Status of the PDG Computing Upgrade

- Overall status
- Editor interface
- pdgLive
- Encoder interface
- Planning for phase 2
- Conclusions

Introduction

- "PDG Computing" refers to the infrastructure needed to **support the full process leading to the publication of the Review of Particle Physics**
  - In addition, must support diary production, ordering system, high-volume reliable web server w/mirrors, outreach activities (ATLAS, Particle Adventure, etc), institutional contacts database, reporting, statistics, monitoring ...
- Old computing system originated in early 1980s and was running on old hardware (without replacement system) and obsolete software
- Several upgrade attempts since mid 1990s did not converge
- LBNL-internal review in 2003 suggested giving highest priority to the completion of the "RPPs 1.5" prototype and let people work with it
  - In spite of concerns about some technology choices and maintainability
  - Upgrade will need to continue (with emphasis on long-term maintainability)
- Urgency of completing at least a partial upgrade increasingly evident in 2004

Upgrade Plan in 2004

- Obviously lacking sufficient resources to carry out a full upgrade on a short time-scale, we **decided in 2004 on a pragmatic (albeit not ideal) approach that would ensure our ability to continue producing the RPP**
- Defined 3 phases of the upgrade:
  - **Phase 1**: Switch to partially upgraded system in time for RPP 2006 production
    - Switch to modern hardware (Linux servers)
    - Reimplementation of existing Oracle/FORMS editor interface
    - If feasible, provide database viewer and initial version of encoder interface
  - **Phase 2**: Improve partially upgraded system in an incremental fashion
    - Address technology choices, long-term maintainability, and documentation
    - Improve or replace existing interfaces as necessary
    - Add new tools (e.g. for handling of Reviews)
  - **Phase 3** (if deemed necessary): Completely redesign database structure
    - Appears to be not necessary

Status Today

- **Phase 1 is essentially complete**
  - Switched RPP data entry and production to the new system on 9/13/2005 ...
  - ... and RPP 2006 was produced completely with the new system!
  - pdgLive – a database viewer with the full core functionaliy – became available at the same time as the "traditional" 2006 web edition
  - An advanced prototype of the encoder interface has been tested by selected PDG persons but remains to be debugged completely before being put into production
- **Phase 2: Planning and cost estimate are in progress**

High-Level Requirements and Roadmap for PDG Computing

Juerg Beringer
Particle Data Group
Lawrence Berkeley National Laboratory

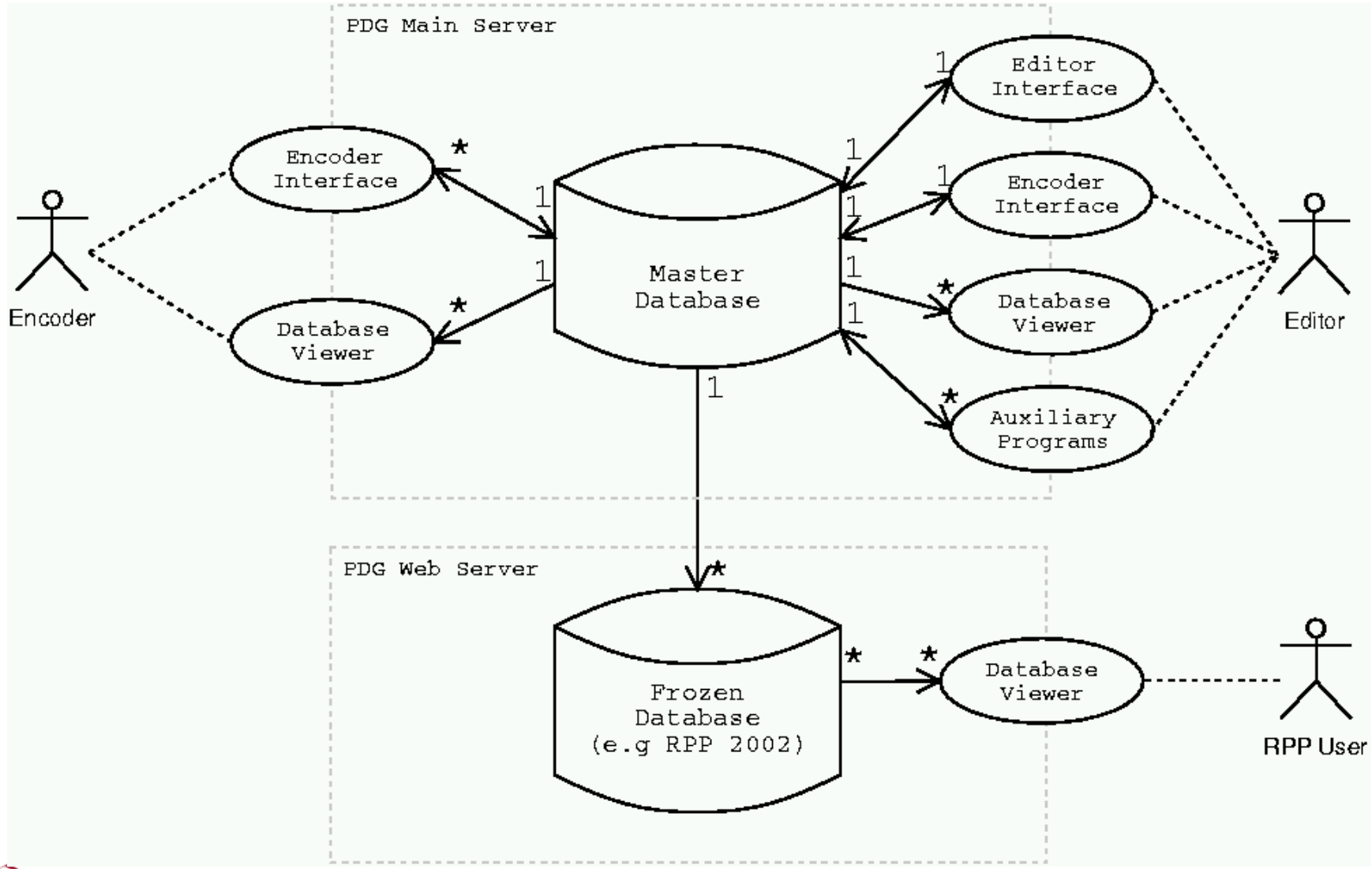
This document summarizes the high-level requirements for the upgraded PDG computing system and proposes a roadmap for completing the upgrade. It is intended to serve as a starting point for a cost estimate for the completion of the upgrade project.

Recent Contributors to PDG Computing Upgrade

- From COMPAS group, IHEP Protvino:
  - Kirill Lugovsky (web interfaces)
  - Slava Lugovsky (web interfaces)
  - Vitaly Lugovsky (core libraries, database, left in 2004)
  - Lyudmila Lugovskaya (documentation, left in 2004)
  - Vladimir Ezhela (group leader, retired)
  - Oleg Zenin (group leader, new)
- From LBNL:
  - Juerg Beringer (project leader, since March 2004)
  - Orin Dahl (auxiliary programs, Oracle/FORMS related work, retired)
  - Piotr Zyla (daily operation, production tasks, editor interface)

These are all part-time contributors, mostly at the 10% to 70% level

High-Level Architecture of Upgraded System



Implementation

- 2 Linux servers (dual-CPU, 2GB RAM each, total 1 TB RAID disk)
- PostgreSQL – mature relational database
  - Interfaced through JDBC
  - Could easily switch to MySQL or Oracle
- Kawa 1.7 – Java based Scheme (Lisp) system
- BRL 2.2.1 – system to embed dynamic content into web pages
  - Similar in spirit to JSP, but uses the Scheme language instead of Java
- Apache Tomcat – servlet container
  - used to run BRL / Kawa within the web server
- Apache web server
- HTML and JavaScript
- Mimetex – standalone tool to generate gif images from TeX snippets

Maintainability Concerns

- **Primary issue is use of Kawa and BRL** regarding
  - Future support for these tools
  - Suitability of Scheme/Lisp for complex web applications
- Kawa (http://www.gnu.org/software/kawa/)
  - Actively maintained by author, small user community, active discussion lists
- BRL (http://brl.sourceforge.net)
  - Based on Kawa, no significant development since 2003
- Possible alternative similar Scheme-based tools exist, e.g. Bigloo, SISC, and SISCweb, but none of them widely used
- Use of Scheme/Lisp for writing web applications rather exotic
- Present code has evolved over many iterations with changing requirements and designs, and needs to be refactored (independently of language choice)

Editor Interface

- An expert-only web-based GUI to edit the raw content of the PDG database
- Knows about connections between tables and constraints on input values

EDITOR interface - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppprod-editor/forms.brl?usagei=M

Go

PDG particle data group | Particle Data | Reviews

Help Log out Send feedback

FORMS: Forms for Measuren

Column header
Correlation
Correlation
Fit control1
Fit control2
Fit Correlation Matrix
Fit seed

Footnote
Footnote body
Footnote linkage
Measurement
Measurement/Footnotes
Reference/Measurements
Reference with long inline comment

Reference with long measurements
THIS PAGE (forms_homepage)
Units
Units none
WWW EDITOR

Other tools:

Transaction viewer
Node viewer
Encoder interface
Utilities (old files)
Check refinfo
Update table Treesort

Documentation:

Red book
Green book
Forms book
RPP upgrade (Wiki)

Done pdg0.lbl.gov

https://pdg0.lbl.gov - REFERENCE MEASUREMENT form - Mozilla Firefox

Where: Order by: source_year desc,s default Table-info save

1. Search for a publication

SOURCE NAME	YEAR	OCC	PUBLICATION NAME	FOREIGN	TMP	REFID		
ABE	2004						Find	reset
ABE	2004	A	PL B578 45			49811	copy	del
ABE	2004	B	PRL 92 171802			49938	copy	del
ABE	2004	C	PR D69 072003			49963	copy	del
ABE	2004	D	PR D69 112002			50011	copy	del
ABE	2004	E	PRL 93 021601			50056	copy	del

8 found ▼ DOWN ▲ UP NEXT PAGE PREVIOUS PAGE FIRST PAGE LAST PAGE

QUERY

2. Choose desired entry

Where: Order by: source_year desc, default Table-info save

NODE	RefId	NAME	YEAR	Oc	Oc	MEASUREMENT	#Ev	CL	P	F	Tech	Chg	COMMENT	MM	YYYY	Ps	Ver_id	Sy	S2	Ty		
																					Find	reset
S035R53	49938	ABE	2004	B		< 3.1E-7		90.0N			BELL		86.3 fb#sup{#n{-1}}, ;1		2005						copy	del

3. Display and edit measurements

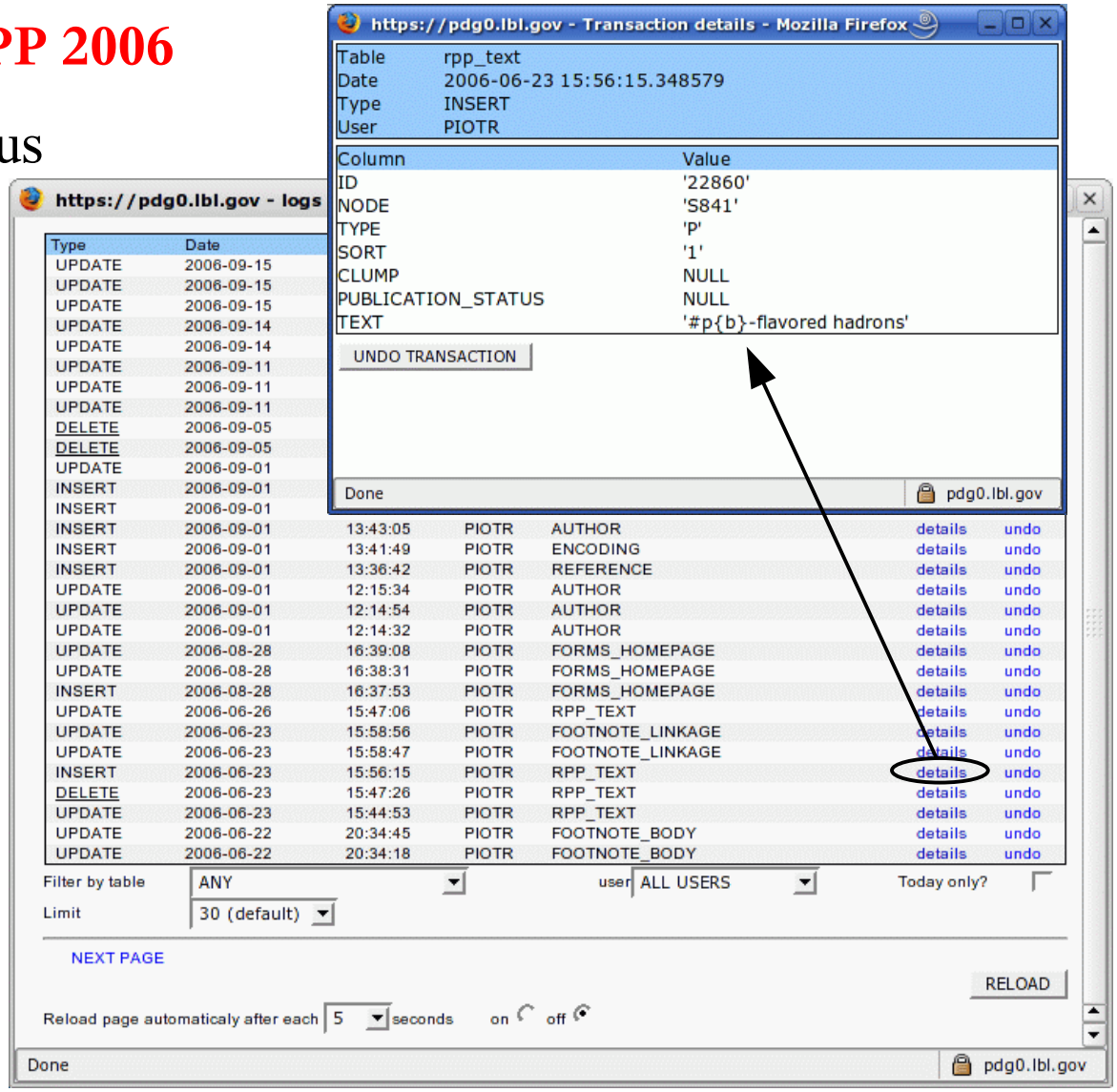
1 found ▼ DOWN ▲ UP NEXT PAGE PREVIOUS PAGE FIRST PAGE LAST PAGE

	49938	ABE	2004	B																	<	copy	del

Done pdg0.lbl.gov

Status of Editor Interface

- **Completed in time for RPP 2006**
- Full replacement of previous Oracle/FORMS interface with several improvements:
  - Database transaction logger with “undo”
  - Improved access to tree table
  - Easily customizable to support new database tables
- Sufficient for short-term
- Maintenance issues



Database Viewer (pdgLive)

pdgLive Homepage - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://pdglive.lbl.gov/listings1.brl?quickin=Y&fsizein=1.2

BETA VERSION

PDG Live

Help
Send feedback
Font size: + / - / Reset

Please use this CITATION: W.-M.Yao et al. (Particle Data Group), J. Phys. G 33, 1 (2006)

Switch to alternative version

GAUGE & HIGGS BOSONS	LEPTONS	QUARKS
Reviews on Gauge & Higgs Bosons	**Reviews on Leptons**	**Reviews on Quarks**
γ	e, μ, τ	Light quarks (u, d, s)
gluon	Heavy Charged Lepton	c
graviton	Neutrino Properties	b
W	Number of Neutrino Types	t
Z	Double β-Decay	b'
Higgs Bosons	Neutrino Mixing	Free quark
Heavy Bosons	Heavy Neutral Leptons	
Axions		

MESONS	BARYONS	OTHER SEARCHES
Reviews on Mesons	**Reviews on Baryons**	**Reviews on Other Searches**
Light Unflavoured	N **Baryons**	Magnetic Monopole
Further States	Δ **Baryons**	Supersymmetric Particles
Strange	**Exotic Baryons**	Technicolor
Charmed	Λ **Baryons**	Quark and Lepton Compositeness
Charmed, Strange	Σ **Baryons**	Extra Dimensions
Bottom	Ξ **Baryons**	WIMPs
Bottom, Strange	Ω **Baryons**	
Bottom, Charmed	**Charmed Baryons**	
$c\bar{c}$	**Doubly-Charmed**	
$b\bar{b}$	**Bottom Baryons**	
Non $q\bar{q}$ Candidates		

CONSERVATION LAWS
Reviews on Conservation Laws
Discrete Space-Time Symm.
Number Conservation Laws

Funded by US DOE, US NSF, CERN, MEXT (Japan), INFN (Italy), MCYT (Spain), IHEP & RFBR (Russia)

Copyright Information: This page and all following are copyrighted by the Regents of the University of California

Done

- A web application to browse the contents of the PDG database
- **Used for pdgLive, our public interface:** http://pdgLive.lbl.gov
  - See demonstration
- **Beta version of pdgLive announced publicly 7/18/2006**
- Used internally to view master database
- Why "beta"? Mainly maintenance concerns

What Users Told Us About pdgLive

- “This is one of the nicest, clearest, and most useful Web pages in HEP. Superb job.”
- “PDG Live is absolutely wonderful. ... Plus, it's really beautiful and lots of fun. I'm so excited I can't even tell you.”
- “Bravo! This is the way I always hoped to browse PDG on the web!”
- “Question: What size army of graduate students was utilised to get pdglive accomplished?”
- ...
- Suggestions:
  - Add links to all reviews (not only the mini-reviews in the Listings)
  - Make decay products link to the corresponding particles
- No bugs reported so far ...

Encoder Interface

- Encoder interface is a web-based application that allows
  - Encoders to enter new measurements
  - Overseers to check, edit and sign off on new entries, fits and averages
  - Editor to check, edit and sign off on new entries
- Encoders can enter (most) encodings entirely themselves
  - **Task oriented system** guides user and knows what pieces of information need to be entered and how to store them into the underlying database
  - Immediate feedback on how it will look in the Listings
  - Allows editor to concentrate on his main tasks
- Simplifies encoding process by managing flow of information between encoders/overseers/coordinators/editor and (eventually) verifiers
- Make precise reports about actual status of encoding possible
- Special tools for meson team

BERINGERPDG List of tasks - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppdemo-encoder/task_list.brl?ufiltr=BERINGER&tfiltr=4

PDG particle data group Encoding System

Send feedback

Help | Vocabularies | View published database | View current database | Add / modify Paper | Meson Team Matrix | Editor Interface | e-mail to Editor

User: BERINGER
Editor status:
Change password
Sign Out

Primary selection: Show **All tasks where I have any role** for user **BERINGER**

Additionally filter tasks by: Status Ignore (exclude published) Contents Ignore Do not show tasks last modified before: JAN 1991
Role Ignore Particle Ignore

Status	Resp	Particle	Par.Code	Author	Year	Journal Number				Chg. date	Paper Summary
Encode	TANABASHI	Heavy Bosons	S056	ABAZOV	2005H	PR	D71	071104R		2005-09-14	
Encode	HAGIWARA	t	Q007	ABAZOV	2005L	PR	D72	011104R		2005-09-14	
Encode	TANABASHI	Heavy Bosons	S056	ABBIENDI	2005	PL	B609	20		2005-02-17	
Check(EDR)	Editor	η	S014	ABDEL-BAR+	2005	PL	B619	281		2005-11-17	
Encode	TANABASHI	Heavy Bosons	S056	ACHARD	2005A	PL	B616	159		2005-09-14	
Encode	HAGIWARA	t	Q007	ACOSTA	2005A	PRL	95	102002		2005-09-13	
Encode	HAGIWARA	t	Q007	ACOSTA	2005D	PR	D71	031101R		2005-09-14	
Encode	TANABASHI	Heavy Bosons	S056	ACOSTA	2005I	PR	D71	112001		2005-09-14	
Encode	TANABASHI	Heavy Bosons	S056	ACOSTA	2005L	PRL	95	071801		2005-09-16	
Encode	GRAB	η	S014	AKHMETSHI+	2005	PL	B605	26		2005-02-17	
Encode	GRAB	η	S014	AMBROSINO	2005A	PL	B606	276		2005-02-17	
Encode	HAYES	τ	S035	ARMS	2005	PRL	94	241802		2005-09-14	

Page 1 of 2 23 tasks shown

Version for printing

Done pdg0.lbl.gov

Status of Encoder Interface

- **Prototype with major features available and awaits final debugging**
  - Already went through several rounds of user testing (and improvements)
  - Completing debugging/testing is main goal of this visit of Kirill and Slava
  - Hope to start using encoder interface in production system for a few select users before the end of this year
- Restrictions in the present version (ie things that must be done by editor)
  - Cannot create arbitrary new nodes (can create new nodes for branching ratios)
  - Cannot add new particles
  - Cannot change which nodes are used in fits
  - Deliberately do not allow some operations (delete, certain changes to tree)
- Main concerns:
  - Potential concurrency issues
  - Long-term maintainability

Many Other Improvements from Phase 1

- For example: system monitoring

PDG System Status Page - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

PDG particle data group

System S

Status of Cron Jobs:

Status	Job name
OK	archive-backup0.sh_2005_11_30_03_01
OK	archive-backup1.sh_2005_11_30_03_20
OK	rppprod-maintenance_2005_11_30_00_55
OK	snapshot-backup0.sh_2005_11_30_01_02
OK	snapshot-backup1.sh_2005_11_30_02_27

Questions or comments? Please contact Juerg Beringer

PDG System Status Page - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

PDG particle data group

System Status Page

Log file of job: rppprod-maintenance_2005_11_30_00_55 Wed Nov 30 10:11:20 PST 2005

```
Log file for:   /usr/local/pdg/bin/rppprod-maintenance

Starting on:    Wed Nov 30 00:55:00 PST 2005
Log file:       /var/log/pdg/rppprod-maintenance_2005_11_30_00_55.log
User:           pdgdist
Host:           pdg0.lbl.gov

Using PDG_WORK = /services/pdg0/pdgdist


--------------------------------------------------------------------------------
Starting to backup rppprod database into CVS at Wed Nov 30 00:55:00 PST 2005
--------------------------------------------------------------------------------
Checking PDG_WORK ...            /services/pdg0/pdgdist OK
Checking database ...            rppprod OK

Exporting schema of table aliases ...
```

PDG System Status Page - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

```
Index: reference.data.sql
===================================================================
RCS file: /services/pdg0/pdgdist/CVSROOT/database/rpp/data/reference.data.sql,v
retrieving revision 1.20
diff -r1.20 reference.data.sql
565d564
< ABE    2005    E       50915   PRL 95 101801   \N      \N      \N
1238,1239c1237,1238
< ACOSTA        2005    O       50888   PR D72 051104   \N      \N      \N
< ACOSTA        2005    P       50889   PR D72 051107   \N      \N      \N
---
> ACOSTA        2005    O       50888   PR D72 051104R  \N      \N      \N
```

A Few Lessons from Phase 1

- High-level design achieved desired isolation of components, greatly simplifying development and deployment
- The time Piotr (testing) and myself (project management, architectural work, testing) can spend on the upgrade is one of the key limiting factors
  - Led to postponing final debugging and deployment of encoder interface
  - In 2004/5 I spent far more time on PDG computing than allocated
    - Cannot be repeated - significant slowdown of progress this year
- While we did succeed in completing production-quality applications in spite of exotic programming language, ...
- Experience of debugging clearly demonstrates that rewriting of existing code base is unavoidable in the long term
- At database level, primarily need a better separation between scientific content and output format (need to define a meta-language)

So What's Next?

- Completion of phase 1 eliminates risk from possible failure of old system
- But it is only the first step:
  - **We do not yet have a system that will be maintainable in the long term**
  - Present system does not address the full functionality
    - No support for handling reviews, verification process, several other issues
- Extensive full-day review by LBNL Physics Division on December 6, 2005
  - Reviewers agreed with our assessment regarding long-term maintainability
  - Recommended replacing tools from phase 1 with new applications developed using industry standard tools and practices, based on proper requirements and design studies for each key component
    - Preliminary project estimate by LBNL IT Division (Jeff Willer) gives cost of about $45k for completing analysis, functional review, and proper cost estimate
  - Recognized the need for substantial additional resources

Planning for Phase 2

- High-level requirements need to include everything we'll ultimately need
- In addition to the primary applications (editor and encoder interface, auxiliary programs, database viewer/pdgLive), will ultimately need at least:
  - Review author interface
  - Interface for updating institution database
  - Mailing system
  - Product ordering system
  - System monitoring
  - Status reporting
  - User profile management
- **Taking into account dependencies among components, required effort and expected benefits, developed a preliminary roadmap for phase 2**
  - Roadmap document describes high-level requirements, milestones and tentative target dates for phase 2
  - **Actual progress of phase 2 will depend greatly on when and how much additional resources will become available**
    - Need to keep producing the book in parallel to work on computing upgrade!

Milestones and Tentative Schedule

NOTE: the dates below are merely a first guess and are extremely preliminary!

Tentative target date	***Milestone***
As soon as possible	Estimate cost, identify resources, and agree on schedule
November 2006	Complete debugging of and deploy existing encoder interface prototype
July 2007	Agree on database schema and meta-language
July 2007	Complete and deploy the new system for managing user information (including all relevant applications)
October 2007	Complete review author interface
July 2008	Complete and deploy new encoder interface
2008	Complete new database viewer
2008/9	Complete update of programs and editor interface (if needed)

Conclusions

- **Completion of all essential parts (and more!) of phase 1 in time for production of RPP 2006 with the upgraded system is a major success**
- Existing system plus soon to-be-debugged encoder interface is expected to be sufficient for us to function until upgrade will be complete
- Main purpose of phase 2 is to arrive at a computing system that
  - Will be maintainable in the long term (10 years), is based on sound technology choices and is well documented
  - Provides at least the same essential functionality available now in the editor interface, pdgLive and prototype encoder interface, but will hopefully be complemented by additional new applications helping us to streamline the book production and work more efficiently
- **Carrying out phase 2 will require a significant effort (4 FTE-years?) that will only be possible through additional resources**
  - Roadmap document provides high-level requirements and tentative milestones
  - Actively working on obtaining additional resources

Demonstration of Encoder Interface

- Will encode the following paper:

PRL **94**, 101805 (2005) PHYSICAL REVIEW LETTERS week ending 18 MARCH 2005

Measurement of the Michel Parameter ρ in Muon Decay

J. R. Musser,[6] R. Bayes,[7,*] Yu. I. Davydov,[7,†] P. Depommier,[4] J. Doornbos,[7] W. Faszer,[7] C. A. Gagliardi,[6] A. Gaponenko,[1] D. R. Gill,[7] P. Green,[1] P. Gumplinger,[7] M. D. Hasinoff,[2] R. S. Henderson,[7] J. Hu,[7] B. Jamieson,[2] P. Kitching,[1] D. D. Koetke,[8] A. A. Krushinsky,[3] Yu. Yu. Lachin,[3] J. A. Macdonald,[7,‡] R. P. MacDonald,[1] G. M. Marshall,[7] E. L. Mathie,[5] L. V. Miasoedov,[3] R. E. Mischke,[7] P. M. Nord,[8] K. Olchanski,[7] A. Olin,[7,*] R. Openshaw,[7] T. A. Porcelli,[7,§] J.-M. Poutissou,[7] R. Poutissou,[7] M. A. Quraan,[1] N. L. Rodning,[1,‡] V. Selivanov,[3] G. Sheffer,[7] B. Shin,[7,‖] F. Sobratee,[1] T. D. S. Stanislaus,[8] R. Tacik,[5] V. D. Torokhov,[3] R. E. Tribble,[6] M. A. Vasiliev,[6] and D. H. Wright[7,¶]

(TWIST Collaboration)

[1]*University of Alberta, Edmonton, Alberta T6G 2J1, Canada*
[2]*University of British Columbia, Vancouver, British Columbia V6T 1Z1, Canada*
[3]*Kurchatov Institute, Moscow 123182, Russia*
[4]*University of Montreal, Montreal, Quebec H3C 3J7, Canada*
[5]*University of Regina, Regina, Saskatchewan S4S 0A2, Canada*
[6]*Texas A&M University, College Station, Texas 77843, USA*
[7]*TRIUMF, Vancouver, British Columbia V6T 2A3, Canada*
[8]*Valparaiso University, Valparaiso, Indiana 46383, USA*
(Received 29 September 2004; published 18 March 2005)

The TWIST Collaboration has measured the Michel parameter ρ in normal muon decay, $\mu^+ \to e^+\nu_e\bar{\nu}_\mu$. In the standard model, $\rho = 3/4$. Deviations from this value imply mixing of left- and right-handed muon and electron couplings. We find $\rho = 0.750\,80 \pm 0.000\,32(\text{stat}) \pm 0.000\,97(\text{syst}) \pm 0.000\,23$, where the last uncertainty represents the dependence of ρ on the Michel parameter η. This result sets new limits on the $W_L - W_R$ mixing angle in left-right symmetric models.

DOI: 10.1103/PhysRevLett.94.101805 PACS numbers: 13.35.Bv, 12.60.Cn, 14.60.Ef

Encoding (Old Style)

```
##########################################################################################

Reference:
==========
Document ID              Publication              Overseer       Particle
MUSSER  05               PRL 94 101805            BERINGER       S004

Authors                                                Collab/Lab
+J.R. Musser, Bayes,Davydov,Depommier et al            TWIST

Measurements:
-------------
Node      FN     Valuestatsyst      cl.  Evt   Tecn  Chrg  Comment   --------|    Usage
S004RHO  A  0.75080+-0.00032+-0.00100     6G   SPEC  +     surface  mu+           used
                                                           at TRIUMF

Footnote A:  The quoted systematic error includes a contribution of 0.00023
             (added in quadrature) from the dependence on the Michel parameter \eta.

##########################################################################################
```

PDG Encode Meas. info - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppdemo-encoder/meas_info.brl

PDG particle data group Encoding System

Send feedback

Help | Vocabularies | View published database | View current database | Add / modify Paper | Meson Team Matrix | Editor Interface | e-mail to Editor

User: BERINGER
Editor status:
Change password
Sign Out

No messages | ADD / DELETE MESSAGES

Task List | Paper Info. | Meas. Info. | CheckandSignoff

CURRENT PAPER: **MUSSER 2005 PRL 94 101805** | Find in SLAC SPIRES

Node	Footnote Place	Measurement	CL	Events	TECN	Inline Comment	Charge	OCC	Hide
show data	U								
ρ PARAMETER				footnotes:					
S004RHO	U	0.75080+-0.00		6G	SPEC	surface μ^+ at TRIUMF	+		

Reset Fields | Save Changes

Toolbox:

Add/modify decay mode | branching ratios | for particle: M001

Copy from datablock | for node: | (select)

View/Edit datablock | for node: select | (select)

View/Edit summary table | for particle: M001

Done | pdg0.lbl.gov

PDG Encode Meas. info - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppdemo-encoder/meas_info.brl

PDG particle data group Encoding System

Send feedback

User: BERINGER

Editor status:

Change password

Sign Out

No messages

ADD / DELETE MESSAGES

Task List

CURRENT PAPER: MUSSER 2

Find in SLAC SPIRES

Node

Footnote Pl

OCC Hide

show data

SPEC

surface μ^+ at TRIUMF

+

Add/modify decay mode | branching ratios | for particle: M001

Copy from datablock | for node: | (select)

View/Edit datablock | for node: select | (select)

View/Edit summary table | for particle: M001

Done

pdg0.lbl.gov

DATABLOCK LIST - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppdemo-encoder/datablock_list.brl?fieldname=measurement_form__NODE&ftype=

click on par. code to see the list of datablock nodes

Help Send feedback

LEPTONS

S004 Data Block Nodes

- S004AL α/A
- S004ALP α'/A
- S004AMU μ MASS (atomic mass units u)
- S004BT β/A
- S004BTP β'/A
- S004CTA
- S004DEL δ PARAMETER
- S004DT τ_μ^+/τ_μ^- MEAN LIFE RATIO

Done

pdg0.lbl.gov

https://pdg0.lbl.gov

Click on Node link to open a window from which you can select a node for new measurement. If there are no appropriate nodes for your measurement in the list and the measurement is for branching ratios - use ADD/MODIFY DECAY MODES & BRANCHING RATIOS button to add new branching ratio node (and new decay, if needed), if the measurement is not for branching ratios - ask an Editor by e-mail to put a new node or put a message to Editor (ADD/DELETE MESSAGES button) describing what new section (node) you need to have for new measurement. Click Show Data link to view the datablock for the chosen node.

OK

OPDG Check and Signoff - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppdemo-encoder/check_signoff.brl

PDG particle data group **Encoding System**

Send feedback

Help | Vocabularies | View published database | View current database | Add / modify Paper | Meson Team Matrix | Editor Interface | e-mail to Editor

User: BERINGER
Editor status:
Change password
Sign Out

No messages — ADD / DELETE MESSAGES

Task List | Paper Info. | Meas. Info. | Check and Signoff

CURRENT PAPER: **MUSSER 2005 PRL 94 101805** — Find in SLAC SPIRES

Color Nonsinglet Spectroscopy

J.R. Musser TWIST

Encoded data

Place	Measurement		(Unit)	Particle (Section)	Observable	
used	0.75080	± 0.00032	± 0.00100	S004RHO μ	ρ PARAMETER	Show Data / Average, Fit and Preview

Sign off encodings

Particle (Section)	Code	Prop.	Finder	Date entered	Status date	Contents	
μ	S004		BERINGER	2006-09-21	2006-09-21	Unknown	Signoff this encoding

Done — .lbl.gov

ρ PARAMETER

($V-A$) theory predicts $\rho = 0.75$.

VALUE	EVTS	DOCUMENT ID		TECN	CHG	COMMENT
0.7509 ±0.0010 OUR NEW AVERAGE [0.7518 ± 0.0026 OUR 2005 AVERAGE]						
0.75080 ±0.00032 ±0.00100		MUSSER	05	SPEC	+	surface μ^+ at TRIUMF
0.7518 ±0.0026		DERENZO	69	RVUE		
• • • We do not use the following data for averages, fits, limits, etc. • • •						
0.72 ±0.06 ±0.08		AMORUSO	04	ICAR		Liquid Ar TPC
0.762 ±0.008	170k	FRYBERGER	68	ASPK	+	25–53 MeV e^+
0.760 ±0.009	280k	[28] SHERWOOD	67	ASPK	+	25–53 MeV e^+
0.7503 ±0.0026	800k	[28] PEOPLES	66	ASPK	+	20–53 MeV e^+

[28] η constrained = 0. These values incorporated into a two parameter fit to ρ and η by DERENZO 69.

https://pdg0.lbl.gov - PDG List of Responsibilities - Mozilla

File Edit View Go Bookmarks Tools Help

PDG List of Responsibilities

GAUGE & HIGGS BOSONS

section name	par.code	par. prop.	encoder	par. prop
γ	S000		GRAB	
graviton	G033		GROOM	
W	S043		CASO, GURTU	CA
Z	S044		CASO, GURTU	CA
Higgs Bosons	S055		HIKASA	
Heavy Bosons	S056		TANABASHI	
		AST	OLIVE	
Axions	S029		MURAYAMA	
		S029MT	PIEPKE, VOGEL	MT
		NUCL	PIEPKE, VOGEL	
		AST	OLIVE	
gluon	G021		MANOHAR	

https://pdg0.lbl.gov - Edit Summary - Mozilla Firefox

Particle: M001

ω(782) $I^G(J^{PC}) = 0^-(1^-$

Due to the length of this section, not all information is displayed. To expand a c
expanded section, click on the ▲ icon. To view a fully expanded version of this s

Mass m = 782.65 ± 0.12 MeV (S = 1.9)
Full width Γ = 8.49 ± 0.08 MeV
Γ_{ee} = 0.60 ± 0.02 keV

ω(782) DECAY MODES

Γ_i	Mode	Fraction (Γ_i / Γ)
Γ_1	$\omega(782) \to \pi^+\pi^-\pi^0$	$(89.1 \pm 0.7) \times 10^{-2}$
Γ_2	$\omega(782) \to \pi^0\gamma$	$(8.90^{+0.27}_{-0.23}) \times 10^{-2}$
Γ_3	$\omega(782) \to \pi^+\pi^-$	$(1.70 \pm 0.27) \times 10^{-2}$
Γ_4	$\omega(782) \to$ neutrals (excluding $\pi^0\gamma$)	$(1.6^{+7.4}_{-1.1}) \times 10^{-3}$
Γ_5	$\omega(782) \to \eta\gamma$	$(4.9 \pm 0.5) \times 10^{-4}$
Γ_6	$\omega(782) \to \pi^0 e^+e^-$	$(7.7 \pm 0.9) \times 10^{-4}$
Γ_7	$\omega(782) \to \pi^0\mu^+\mu^-$	$(9.6 \pm 2.3) \times 10^{-5}$
Γ_8	$\omega(782) \to \eta e^+e^-$	
Γ_9	$\omega(782) \to e^+e^-$	$(7.18 \pm 0.12) \times 10^{-5}$

Done

Meson Team Matrix - read mode - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rpptest-encoder/papers_list_mm_read.brl

PDG Meson Team Matrix

Help | Send feedback

Meson Team Matrix (READ MODE)

go to **EDIT MODE**
Version for printing

Filter papers by Encoder: ALL Overseer: ALL status: Ignore RESET FILTERS
author: SUBMIT FILTER
any letter A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Note	Reference Author ▲/▼	Year ▲/▼		Journal			Encoder	Status	Overseer	Status	Note(tex)	Note(pdf)	Mesons
-	ACHASOV	89		text NP	B315	465	N/A	-	N/A	-	-	-	
-	ACCIARRI	97	T	text PL	B413	147	N/A	-	N/A	-	-	-	$a_2(1320)$ more
-	ACKERSTAFF	97	W	text ZPHY	C76	425	N/A	-	N/A	-	-	-	$D_1(2420)^0$ more
-	ACHASOV	98	I	text PL	B440	442	N/A	-	N/A	-	-	-	$f_0(980)$ more
-	ACHASOV	98	J	text SPU	41	1149	N/A	-	N/A	-	-	-	
-	ADAMS	98	B	text PRL	81	5760	N/A	-	N/A	-	-	-	$\pi_1(1600)$ more
-	ALDE	98		text EPJ	A3	361	N/A	-	N/A	-	-	-	$f_0(980)$ more
-	AMSLER	98		text RMP	70	1293	N/A	-	N/A	-	-	-	$a_0(980)$ more
-	BAI	98	J	text PRL	81	5080	N/A	-	N/A	-	-	-	$\psi(2S)$ more
-	BALDINI	98		text PL	B444	111	N/A	-	N/A	-	-	-	$J/\psi(1S)$ more
-	BARKO												
-	BRISU												
-	BURA												
-	BURA												
-	TROY												

Done

BRANCHING RATIOS - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pdg0.lbl.gov/rppdemo-encoder/MakeBRs.brl?pcode=S004&role=()#S004

Help Send feedback

SHOW DECAYS: SHOW BRANCHING RATIOS:

S004 **μ BRANCHING RATIOS**

Node	BR (show decays)	new BR
	μ^- BRANCHING RATIOS	
		insert
S004R1	$\Gamma(e^-\bar{\nu}_e\nu_\mu\gamma)/\Gamma_{total}$	insert
S004R6	$\Gamma(e^-\bar{\nu}_e\nu_\mu e^+e^-)/\Gamma_{total}$	insert
S004R2	$\Gamma(e^-\nu_e\bar{\nu}_\mu)/\Gamma_{total}$	insert
S004R3	$\Gamma(e^-\gamma)/\Gamma_{total}$	insert
S004R4	$\Gamma(e^-e^+e^-)/\Gamma_{total}$	insert
S004R5	$\Gamma(e^-2\gamma)/\Gamma_{total}$	insert

Done pdg0.lbl.gov