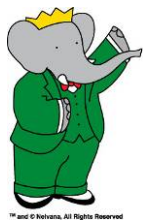
BABAR Overview and Future Plans

David B. MacFarlane

B Factory Operations Review

April 26, 2006

Stanford Linear Accelerator Center



The *BABAR* Collaboration

11 Countries
80 Institutions
623 Physicists

USA [38/311]

California Institute of Technology
UC, Irvine
UC, Los Angeles
UC, Riverside
UC, San Diego
UC, Santa Barbara
UC, Santa Cruz
U of Cincinnati
U of Colorado
Colorado State
Harvard U
U of Iowa
Iowa State U
LBNL
LLNL
U of Louisville
U of Maryland
U of Massachusetts, Amherst
MIT
U of Mississippi
Mount Holyoke College
SUNY, Albany
U of Notre Dame
Ohio State U
U of Oregon
U of Pennsylvania
Prairie View A&M U
Princeton U
SLAC
U of South Carolina
Stanford U
U of Tennessee
U of Texas at Austin
U of Texas at Dallas
Vanderbilt
U of Wisconsin
Yale

Canada [4/24]

U of British Columbia
McGill U
U de Montréal
U of Victoria

China [1/5]

Inst. of High Energy Physics, Beijing

France [5/53]

LAPP, Annecy
LAL Orsay
LPNHE des Universités Paris VI et VII
Ecole Polytechnique, Laboratoire Leprince-Ringuet
CEA, DAPNIA, CE-Saclay

Germany [5/24]

Ruhr U Bochum
U Dortmund
Technische U Dresden
U Heidelberg
U Rostock

Italy [12/99]

INFN, Bari
INFN, Ferrara
Lab. Nazionali di Frascati dell' INFN
INFN, Genova & Univ
INFN, Milano & Univ
INFN, Napoli & Univ
INFN, Padova & Univ
INFN, Pisa & Univ & Scuola Normale Superiore
INFN, Perugia & Univ
INFN, Roma & Univ "La Sapienza"
INFN, Torino & Univ
INFN, Trieste & Univ

The Netherlands [1/4]

NIKHEF, Amsterdam

Norway [1/3]

U of Bergen

Russia [1/13]

Budker Institute, Novosibirsk

Spain [2/3]

IFAE-Barcelona
IFIC-Valencia

United Kingdom [11/75]

U of Birmingham
U of Bristol
Brunel U
U of Edinburgh
U of Liverpool
Imperial College
Queen Mary , U of London
U of London, Royal Holloway
U of Manchester
Rutherford Appleton Laboratory
U of Warwick

Pillars of BABAR physics program

- *Highly constrained and redundant set of precision tests of weak interactions in the Standard Model*

  - Full program of flavor physics/CP violation measurements will provide a legacy of fundamental constraints on future New Physics discoveries

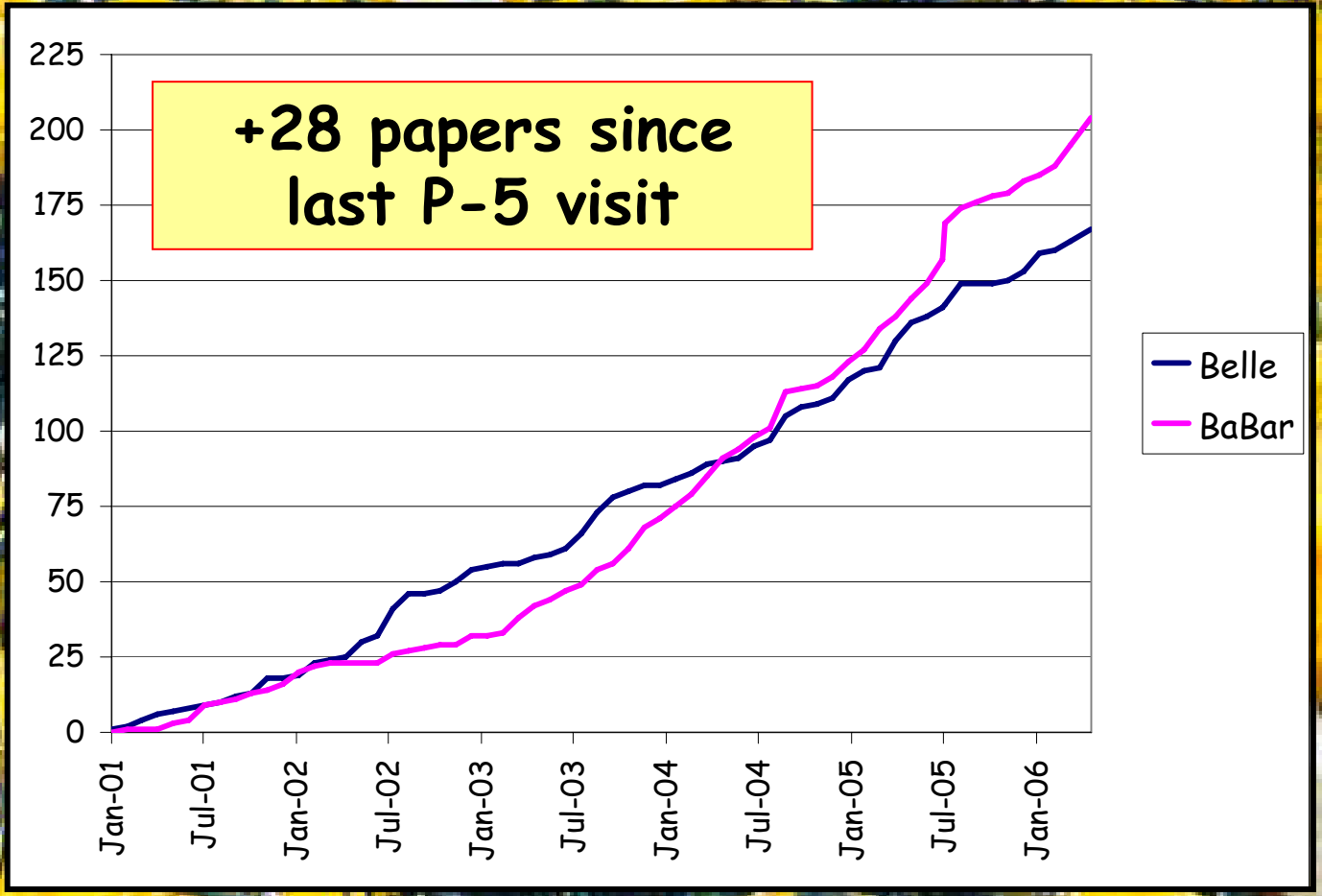
- *Searches for physics beyond the Standard Model in a well understood & characterized environment*

  - Sensitivity to New Physics at LHC mass scales through rare decays and *CP* violation
  - Discovery potential from large data sample across a whole range of beauty, charm, tau, two-photon, ISR physics

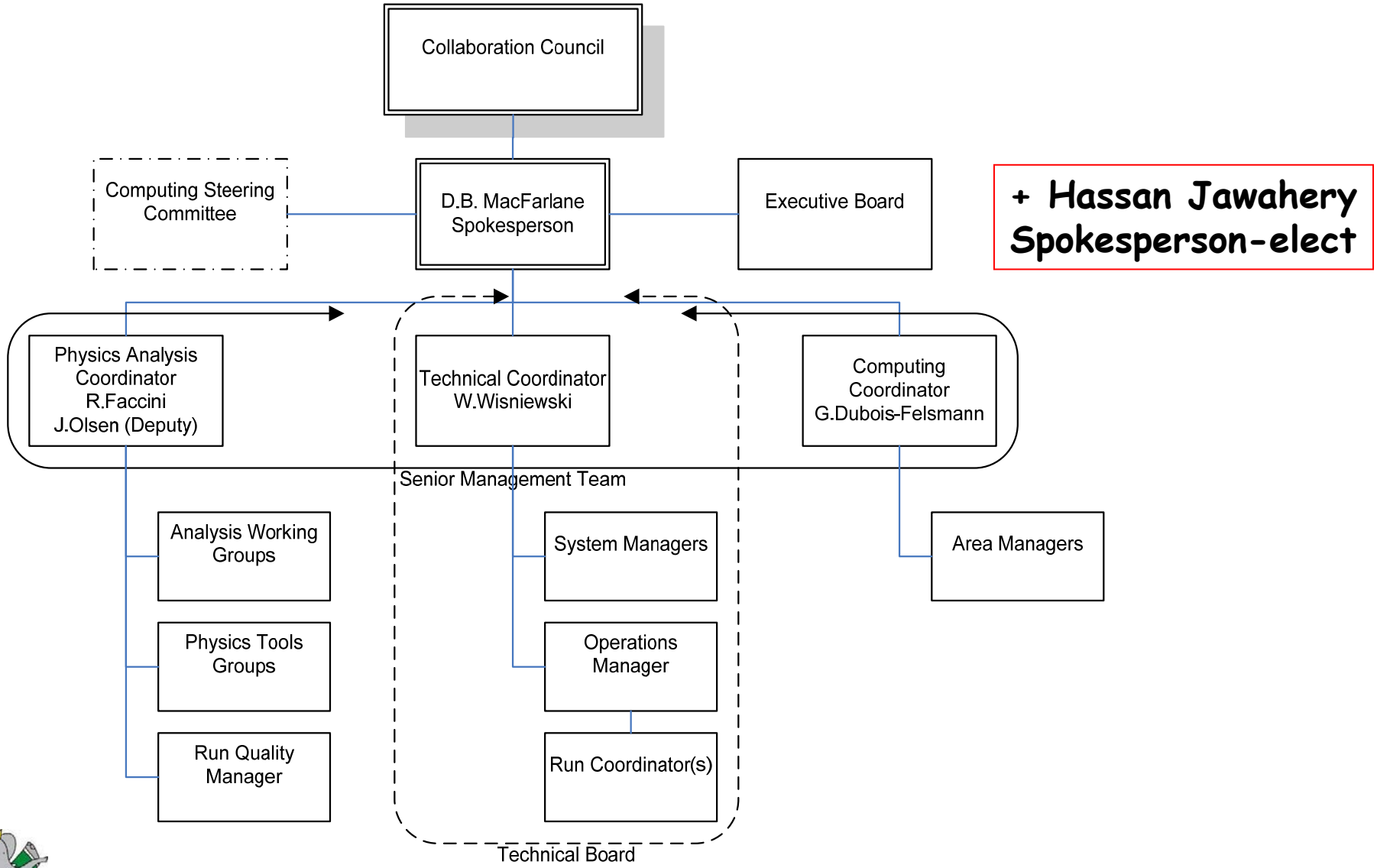
Challenging measurements at the edge of sensitivity benefit enormously from operation of both PEP-II & KEK B Factories

BABAR & Belle physics results

Journal Papers	BABAR	Belle
Total [Today]	204	167



BABAR Organization Chart



Technical Coordinator

- ***Selection***
  - Proposed by Spokesperson after consultations between SLAC and BABAR Management; confirmed by majority of Executive Board for indefinite term
- ***Responsibilities***
  - Broadly responsible for all technical matters related to the BABAR detector
  - In charge of the detector operations and hardware development
    - Manages resources to ensure capability to take data well adapted to the physics requirements of the experiment and to the conditions of the PEP-II rings
    - Supervises detector repairs and upgrades, anticipates and identifies potential problems, and is responsible for identifying the best strategy for their solution
  - Chairs PEPII/BABAR Forum, and together with the Spokesperson is the designated point of contact between the experiment and PEP-II management
  - Chairs the Technical Board, which advises on medium- and long-term issues

Technical Board

- Technical Board includes subsystem managers, senior management team, representatives from computing.
- Senior technical team for the collaboration. Includes electrical, mechanical and software engineers as well as the safety team.

Silicon Vertex Detector (SVT)	-G. Calderini/D. Roberts
Drift Chamber (DCH)	-M. Kelsey/S. Prell
Detector of Internally Reflected Cherenkov light (DIRC)	-J.Schwiening/G. Vasseur
Electromagnetic Calorimeter (EMC)	-M.Kocian/S. Playfer
Instrumented Flux Return (IFR:RPC)	-H. Band/E. Robutti
Instrumented Flux Return (IFR:LST)	-R. Calabrese/A.J.S. Smith
Trigger (TRG)	-D. Su/R. Bartoldus
Machine Detector Interface (MDI)	-W. Kozanecki/M. Weaver

Technical Board

- ***Operations manager***
  - Reports to Technical Coordinator
  - Coordinates BABAR activities in IR-2, working closely with system managers and with chief mechanical and electrical engineers.
  - Proposes Run Coordinators to Technical Board
- ***Run Coordinators***
  - Organize day-to-day BABAR operations
  - Responsible for planning and filling BABAR shifts
- ***Chief Engineers***
  - Work with Operations manager and Technical Coordinator to design and implement maintenance, repairs, and improvements
- ***Safety Officer***
  - Maintains safe and efficient operations environment
  - Reports to Spokesperson and Technical Coordinator

Physics Analysis Coordinator

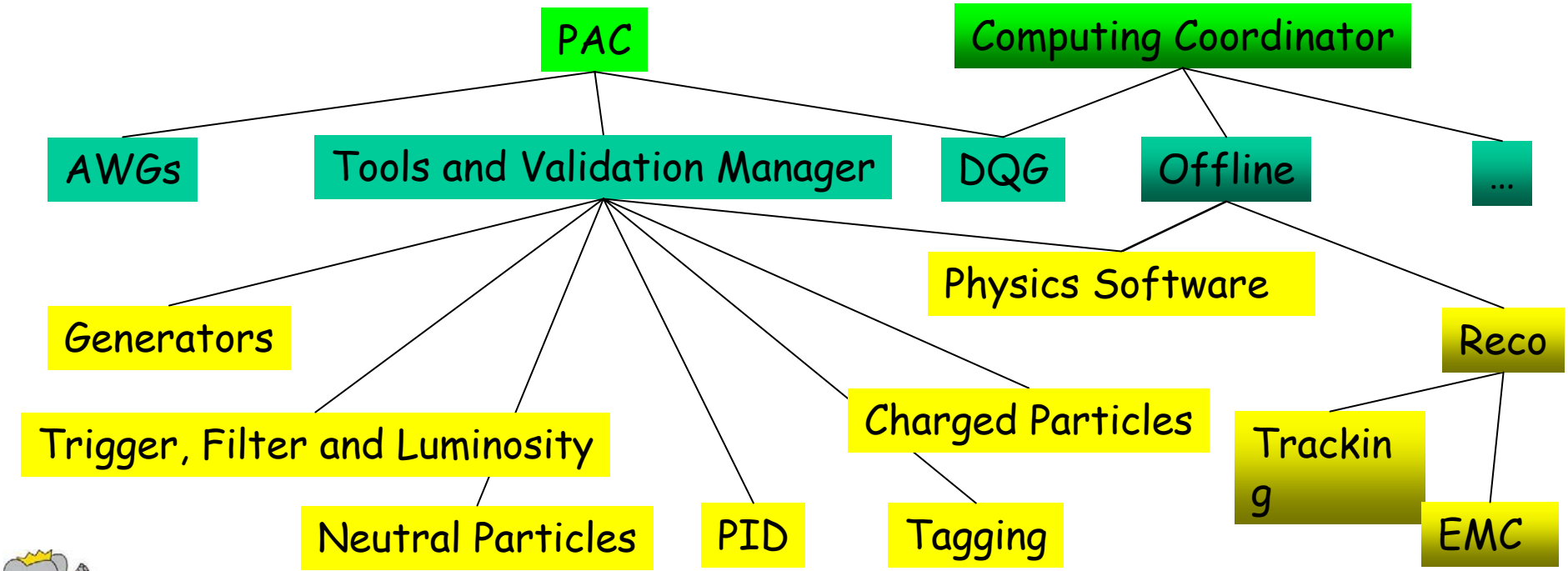
- ***Selection***
  - Proposed by Spokesperson via a search committee; confirmed by majority of Executive Board for a one year term as Deputy, followed by a year as PAC
- ***Responsibilities:***
  - Provides guidance on physics priorities, Monte Carlo production priorities, machine energy parameters, etc
  - Together with the Computing Coordinator, is responsible for a physics and computing integrated plan of delivery of data, MC, skims, and other computing resources
  - Via the Tools and Validation Manager, ensures availability of physics analysis tools to analysts
  - Ensures efficient production of high-quality physics results that realize the full potential of the BABAR detector
  - Gathers abstracts and proposes topics for conference talks; serves as the interface for non-BABAR speakers presenting BABAR results
  - Organizes Physics Analysis parallel and plenary sessions at Collaboration Meetings
  - Organizes Analysis Working Groups (AWGs) and Physics Tools Groups
  - Appoints convener(s) of AWG's in consultation with AWG members

Physics Analysis Organization

- *Physics analysis coordinator & deputy*
- *Advised by analysis coordination team including an advisory group, the pub board and speakers' bureau chairs*
- *Coordinates analysis working groups & tools groups (2 conveners each):*
  - sin2beta/lifetimes & mixing; charmonium; charm; exclusive B decay to charm; charmless B decays (3 sub-groups); inclusive hadronic B Decays; B lifetimes and mixing using fully-reconstructed decays; leptonic b and c decays; radiative penguins; inclusive hadronic particle spectra; inclusive semi-leptonic; exclusive semi-leptonic; tau & QED
  - charged particles ID; neutrals reconstruction and ID; luminosity; trigger and filter

Organization of Tools Groups

- ***Aims:***
  - Single point of contact for PAC and Computing Coordinator:
    - Improved coordination of validation efforts & tools groups
  - Consolidation and rationalization of tools effort



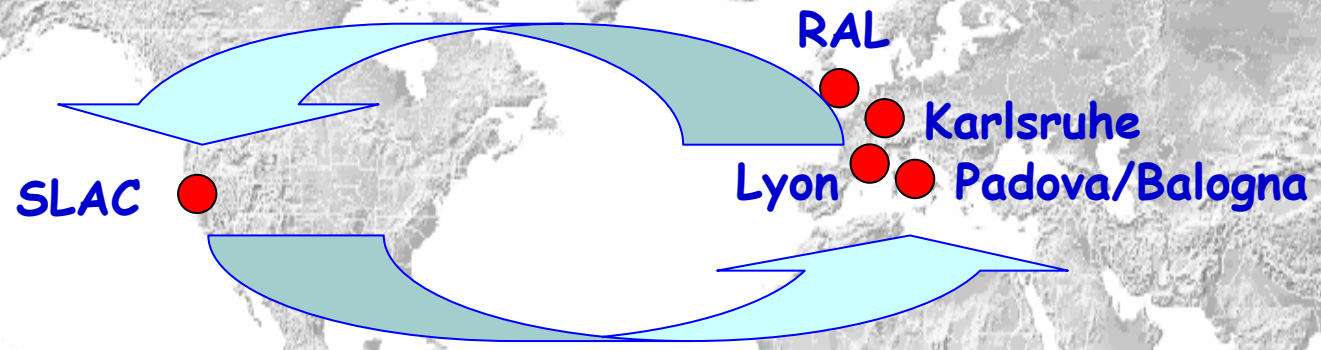
Computing Coordinator

- **Selection:**
  - Proposed by Spokesperson via a search committee; confirmed by majority of Executive Board to serve for an indefinite term
- **Responsibilities:**
  - Manages all aspects of BABAR computing, including offline computing, online computing, operations, and tools.
  - Interacts with coordinators of these areas to plan and implement short- and long-term goals, and to ensure the integrity of the code.
  - Coordinates wide-area networking.
  - In consultation with the Collaboration, decides on supported platforms and code packages.
  - Devises schedules for the development of BABAR software necessary to meet the physics goals of the experiment.
  - Plans necessary hardware acquisitions with the directors of each Tier A computing site.

Scope of Computing System

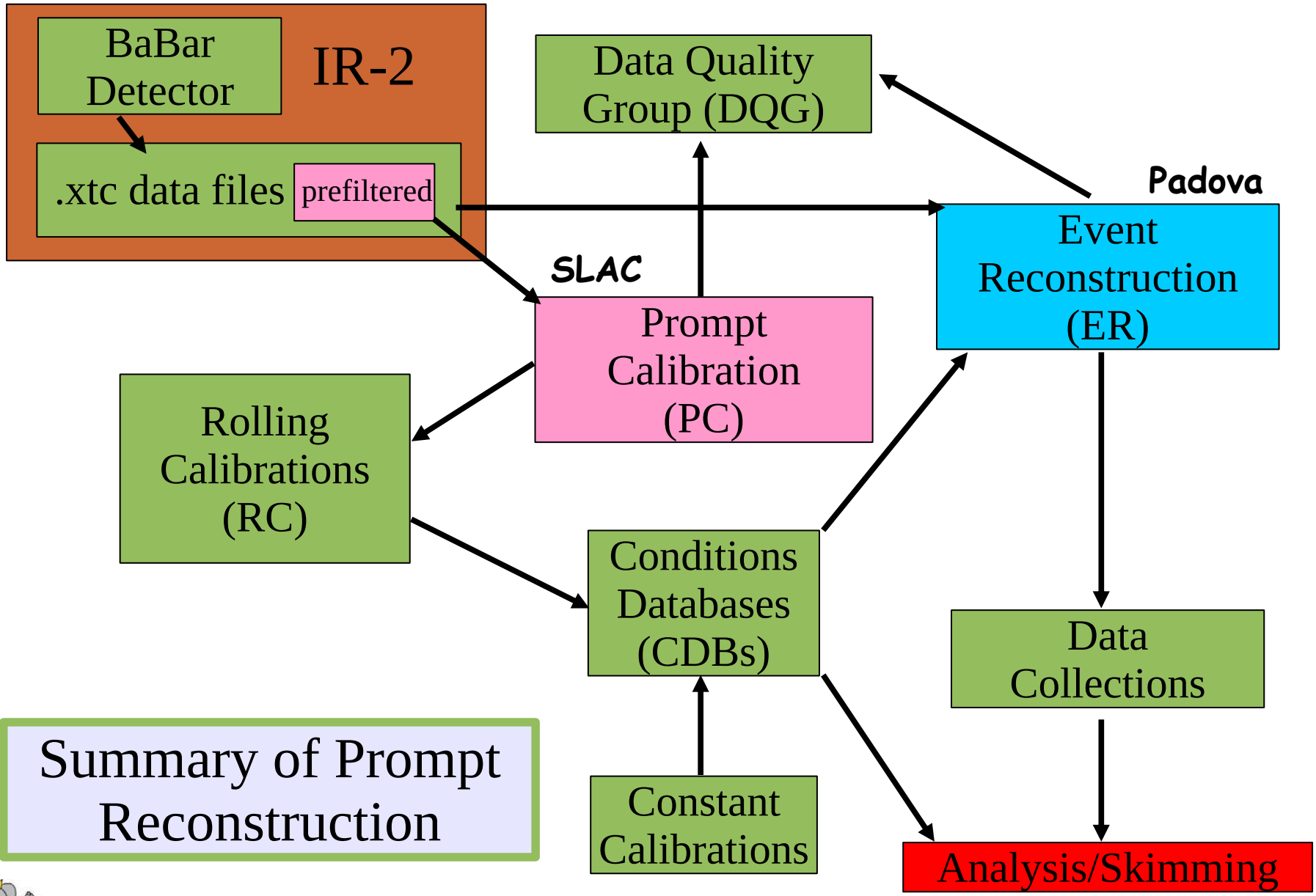
- ***The BABAR Computing System includes the following elements:***
  - Online including data acquisition, control, and monitoring;
  - Offline hardware, including CPU, network, and storage;
  - Software environment in which the computing work is done, including code development/management, user concerns, and distributed computing issues, etc.; and
  - Collaboration code itself, for online, event reconstruction, simulation, analysis, etc.
- ***Computing resources are distributed worldwide***
  - 5 Tier A centers including SLAC
  - About 40 facilities for Monte Carlo production
  - Backbone of computing professionals (22.5 FTE) distributed to various sites

BABAR Tier A computing centers



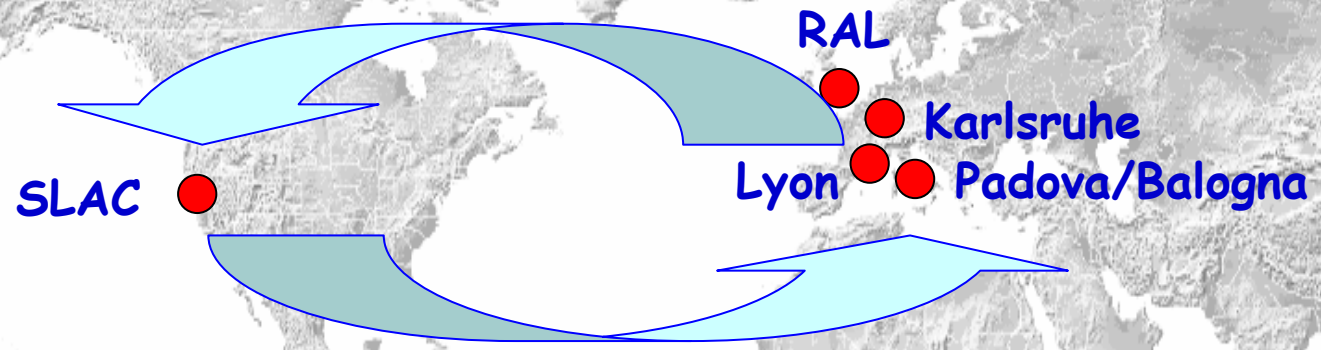
Usage 1

- Fast calibration pass at SLAC
- Data sent via network to Padova for reconstruction & skimming
- Data reconstructed and returned via network to SLAC



Summary of Prompt Reconstruction

BABAR Tier A computing centers



Maximum transfer rates:

IN2P3	3 Tb/day
RAL	2 Tb/day
GRIDKA	1 Tb/day
CNAF	1 Tb/day

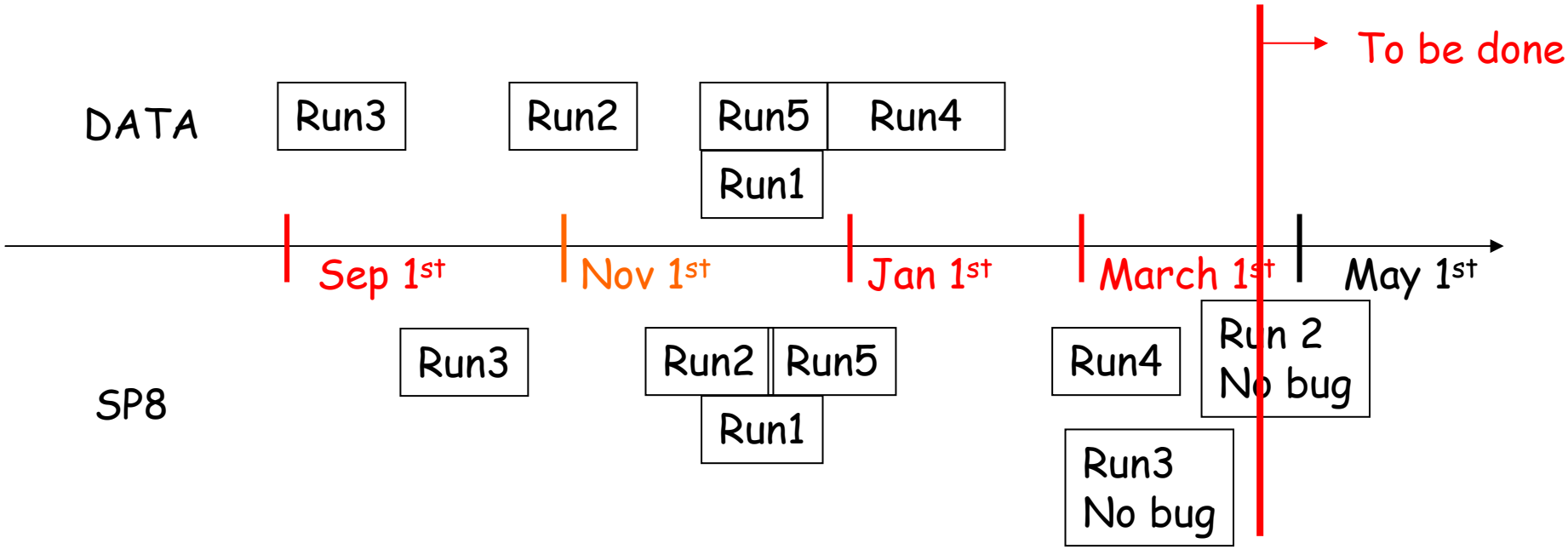
Usage 2

- Data skims are uniquely assigned to Tier A Centers
- Disk space for corresponding Analysis Working Group located at same Tier A

Ongoing shared contributions from all agencies

Operating Common Fund: $2.7 million for CY06
Computing Budget: $2.9 million for CY06

R18 full reprocessing



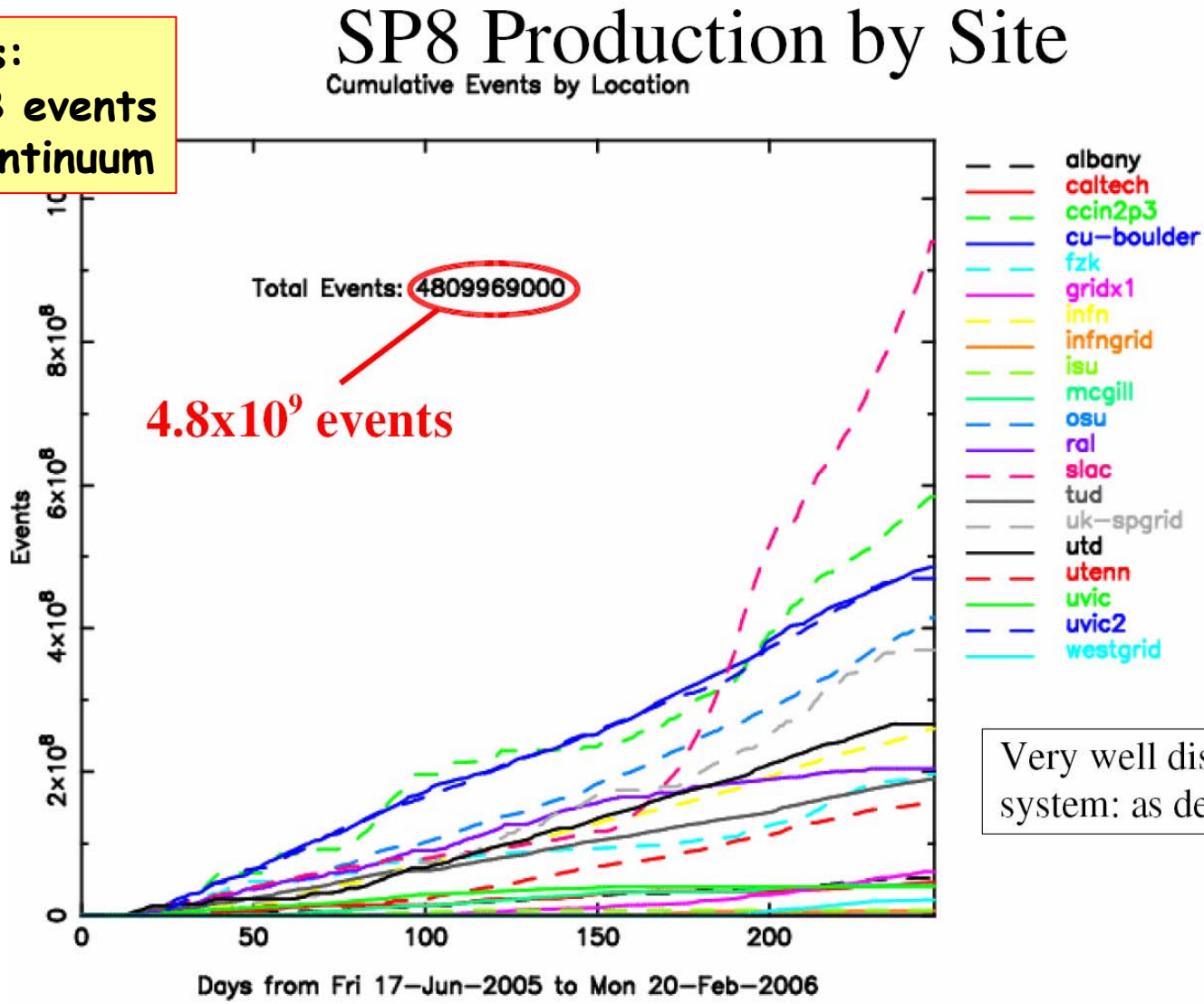
Skims are being allocated uniquely to Tier A sites and SLAC

Relies on planning for adequate resources over time to provide stability:

- o May need to adjust current allocations
- o Need adequate planning horizon

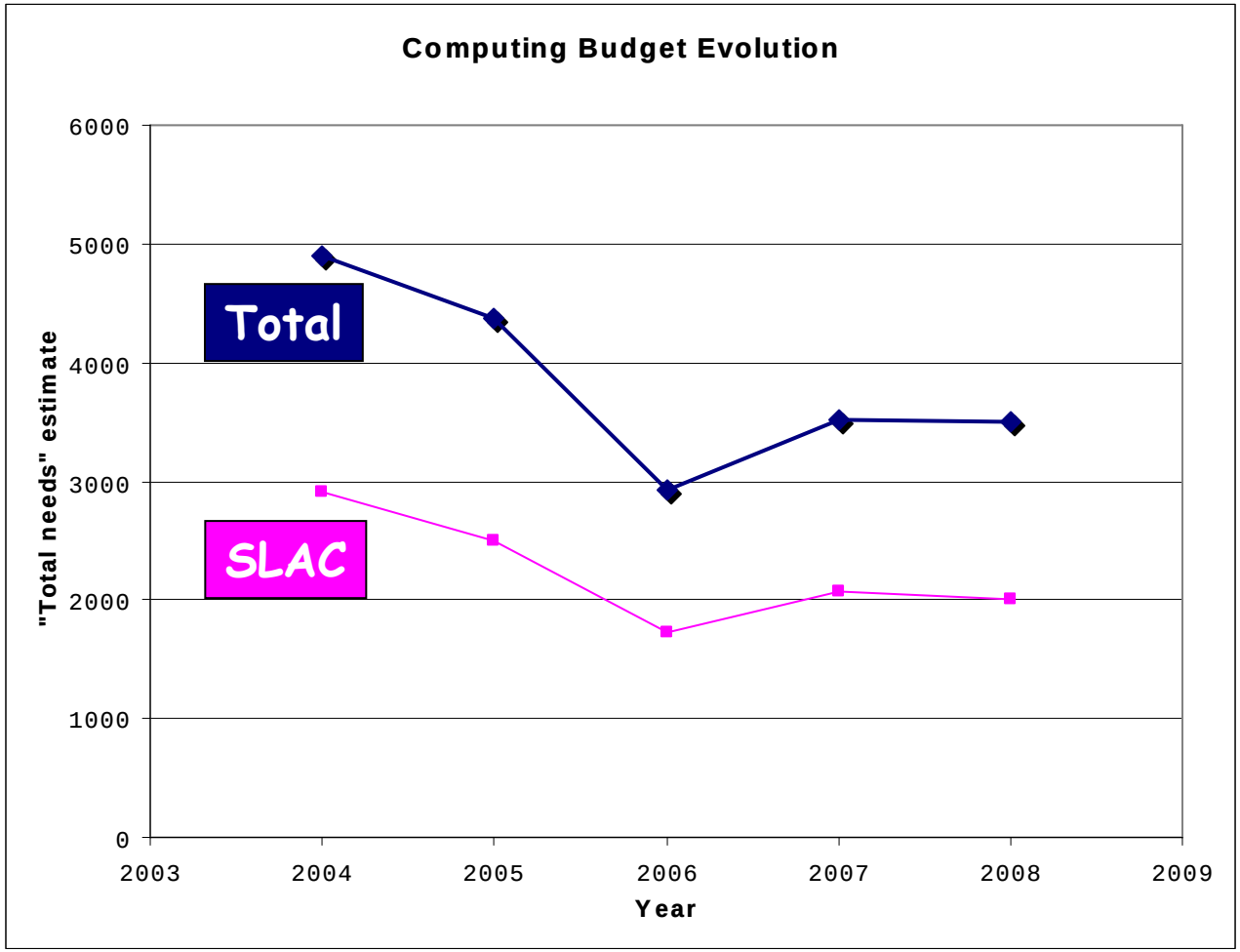
Current Monte Carlo production

Goals:
3x data BB events
1x data continuum



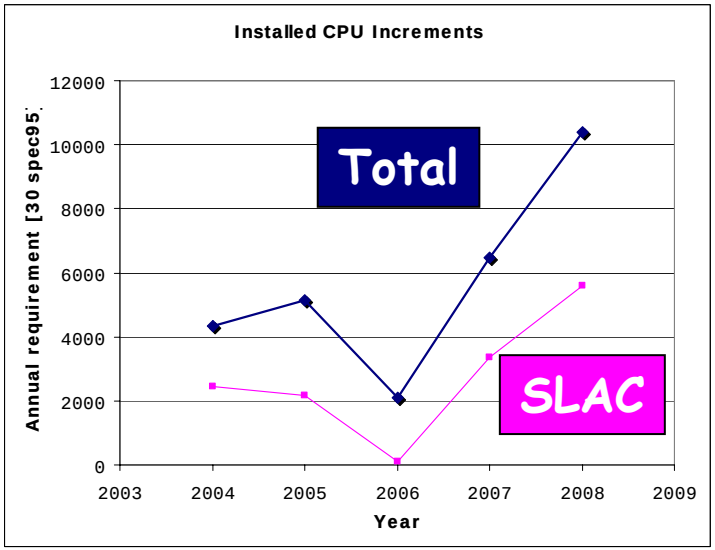
Very well distributed system: as designed!

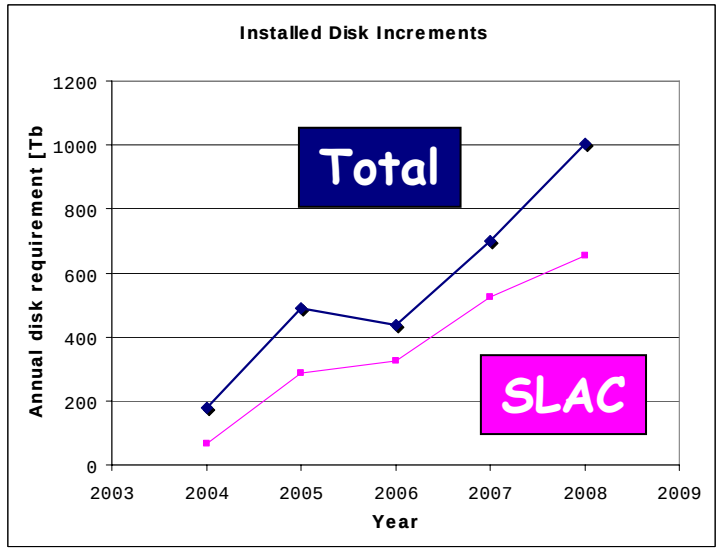
Predicted evolution of computing budget

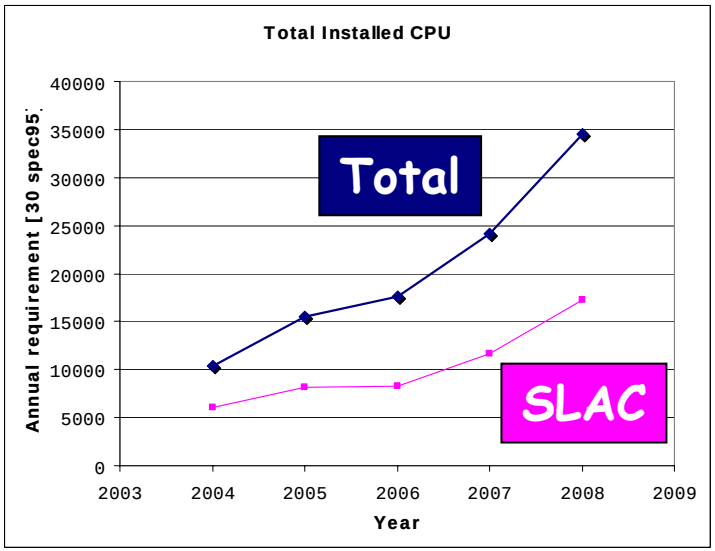


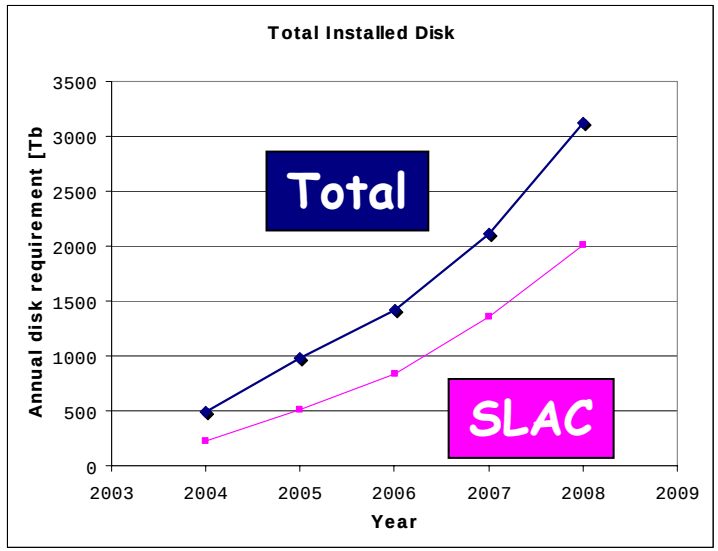
Dip in budget is caused by difference between anticipated and delivered luminosity in 2005

Installed computing capacity



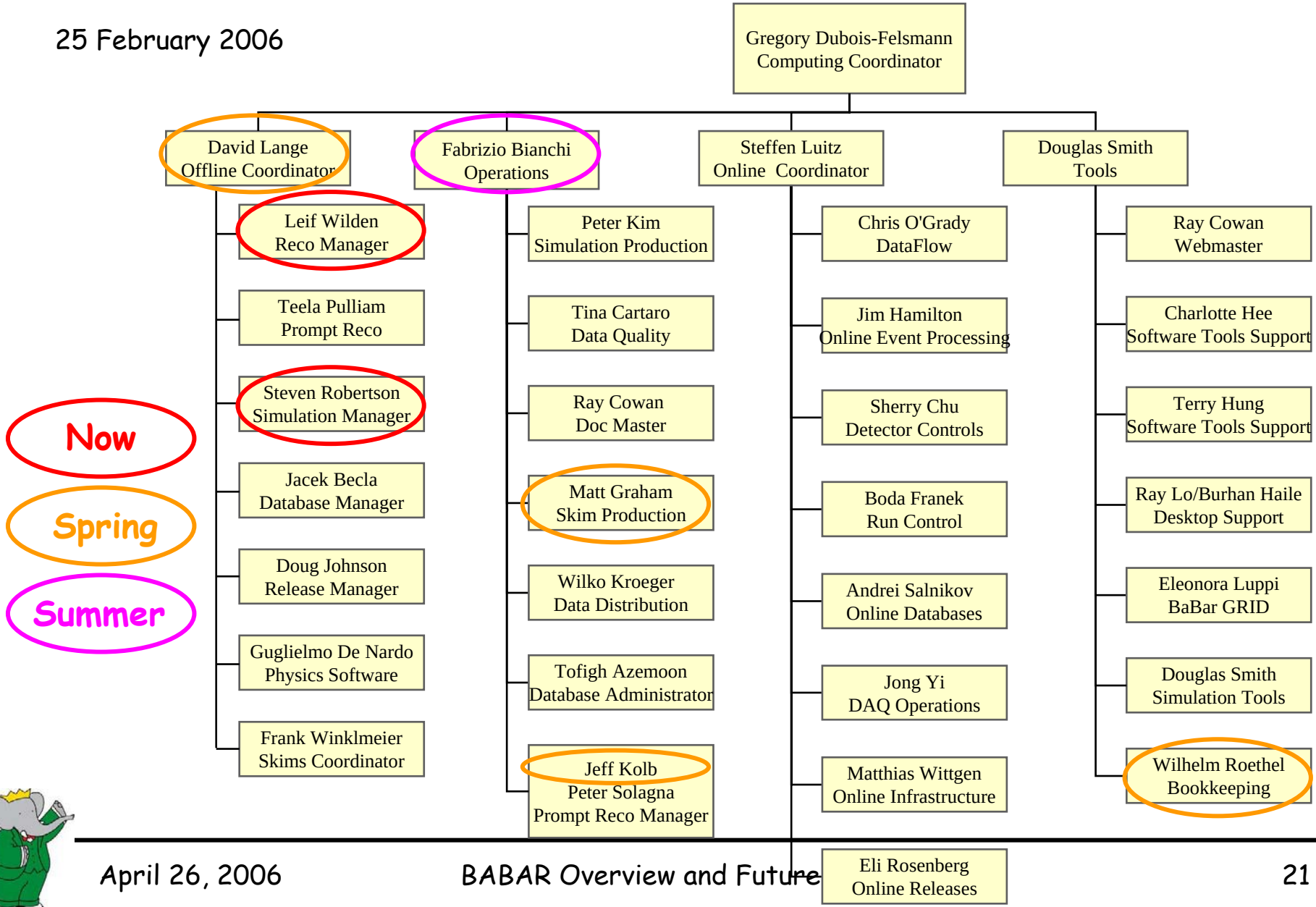






Computing Organization

25 February 2006



Computing professionals - 2006

DOE 8

On-line Core / System Engineer	1.0	Matthias Wittgen
Tools Manager	1.0	Douglas Smith
On-line Core / System Engineer	1.0	Chris O'Grady
Infrastructure	1.0	Charlotte Hee
DB Administrator	1.0	Wilko Kroeger/Tofigh Azemoon
Bookkeeping	0.75	Will Roethel
DataFlow	0.25	Matt Weaver
Geant4 Core	1.0	Dennis Wright
Offline Manager	1.0	David Lange
Total	8.0	

Common Fund "8"

CVS Core Support	1.0	Terry Hung
On-line Database	1.0	Andrei Salnikov
Eventstore Core	0.5	Andrew Hanushevsky
Database Core	0.5	Jacek Becla
Database Core	1.0	Igor Gaponenko (possibly split)
EPICS Core	1.0	Sherry Chu
Reco Core	1.0	(preparing f
Release Manager	0.5	Doug Johns
Total	6.5	

+ 7 FTE non-DOE8 professionals

Computing professionals - 2006

Non-DOE 8		
Infrastructure	1.0	Jean Yves Nief (France)
Infrastructure	0.5	Zoulikha Georgette (France)
Reco-core	0.5	Unfilled (France)
Online Run Control	0.5	Boda Franek (UK)
Kanga Development	0.5	David Bailey (UK)
Grid Tools	0.5	Chris Brew (UK)
Bookkeeping	0.5	Tim Adeye (UK)
Framework Core Support	0.5	Asoka de Silva (Canada)
Reco Core	0.5	Matthias Steinke (Germany)
XRootd	0.8	Fabrizio Furano (Italy)
Database Core	0.5	Elisa Stevanato (Italy)
Grid Tools	0.7	Armando Fella (Italy)
Grid Tools	1.0	Daniele Andreotti (Italy)
Total	**8.0**	

DAQ replacement and upgrade

- ***Arguments for replacement:***
  - Online event build switch may not keep up comfortably with increased rates and event sizes through 2008
  - Online farm (Event Build / OEP / Level 3) will be over six years old by 2008
    - Well beyond normal replacement lifetime for production systems
  - Farm capacity may also not be sufficient
- ***Presentation of situation and plan to IFC resulted in $400K budget for upgrade this summer***
  - Envisions new switch, new dual-dual Opteron farm
- ***Will be coordinated by Steffen Luitz***

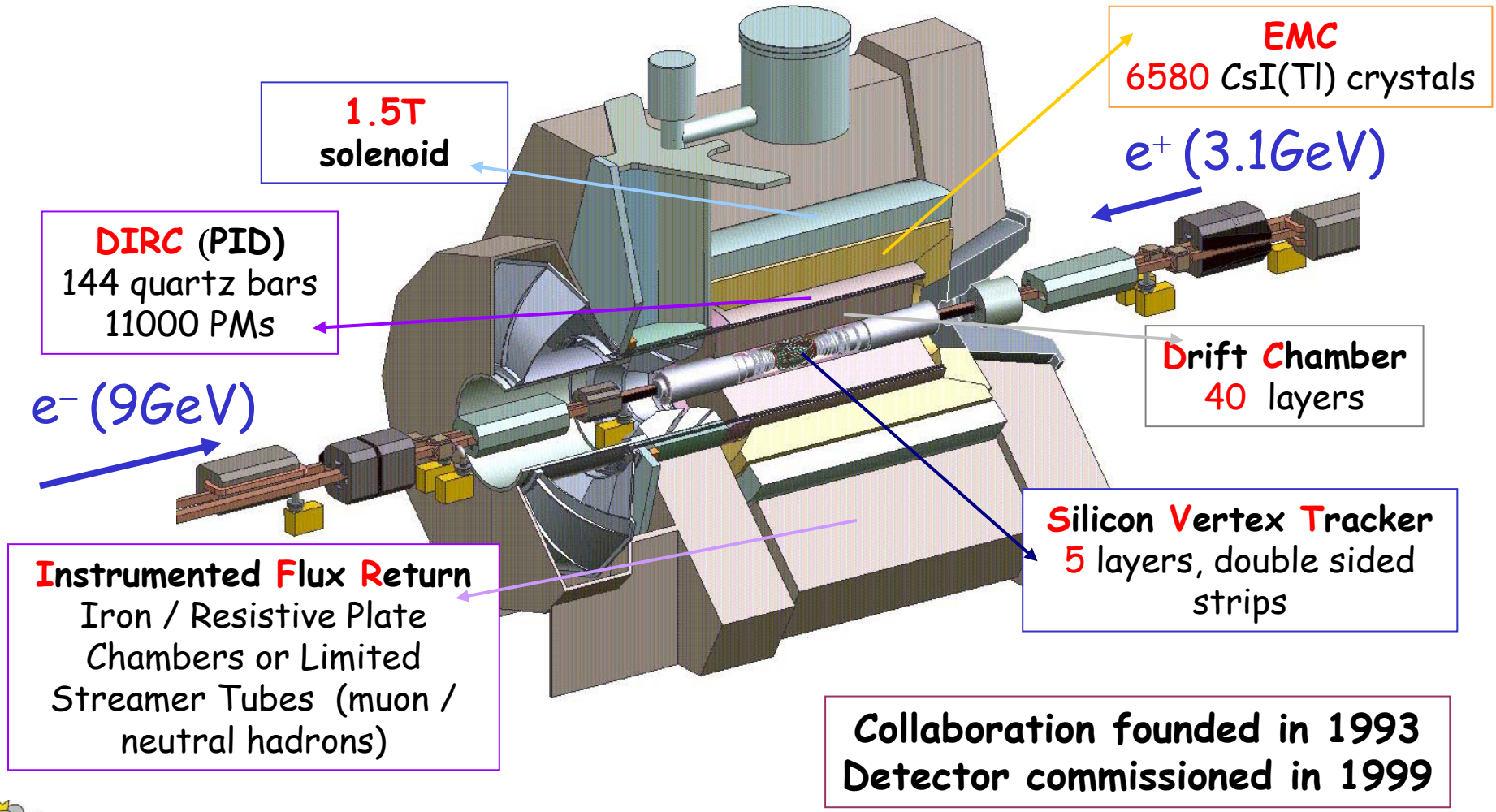
Major actions in computing

- *Finish up R18c skim, complete configuration of small R18d skim*
- *Release capability to read ROOT conditions for analysis, avoiding run-time use of Objy altogether*
- *Bring two major reconstruction-improvement projects to conclusion:*
  - EMC calibration (deferred from R18 reconstruction)
  - TrkFixup - refinements to charged-track selection and fitting, performed on the mini (no XTC reprocessing)
- *Define and schedule next skim cycles*
  - Including the deployment of the above…

Complete Objectivity phase-out

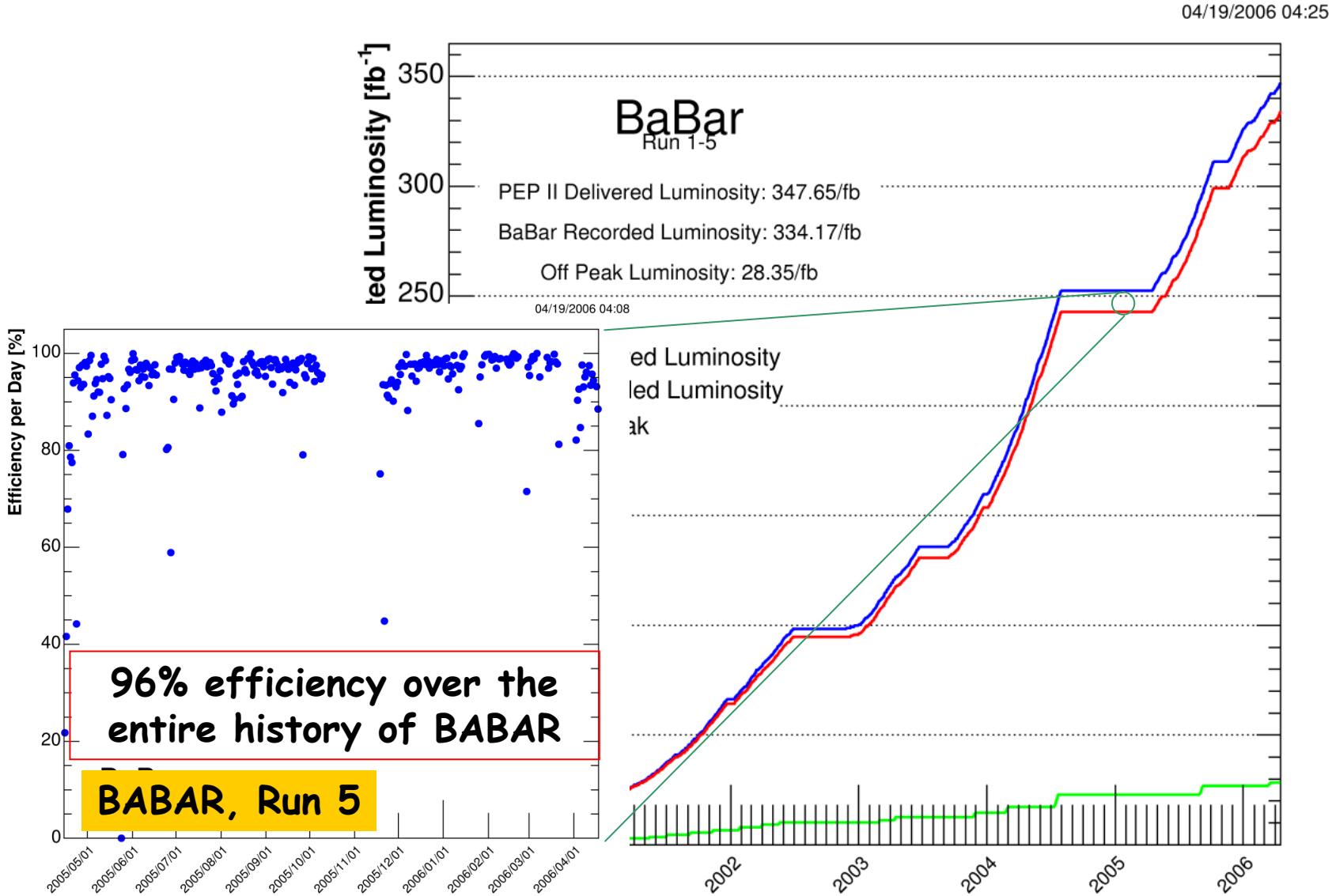
- *Objectivity still used in non-event databases*
  - Configuration, Conditions: used in analysis
  - Ambient, Spatial, Temporal: used in online, reco
- *Initial plan outlined in BaBar Note 576*
  - Object storage in ROOT-serialized form
  - ROOT (read-only) and mySQL (read-write) implementations
- *Make available for analysis (~January ⇒ now)*
  - Provide the code in an analysis-35 release
  - Regular data distribution of Cfg/Cdb snapshots
- *Switch online to mySQL Cfg database*
- *Make it possible to run SP without Objectivity*
  - Should help management of SP sites, esp. SPGrid
- *Eliminate Objectivity altogether from releases by Run 6*
  - Will be challenging and possibly an area where limits on available technical manpower may be an issue

BABAR Detector

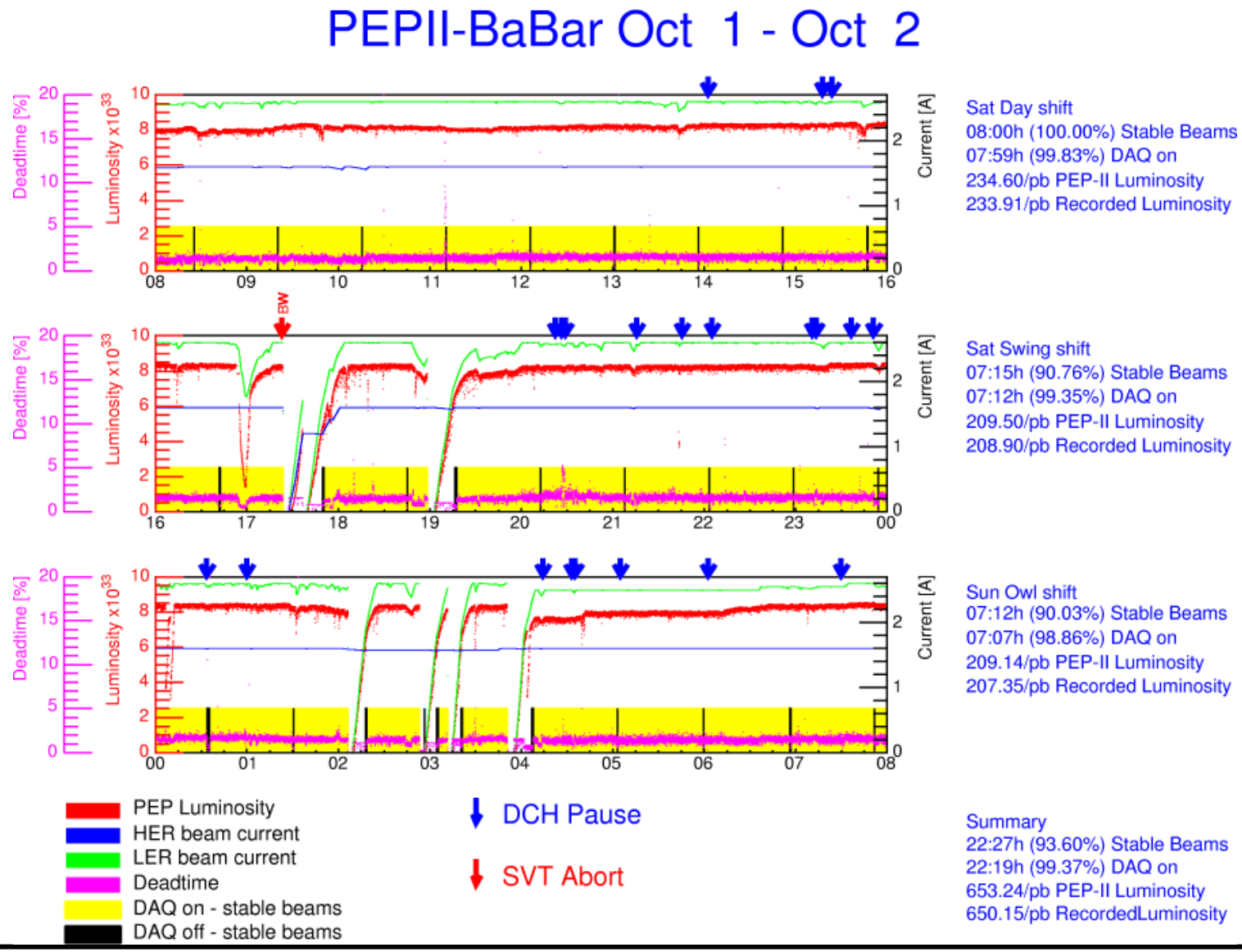


Collaboration founded in 1993
Detector commissioned in 1999

Integrated data sample to date



A day in the life of a B Factory



Trickle injection implementation

Trickle injection: charge added to bunch at ~10 Hz

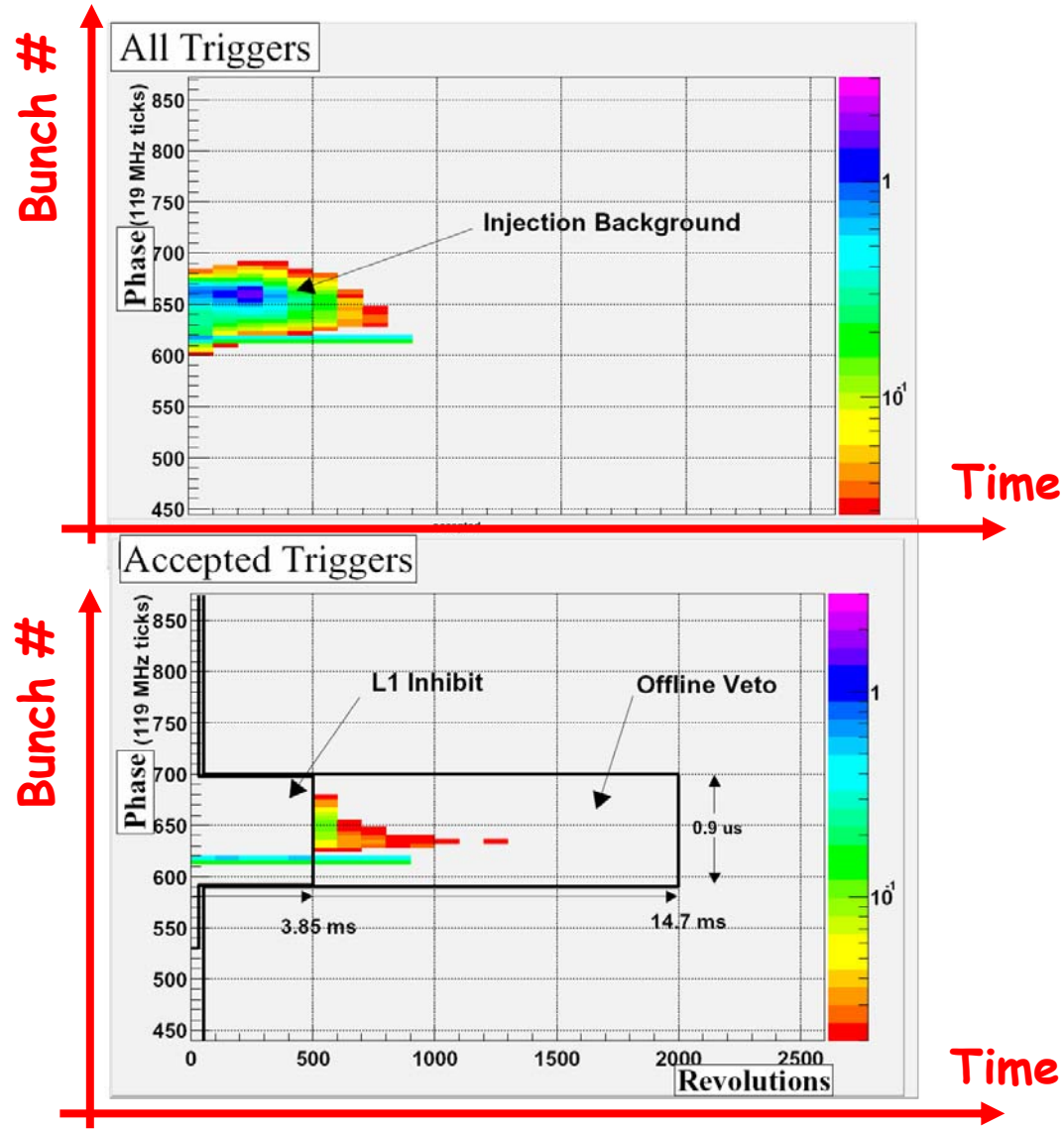
Problem

Injected bunch and its neighbors disturbed for about 5ms

Solution

L1 inhibit for injected bunch and its nearby neighbors for 3.85ms

BABAR Trigger & DAQ very flexible & high performance



Data Taking

- ***Two Run Coordinators with a deputy***
  - Responsible for smooth data-taking; work with Operations Manager and Technical Coordinator.
- ***All institutions provide shift takers from among their members***
  - Have recently emphasized need for more intensive participation in shifts
  - Instituted policy for minimal number of shifts by graduate students and postdocs
- ***Shift crew:***
  - At IR2: shift leader "pilot", data quality monitor "navigator"
  - At MCC: liaison at the start of major running cycle only

Task Coverage

- *Each institution is responsible to provide its share of service proportional to its membership count*
- *Philosophy of 'you build it, you maintain it' works reasonably well*
  - Funding agencies have a strong preference for this
    - a legacy of the Memoranda of Agreement signed during detector construction
  - Software/computing service is more flexible.
- *Effort for major upgrades come from the existing groups. These new efforts never have problems attracting eager post-docs and students from the more flexible US institutions.*
  - It is more difficult to man systems that require only routine maintenance: streamlining the task helps here.
- *New groups joining BaBar sign MOAs taking responsibility for specific tasks. New member burdens are 0.5 FTE in the first year.*

Detector Routine Maintenance

- ***Operations***
  - Mechanical (ops crew, engineers, Operations:SEM)
  - Electronics (ops crew, engineers)
  - Cryogenics (Operations:EFD)

- ***Upgrades***
  - Ops crew + Experimental Facilities Department
  - Rely on infrastructure of lab
  - Safety oversight help during upgrades crosses division lines

BABAR Training Matrix

Category	Training Requirement	Recommended Supervisor	Documentation Requirements
a. Short-term visitor	None. Category (b) or higher recommended for BABAR users.	None	None
b. Office worker	EOESH, GERT, ES&H 239	Member of BABAR Management team or SLAC Group Leader	Office JHAM, Office Building AHA
c. Shift-taker	(b) above plus Shift Training	Run Coordinator	(b) above plus Shifter JHAM, IR-2 AHA
d. System worker	(b) above plus BABAR Orientation, job specific training	System Manager	(b),(c) above plus System JHAM(s)
e. R&D worker	(b) above plus job specific training	R&D Manager	(b) above plus job specific JHAM, job site AHA

http://www.slac.stanford.edu/BFROOT/www/Organization/Spokesperson/safety/safety_checklist.htm

BABAR Work Category Definitions

Short-term visitor	*Attends no more than one collaboration meeting per year or equivalent*
Office worker	*Only works in the ROB or one of the other office areas but not IR-2 or other laboratory space*
Shift-taker	*Stands shifts on BABAR in IR-2*
System worker	*Does maintenance work on a detector system in IR-2 or in a system laboratory space*
R&D worker	*Does development or testing work in a lab setting or temporary system space*

Training Database

- ***Modified SLAC Training Assessment database to record training status against BABAR requirements***
  - Very useful tool for Run Coordinators and System Managers to verify training and suitability of shift crews and system workers
  - Required training keyed against assigned category from training matrix
  - Includes record of JHAMs signed by individuals
  - Includes automated expiration and renewal requirements

Line of Authority for Safety on BABAR

BABAR shift worker

Spokesperson D.B.MacFarlane — Technical Coordinator W.Wisniewski — Operations Manager W.Innes — Run Coordinators J.McKenna/ G.Bonneaud — BABAR Shifter

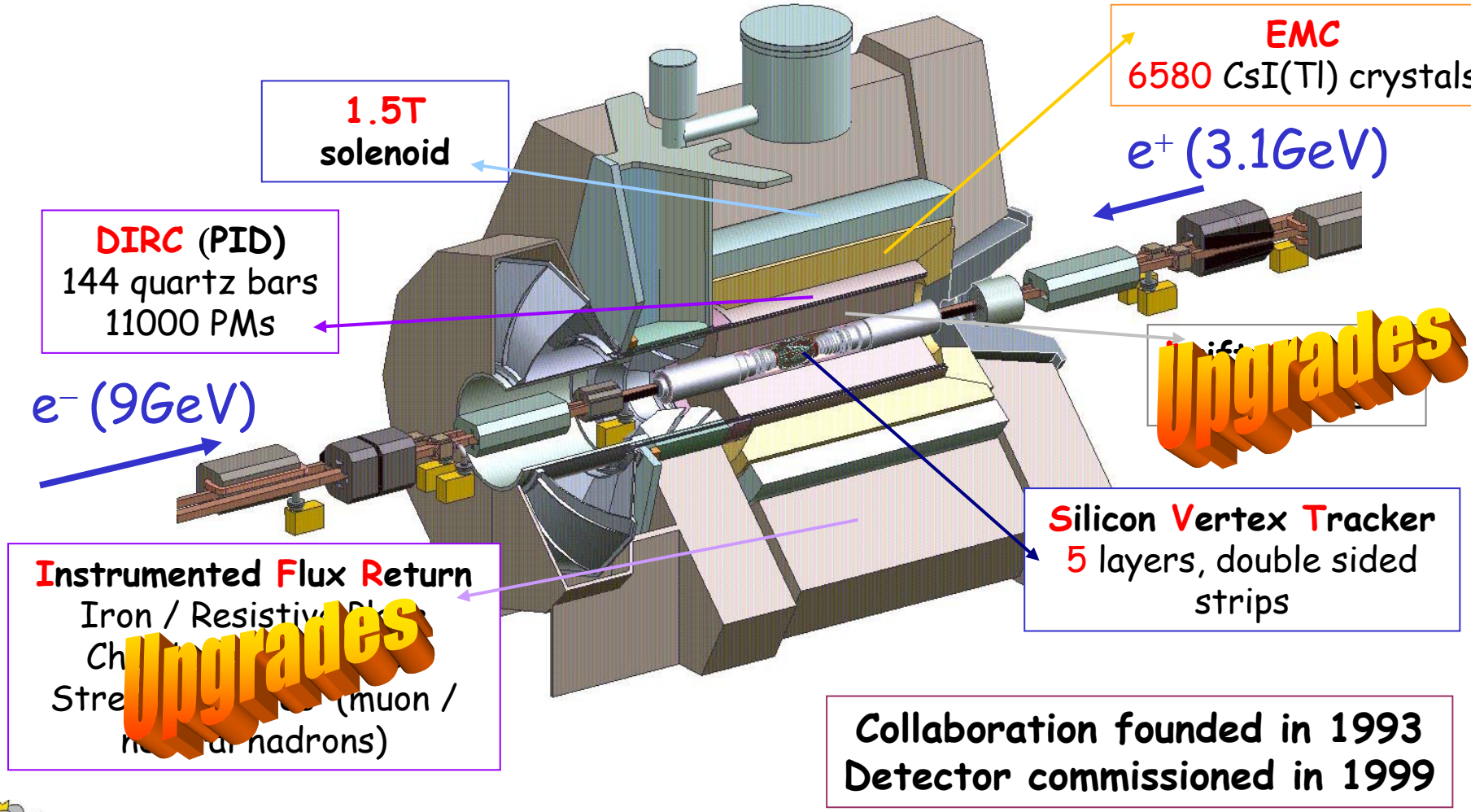
BABAR system worker

Spokesperson D.B.MacFarlane — Technical Coordinator W.Wisniewski — System Manager — System Operations Manager — System Worker

Planning

- ***Short term:***
  - Daily operations meetings where all subsystems represented
  - Daily operations meeting PEPII & BABAR
  - Weekly BABAR management meetings
  - Weekly PEPII-BABAR coordination meetings
- ***Middle term: technical board & exec board (~monthly)***
- ***Long term: We have done internal self-assessments.***
  - Soon after data-taking began (report Apr 2000), we looked forward to detector upgrades that might be needed for operations at up to 10x design luminosity. Some upgrades identified (trigger, online computing) and acted on.
  - In 2002 we returned to consider physics justification for the program to ~1-2/ab, with some consideration of possible detector upgrades (other than IFR).
  - Computing model evaluations have occurred in parallel. External reviews (e.g. Butler review for CM2; IFC, EPAC for IFR) follow.

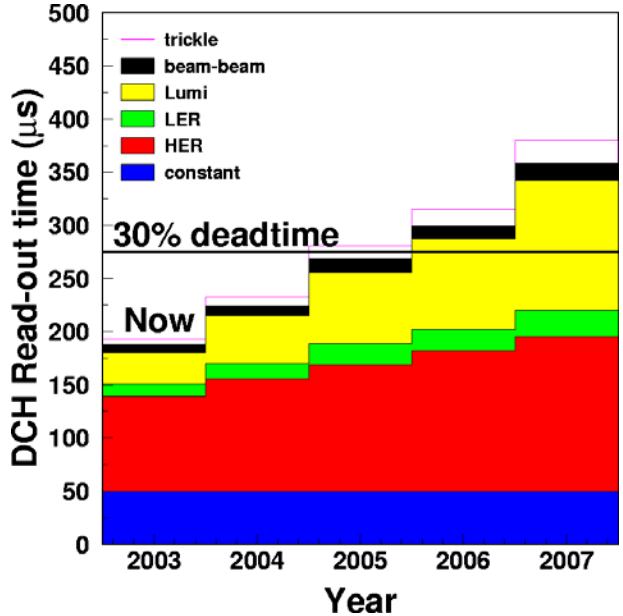
BABAR Detector

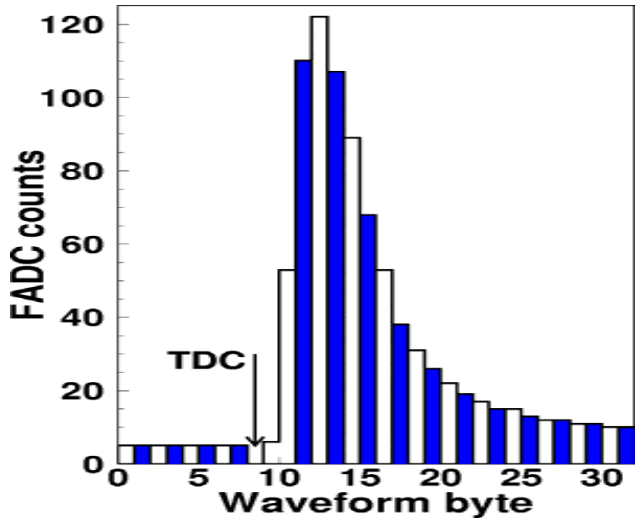


Collaboration founded in 1993
Detector commissioned in 1999

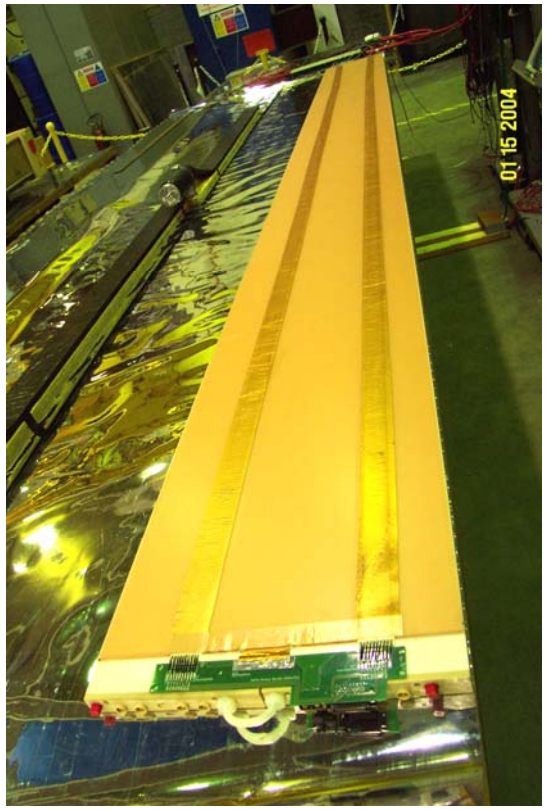
DCH electronics upgrade

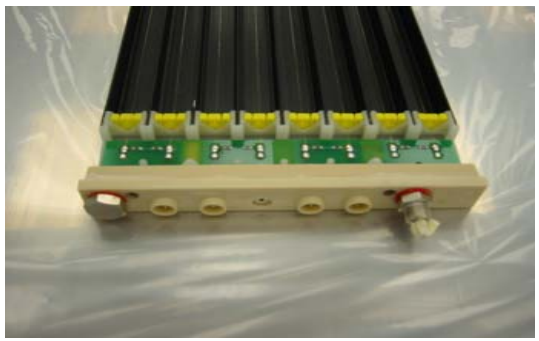
- ***Motivation:***
  - Remove anticipated deadtime problem due to serialization and shipping of data from DCH to readout module
- ***Upgrade in two steps:***
  - Phase 1 (summer 2004): L1 to ~4kHz
    - Reduce ADC payload (32→16 bytes) from front ends with no impact on dE/dx performance
  - Phase 2 (Oct 2005) : L1 to ~5kHz
    - Larger FPGA to allow feature extraction on DCH endplate
    - New boards installed in Oct down, ready to activate FPGA code

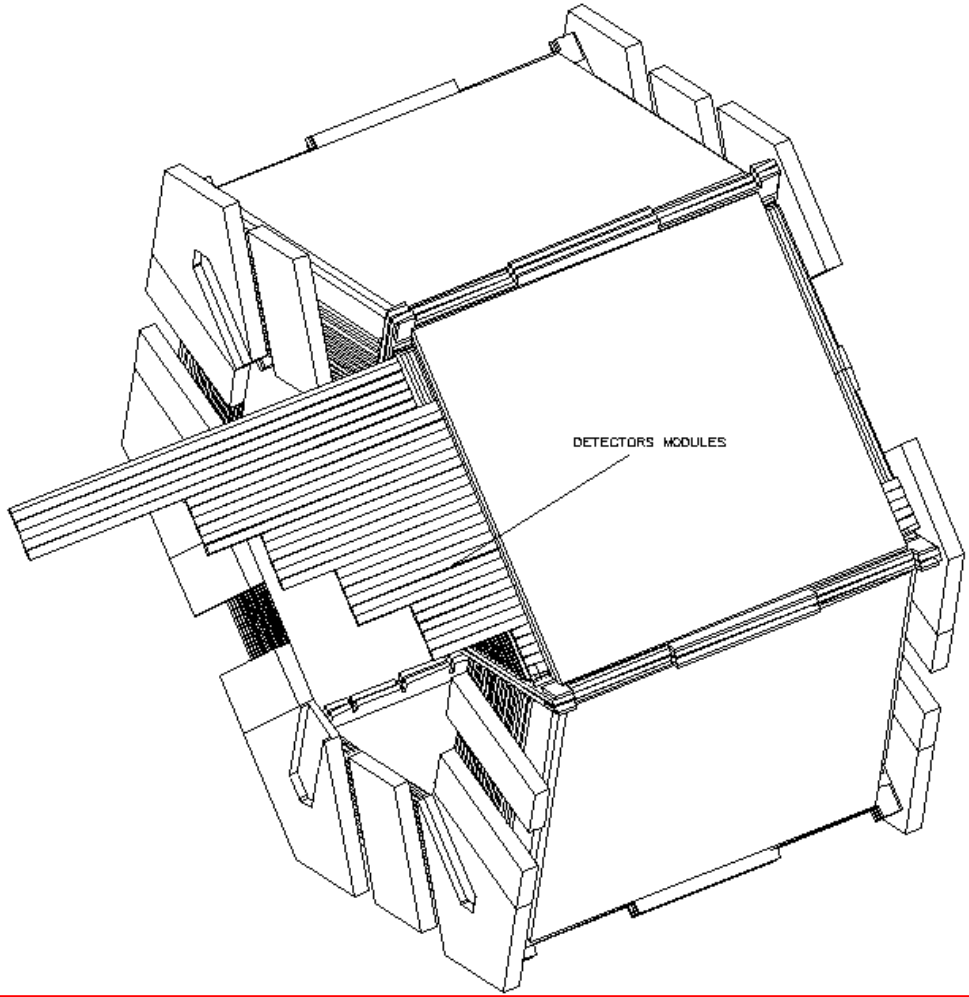




IFR upgrade with LSTs

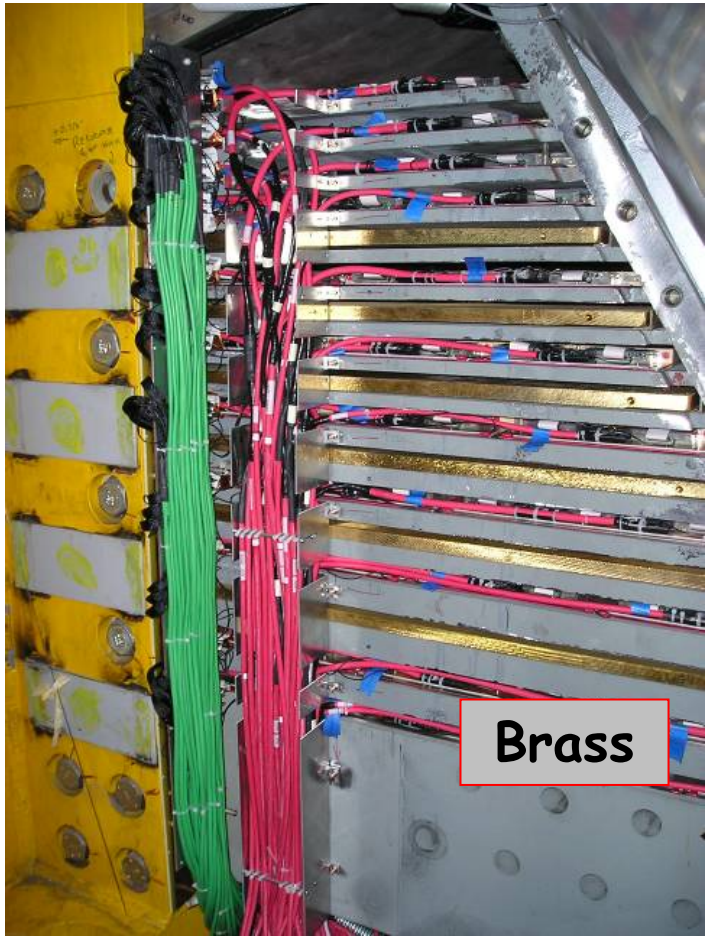


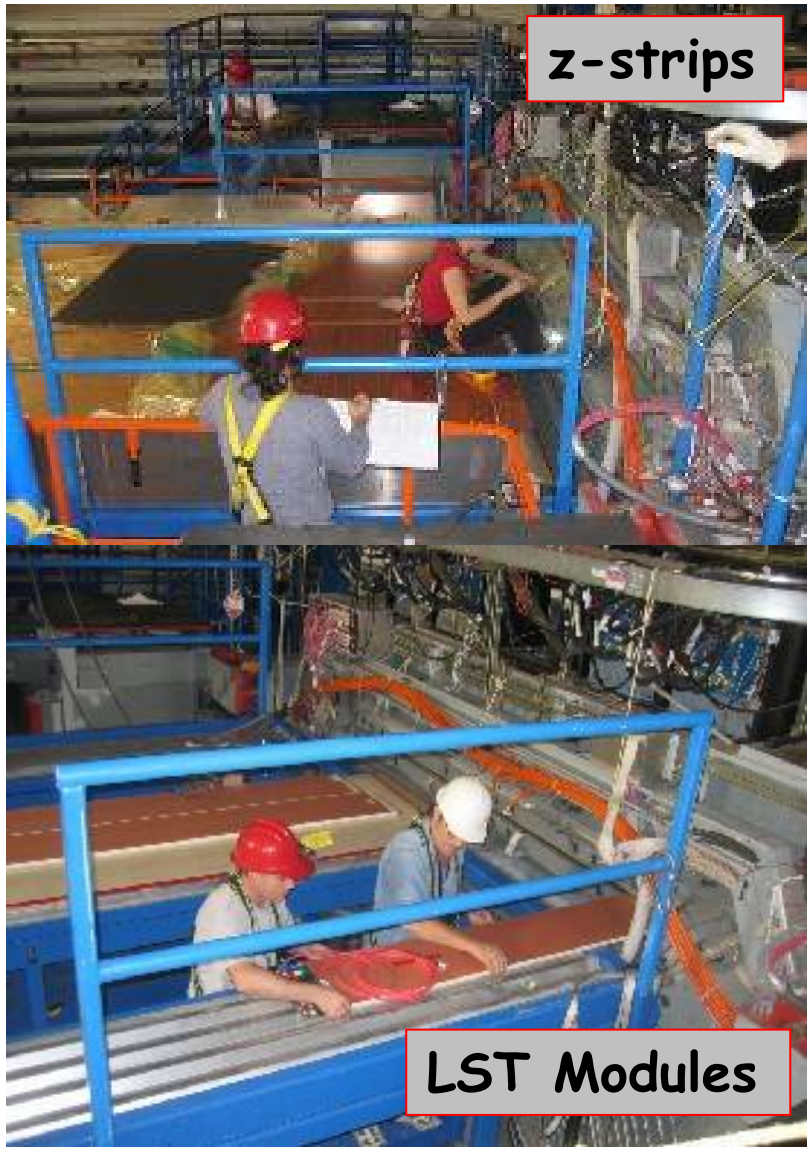




Bottom & top sextants installed summer 2004
Remaining sextants delayed until fall 2006

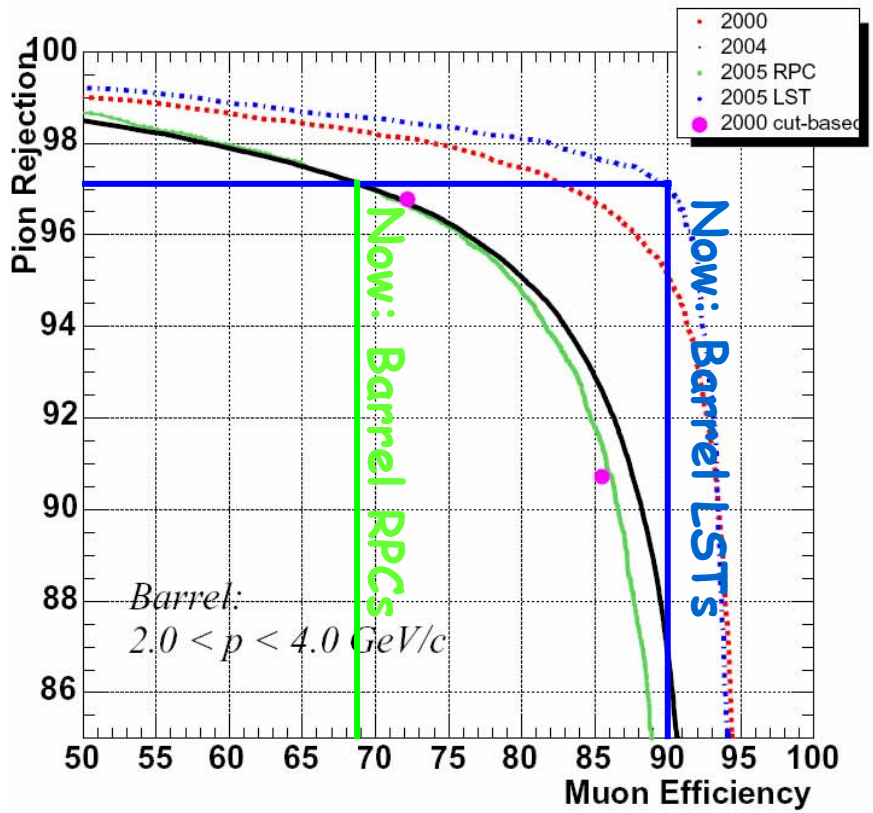
LST installation summer 2004

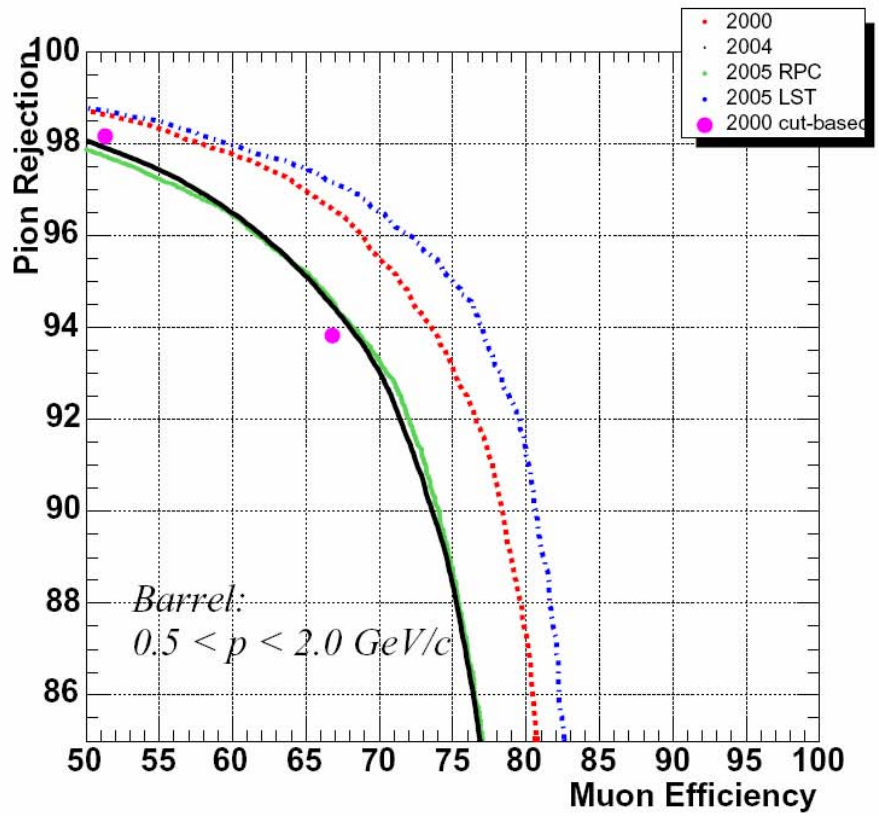




Bottom sextant: Aug 15-Sep 4
Top sextant: Sep 16-29

Impact on physics performance





Installation of 4 remaining sextants in 4-month down concurrent with PEP-II & LCLS work

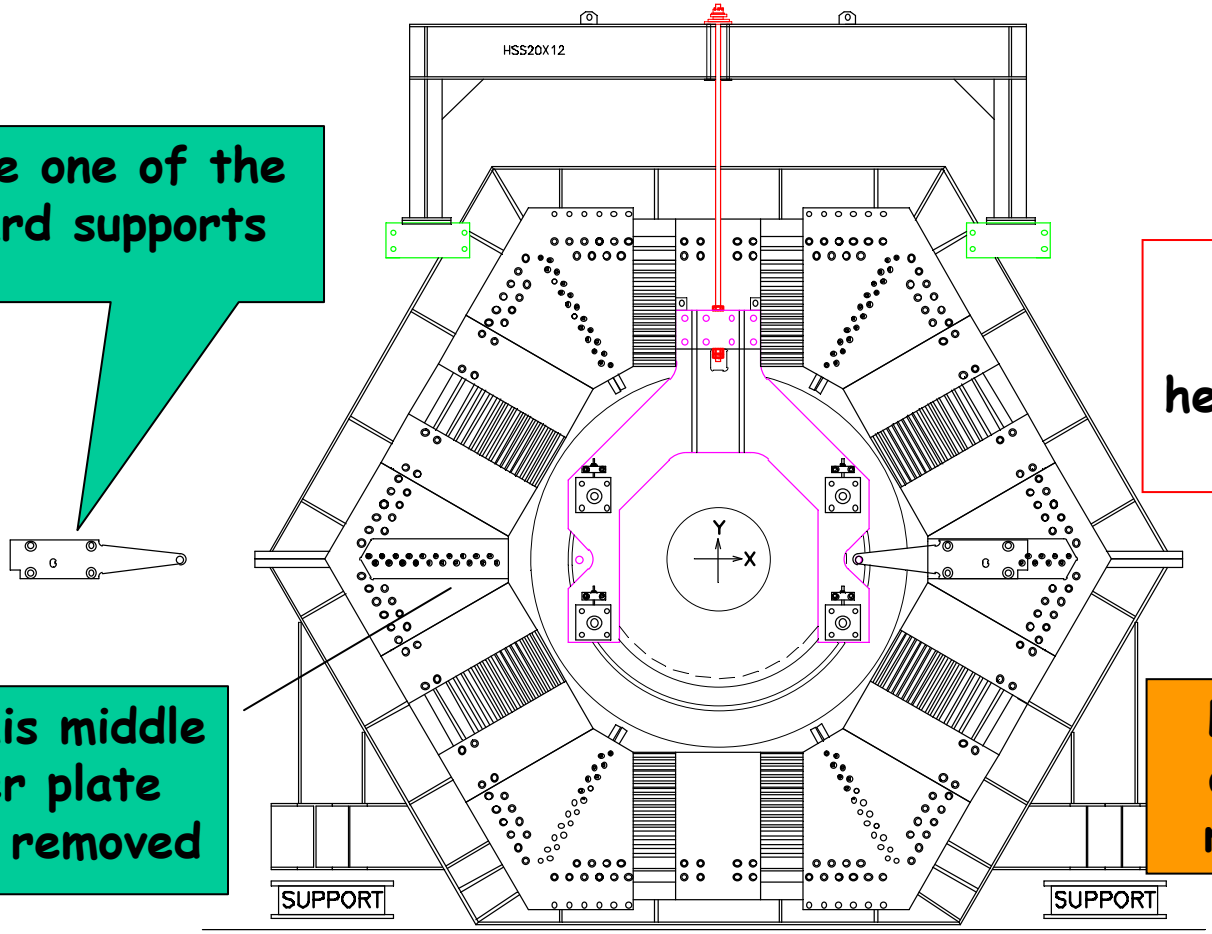
Installation & schedule requirements based on 2004 experience

Fall 2006 preparations & tooling

Remove one of the forward supports

Richard Boyce, Les Dittert, Jim Krebs

Ready for fabrication with helpful improvements from reviewers



Now this middle corner plate can be removed

LST modules and almost all tooling ready installation

Transfer the load to the temporary tooling, remove the west flexible support arm and the corner plate can now be removed.

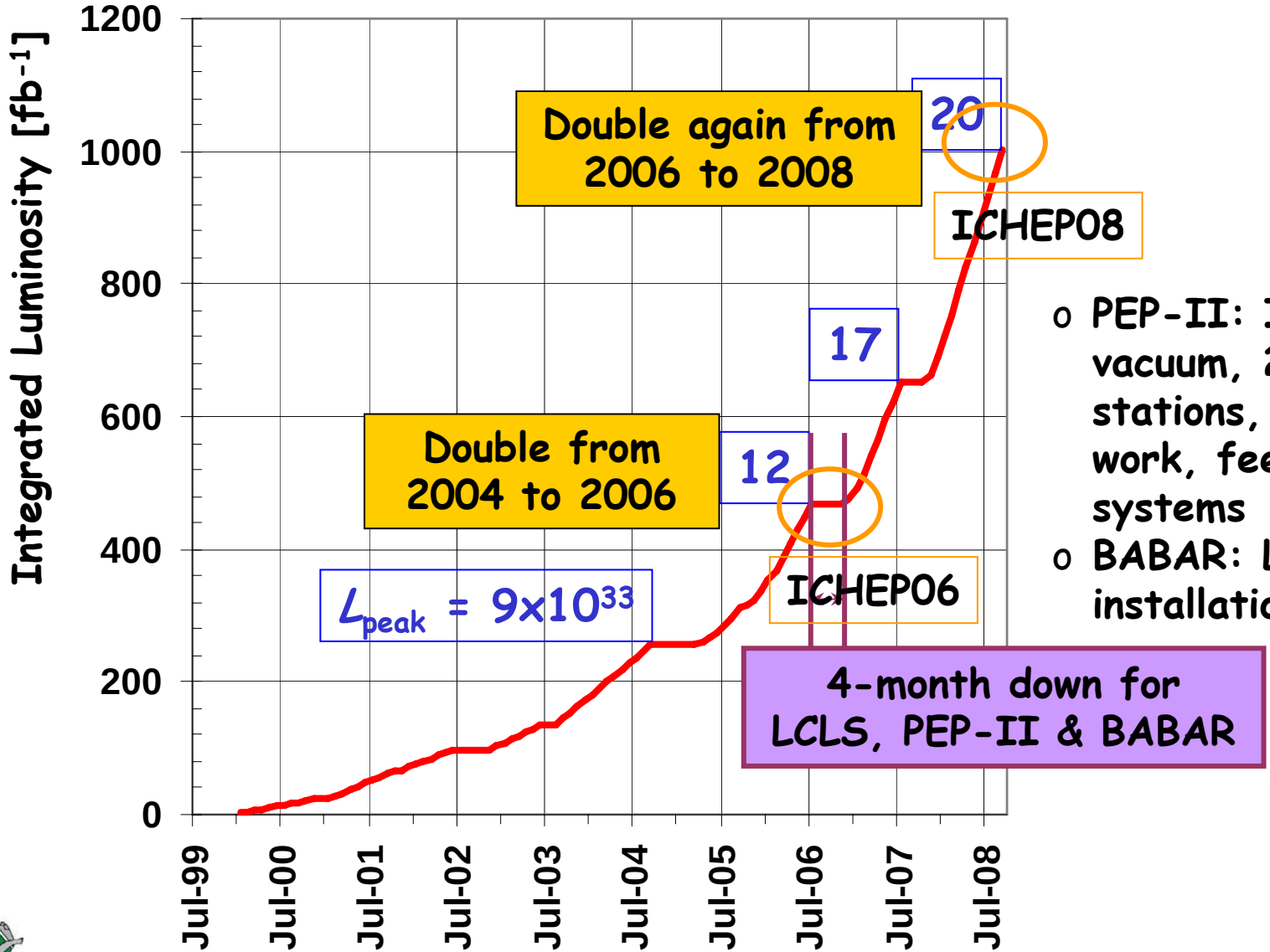
Funding

- ***International Finance Committee (IFC)***
  - Provides oversight of the experiment, funds
  - Members represent the funding agencies
  - Common Fund: contributions based on PhD headcount distrubution
    - Detector: consumables, some general upgrade funds & operations salaries
    - Computing: Common Fund-8, hardware (also in-kind)
- ***Laboratory Support***
  - BABAR support group & EFD
  - Physics research groups (Ratcliff, et al.)
- ***Upgrades***
  - Agencies which fund the groups involved in upgrade (legacy) and DOE
    - DIRC electronics: France only
    - Trigger DCZ: DOE, PPARC
    - IFR Upgrades: DOE, INFN, IFC

Budget Process

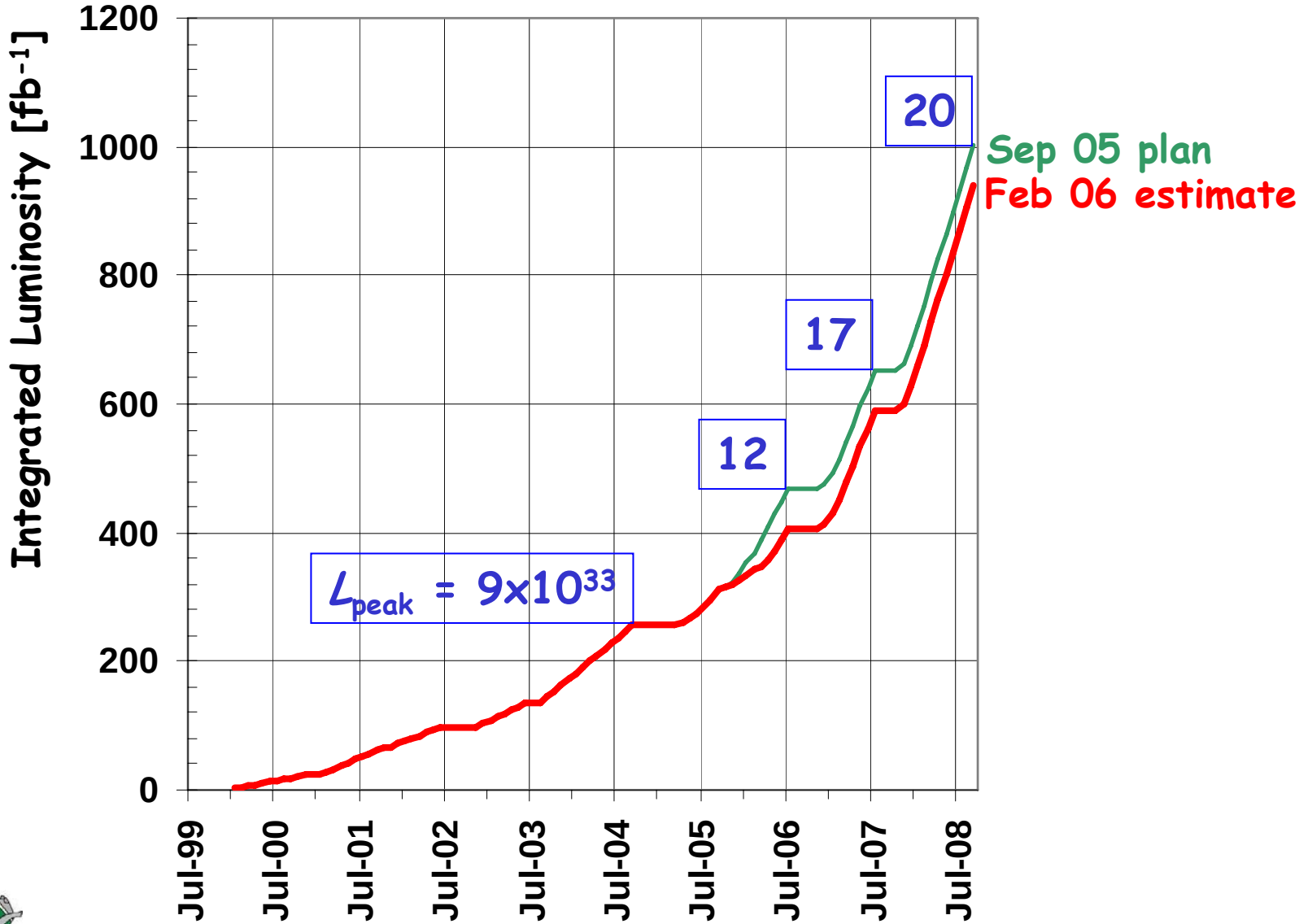
- ***SLAC operating support***
  - Developed between BABAR Management and Laboratory management in consultation with the stakeholders of the technical board and the computing organization. (FY budget)
- ***International Finance Committee support***
  - Oversight and approval of the Operating Common Fund and Computing Budget takes place twice yearly. (CY budget)

Projected data sample growth

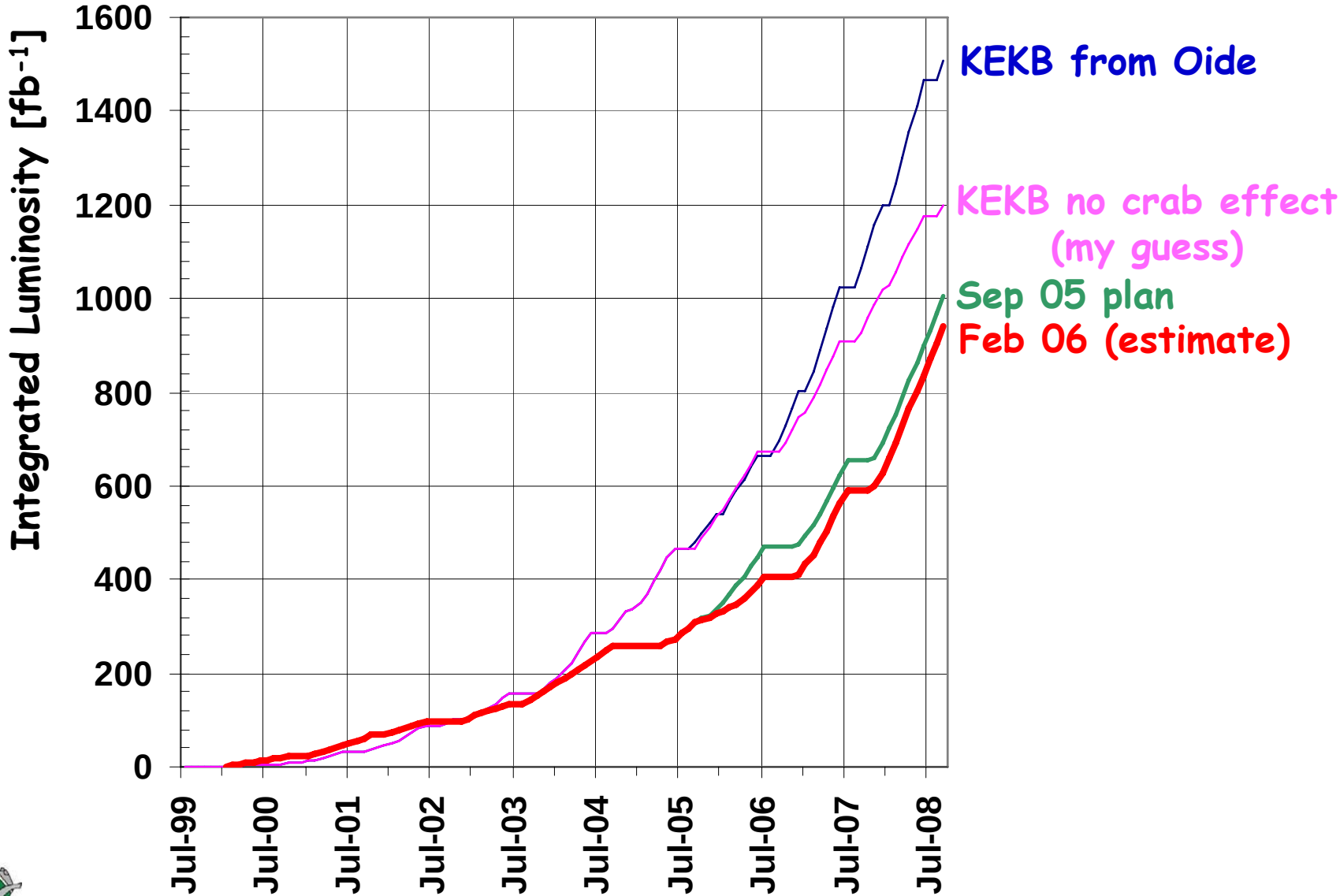


- PEP-II: IR-2 vacuum, 2xrf stations, BPM work, feedback systems
- BABAR: LST installation

Projected data sample growth



How does this compare with KEKB?



Updated performance comparison

Revised from 2005 results; conclusions unchanged from 2004 study

S	Belle				BABAR				Errors/Luminosity			
									Belle	BABAR		
Mode	S	stat err	lumi	Untag sample	S	stat err	lumi	Untag sample	st*sqrt(L)	st*sqrt(L)	Perf Ratio	Lumi Ratio
phiK0	0.440	0.270	357	258	0.500	0.250	205	212	5.101	3.579	1.425	2.031
etapK0	0.620	0.120	357	1017	0.270	0.140	205	819	2.267	2.004	1.131	1.279
KKK0	0.600	0.180	357	536	0.550	0.170	205	452	3.401	2.434	1.397	1.952
KSKSKS	0.580	0.360	357	105	0.630	0.320	205	129	6.802	4.582	1.485	2.204
f0K0	0.470	0.360	357	145	0.950	0.320	192	152	6.802	4.434	1.534	2.353
pi0K0	0.220	0.470	357	344	0.150	0.300	205	300	8.880	4.295	2.067	4.274
ccbarK0	0.652	0.039	357	5264	0.722	0.040	205	10320	0.737	0.573	1.287	1.655
pipi	-0.670	0.160	253	666	-0.300	0.170	205	467	2.545	2.434	1.046	1.093
rhopi S	-0.280	0.230	140	483	-0.100	0.140	192	1184	2.721	1.940	1.403	1.968
rhopi A+-	-0.020	0.160	140	483	-0.210	0.110	192	1184	1.893	1.524	1.242	1.543
rhopi A-+	-0.530	0.290	140	483	-0.470	0.140	192	1184	3.431	1.940	1.769	3.129
rhorho	0.090	0.420	253	142	-0.330	0.240	205	617	6.681	3.436	1.944	3.780
Averages											1.477	2.272

Typically better errors for BABAR despite larger Belle dataset

Normalized performance ratio

BABAR CKM physics goals

Physics	Impact	FY2006 450 fb^{-1}	FY2007 650 fb^{-1}	FY2008 1000 fb^{-1}
Precision measurement of sin2β	Fundamental constant of the SM, whose precision is only limited by statistics			Improve error by factor of two to 2%
Precision measurement of *CP* asymmetry in $b \to s\bar{q}q$ penguin modes	Primary approach to new physics in loop decays; $b \to s\bar{s}s$ presently discrepant with SM predictions at 2.4σ level when averaged over all available modes	Potentially reach the 4-5σ level for average of all $b \to s\bar{s}s$ modes		Could reach the 4-5σ level for individual theoretically-clean modes
Precision measurement of unitarity angle α	Fundamental constraint on the UT		Discovery of $B^0 \to \rho^0\rho^0$ if it has SM branching fraction	Isospin analysis in $B \to \rho\rho$ allows better than 10° measurement
Precision measurement of unitarity angle γ	Fundamental tree-level constraint on phases and amplitudes originating from any new physics beyond the SM	Pioneering measurements with 10-15° accuracy		Determine to 5-10° precision
Precision measurement of $\lvert V_{ub}\rvert$ with inclusive & exclusive semileptonc *B* meson decays	Fundamental tree-level constraint on amplitudes and phases originating from any new physics beyond the SM	Inclusive decays reach 6.5% precision		Exclusive decays reach 8% precision

BABAR rare decay physics goals

Physics	Impact	FY2006 450 fb^{-1}	FY2007 650 fb^{-1}	FY2008 1000 fb^{-1}
Discovery of $B \to \tau \nu_\tau$	Provides a determination of $\lvert V_{ub} \rvert$ and constrains Higgs sector in MSSM and NP in a parameter regime that is complementary to LHC	Limit	First hints	Discovery if it has SM branching fraction
Precision determination of $b \to s\gamma$ branching fraction, *CP* asymmetry, and photon energy spectrum	Loop diagram that provides unique insight into *B* meson structure and constrains Higgs sector in MSSM and NP in a parameter regime that is complementary to LHC		Ultimate precision on photon energy spectrum	Strong constraints from 5% error on BF; 1-2% error on *CP* asymmetry
Precision determination of $b \to s\ell^+\ell^-$ branching fractions, *CP* and FB asymmetries	Contributions from Z-penguin and W-exchange loops that give additional constraints on MSSM and NP in a parameter regime that is complementary to LHC	Useful precision for constraints on NP		Strong constraint for NP from BF, *CP* and FB asymmetries
Discovery of $B \to \rho\gamma$	Provides a unique determination of CKM matrix elements $\lvert V_{td} \rvert / \lvert V_{ts} \rvert$; likely before B_S^0-$\bar{B}_S^0$ mixing discovery	First hints	Discovery if it has SM branching fraction	Precise measurement of BF

New Belle result

BABAR Physics Goals

Physics	Impact	FY2006 450 fb^{-1}	FY2007 650 fb^{-1}	FY2008 1000 fb^{-1}
Search for D^0-$\bar{D}^0$ mixing	Highly suppressed in the SM and therefore an ideal place to search for new physics in charm mixing diagram	Hint if 1% mixing amplitude		Discovery if 1% mixing amplitude
Search for lepton-flavor violation in $\tau \to \mu\gamma$ or other tau decays	Expected to be significantly enhanced in many extensions of the SM accommodating neutrino mass, but extremely small in the SM itself			Limits reach 2×10^{-8} sensitivity
New discovery in heavy hadron spectroscopy	Improved understanding of QCD in non-perturbative regime	Discoveries possible anytime	Discoveries possible anytime	Discoveries possible anytime

Summary: Physics reach of BABAR

- ***Goal for 2005-2006: double current data set***
  - Delay in Run 5 can be overcome by summer 2006 with extended running period, with substantial reduction in errors on CP violation asymmetries in rare decay modes
  - Error on average of Penguin modes should reach 0.06
- ***Goal for 2007-2008: double again to ~1 ab^{-1}***
  - Individual Penguin modes with errors in range 0.06-0.12
  - Suite of fundamental Standard Model measurements with substantially improved levels of precision

  - **Sensitivity to New Physics through rare decays, *CP* violation, & large data sample with a significant discovery potential**
  - **Full program of flavor physics/CP violation measurements provide fundamental constraints on future New Physics discoveries**

- ***Program will continue to be exciting and competitive through at least 2008***

Backup Slides

Approved CY06 OCF budget

Categories	Description	CY2005	CY2006	Change (CY06 - CY05)
BaBar Computing		1,848	1,850	2
	Maintenance	540	500	-40
	Production Support	231	250	19
	Engineering*	883	925	42
	Training	60	60	0
	Eng. Travel	30	25	-5
	Miscellaneous	104	90	-14
	Administrator			
BaBar Cryo Technical Support		267	253	-14
	Technical Staff*	45	47	2
	Cryo Operations Staff*	105	110	4
	Cryo Operations M&S	117	97	-20
BaBar Hall Support		661	608	-52
	Babar Electrical	135	85	-50
	Electrical Technician*	101	105	4
	BaBar Mechanical*	215	224	9
	Misc. Operating Supplies	10	10	0
	Chiller Maintenance	25	25	0
	Detector System Consumables	175	160	-15
BaBar Collaboration Support		30	30	0
		30	30	0
T		2,806	2,742	-64

Grounds-up analysis suggests 64K reduction for CY06

Approved CY06 OCF budget

Categories	Description	CY2005	CY2006	Change (CY06 - CY05)
Upgrade				
Completed	1. IFR Upgrade: Brass	276	0	-276
New Proposal	2. Computing: Copy Data Set for New Media	0	76	76
New Proposal	3. Computing: DAQ Replacement & Upgrade	0	400	400
Total Common Fund For Upgrade		276	476	200
Total Calendar Year 2006		3,081	3,218	136
	2005 Carry Forward		-236	-236
Net Request for New Funding For 2006			2,982	-100

Media upgrade for new silo hardware system

- Do not have new media prices yet, but assume unspent balance in CY05 production account will cover this one-time copy of data set

DAQ replacement and network switch upgrade proposal

- October operations at 10^{34} revealed that DAQ deadtime wall is at somewhat lower L1 rates than models indicated
- Suggests replacement of network switch in event builder
- Re-examination of DAQ system also led to recognition of risk due to aging hardware in L3 farm
  - Farm machines, servers, and disks will be over 6 years old by summer 2008 with significant risk of common failure modes
- Propose replacement in 2006 down period

Approved CY06 OCF budget

Categories	Description	CY2005	CY2006	Change (CY06 - CY05)
BaBar Computing		1,848	1,850	2
	Maintenance	540	500	-40
	Production Support	231	250	19
	Engineering*	883	925	42
	Training	60	60	0
	Eng. Travel	30	25	-5
	Miscellaneous	104	90	-14
	Administrator			
BaBar Cryo Technical Support		267	253	-14
	Technical Staff*	45	47	2
	Cryo Operations Staff*	105	110	4
	Cryo Operations M&S	117	97	-20
BaBar Hall Support		661	608	-52
	Babar Electrical	135	85	-50
	Electrical Technician*	101	105	4
	BaBar Mechanical*	215	224	9
	Misc. Operating Supplies	10	10	0
	Chiller Maintenance	25	25	0
	Detector System Consumables	175	160	-15
BaBar Collaboration Support		30	30	0
	BaBar Publicaton Cost	30	30	0
Total Operating Common Fund		2,806	2,742	-64
Upgrade				
Completed	1. IFR Upgrade: Brass	276	0	-276
New Proposal	2. Computing: Copy Data Set for New Media	0	76	76
New Proposal	3. Computing: DAQ Replacement & Upgrade	0	400	400
Total Common Fund For Upgrade		276	476	200
Total Calendar Year 2006		3,081	3,218	136
	2005 Carry Forward		-236	-236
Net Request for New Funding For 2006			2,982	-100

Including carry forward from CY05, net new funding for CY06 is down by 100K from CY05

CY07 should see perhaps 400K reduction due to elimination of most Obj licenses & no upgrade costs