source files and create corrected review;
+ Replace the affected files;
+ Add an entry to errata file;

***** Other computing tasks**

- Coordinate PDG mirrors updates / setup;
- Create RPP statistics;
- Address users questions and comments directed to PDG;
- RPP ordering system maintenance;
- Preparing self-contained local versions of RPP web edition for different platforms;
- Improving RPP production environment structure;
- Developing utilities and new program features to improve quality of RPP and efficiency of op
eration;
- Configuration / maintenance /monitoring of backups and archives;
- Maintain authors list;

RPP 2008 production

- 645 new papers
- 2,778 new measurements
- 109 reviews



~ 10,000 email communications with editor needed

Conclusions

Current system was conceptually designed as a single user system with communications via postal mail and fax

This limits the scalability of the system and the type of possible improvements (to email, web posting)

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1. Role of Search Engines
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Presented by Juerg Beringer (JBeringer@lbl.gov)

PDG Computing System

- **The presently used system dates back to late eighties**
  - NB: This is before the web was born
  - At that time it was an extremely modern system that held up amazingly well over such a long period of time
- **Yet in spite of hardware upgrades from original VAX to now Linux PCs, software philosophy still dates back to single-user data entry on an ASCII terminal**

Upgrade is Urgent

- **We can no longer handle current requirements w/o great risk to data integrity and availability**
  - Amount of data, number of papers covered, and number of reviews more than tripled since current system was created
  - Complexity of data (often involving searches) has grown greatly
  - PDG collaboration was very small, but has now grown to 170 physicists worldwide (all volunteers except in Berkeley)
  - Giving the HEP community electronic access to the information in the PDG database requires a new system

Upgrade in Parallel

- **Workload for "getting RPP† out" has risen to the point where timeliness of publication is impacted and scientific quality is threatened**

  † RPP = Review of Particle Physics, ie the "book"

- **We no longer have a programmer in our group, as we had previously for a long time**
  - Position eliminated during a budget crunch in 2000

- **We need additional resources to carry out an upgrade**

Relying on Volunteers

- **Without additional resources at LBNL, had to rely on volunteer collaborators from Russia**
  - **Prevented PDG computing system from collapse, but the current system does not address our needs and is not maintainable**
  - Prototype applications such as pdgLive show potential of a new system for our users, and allowed to get a detailed understanding of our requirements

- **Developed plan to address problems of current system**
  - Vetted by the PDG Advisory Committee

Written in 2006

High-Level Requirements and Roadmap for PDG Computing

Juerg Beringer
Particle Data Group
Lawrence Berkeley National Laboratory

This document summarizes the high-level requirements for the upgraded PDG computing system and proposes a roadmap for completing the upgrade. It is intended to serve as a starting point for a cost estimate for the completion of the upgrade project.

Upgrade Plan Endorsed

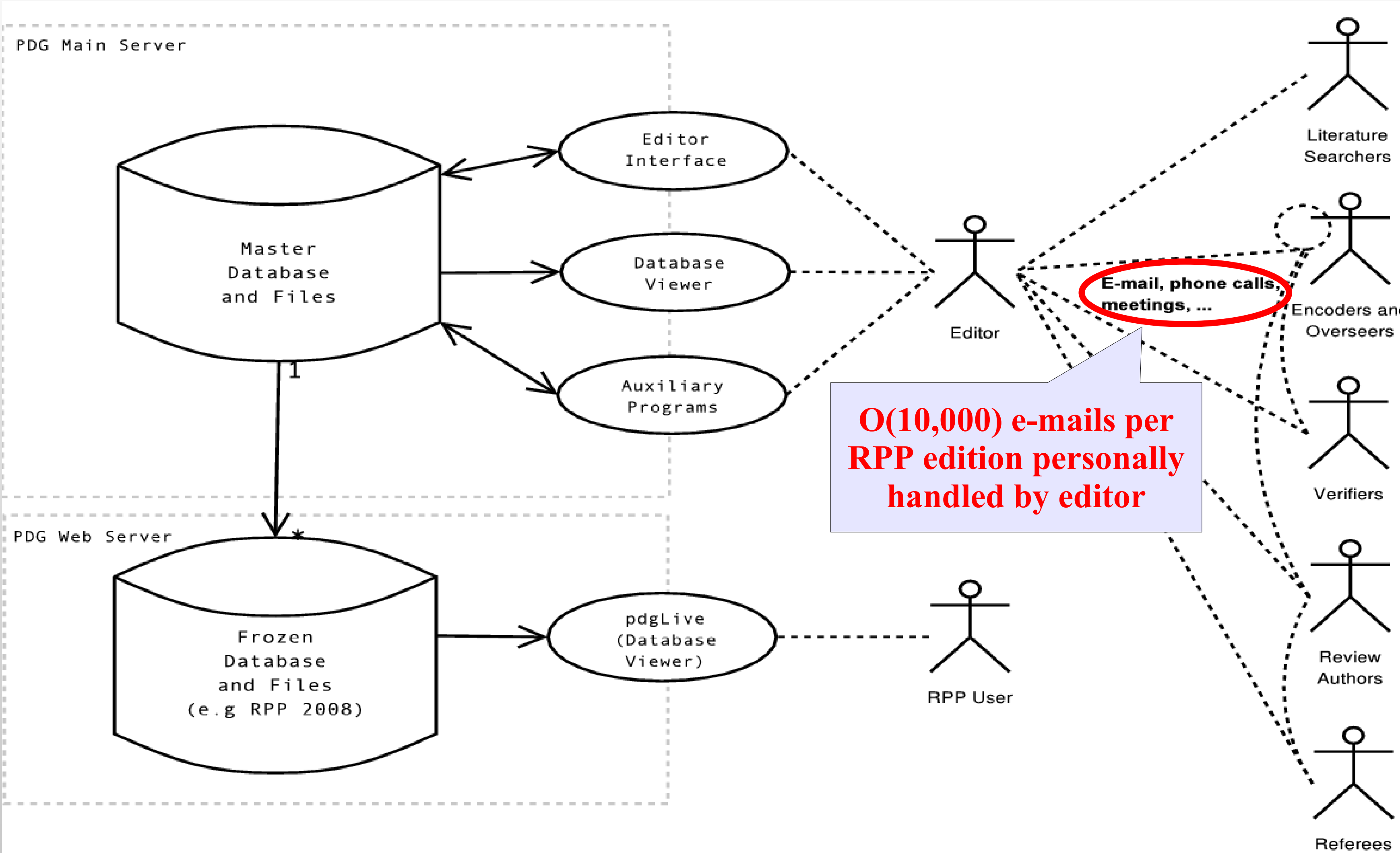
- **Urgency of upgrade and need for additional resources widely recognized in reviews, e.g. in reports of**
  - Director's Review of LBNL Physics Division (Nov '05)
  - LBNL internal review of PDG computing (Dec '05)
  - PDG Advisory Committee Meeting (Sep '06)

> **"We ... fully endorse the request of the Physics Division to recruit 2 FTEs for two years in order to place the remaining effort for the computing upgrade on a secure basis."**

- **NSF recognizes urgency of the computing upgrade and grants a temporary increment of 0.2 FTE in its most recent award (PHY-0652989)**

Current Production System

DOE Review



Technical Details

- **Hardware**
  - 2 Linux-based servers
- **Software**
  - PostgreSQL, Apache Tomcat, Apache web server
  - O(100k) lines of application code
    - Fortran and C for auxiliary programs
    - Kawa and BRL for user interfaces
    - HTML and JavaScript
  - Mimetex (tool to generate gif images from TeX snippets)
  - TeX and TeXsis
- **Database**
  - Small (ASCII dump is 40MB) but **very complex database**
  - ~100 database tables, about 2/3 storing scientific information

Shortcomings (I)

- **System designed as single-user system and doesn't scale**
  - No support for concurrent data entry by multiple users
  - No support for workflow management
- **All data entry must go through editor**
- **Arcane, inefficient and error prone data entry method**
  - Editor interface basically only graphical SQL editor
- **No support for producing Reviews**
  - Authors, referees and overseers communicate mostly by e-mail
  - Updated review source files are circulated by e-mail and must often be merged by overseer or editor
  - Review authors have to deal with TeXsis (a special TeX-based macro package used internally by PDG), or editor has to convert from other formats

Shortcomings (II)

- **No support for verification of Listing entries**
  - Proofs are sent by e-mail to verifiers hoping for a reply in case of a problem (“no news is good news”)
- **Lack of information on progress of Listings and Reviews**
  - Difficult to manage hundreds of people towards a timely completion of RPP if current status is not known
- **Current user interfaces are not maintainable long-term**
  - Arcane tools, programming languages (Kawa, BRL)
  - Not documented
  - **But are very valuable prototypes of what we need**
- **Auxiliary programs written in Fortran (and C)**
  - Maintenance completely dependent on single retiree

Computing Needs

- **A modern, modular, extendable, easy-to-use, maintainable and well-documented computing infrastructure**
- **Production quality system – PDG data must be correct**
  - Extensive error-checking and cross-checking built into system
- **Need to support all areas of our work, including in particular:**
  - Decentralized, web-based data entry and verification for Listings
  - Interaction with over 100 review authors
  - Monitoring of progress in RPP production
  - Programs for evaluation of data (fits, averages, plots, ...)
  - Expert tools for editor, including creation of book manuscript and static web pages (PDF files)
  - Interactive browsing of PDG database similar to pdgLive

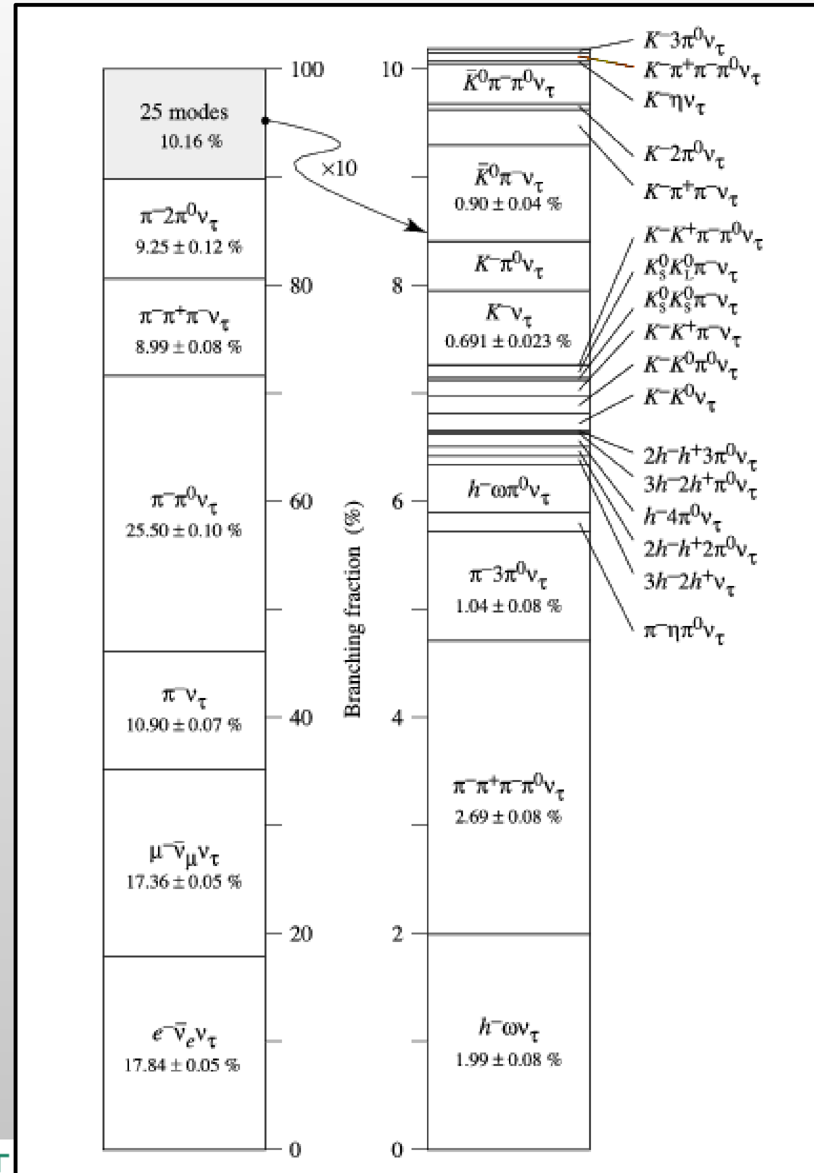
Listings with Complex Fits

τ^- DECAY MODES

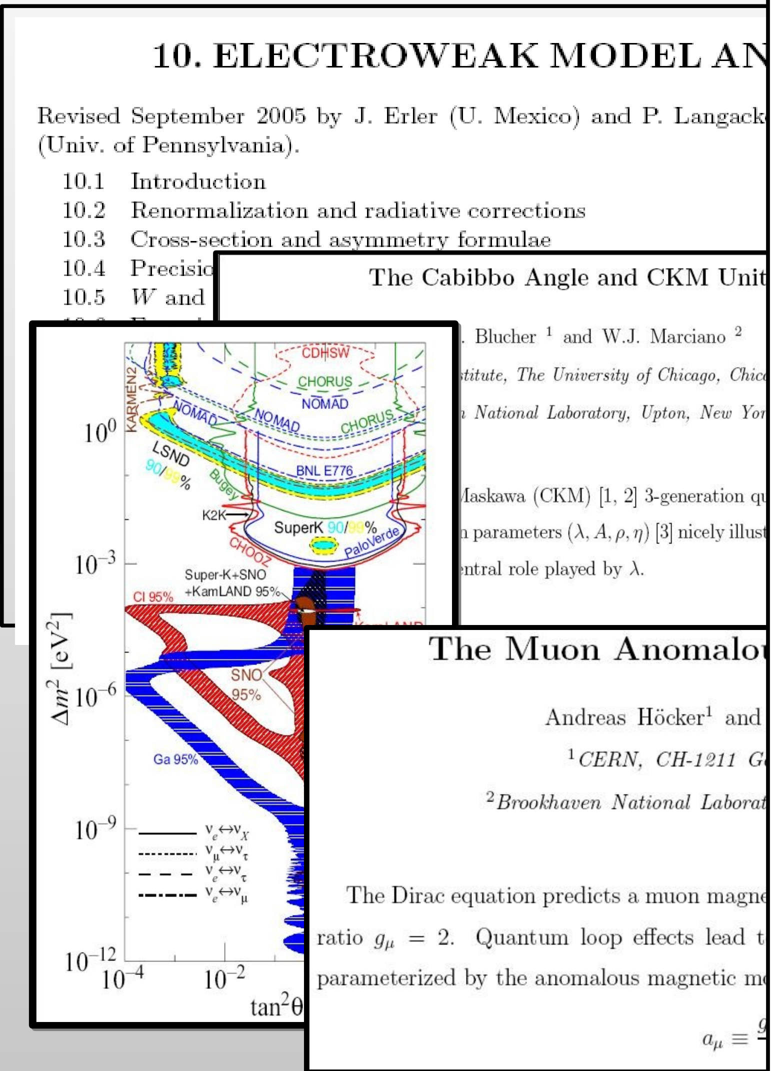
τ^+ modes are charge conjugates of the modes below. "$h^\pm$" stands for $\pi^\pm$ or $K^\pm$. "ℓ" stands for e or μ. "Neutrals" stands for γ's and/or π^0's.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Modes with one charged particle			
Γ_1	particle$^-$ ≥ 0 neutrals $\geq 0K^0\nu_\tau$ ("1-prong")		(85.33 ± 0.08) %	S=1.4
Γ_2	particle$^-$ ≥ 0 neutrals $\geq 0K^0_L\nu_\tau$		(84.69 ± 0.09) %	S=1.4
Γ_3	$\mu^-\overline{\nu}_\mu\nu_\tau$	[a]	(17.36 ± 0.05) %	
Γ_4	$\mu^-\overline{\nu}_\mu\nu_\tau\gamma$	[b]	$(3.6\pm0.4)\times10^{-3}$	
Γ_5	$e^-\overline{\nu}_e\nu_\tau$	[a]	(17.84 ± 0.05) %	
Γ_6	$e^-\overline{\nu}_e\nu_\tau\gamma$	[b]	(1.75 ± 0.18) %	
Γ_7	$h^-\geq 0K^0_L\,\nu_\tau$		(12.14 ± 0.07) %	S=1.1
Γ_8	$h^-\nu_\tau$		(11.59 ± 0.06) %	S=1.1
Γ_9	$\pi^-\nu_\tau$	[a]	(10.90 ± 0.07) %	S=1.1
Γ_{10}	$K^-\nu_\tau$	[a]	$(6.91\pm0.23)\times10^{-3}$	
Γ_{11}	$h^-\geq 1$ neutralsν_τ		(37.05 ± 0.12) %	S=1.3
Γ_{12}	$h^-\geq 1\pi^0\nu_\tau$ (ex.K^0)		(36.51 ± 0.12) %	S=1.3
Γ_{13}	$h^-\pi^0\nu_\tau$		(25.95 ± 0.10) %	S=1.1
Γ_{14}	$\pi^-\pi^0\nu_\tau$	[a]	(25.50 ± 0.10) %	S=1.1
Γ_{15}	$\pi^-\pi^0$ non-$\rho(770)\nu_\tau$		$(3.0\pm3.2)\times10^{-3}$	
Γ_{16}	$K^-\pi^0\nu_\tau$	[a]	$(4.52\pm0.27)\times10^{-3}$	
Γ_{17}				=1.5
Γ_{18}				=1.3
Γ_{19}				=1.3
Γ_{20}				=1.3
Γ_{21}				95%
Γ_{22}				95%
Γ_{23}				
Γ_{24}	$h^-\geq 3\pi^0\nu_\tau$		(1.33 ± 0.07) %	S=1.1
Γ_{25}	$h^-\geq 3\pi^0\nu_\tau$ (ex. K^0)		(1.25 ± 0.07) %	S=1.1
Γ_{26}	$h^-3\pi^0\nu_\tau$		(1.17 ± 0.08) %	S=1.1
Γ_{27}	$\pi^-3\pi^0\nu_\tau$ (ex.K^0)	[a]	(1.04 ± 0.08) %	S=1.1
Γ_{28}	$K^-3\pi^0\nu_\tau$ (ex.K^0, η)	[a]	$(4.2\pm2.1)\times10^{-4}$	
Γ_{29}	$h^-4\pi^0\nu_\tau$ (ex.K^0)		$(1.6\pm0.4)\times10^{-3}$	
Γ_{30}	$h^-4\pi^0\nu_\tau$ (ex.K^0,η)	[a]	$(1.0\pm0.4)\times10^{-3}$	
Γ_{31}	$K^-\geq 0\pi^0\geq 0K^0\geq 0\gamma\,\nu_\tau$		(1.57 ± 0.04) %	S=1.1
Γ_{32}	$K^-\geq 1$ (π^0 or K^0 or γ) ν_τ		$(8.78\pm0.33)\times10^{-3}$	

- **Total of 203 τ decay modes**
- **82 branching fractions determined from constrained fit using 31 basis modes**



Review Articles



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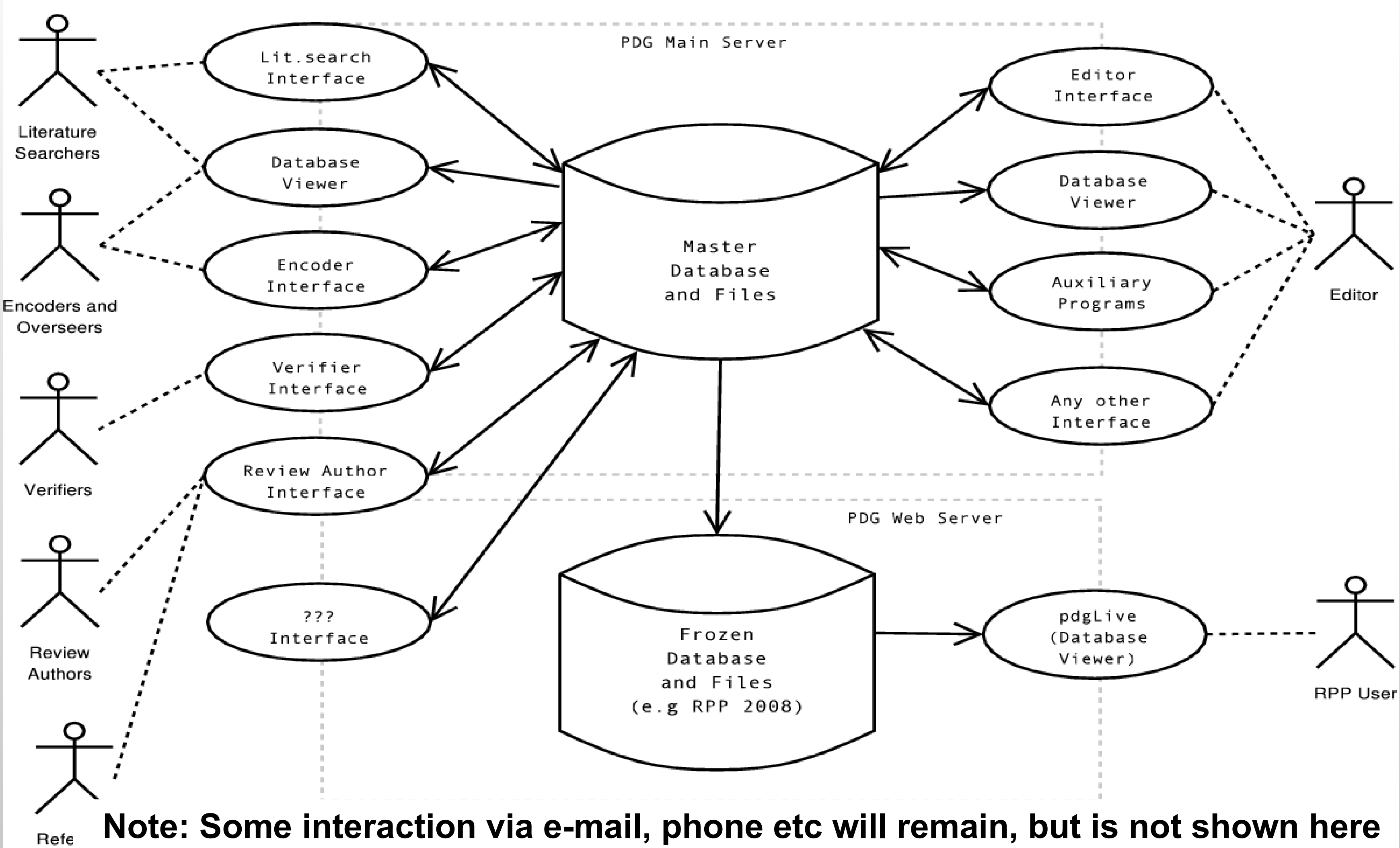
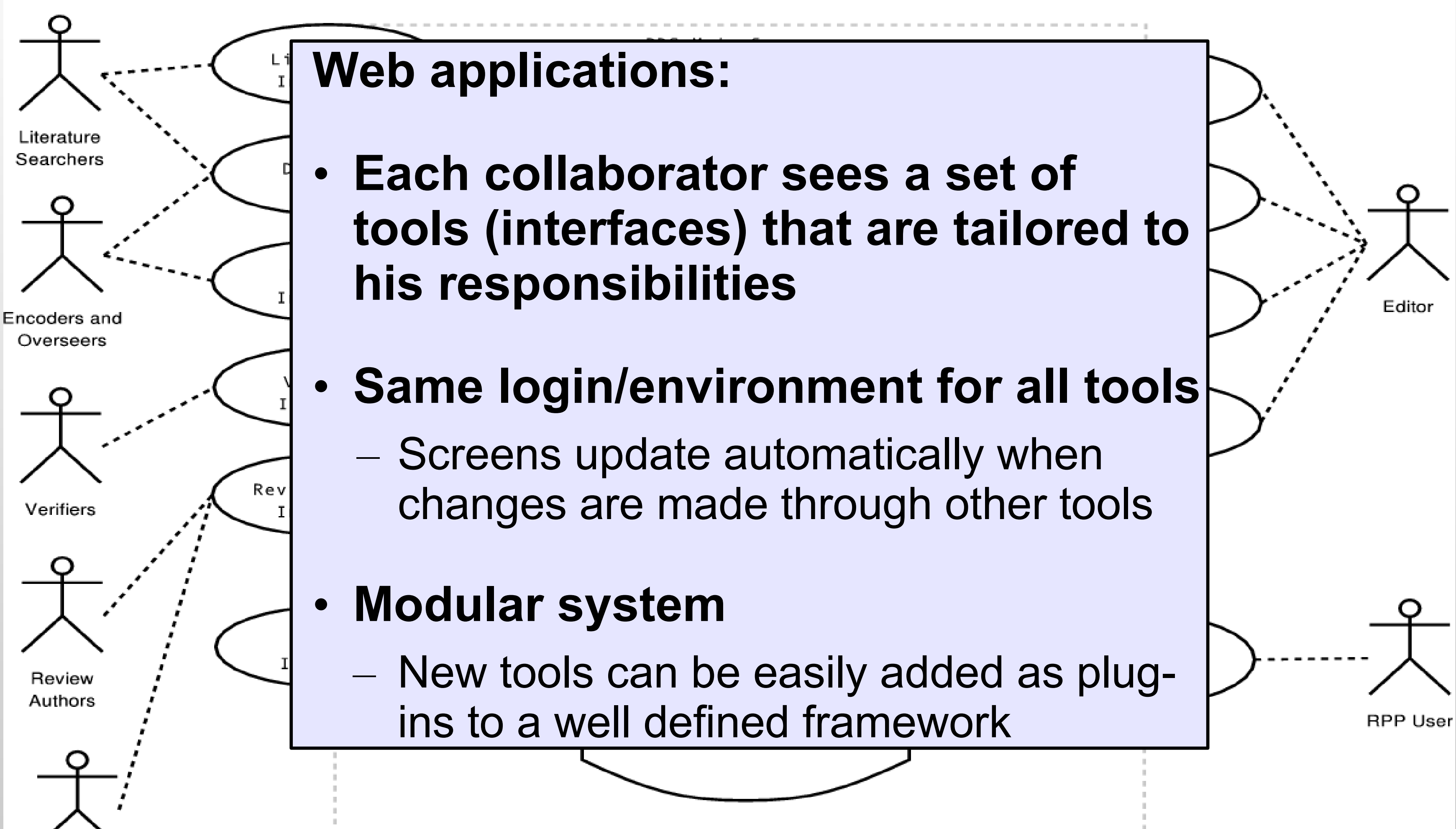
Planned System



Note: Some interaction via e-mail, phone etc will remain, but is not shown here

Planned System



Web applications:

- **Each collaborator sees a set of tools (interfaces) that are tailored to his responsibilities**
- **Same login/environment for all tools**
  - Screens update automatically when changes are made through other tools
- **Modular system**
  - New tools can be easily added as plug-ins to a well defined framework

Note: Some interaction via e-mail, phone etc will remain, but is not shown here

Required Web Applications (I)

- **Encoder interface and Literature Search interface**
  - Future primary data entry interfaces
  - Task driven, easy-to-use tools for non-experts
  - Single-user prototype available but needs to be redesigned as production-quality tool for concurrent usage

- **Database viewer (pdgLive)**
  - Web-based application for browsing of database contents
  - Dynamically generates web-pages in format similar to RPP book
  - Used both for pdgLive (on published RPP edition),
  - And as tool to inspect new entries during encoding process
  - Provides direct links from RPP entries to SPIRES to actual papers
  - Current version of pdgLive is not maintainable, must be replaced

Required Web Applications (II)

- **Verifier interface**
  - Manage verification process and provide web page for verifiers to report their acceptance or corrections
- **Review author interface**
  - Keep track of status and responsibilities for each review
  - Manage different versions during authoring and refereeing
- **Editor interface**
  - Expert-only web-based GUI to edit raw content of PDG database
  - Only used by editor
  - Diminishing role as most data entry tasks will be done decentralized through Encoder Interface
- **Status Reporting**
  - Reports on progress of Listings & Reviews

Required Web Applications (III)

- **User Profile Management and Configuration**
  - Users (including collaborators) can create a profile, order products, and update their address and preferences
  - Configuration tool allows coordinators and editors to assign responsibilities
- **Mailing System**
  - Send messages to different groups of users, e.g. to announce availability of new RPP edition, to remind collaborators about deadlines, etc.
- **Interface for updating Institution Database**
- **Additional smaller applications can be added easily when needed once the framework is available**

Required Programs & Scripts

- **Data analysis environment**
  - Environment with both access to PDG data and to numerical algorithms, data analysis and graphics tools (for example ROOT, CERN libraries, ...)
  - Preferably has option to work interactively
- **Auxiliary programs and scripts**
  - Fitting, averaging, graphics, production of TeX files for Listings
  - Used directly by editor and indirectly through encoder interface
  - Ultimately based on above data analysis environment
- **System Monitoring**
  - Scripts and web pages that alert us as early as possible to problems (e.g. web server down, low disk space, etc.)

Challenges (I)

- **Distributed data entry**
  - Concurrency issues (locking) to be addressed in the design
  - Need to define exactly when changes become visible to other collaborators
  - Editor must still sign off each individual entry / change
- **Use of TeXsis and TeX needs to be rethought**
  - Use of TeX unavoidable for printed book(let),
  - but not ideal for web output
  - How to efficiently display equations in a web browser?
    - Investigating jsMath, MathML, conversion to gif images, ...
- **Browser and platform independence for data viewer**
  - Use existing libraries where possible

Challenges (II)

- **Database structure and contents**
  - Current database structure for scientific information non-optimal since some modern database features were not available or efficient when current system was designed
    - Need middleware to address this
  - Improve separation between content and output format
    - Use of TeX snippets in data entries
    - Non-unique specification of particles (e.g.”K_s^0” prints same as “K^0_s”)
  - Concurrency requires additional locking information
  - Workflow information needs to be added / redesigned
  - Mechanism for history and errata needs to be revisited
- **All changes (to the database) must be made incrementally without jeopardizing the ongoing production of the Review**

Conclusions

- **An upgrade of the aging PDG computing system has become critical**
- **We have a clear understanding of the requirements for the future PDG computing system**
- **We have identified a team of experienced LBNL computer scientists for the design and implementation of the upgrade**
  - Supplemental DOE funding for FY08 allowed us to work out system architecture and project plan
    - **THANK YOU!**
  - See following slides by Cecilia Aragon

Contents

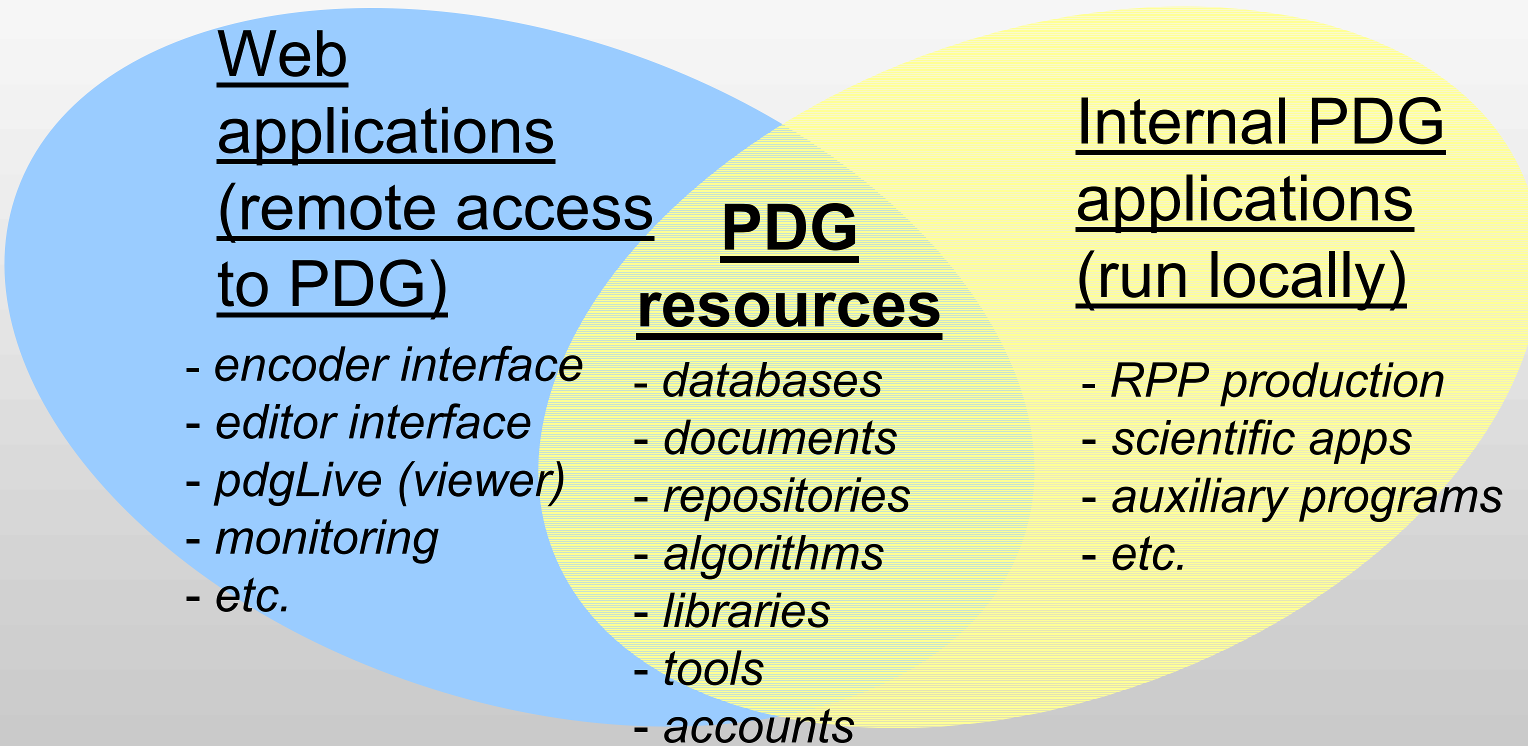
1. Role of Search Engines
2. Production of the *Review of Particle Physics* with the existing system
3. Why we need the computing upgrade
4. Requirements for the upgraded system
5. Computing upgrade project plan

Presented by Cecilia Aragon (CRAragon@lbl.gov)

Computing Redesign Goals

- **Expand current functionality**
  - Move to more modern, scalable system with multi-user capability
- **Modularity and flexibility**
  - Use industry standard frameworks rather than custom, one-of-a-kind code
  - Easy to add new tools into framework
- **Usability**
  - Apply best practices such as user-centered design and standard usability metrics for interface evaluation
  - Consistent interfaces tailored to individual roles; view updates automatically when changes made to another component
- **Long-term maintainability and documentation**
- **Production quality system**

Summary of PDG System Functions



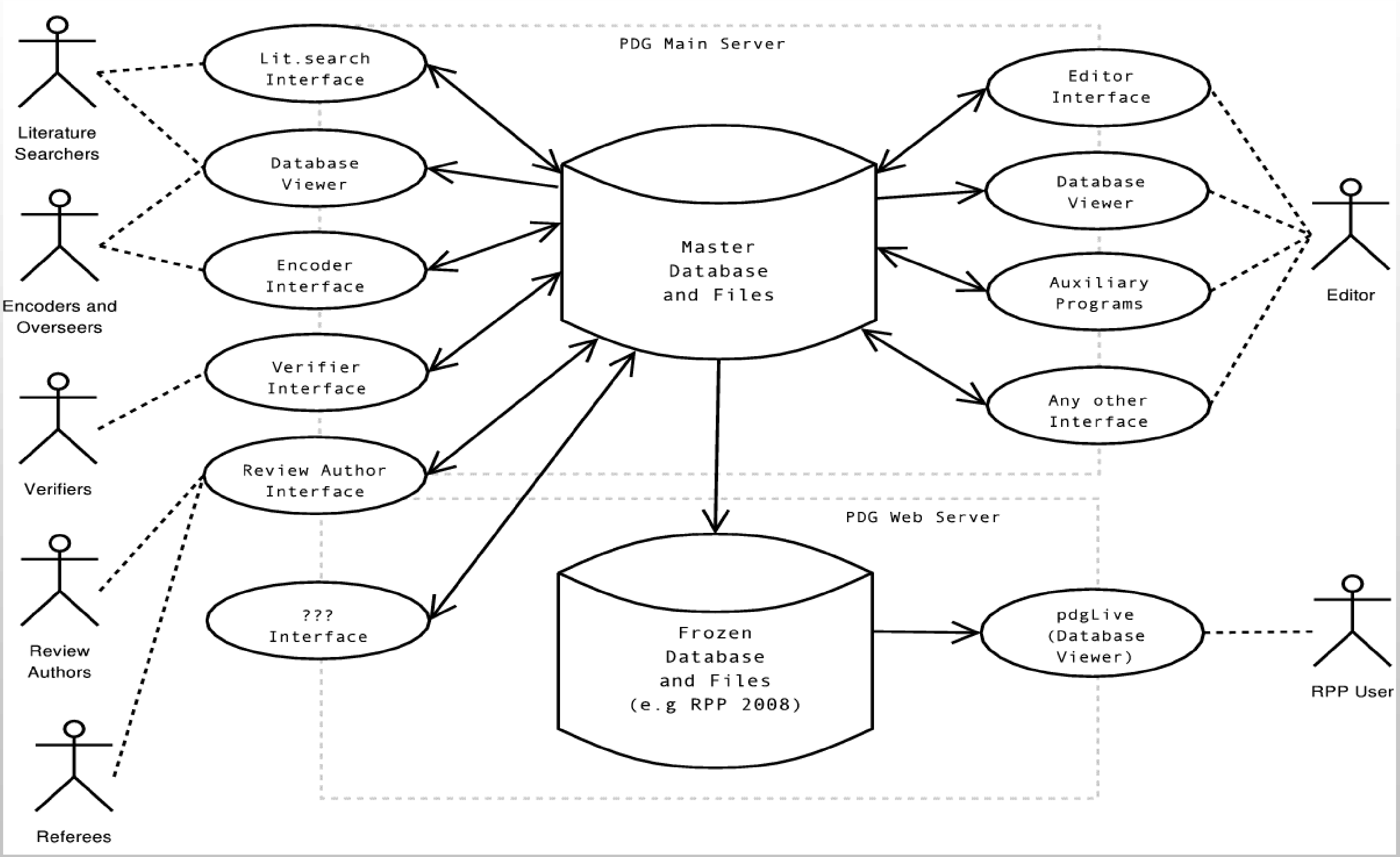
Note: common resources

Goals

- **Proposed architecture must be**
  - **Adequate** to fulfill functional requirements
  - **Flexible** to accommodate further extensions/modifications
  - **Scalable** to cope with ever-increasing load
  - **Lean** system (easy to maintain)

Driven by requirements

PDG Computing Architecture



Key Technology Principles

- **Chosen technologies must be**
  - **Suitable** for specific PDG problems
    - "one size does not fit all"
  - **Stable and mature** - production system
  - **Sustainable** in the long run (~10 years from now)
    - based on standards
  - **Popular**
    - another guarantee for stability
  - For which there is **sufficient expertise** (at LBNL)
  - **Relatively easy** to learn and deal with
  - **Free** (open source, GPL, etc.)

Software Development Process

- **The process should**
  - Adhere to **widely-adopted** practices
  - Be **well-documented** (including the code itself)
  - **Minimally personalized** (to facilitate long term code maintenance)
  - **Maximally efficient** (use existing tools, components, libraries)

Three-Tier Web Architecture

Web Browser

Execute AJAX enabled Web pages (HTML, JavaScript)

- *interact with user*
- *input processing*
- *dynamic page rendering*

HTTP →

Web Application Server (J2EE)

JSP

Servlets

HTML

JS libraries

- *generate dynamic HTML*
- *AJAX back end support*
- *static HTML pages*
- *JavaScript libraries*
- *rendering of formulas (jsMath, mathML)*

→

Persistency

Session

Algorithm Execution

Etc.

- *object-relational mapping*
- *sessions support*
- *user authorization*
- *complex application logic*
- *interface to legacy code*
- *monitoring, etc.*

Resources

JDBC → **RDBMS**

File I/O → **Data Files**

CALL → **Programs Libraries**

Access → **Reposit. (CVS)**

Web Applications Domain

- **J2EE-based Web Application Framework**
  - Commonly used industry standard (ex: eBay - 1B transactions/day)
  - Dynamic HTML generation
  - An infrastructure for building scalable, distributed Web apps
  - A number of useful services/mechanisms (ORM, sessions, etc.)
  - Leverage from broad community
  - Employs component-based development approach
  - Multiple implementations exist (free examples: GlassFish, JBoss)
- **AJAX-enabled Web pages on the client side**
  - User-friendly and highly interactive GUI behavior
  - De-facto standard for Web pages
  - Asynchronous interaction with the Web server
  - “Smart” user input (auto-suggestion/auto-completion “as you type”)

Choice of Programming Languages

- Select **minimal set** of programming languages that **meet requirements** and are **widely accepted**
  - **Java** and JSP for the Web Application Framework backend
  - **JavaScript** for client-side HTML (AJAX)
  - **Python** API for programmatic access to database
- **Benefits of leverage from broad community of developers**
  - maintainability

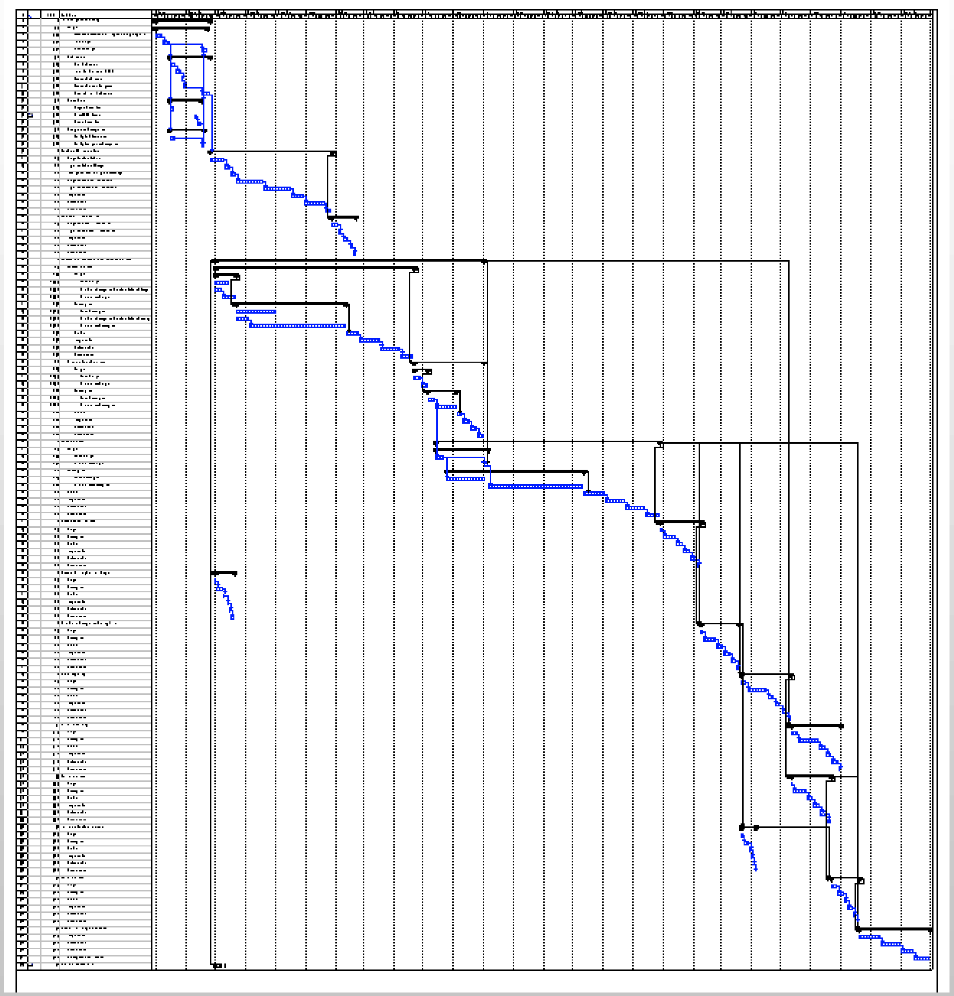
Why not use just one language?

– each has its own benefits (Java, JS, Python)

Handling Legacy Applications

- **Legacy FORTRAN applications**
  - Restructured as libraries (to be usable as **resources**)
  - Migrated onto the unified high-level database access API

Computing Project Plan



Key Computing Personnel

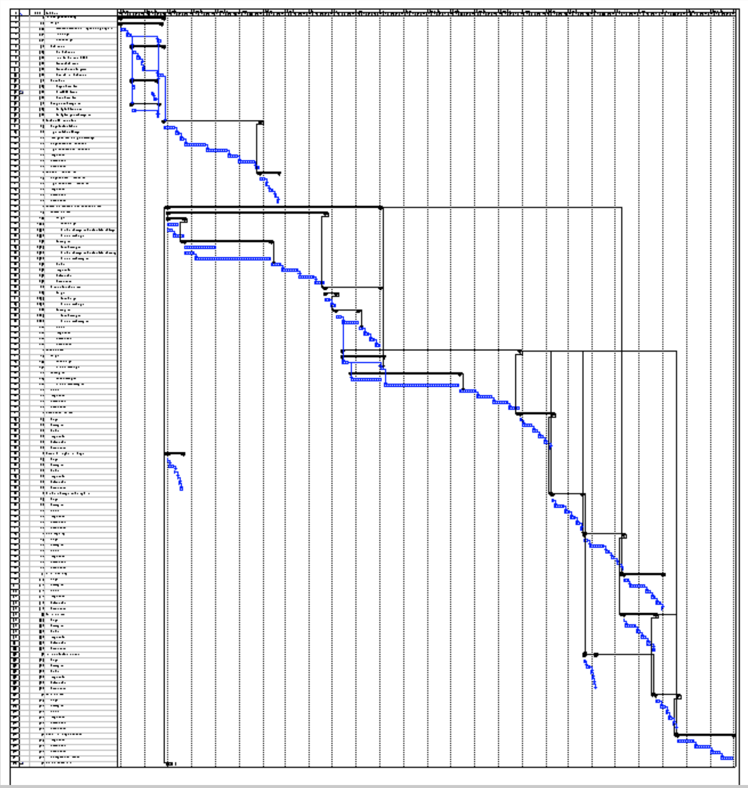
- **Cecilia Aragon** (50%)
  - Computer scientist/architect/programmer, 20+ years experience in computing including physics applications and user interface design; PhD in CS from UC Berkeley. Most recent project: Sunfall for the Nearby Supernova Factory.
- **Igor Gaponenko** (25-50%)
  - Computer software engineer/architect, ~20 years experience in scientific databases and automation of HEP experiments; MS physics/CS. Most recent project: BaBar.
- **Computing professional** (100%)
  - Web application software engineer/user interface designer, experience in scientific databases, physics experiments
- **Advanced Computing for Science (ACS) Department staff** at LBNL (up to 25%)
  - multiple skill sets in physics computing, consulting expertise, including all technologies in architecture plan
- **Work will be performed in close collaboration with PDG physicists (J. Beringer, O. Dahl, P. Zyla)**

Key Project Tasks

- **Initial Design and Planning**
- **System Architecture**
- **Database Abstraction Layer**
- **Data Analysis Environment**
- **Encoder Interface and Literature Search Interface**
- **Database Viewer**
- **Review Author Interface**
- **Other System Tasks**
  - Refactor Existing Auxiliary Programs
  - User Profile Management/Mailing System
  - Status Reporting
  - System Monitoring
  - Verifier Interface
  - Institution Database Interface
  - Editor Interface
- **Final System Integration and Test**

Computing Project Plan

- **We have prepared a WBS (Work Breakdown Structure) and Gantt chart**
  - Upgrade requires 2 FTEs for 2 years (4 FTE-years)
  - See WBS link on agenda page for the detailed project plan
- **Includes task breakdown and resource allocation**



Computing Project Plan

High level WBS (4 FTEs total effort)

WBS Task Name	Start	End
1. Initial Design and Planning	8/1/2008	9/25/2008
2. Database Abstraction Layer	9/26/2008	2/3/2009
3. Data Analysis Environment	2/4/2009	2/27/2009
4. Encoder Interface/Lit. Search Int.	10/1/2008	7/8/2009
5. Database Viewer	5/21/2009	1/8/2010
6. Review Author Interface	1/11/2010	2/19/2010
7. Refactor Existing Auxiliary Programs	10/1/2008	10/20/2008
8. User Profile Management/Mailing	2/22/2010	4/1/2010
9. Status Reporting	4/2/2010	5/19/2010
10. System Monitoring	5/20/2010	7/6/2010
11. Verifier Interface	5/20/2010	6/29/2010
12. Institution Database Interface	4/2/2010	4/16/2010
13. Editor Interface	6/30/2010	7/21/2010
14. Final System Integration	7/22/2010	9/30/2010

– *Note that design phases for some components are shorter because of IHEP prototype*

Contingency Plans

- Design of framework so new tasks can easily be added
- If necessary, can de-scope individual tasks and still accomplish main goals

Risks and Mitigations (I)

1. **PDG is different from commodity interfaces**
   - Database structure for scientific information
   - Non-ASCII formats for particles
   - Use of custom formatting macros and TeXsis

- **Mitigation: careful design, staff experience in building physics systems**

Risks and Mitigations (II)

2. Technology risks

– J2EE, Python platform stability

- **Mitigation: industry standard, weight of community (ex. RHEL)**

3. Internal risks

– Underestimate amount of work, loss of staff

- **Mitigation: incremental plan (do highest priority items first), use industry standard technologies, large pool of expertise at LBNL**

Summary

- **New system capabilities achievable within planned 2-year timeframe**
  - Multi-user
  - Usable
  - Long-term maintainability
  - Positioned for future development
  - Well-documented
  - Uses widely accepted programming languages
  - Training and transition plan
  - Consulting staff at LBNL available during and after 2-year development period
- **High-level system architecture and project plan have been developed**

Conclusions

- Current computing system can no longer support PDG work
- Timing is critical – LHC is here
- Supplemental DOE funding for FY08 made it possible to work out a detailed project plan
  - Addresses needs of PDG
  - Minimal, lean, efficient
  - Extensible system
- Computing team is in place at LBNL to carry out upgrade work

Questions?

Juerg Beringer

JBeringer@lbl.gov

Piotr Zyla

PAZyla@lbl.gov

Cecilia Aragon

CRAragon@lbl.gov