BABAR Status and Future Plans

David B. MacFarlane
for the BABAR Collaboration

SLAC Annual Program Review

BABAR Collaboration

10 Countries
77 Institutions
593 Physicists
May 2004

Gathering at SLAC, July 2002

The *BABAR* Collaboration

10 Countries
77 Institutions
593 Physicists

USA [38/300]
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
Florida A&M
Harvard
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 [4/20]
U of British Columbia
McGill U
U de Montréal
U of Victoria

China [1/5]
Inst. of High Energy Physics, Beijing

France [5/51]
LAPP, Annecy
LAL Orsay
LPNHE des Universités Paris VI et VII
Ecole Polytechnique, Laboratoire Leprince-Ringuet
CEA, DAPNIA, CE-Saclay

Germany [4/31]
Ruhr U Bochum
Technische U Dresden
Univ Heidelberg
U Rostock

Italy [12/101]
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 & ScuolaNormaleSuperiore
INFN, Perugia & Univ
INFN, Roma & Univ "La Sapienza"
INFN, Torino & Univ
INFN, Trieste & Univ

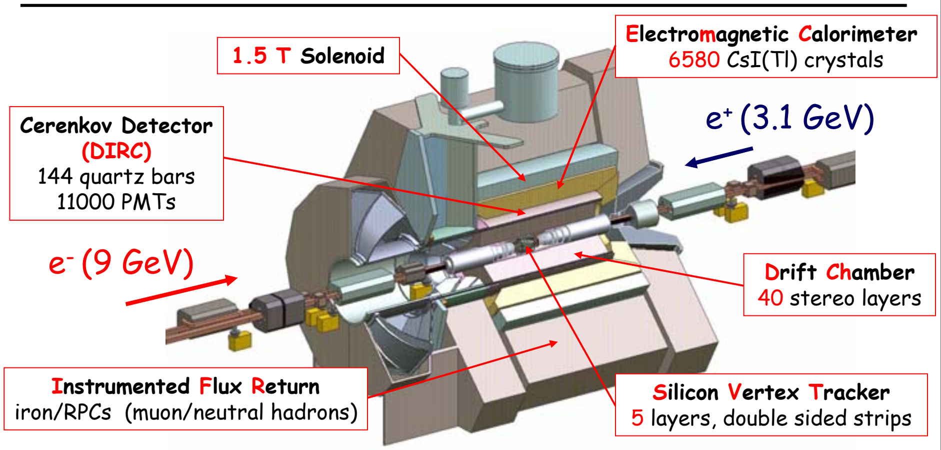
The Netherlands [1/5]
NIKHEF, Amsterdam

Norway [1/3]
U of Bergen

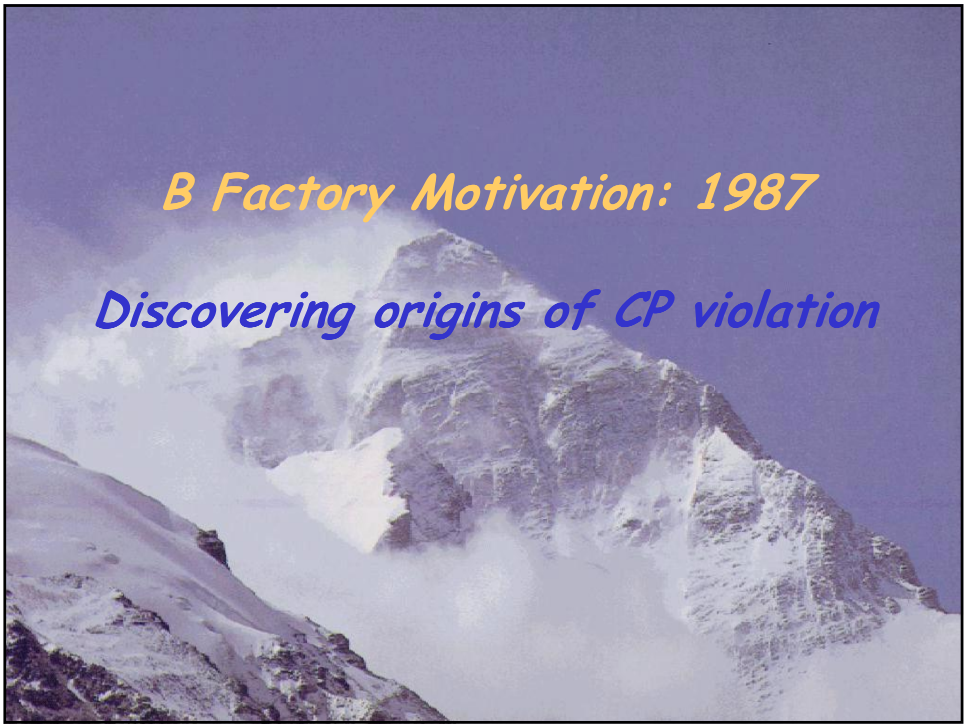
Russia [1/11]
Budker Institute, Novosibirsk

United Kingdom [10/66]
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

The BABAR Detector

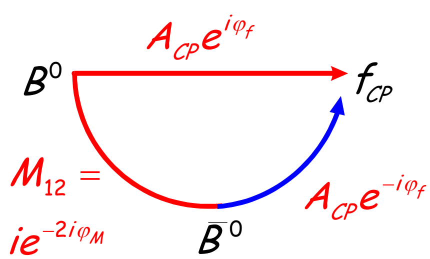


SVT: 97% efficiency, 15 μm z hit resolution (inner layers, perp. tracks)
SVT+DCH: $\sigma(p_T)/p_T = 0.13\ \% \times p_T + 0.45\ \%$
DIRC: K-π separation 4.2σ @ 3.0 GeV/c → >3.0σ @ 4.0 GeV/c
EMC: $\sigma_E/E = 2.3\ \% \cdot E^{-1/4} \oplus 1.9\ \%$



CP Violation in the B System

- CPV through interference of decay amplitudes
- CPV through interference of mixing diagram
- CPV through interference between mixing and decay amplitudes

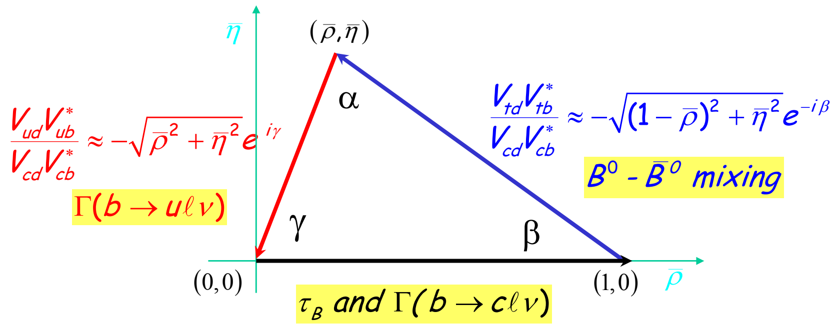


Directly related to CKM angles for single decay amplitude

CKM Unitarity

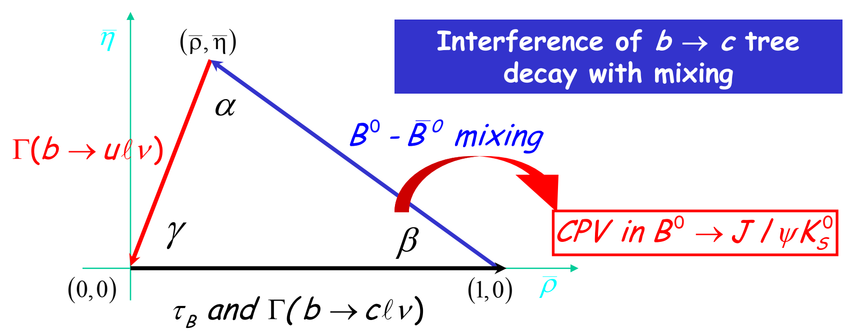
Unitarity Condition: $V_{ud}V_{ub}^{*} + V_{cd}V_{cb}^{*} + V_{td}V_{tb}^{*} = 0$

Product of 1st and 3rd columns
(1 of 6 relations)



$\beta = -\arg V_{td};\ \gamma = \arg V_{ub}^{*};\ \ \alpha = \pi - \gamma - \beta$

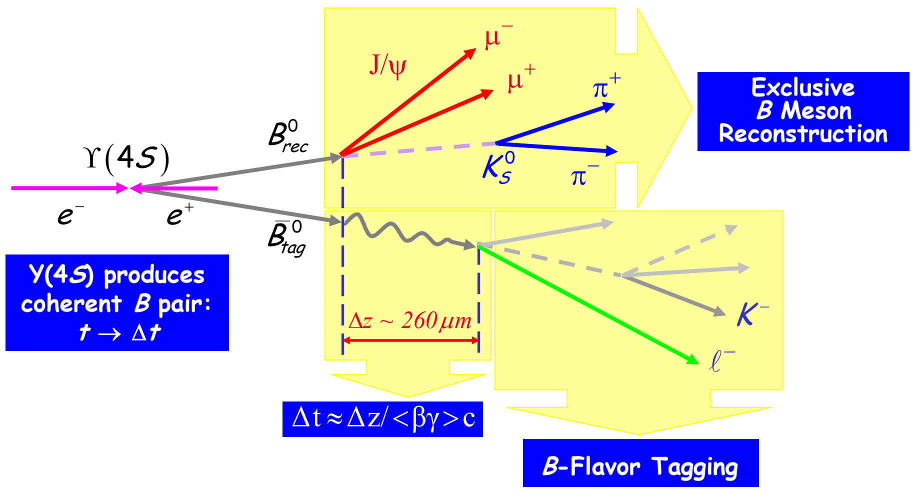
CPV and Unitarity Constraints



$b \to c\bar{c}s$ channels

- Theoretically clean way to measure sin2β
- Clear experimental signatures
- Relatively large branching fractions

Time-Dependent Asymmetry Measurements



Luminosities at the $\Upsilon(4S)$

CESR/CLEO

$$\text{peak} = 1.25\times10^{33}\,\text{cm}^{-2}\,\text{s}^{-1}$$
$$\text{day} = 73\ \text{pb}^{-1}$$
$$\text{Int. Lumi} = 16.0\ \text{fb}^{-1}\ (6.7\ \text{off})$$

PEP-II/*BABAR* (as of Jun 30, 2002)

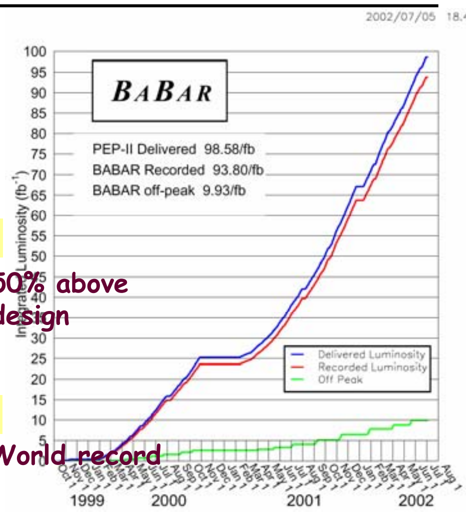
$$\text{peak} = 4.60\times10^{33}\,\text{cm}^{-2}\,\text{s}^{-1}$$
$$\text{day} = 303.4\ \text{pb}^{-1}$$
$$\text{Int. Lumi} = 93.8\ \text{fb}^{-1}\ (9.9\ \text{off})$$

KEK-B/*BELLE* (as of Jun 30, 2002)

$$\text{peak} = 7.35\times10^{33}\,\text{cm}^{-2}\,\text{s}^{-1}$$
$$\text{day} = 391.4\ \text{pb}^{-1}$$
$$\text{Int. Lumi} = 89.6\ \text{fb}^{-1}\ (7.9\ \text{off})$$

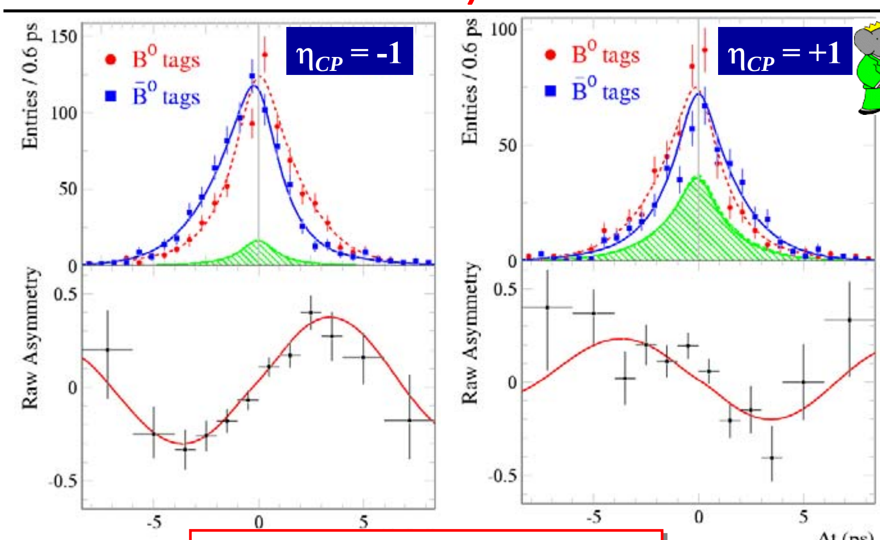
50% above design

World record



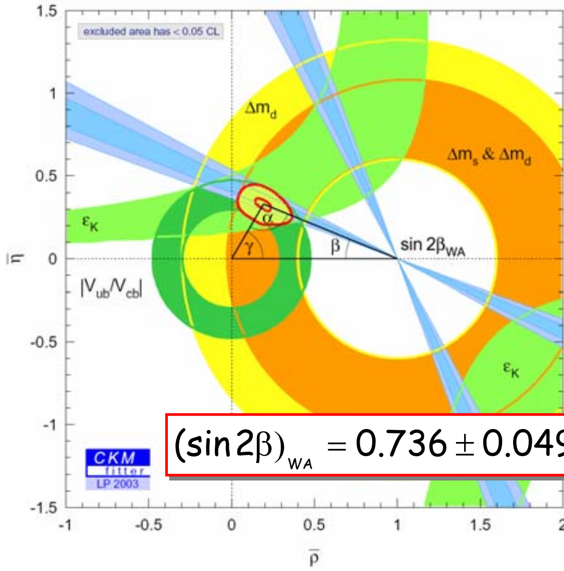
Luminosity at PEP-II and KEK-B the key factor in new results

BABAR Result for sin2β



$$\sin 2\beta = 0.741 \pm 0.067_{(stat)} \pm 0.033_{(syst)}$$

Standard Model Constraints



Indirect constraints vs direct measurement

At 95% CL:

$19.4 < \beta < 26.5^{o}$

$77 < \alpha < 122^{o}$

$37 < \gamma < 80^{o}$

$(\sin 2\beta)_{WA} = 0.736 \pm 0.049$ (stat+syst)

A.Hoecker et al.

Ongoing BABAR Physics Program

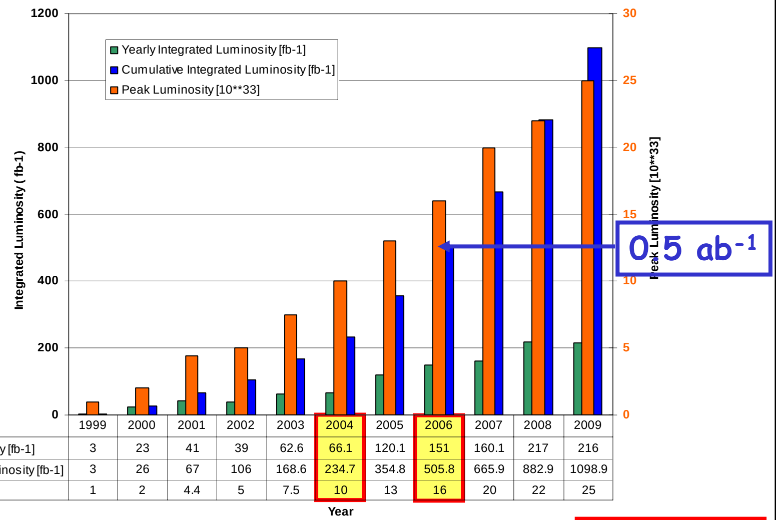
- ***Comprehensively explore CP-violating asymmetries in B meson decays. Test the SM and search for CP-violating amplitudes from processes beyond the SM.***
- ***Systematically map out rare B decay processes, including all those with sensitivity to new physics.***
- ***Extract the magnitudes of CKM elements and other well-defined SM parameters.***
  - New physics processes exist in context of SM physics
  - Requires detailed studies to elucidate the dynamics of processes and states involving heavy quarks.
- ***Perform studies over a broad range of physics, such as τ-lepton physics, QED studies, strong-interaction physics utilizing ISR processes, etc.***

Ongoing BABAR Physics Program

- ***Comprehensively explore CP-violating asymmetries in B meson decays. Test the SM and search for CP-violating amplitudes from processes beyond the SM.***
- ***Systematically map out rare B decay processes, including all those with ... s.***
- ***Extr ... ther well- ...***
  - Ne... processes exist in context of SM physics
  - Requires detailed studies to elucidate the dynamics of processes and states involving heavy quarks.
- ***Perform studies over a broad range of physics, such as τ-lepton physics, QED studies, strong-interaction physics utilizing ISR processes, etc.***

Comprehensive Program

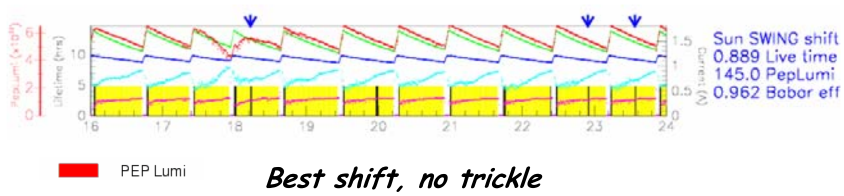
PEP II Luminosity Projections



Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Yearly Integrated Luminosity [fb-1]	3	23	41	39	62.6	66.1	120.1	151	160.1	217	216
Cumulative Integrated Luminosity [fb-1]	3	26	67	106	168.6	234.7	354.8	505.8	665.9	882.9	1098.9
Peak Luminosity [10**33]	1	2	4.4	5	7.5	10	13	16	20	22	25

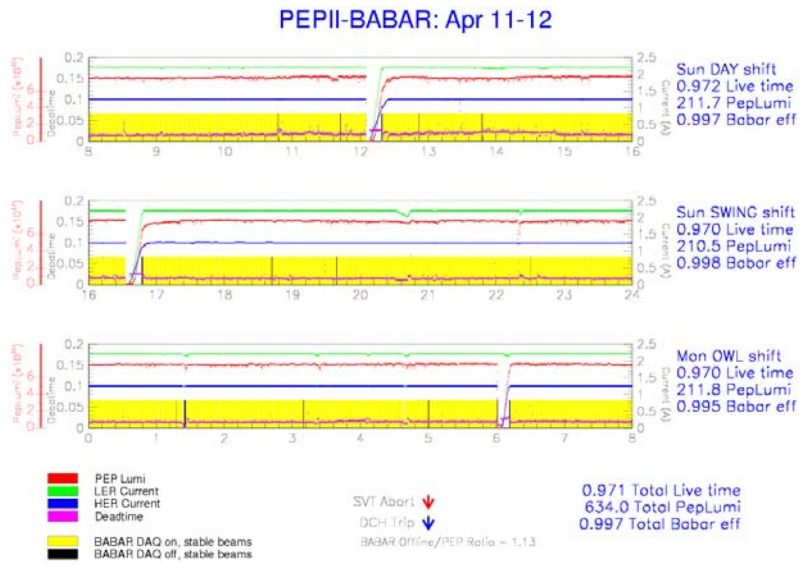
2004 2006 ← 1.6×10^{34}

PEP-II Operations before Trickle Injection



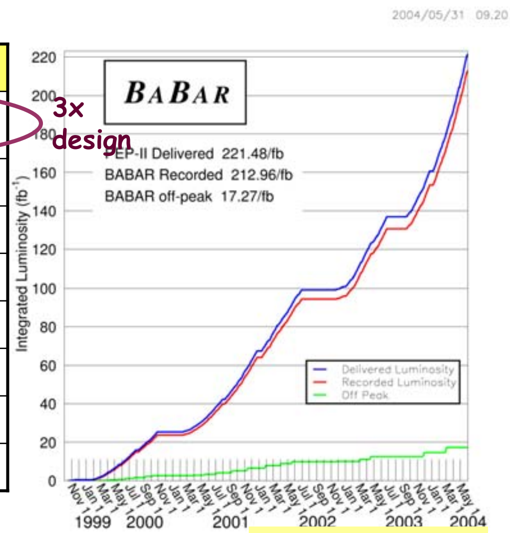
Best shift, no trickle

PEP-II Operations with Trickle Injection



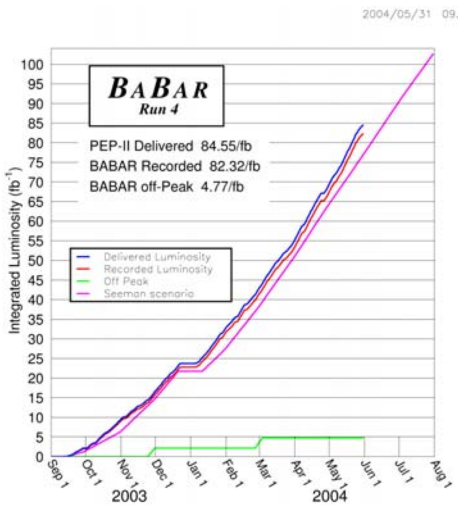
PEP-II Integrated Luminosity

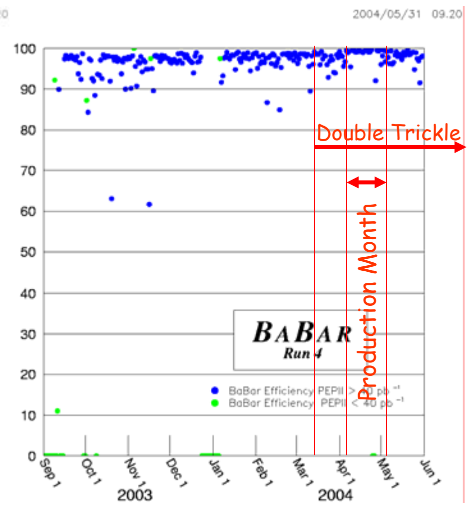
PEP-II Records	
Peak luminosity	9.21x10^{33} cm^{-2} s^{-1}
Best shift	246.3 pb^{-1}
Best day	710.5 pb^{-1}
Best 7 days	4.258 fb^{-1}
Best week	4.194 fb^{-1}
Best month	14.14 fb^{-1}
Best 30 days	16.05 pb^{-1}
BABAR logged	221.5 fb^{-1}



(as of May 31, 2004)

BABAR Running Well





BABAR Hardware Projects

- ***Possible horizontal module replacement for SVT***
  - Modules complete and ready to install; presently considering support tube removal and module replacement in summer 2005
    - Evaluating physics benefit versus risk and downtime
    - May only replace PIN diodes for radiation monitoring

Need to minimize downtime; particularly in summer 2005

- ***Replacing barrel RPCs with Limited-Streamer Tubes***
  - Major collaboration effort involving SLAC and other west coast institutions, Princeton, OSU, and Ferrara, Genova, Padova and other Italian institutions
  - Fast tracked: 1/3rd for installation in summer 2004, 2/3rd in summer 2005

Major hardware project: Strong team in place to achieve timely and successful execution

BABAR Hardware Projects

L1 Tracking Trigger with Z-Vertex Selection (DCZ)

- New Track-Segment Finder (TSF), track fit (ZPD) boards, interface cards, GLT modifications
  - Will allow reduction of L1 rate by removal of beam background events, enabling operation at 10^{34}
  - Partial system now running in parallel with existing L1

Full DCZ trigger system should be available for test in July 2004

Removal of DCH Readout Bottleneck for DAQ

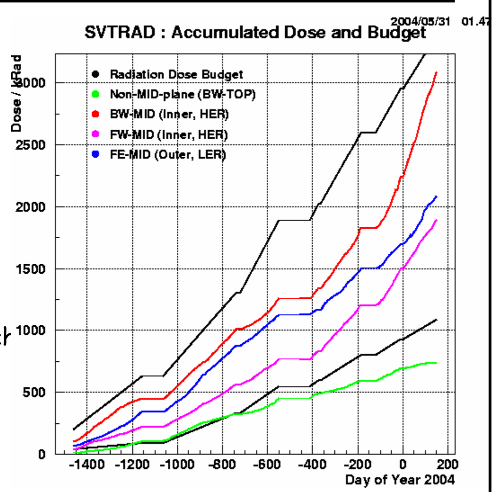
- Contributes now to small amount deadtime, but will grow significant by summer 2005
- FADC front-end decimation in feature extraction looks promising short term; other options investigated longer term

Projections for trigger and DAQ actively monitored in light of spectacular luminosity improvements

SVT Radiation Status

Double trickle very beneficial, due to more stable beams & much cleaner injection

- On average, 2 SVTRAD aborts/day
- Dose rate < 3 krad/day in mid plane, < 0.4 krad/day outside
- Dose < 2.5 Mrad in mid plane, < 0.8 Mrad outside
  - Non-mid plane modules reach ~1-1.5Mrad in 2009
  - Mid-plane modules under design budget (5Mrad in 2005)



Will take decision in July concerning possible SVT module replacement in summer 2005

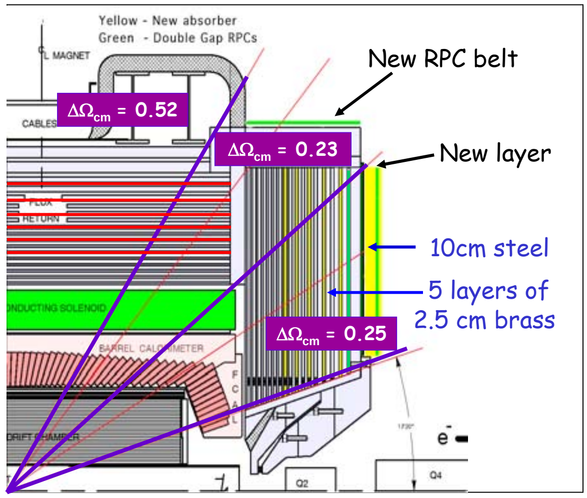
Upgrade of IFR

Phase I: Forward endcap

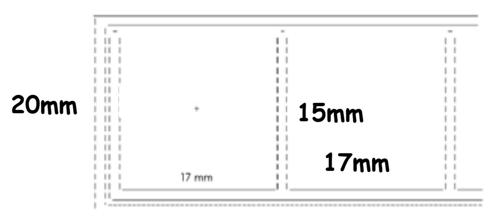
- *5 brass layers*
- *New RPC's to improve efficiency*
- *Installed summer 2002*

Phase II: Barrel

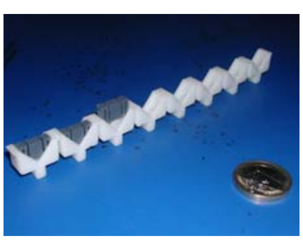
- *6 brass layers*
- *Replace RPC's with LSTs*
- *2 sectors to be installed summer 2004*
- *4 more in summer 2005*

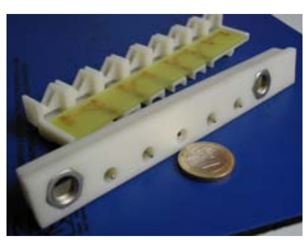


LST Tube Design

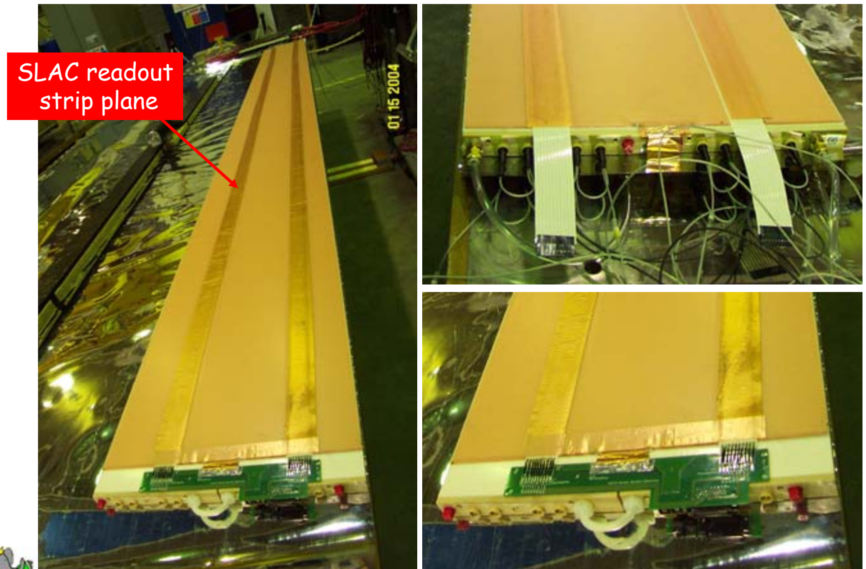


Single layer: wire readout in phi, strips in *z*

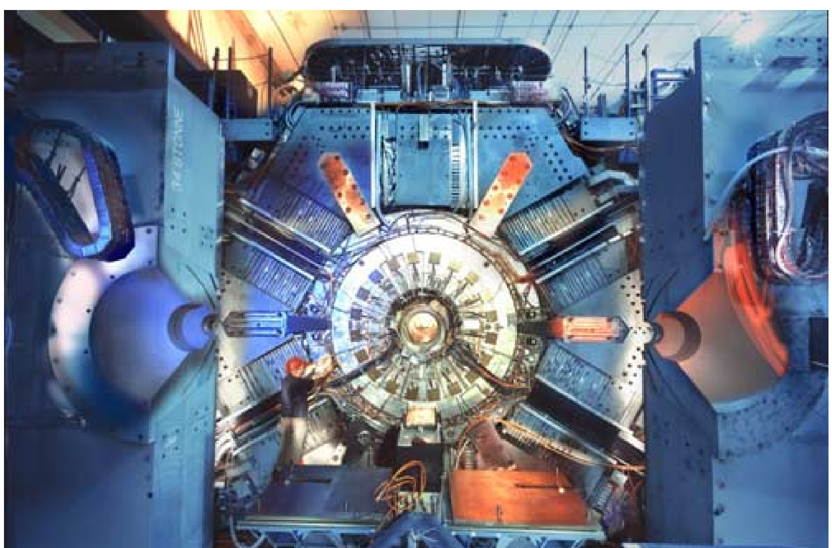




Module Assembly at Princeton & OSU



Vast disassembly…



LST Milestones

12/15/02	LST chosen for IFR upgrade
6/12/03	EPAC approves LST proposal
6/27/03	IFC approval for upgrade project
7/27/03	Electronics design review
8/1/03	Place tube order
8/26/03	QA review
10/1/03	Adopt wire readout for phi view
10/22/03	Mechanical, schedule, and budget review
11/10/03	LST tube production begins
11/30/03	Orders placed for electronic, HV components
12/15/03	Strip production begins at SLAC
12/18/03	First tube shipment to Princeton/OSU
1/9/04	First modules produced at Princeton
3/29/04	First tube shipment arrives at Princeton
4/5/04	Electronics readiness review

LST Milestones

5/6/04	Installation readiness review
6/1/04	First modules arrive at SLAC
6/15/04	All modules for 2 sextants at SLAC
8/1/04	Barrel RPC removal begins
8/15/04	Install bottom sextant
9/4/04	Install top sextant
10/6/04	LST installation complete
10/10/04	Close detector
10/15/04	Start Run 5
10/1/04	All modules complete
10/20/04	All modules shipped to SLAC
Summer 05	Install remaining 4 sextants of LSTs

Major Revision of Computing Model

- ***In Dec 2002, BABAR decided to eliminate Objectivity as basis for EventStore = CM2***
  - "micro"-DST as subset of new "mini"-DST, allowing much more sophisticated analyses, cache or refit mode, much easier detector calibration & performance studies
  - Provision for user-added data; aim to move more of analyses upstream and away from PAW/root ntuples
  - Deep copies and portability should be much easier; allows a more disbursed approach to analysis
  - Aim for 4 skims of data set per year, allowing much more flexibility for new ideas and analyses
  - Provision for interactive analysis and possibility of evolving into a more user-friendly analysis environment

Heroic and spectacular effort by Computing organization to develop and implement CM2 in the short period since Dec 2002

CM2 Deployment Well Advanced

- ***Writing Run4 data in CM2 eventstore***
  - Run1-3 data converted, skimmed, and tested; first major block of Run 4 also available
  - Physics community is now actively engaged in moving to CM2 for analysis, refining new features, e.g. user-added data
  - Momentum is high, but challenge is to enable full spectrum of analyses on Run1-4 in time for summer 2004 conferences
  - Detector systems are very happy with fast turn-around of processed data

New Data Quality group established to coordinate across experiment

- ***Some aspects of project deployed but still in refinement***
  - Event servers, bookkeeping, interactive analysis, speed refinements

Not hindering our ability to get at and analyze data

People: Operations to Data Reconstruction

Actual service task breakdown

Community	Count CY03	Actual avg: '00-'02	Actual avg: '00-'03
US University		51	52
students	68	12	12.5
postdocs	61	12	12.6
faculty/staff	107	26	26.8
Subtotal	236	51	52.0
SLAC		24	26
students	6	6	6.3
postdocs	14	6	6.3
faculty/staff	44	12	13.4
Subtotal	64	24	26.0
non-US		63	63
students	80	15	15.2
postdocs	43	15	15.3
faculty/staff	172	33	32.5
Subtotal	295	63	63.0
Total		138	141
students	154	33	34.0
postdocs	118	34	34.3
faculty/staff	323	71	72.8
Total	595	138	141.0

Conclude

Category	Service Weight
Student	0.93
Postdoc	1.23
Staff	1.52
Faculty	0.47

Faculty ~50% research time, compensated by staff, postdocs

People: Operations & Physics Projections

Actual service task breakdown | Estimated: Based on present service task breakdown | Physics estimated

Community	Count CY03	Actual avg: '00-'02	Actual avg: '00-'03	CY2004	CY2005	CY2006	CY2007	CY2008	CY2009	Physics	Weighted 50%
US University		51	52	63	60	56	52	52	50		
students	68	12	12.5	15.2	14.5	13.5	12.5	12.5	12.1	68	34
postdocs	61	12	12.6	15.3	14.6	13.6	12.6	12.6	12.2	61	31
faculty/staff	107	26	26.8	32.5	31.0	28.9	26.8	26.8	25.8	34	17
Subtotal	236	51	52.0	63.0	60.0	56.0	52.0	52.0	50.0	163	81
SLAC		24	26	33	32	30	26	26	24		
students	6	6	6.3	8.0	7.7	7.2	6.3	6.3	5.8	6	3
postdocs	14	6	6.3	8.0	7.8	7.3	6.3	6.3	5.8	14	7
faculty/staff	44	12	13.4	17.0	16.5	15.5	13.4	13.4	12.4	21	10
Subtotal	64	24	26.0	33.0	32.0	30.0	26.0	26.0	24.0	41	20
non-US		63	63	65	63	62	60	60	57		
students	80	15	15.2	15.7	15.2	14.9	14.5	14.5	13.7	80	40
postdocs	43	15	15.3	15.8	15.3	15.1	14.6	14.6	13.9	43	22
faculty/staff	172	33	32.5	33.5	32.5	32.0	31.0	31.0	29.4	64	32
Subtotal	295	63	63.0	65.0	63.0	62.0	60.0	60.0	57.0	187	93
Total		138	141	161	155	148	138	138	131		
students	154	33	34.0	38.8	37.4	35.7	33.3	33.3	31.6	154	77
postdocs	118	34	34.3	39.1	37.7	36.0	33.5	33.5	31.8	118	59
faculty/staff	323	71	72.8	83.1	80.0	76.4	71.2	71.2	67.6	118	59
Total	595	138	141.0	161.0	155.0	148.0	138.0	138.0	131.0	390	195

Increase due to LSTs, CM2

BABAR Publications

	BABAR*	Belle
<2003	34	54
2003	47	28
2004 (June 1)	16	9
Total	97	91

* Labeled according to internal circulation date

- At time of Feb 19 Collab meeting: 80 (BABAR) vs. 83 (Belle).
- GOAL: at least 100 papers by the July collaboration meeting!

Current Analysis Status-June 2004

sin2β modes

- $B \rightarrow K_S\pi^0$: 1st time-dependent *CP* analysis; β measurement using beam constraint to get *B* vertex. Submitted to PRL.
- $B \rightarrow f_0 K_S$: 1st time-dependent *CP* analysis (β) and observation of new mode. Submitted to PRL.
- $B \rightarrow \phi K_S$, $B \rightarrow \phi K_L$: final Run 1-3 result, submitted to PRL
- $B \rightarrow K^+K^-K_S$ with m(K^+K^-) above the ϕ mass (sin2β measurement consistent with $B \rightarrow J/\psi K_S$). *BABAR* and Belle agree above the ϕ mass! Submitted to PRL.
- $B \rightarrow J/\psi\ K\pi$: 1st ambiguity-free measurement of cos2β and strong phases using s-wave $K\pi$ interference with p-wave (K^*). Preliminary result presented at Moriond EW. PRD in progress.

***CP* in EW Penguin**

- $B \rightarrow K^{*0}\ (\rightarrow K_S\pi^0)\gamma$: 1st time-dependent *CP* analysis of an electroweak penguin mode. Submitted to PRL.

Current Analysis Status-June 2004

sin2α modes

- $B \rightarrow \rho^+\rho^-$: 1st observation of mode; demonstrated that polarization is almost 100% longitudinal $\rightarrow$ *CP* = +1, not a mixture. To appear in PRL.
- $B \rightarrow \rho^+\rho^-$: 1st time-dependent *CP* asymmetry: presented at La Thuile and Moriond. Since G-Q bound is 13°, this measurement provides a much better constraint on α than $B \rightarrow \pi^+\pi^-$. Belle has not yet produced a branching fraction measurement. Submitted to PRL.

CKM Elements

- $|V_{cb}|$ from inclusive *B* decays, hadron spectrum moments, lepton spectrum moments: 2 PRDs and 1 PRL accepted. Uncertainty on $|V_{cb}|$ is significantly reduced.

Current Analysis Status-June 2004

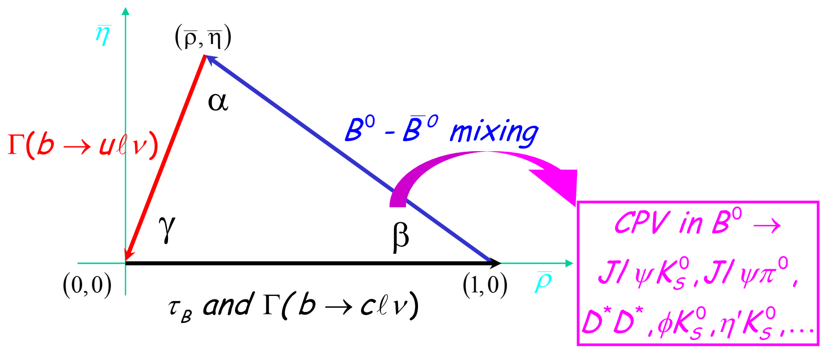
- ***Other major new results presented at Moriond***
  - $B \rightarrow \eta\omega$ (4.3σ), $\eta\eta$, $\eta\eta'$, $\eta'\eta'$, $\eta\phi$, $\eta'\omega$, $\eta'\phi$, $\phi\phi$: PRL submitted.
  - $B \rightarrow D(K\pi)\ K$ (ADS) –limit: submitted to PRL
  - Observation of $D_{sJ}(2317)$ and $D_{sJ}(2460)$ in B decays. Last year, Belle beat us on observing some of these B decays, but we have now found several new modes. Presented at Moriond QCD.
  - Observation of $X(3872)$ in $B \rightarrow X(3872)K$: presented at Moriond QCD, submitted to PRL.
  - Angular analysis of $B \rightarrow \phi K^*$ preliminary result presented at Moriond. Mystery of the very low longitudinal polarization (52%) compared to other $B \rightarrow VV$ modes.
  - $B \rightarrow \eta'(K^*, \rho, \pi^0)$+$(\omega,\phi)\ \pi^0$: PRD submitted
  - $B \rightarrow X_s\ l^+l^-$: PRL submitted
  - $B \rightarrow X_s\gamma$ direct CP: PRL submitted

Current Analysis Status-June 2004

  - $B \rightarrow K^*\gamma$ branching fractions and direct CP search: PRL draft almost ready for CWR.
  - $B \rightarrow a_0\ (K, K^0,\pi)$: preliminary result
  - $B \rightarrow K^0\ \pi^+\pi^-$: preliminary result
- ***Overall assessment of Winter Conferences***
  - 14/14 new results→ Moriond EW; 8/10 new results→Moriond QCD.
  - The Pub Board & Review Committees did a great job handling the large number of analyses.
  - APS: 33 parallel session talks by *BABAR* grad. students & postdocs.
  - New results for APS! $B \rightarrow ppK$; $B \rightarrow \omega\rho$, $K^*\omega$; $B \rightarrow \phi\gamma$, 1st results from pentaquark searches.

About 100 analyses and updates in preparation for ICHEP04

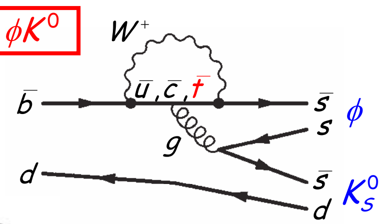
Testing the Origins of CPV



Interference of suppressed $b \to s$ Penguin decay with mixing

Asymmetries for $b \to s\bar{s}s$ Penguins

$B^0 \to \phi K^0$



"Internal Penguin"

u-penguin CKM suppressed by ~0.02

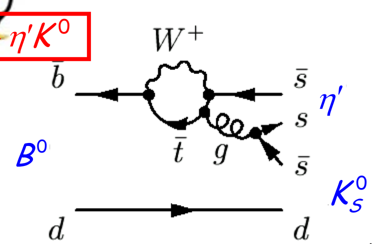
Expectation

$S_{\phi K_S^0} = \sin 2\beta, C_{\phi K_S^0} = 0$

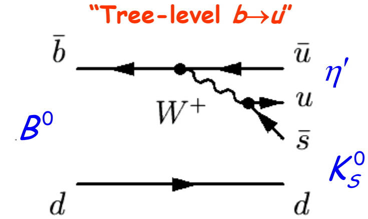
Challenge

$BF = \left(7.6^{+1.3}_{-1.2} \pm 0.5\right) \times 10^{-6}$

$B^0 \to \eta' K^0$



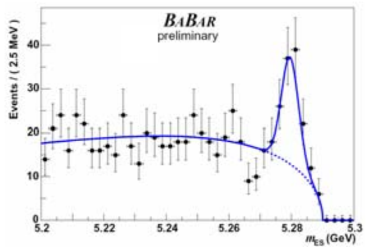
"Tree-level $b \to u$"

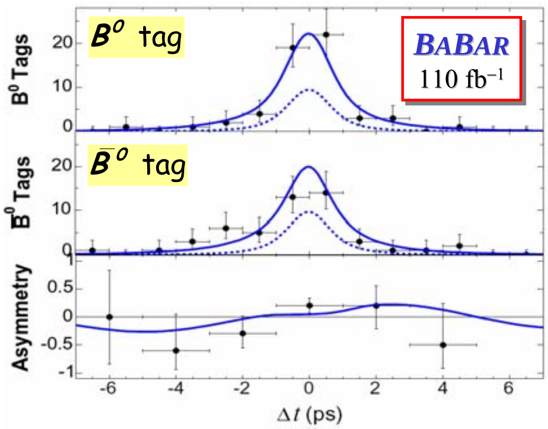


$BF = (55.4 \pm 5.2 \pm 4.0) \times 10^{-6}$

u-tree CKM suppressed T/P < 0.1

BABAR Results for $B \to \phi K_S^0$





Signal

$N\left(\phi K_S^0\left(\to \pi^+\pi^-\right)\right) = 70 \pm 9$

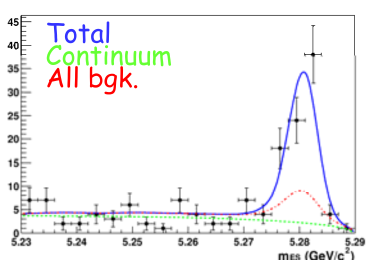
Submitted to PRL

$S_{\phi K_S^0} = +0.45 \pm 0.43_{(stat)} \pm 0.07_{(syst)}$

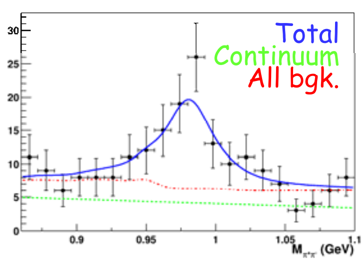
$C_{\phi K_S^0} = -0.38 \pm 0.37_{(stat)} \pm 0.12_{(syst)}$

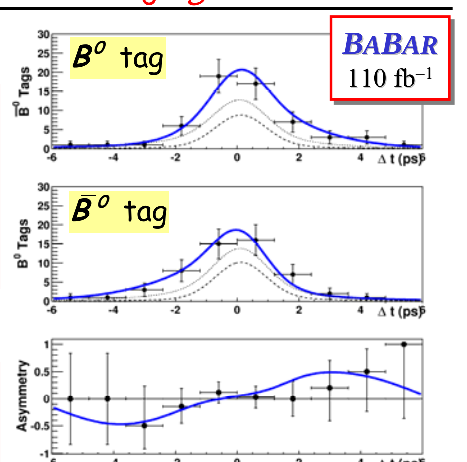
BABAR Results for $B \to f_0 K_S^0$

m_{ES}



$m_{\pi\pi}$





$S_{\phi K_S^0} = +0.45 {}^{+0.56}_{-0.51}{}_{(stat)} \pm 0.07_{(syst)}$

$C_{\phi K_S^0} = -0.38 \pm 0.37_{(stat)} \pm 0.12_{(syst)}$

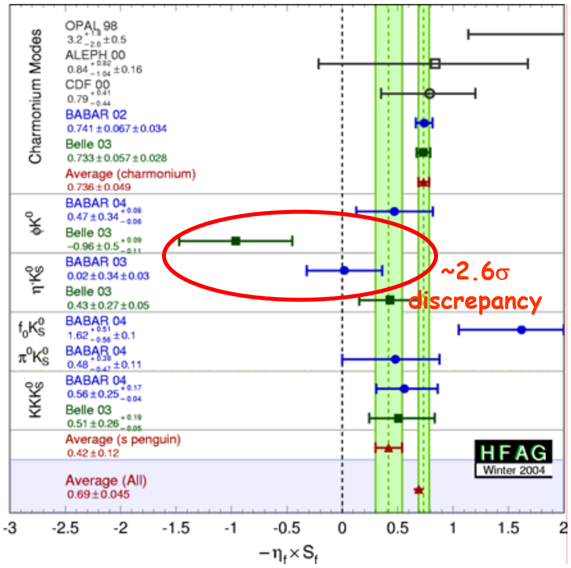
Intriguing Hint?

Present average for $b \to s\bar{s}s$

0.42 ± 0.12

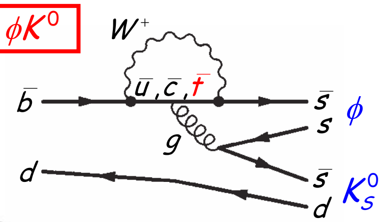
~2.4 sigma below charmonium modes

If central value remains as is, this would become ~5 sigma by 2005



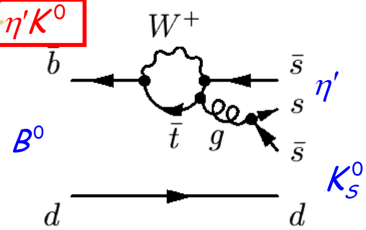
Asymmetries for $b \to s\bar{s}s$ Penguins

$B^0 \to \phi K^0$



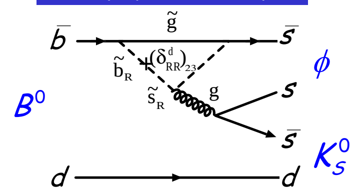
"Internal Penguin"

$B^0 \to \eta' K^0$

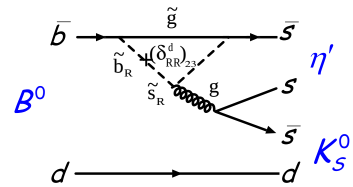


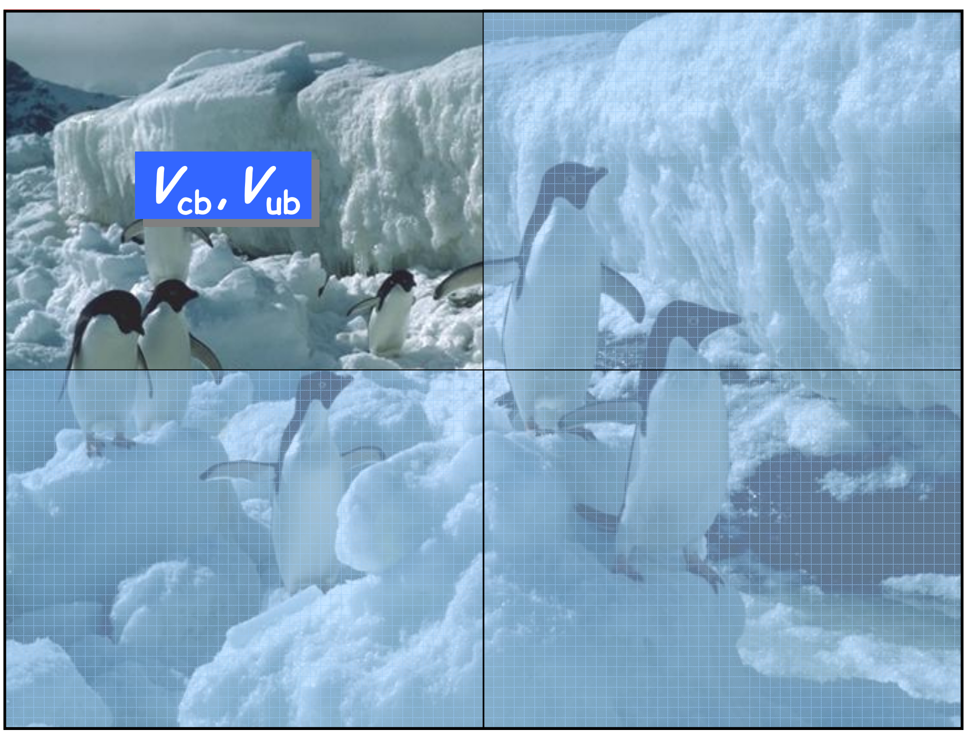
$BF = (55.4 \pm 5.2 \pm 4.0) \times 10^{-6}$

New physics in loops?

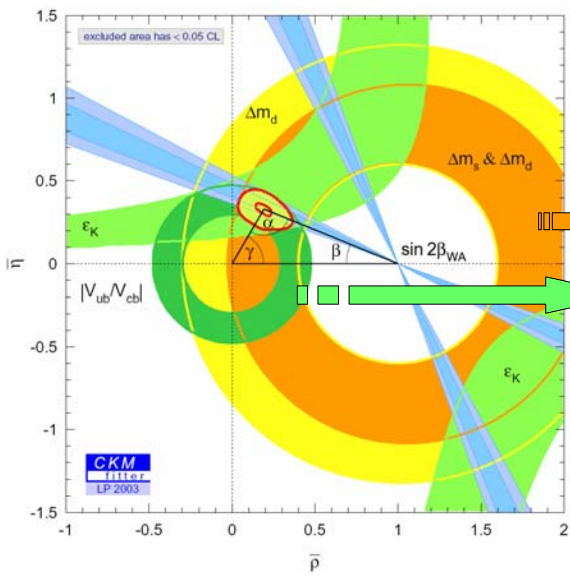


SUSY contribution with new phases





Standard Model Constraints



Tevatron

B Factories

Indirect constraints not as good as direct measurement!

Fully Reconstructed B Sample

Old idea with new level of sensitivity

Reconstruct *B* mesons in ~1000 modes

$B \to D^{(*)}\pi, D^{(*)}\pi\pi^0, D^{(*)}3\pi$,etc

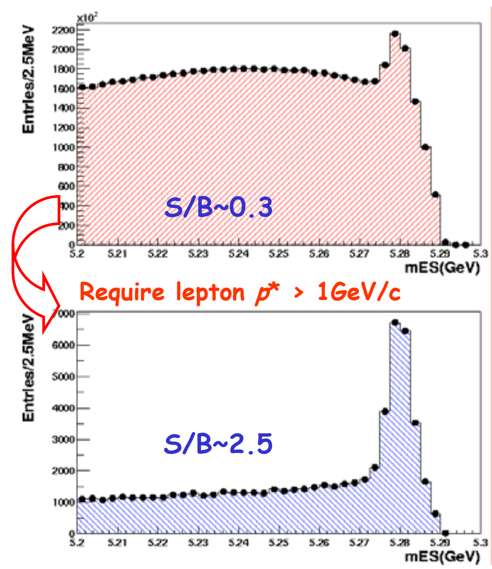
Efficiency ~0.4% or ~4000 *B* mesons/fb^{-1} (charged and neutral)

Now

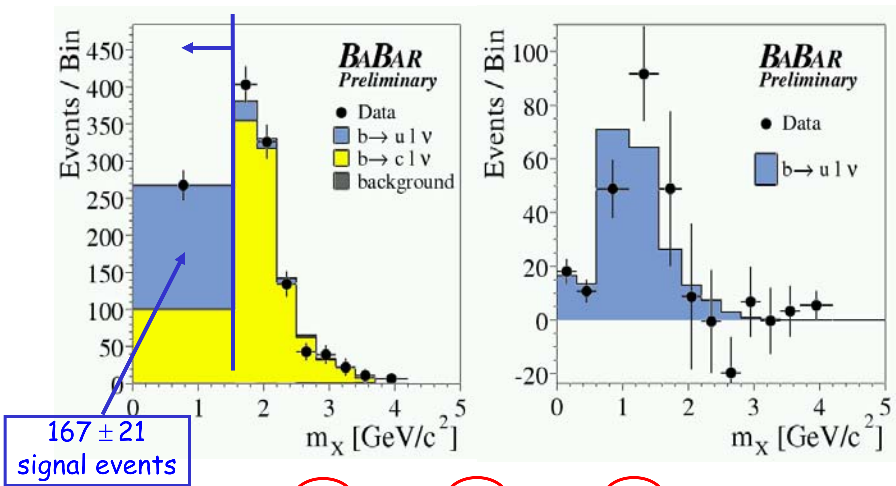
~330000 events tagged with fully reconstructed *B* meson

By 2006

2,000,000 events



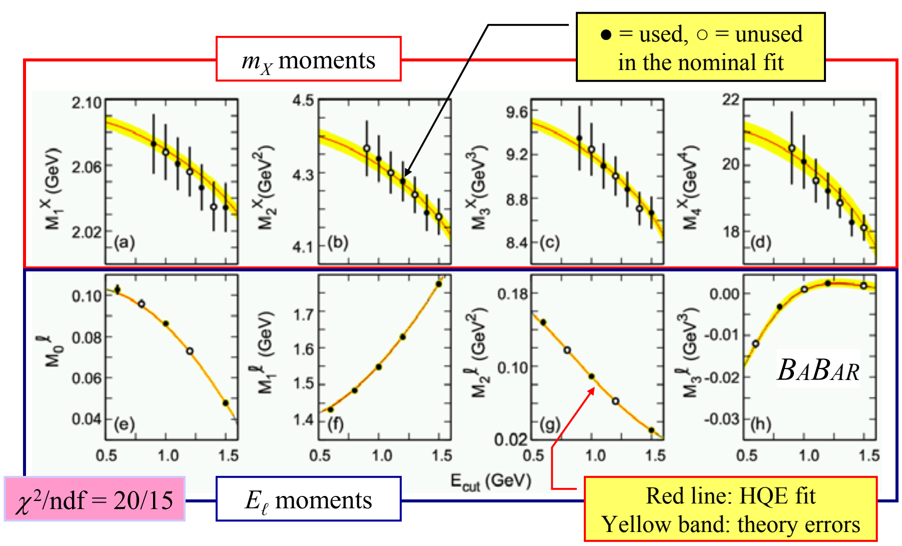
Study of b → u Enriched Sample



$$|V_{ub}| = (4.52 \pm 0.31(stat) \pm 0.27(syst) \pm 0.40(theo)) \times 10^{-3}$$

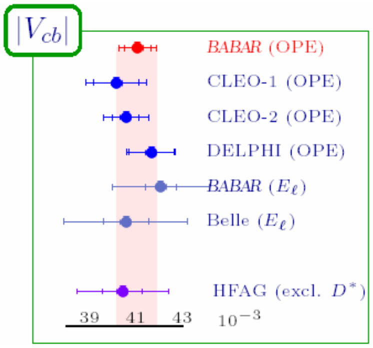
6.9% 6.0% 8.8%

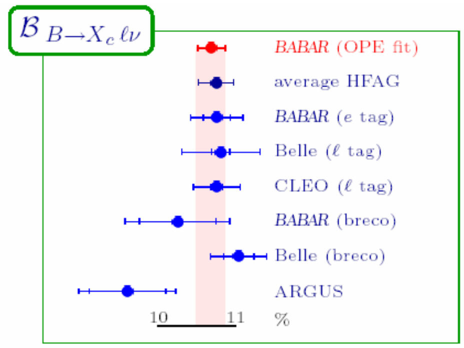
HQE Fit Results for Combined Moments



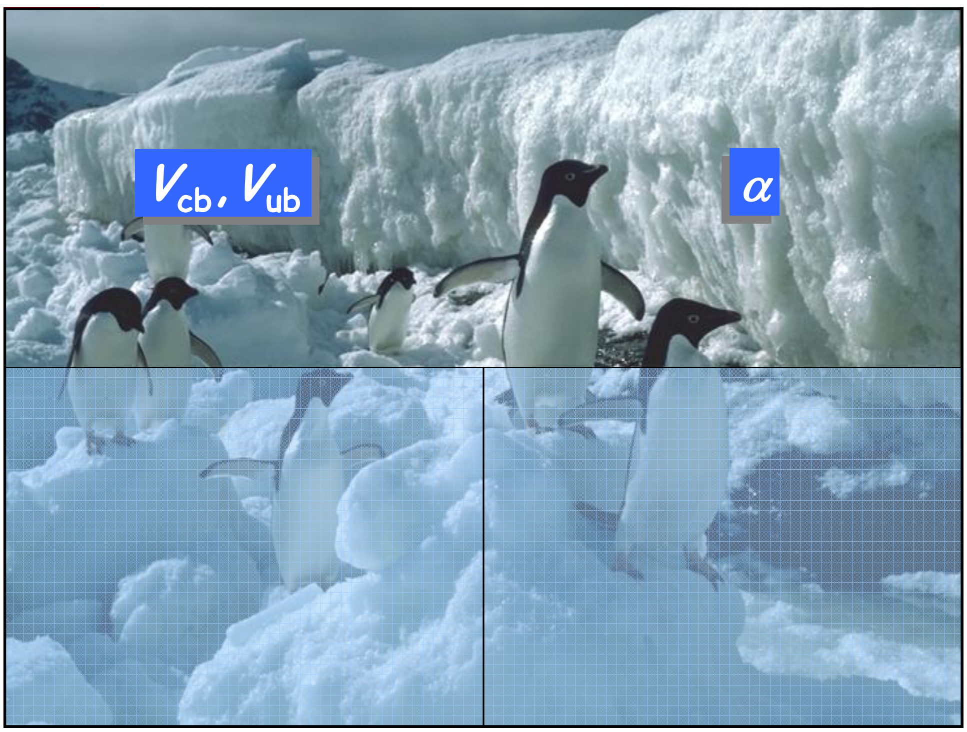
Measurement Improvements

- New BABAR result compares well with previous measurements

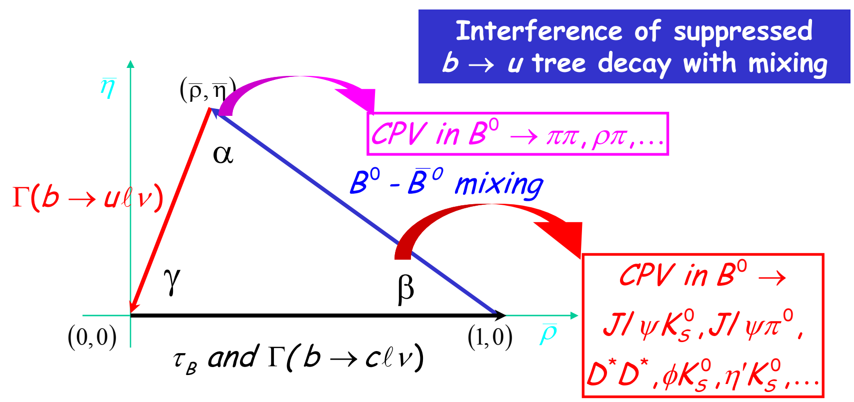




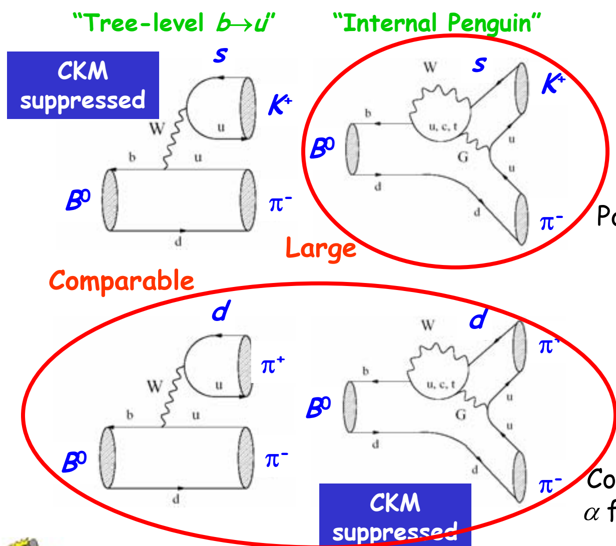
- $|V_{cb}|$ is now measured to ±2%



Testing the Origins of CPV



Competing Amplitudes for $B \to h^+ h^-$



Large

$BF(B^0 \to K^+\pi^-) = (18.5 \pm 1.0) \times 10^{-6}$

Penguin dominated: $A_{K\pi} = \lambda^2 e^{i\gamma} T + P$

Potential direct *CPV* and constraints on γ

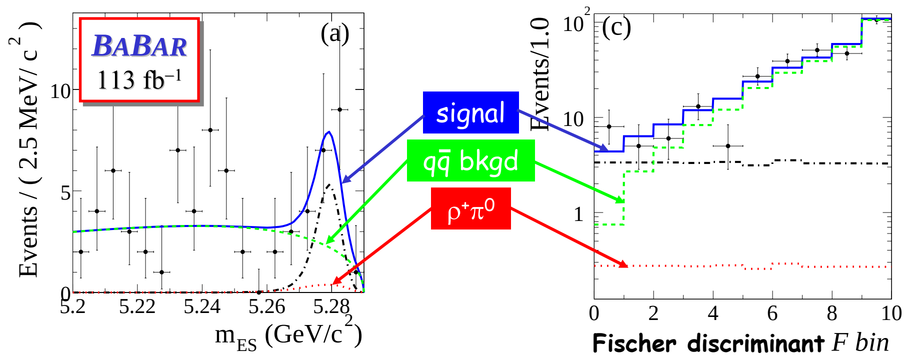
Small

$BF(B^0 \to \pi^+\pi^-) = (4.8 \pm 0.5) \times 10^{-6}$

|Penguin| ~ 0.3|Tree|

Complicates extraction of α from mixing induced *CPV*

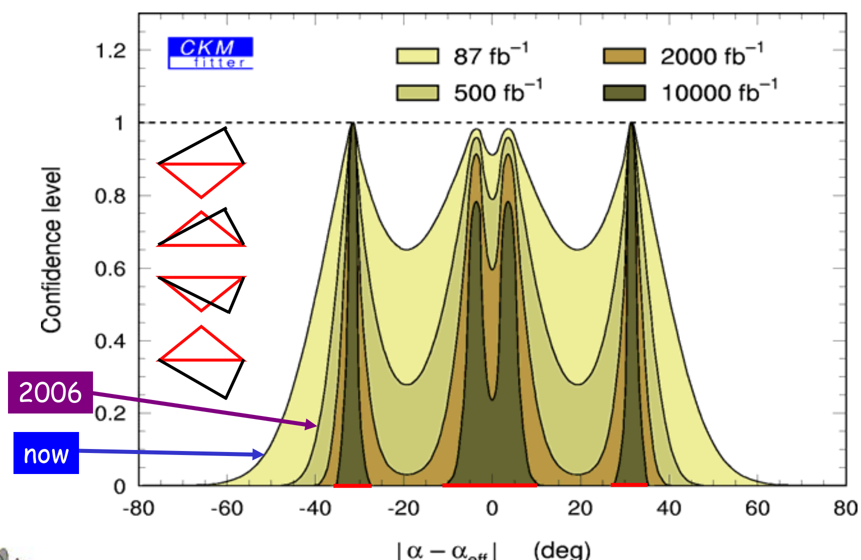
Observation of $B^0 \rightarrow \pi^0\pi^0$



	Signal	BF x 10^{-6}	σ
BABAR	46^{+14+2}_{-13-3}	$2.1 \pm 0.6 \pm 0.3$	4.2
BELLE	$25.6^{+9.3}_{-8.4}$	$1.7 \pm 0.6 \pm 0.3$	3.4

Large!

Projections of $\pi\pi$ Isospin Analysis

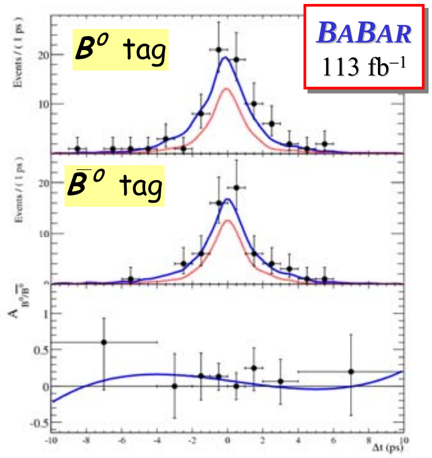


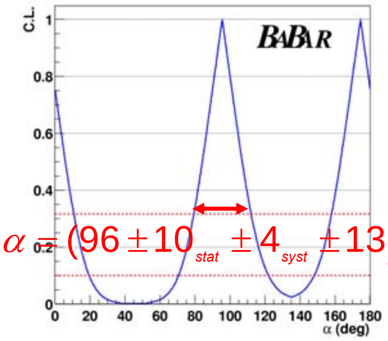
New Result on $B^0 \to \rho^+\rho^-$

$S_{long} = -0.19 \pm 0.33_{(stat)} \pm 0.11_{(syst)}$
$C_{long} = -0.23 \pm 0.24_{(stat)} \pm 0.14_{(syst)}$

$BF(B^0 \to \rho^0\rho^0) <$
2.1×10^{-6} (90% CL)

Small!

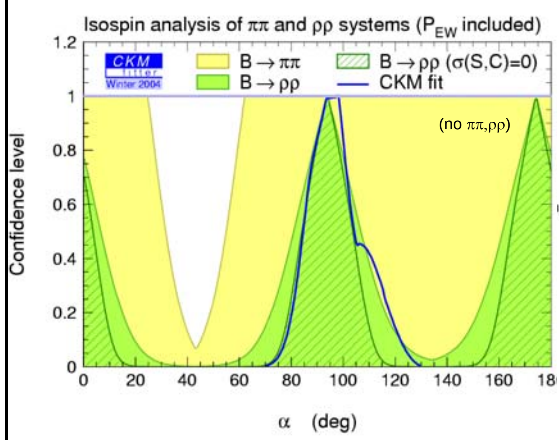


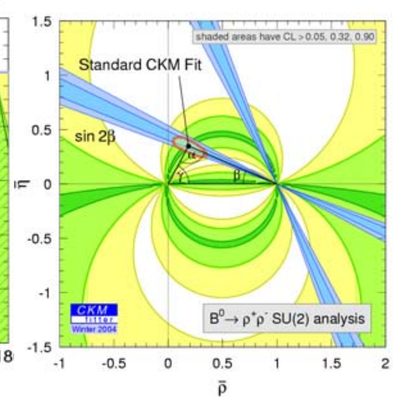


$\alpha = (96 \pm 10_{stat} \pm 4_{syst} \pm 13_{peng})^\circ$

- Isospin analysis: interference, NR contributions, I=1 amplitudes neglected

Analysis from CKMFitter Group

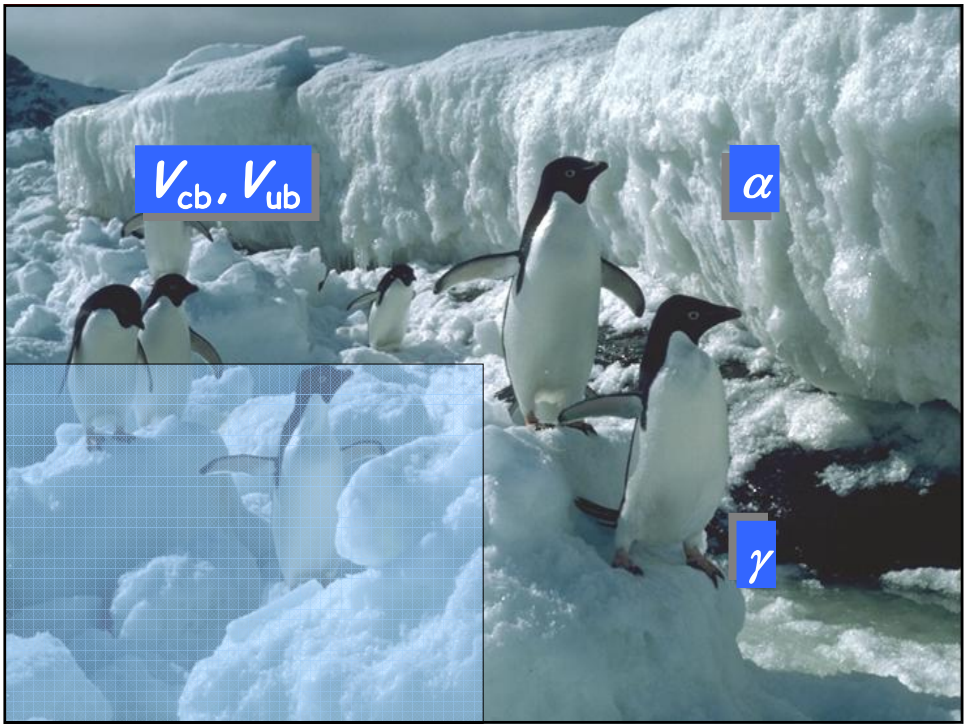




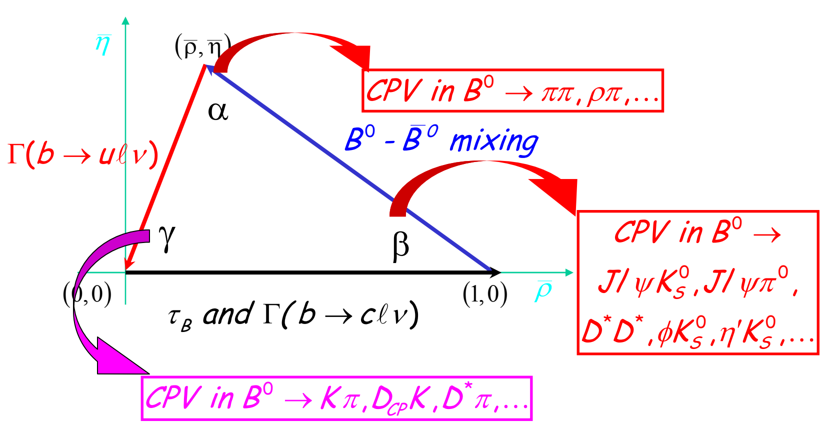
Other ingredients in $\rho\rho$ isospin analysis:

$BR(\rho^+\rho^0) = (26.4 \pm 6.4)10^{-6}$ [*BABAR*,Belle] $BR(\rho^0\rho^0) = (0.62^{+0.72}_{-0.60} \pm 0.12)10^{-6}$ [*BABAR*]

$f_{long}(\rho^+\rho^0) = 0.962^{+0.049}_{-0.065}$ [*BABAR*,Belle] $f_{long}(\rho^0\rho^0) = 1.0$ [assumed]

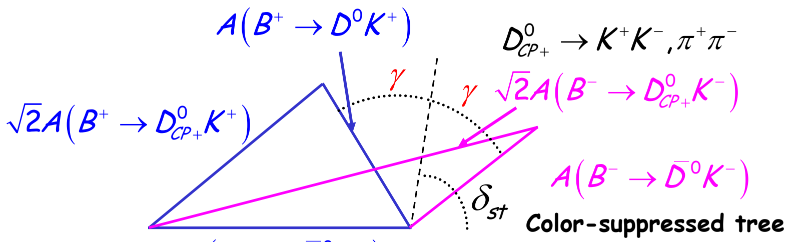


Testing the Origins of CPV



Method for $\sin^2\gamma$

Gronau-London-Wyler, 1991



Color-suppressed tree

$\bar{b} \to \bar{u}c\bar{s} \propto V_{ub}^* V_{cs} \sim \lambda^3$

$A(B^+ \to \bar{D}^0 K^+) =$
$A(B^- \to D^0 K^-)$

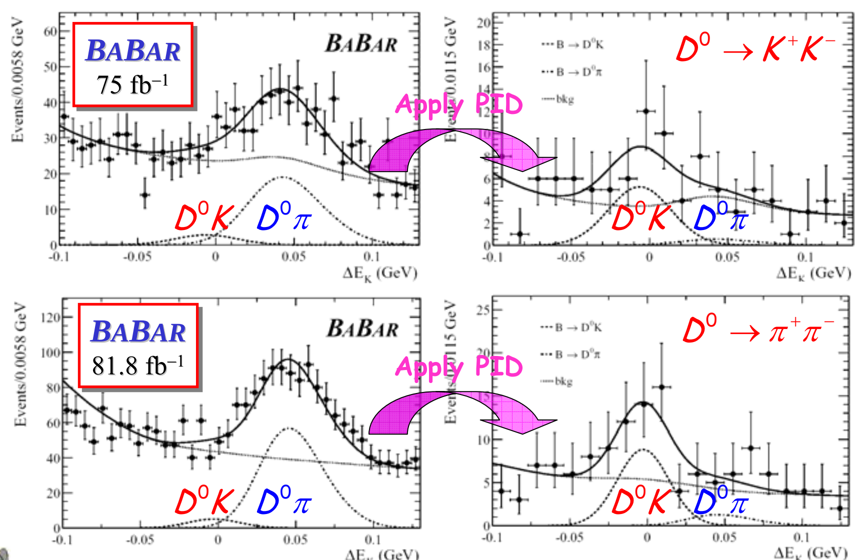
Color-allowed tree

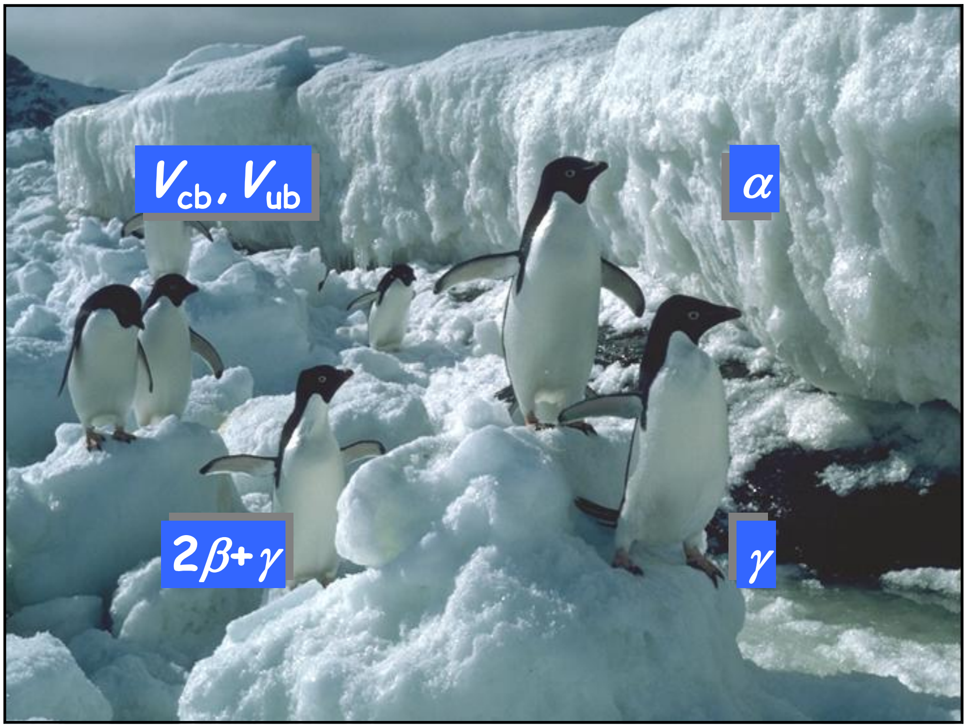
$\bar{b} \to u\bar{c}s \propto V_{cb}^* V_{us} \sim \lambda^3$

$$r = \frac{|A(B^- \to \bar{D}^0 K^-)|}{|A(B^- \to D^0 K^-)|} \sim 0.1 - 0.3$$

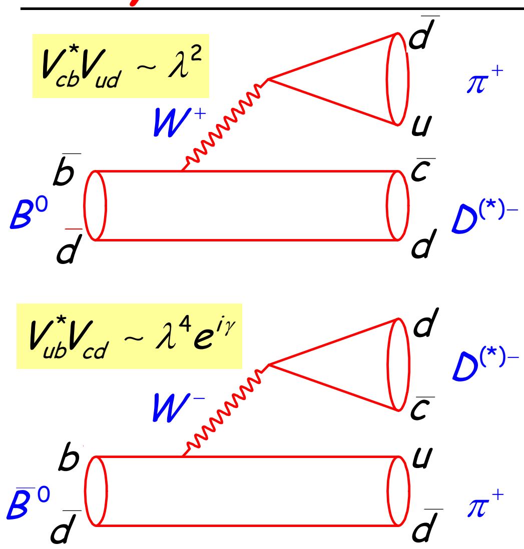
$$A_{CP} = \frac{BF(B^- \to D^0_+ K^-) - BF(B^+ \to D^0_+ K^+)}{BF(B^- \to D^0_+ K^-) + BF(B^+ \to D^0_+ K^+)} = \frac{\pm 2r\sin\delta\sin\gamma}{1 \pm 2r\cos\delta\cos\gamma + r^2}$$

BABAR Signals for $B^- \to D^0_{CP+} K^-$





Decays to Common Final States



Ingredients

Both B^0 and $\bar{B}^0$ decay to $D^{(*)+}\pi^-$ and $D^{(*)-}\pi^+$

Sensitivity to γ enters via amplitude $\propto V_{ub}$

Mixing induced time-dependent asymmetries

Current status

$$\left|\lambda_{D^{(*)}\pi}\right| = \frac{\left|A\left(\bar{B}^0 \to D^{(*)-}\pi^+\right)\right|}{\left|A\left(B^0 \to D^{(*)-}\pi^+\right)\right|} \sim 0.02$$

from $BF\left(B^0 \to D_S^+\pi^-\right)$ and SU(3) symmetry

Estimated error

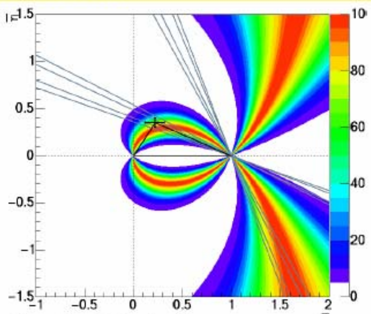
$\sigma[\sin(2\beta+\gamma)] \sim 0.6$ for 80fb^{-1}

Limits on $|\sin(2\beta+\gamma)|$

Method assuming SU(3) :

minimise a χ^2 : fit $|(\sin(2\beta+\gamma)|$, δ, δ^*, r & r*
assume a 30% flat theoretical error for r and r*

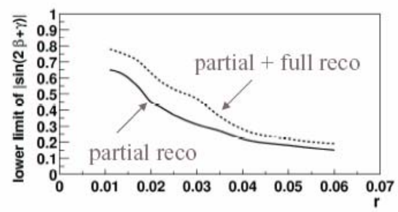
$|\sin(2\beta+\gamma)|$ > 0.74 at 90 % CL
$|\sin(2\beta+\gamma)|$ > 0.58 at 95 % CL



Constraints in the plane ρ,η

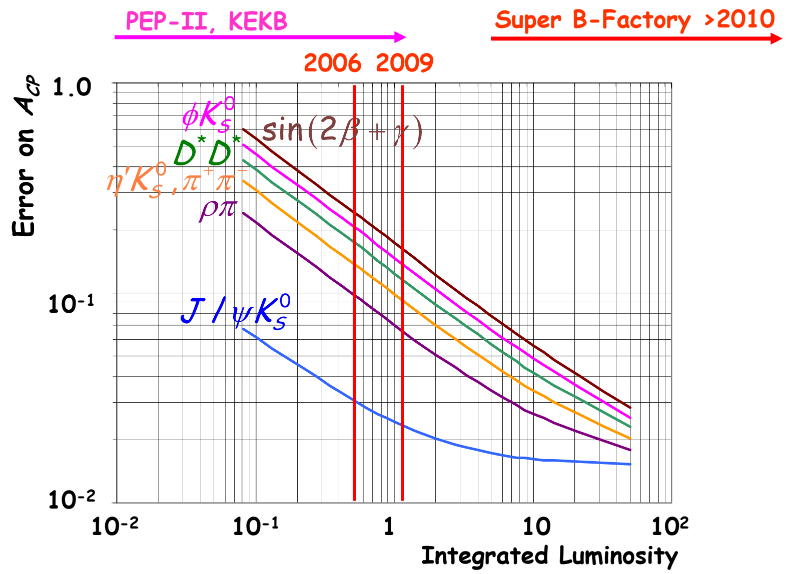
Method « r* scan »
(only with $B^0 \to D^*\pi$)

To avoid any assumption on r* :
Fit only $|(\sin(2\beta+\gamma)|$ & δ^* in the χ^2



95% CL lower limit on $|\sin(2\beta+\gamma)|$ as a function of r*

Error Projections for A_{CP}



Super B Factory

- ***Current program of PEP-II/BABAR and KEKB/Belle could attain ~1-2 ab^{-1} by end of the decade***
  - Data samples are 10x larger than CLEO II and will eventually be 50-200x times larger
    - **With such a large increase in sensitivity to rare decays, expect that there is a significant discovery potential**
    - **Rich program of flavor physics/CP violation to be pursued**
- ***Even larger samples may offer opportunity to search for new physics in CP violation and rare decays***
  - High-luminosity asymmetric e^+e^- colliders with luminosities 10^{35}-10^{36} $cm^{-2}s^{-1}$ and up to 10 ab^{-1}/year – "Super *B* Factory"
    - **Emphasis on discovery potential and complementarity in an era when LHC is operating, along with LHCb and BTeV (?)**
    - **Complementary flavor physics if LHC discovers SUSY, etc; discovery window if no new physics seen?**

Roadmap Process within BABAR

- **Defining of physics case for Super B Factory**
  - Emphasize sensitivity to new physics in CP violation & rare decays
  - Emphasize need & capability for precision SM measurements
- **Requirements of viable project plans**
  - Peer review, approval and funding process
  - Collider options and upgrade capabilities
  - Detector capabilities & requirements in light of projected backgrounds
  - Integrated scenarios for collider and detector construction, with implications for time to first data
- **Projections of physics reach in light of competition & other opportunities**
  - Projections of samples and sensitivities; analysis of physics reach

Parameters for High-Luminosity B Factory

Luminosity	$2\text{-}3\times10^{34}$	1.5×10^{35}	2.5×10^{35}	7×10^{35}	Units
e^+	3.1	3.1	3.5	8.0	GeV
e^-	9.0	9.0	8.0	3.5	GeV
I^+	4.5	8.7	11.0	6.8	A
I^-	2.0	3.0	4.8	15.5	A
$\beta(y^*)$	7	3.6	3.0	1.5	mm
$\beta(x^*)$	30	30	25	15	cm
Bunch length	7.5	4	3.4	1.7	mm
# bunches	1700	1700	3450	6900	
Crossing angle	0	0	±11	±15	mrad
Tune shifts (x/y)	8/8	11/11	11/11	11/11	x100
rf frequency	476	476	476	952	MHz
Site power	40	75	85	100	MW

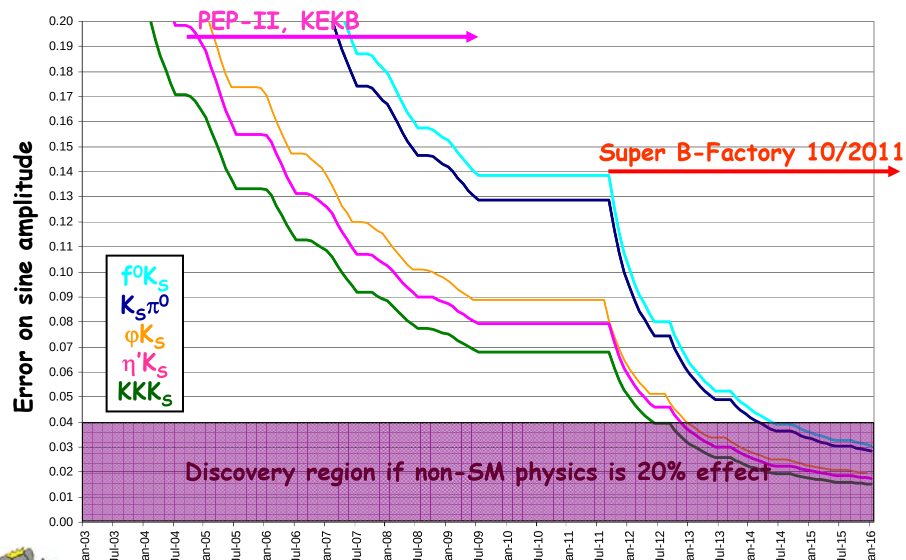
J.Seeman

Detector Upgrade Requirements

Requirements depend on projecting backgrounds for luminosities that are >20 times larger than at present

- *Replace inner layers of present SVT with segmented strips*
  - Should be viable to about 5×10^{35}
  - Develop thin pixels and replace inner SVT at an appropriate time to go higher in luminosity
- *Replace DCH with all silicon tracker or equivalent*
- *Replace DRC SOB and bar boxes due to smaller radius for EMC*
- *Replace EMC with either radiation hard crystals or liquid xenon*
- *Replace IFR forward endcap*

Searching for New Physics



Conclusions

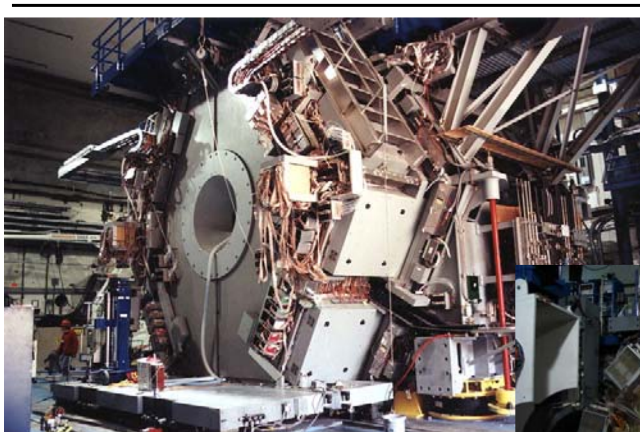
- ***BABAR and PEP-II continuing along planned path towards ever higher luminosity***
  - Accumulating data with high efficiency, exploiting great strides by PEP-II; addressing known detector & computing issues
  - Expect to accumulate 0.5 ab^{-1} in calendar 2006, representing a doubling of current data sample
  - Strong physics case for doubling the data sample again by end of decade, achieving 1-2 ab^{-1}
- ***BABAR currently has one of the greatest data samples in particle physics***
  - Physics is being vigorously exploited, both across a broad range of important problems, and broadly within the Collaboration
  - Expect many new and updated results at ICHEP04, including results that use our full data sample from Run 4

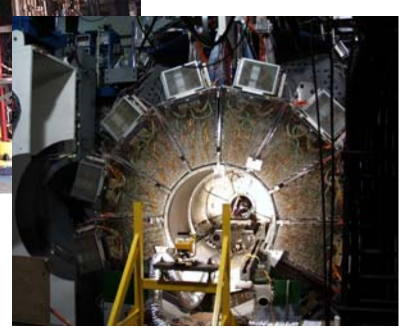
Conclusions

- ***Have made good progress as a physics community in defining a longer-term roadmap***
  - Builds on ideas of Super *B* Factories from Snowmass 2001 and subsequent workshops
  - Builds on proven track record of high-luminosity storage rings and general purpose e^+e^- detectors
  - Builds on our present knowledge of *CP* violation and rare *B* decays; expect that case will only strengthen as we achieve planned luminosity improvements over the next few years
  - Outlines now exist of the detector and collider requirements and goals for a major upgrade to existing facilities

Backup Slides

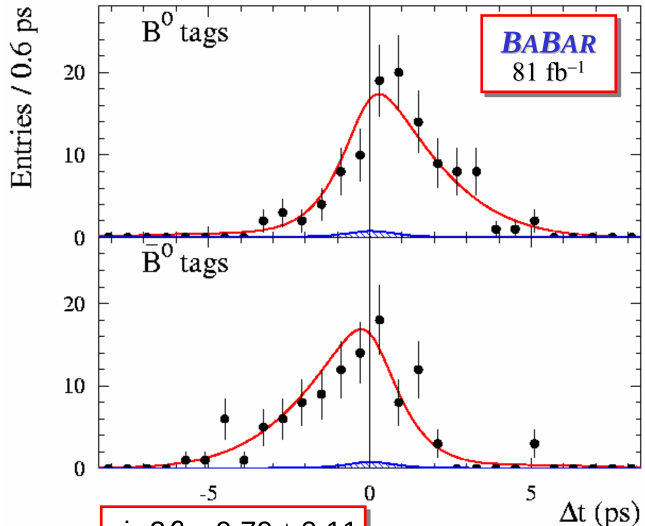
Assembled Detector





Completed Feb 1999
First collisions May 26, 1999

Pure Gold: Lepton Tags Alone



$\sin 2\beta = 0.79 \pm 0.11$

220 tagged η_f = -1 events

98% purity
3.3% mistag rate
20% better Δt resolution

BABAR Downtime 2/13 – 4/30/04

Recent sample of downtime sources

System	*Cause*	*Downtime [min]*
DCH	*HV power supplies, waveform*	*310*
Online	*DCH waveform*	*193*
High backgrounds		*148*
EMC	*Chiller, LV power supplies*	*60*
IFR	*Cooling leak*	*45*
Operator error		*30*
Total		*786 = 0.6% loss*

Lots of < 3min inefficiencies not accounted for (difficult to attribute)

Machine Detector Interface

➢ *Backgrounds, present & future*

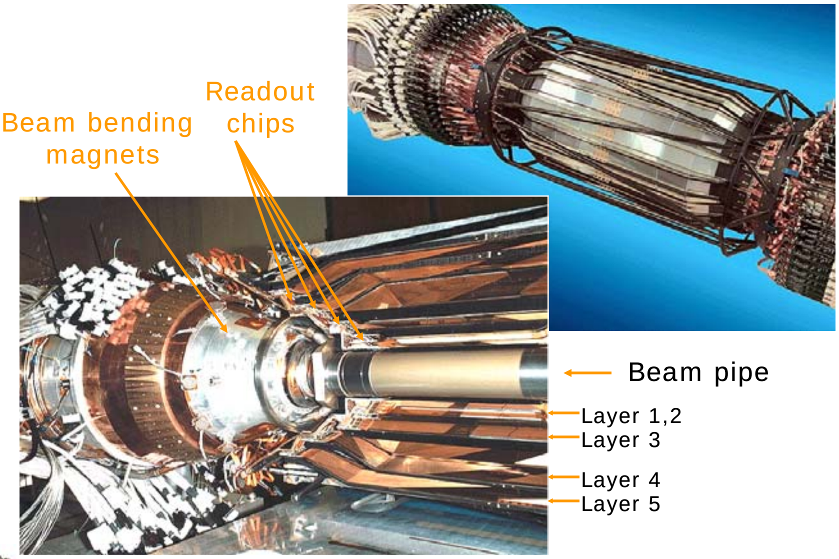
- Radiation-abort policies (an ongoing effort...)
  - Detailed analysis of thresholds/procedures -> improved flexibility, reduced # aborts
- Operational issues such as beam-beam backgrounds, injection (dose! inefficiencies!), radiation bursts
- Background projections
  - Medium-term vulnerabilities (SVT dose, DCH data flow) better understood
  - Some subsystems may be marginal on the long run (>'06-'07)
- Simulations: small group accreting and making progress
  - Revive/update mothballed tools (beam-gas Turtle, GEANT IR description)
  - Benchmark on present machine + evaluate improvements (IR upgrade, collimation)

Machine Detector Interface

➢ *Accelerator Performance Improvements*

- Machine tuning: trickle backgrounds, detector occupancies → on-line in MCC
- Beam size measurements → understand optics, beam-beam (Workshop, Oct. 03)
  - @ IP, using BaBar data ($\mu^+ \mu^-$, $e^+ e^-$) → on-line
  - Bunch-by-bunch beam size in LER & HER commissioned ("gated camera")
  - New X-ray vertical size monitor for LER: engineering design, install summer
- Beam-beam simulations (→medium-term Luminosity optimization strategy)

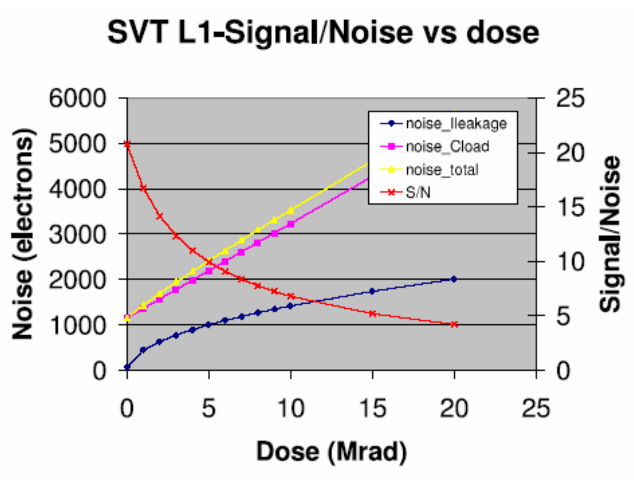
Silicon Vertex Detector



SVT Radiation Damage

- ***Limiting factors on SVT lifetime***
  - Damage to the sensors:
    - Instantaneous: p-stop shorts; affect efficiency
    - Integrated: increase in leakage current→ shot noise; change in depletion voltage & type inversion→ electronics noise; damage to crystal structure→ decrease in charge collect efficiency
  - Damage to the electronics:
    - Increase in noise & decrease in gain → decrease S/N; Digital failures → inefficiency
    - Recently observed pedestal shift at about 1MRad, not seen in previous tests
      - Able to optimize occupancy/efficiency to retain performance
      - Appears to restore itself after about 2MRad

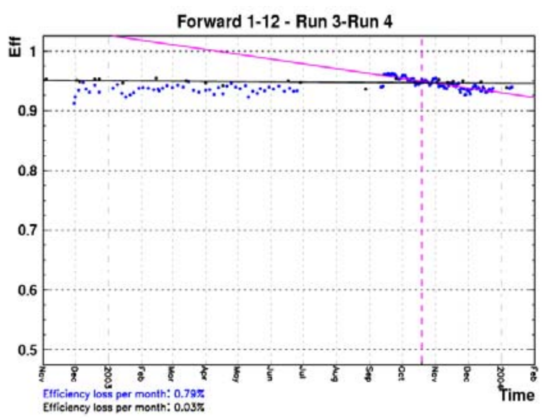
SVT Radiation Damage



Expected evolution in the noise level and signal/noise ratios as a function of the integrated dose

Forward Endcap RPC Performance

- *Efficiency*
  - Flat when measured with cosmics
  - Small decrease in Run 4 with data
- *High backgrounds in some layers*
  - Layer 14 (5/6) and 13 (1/6)
  - In process of adding a shielding wall



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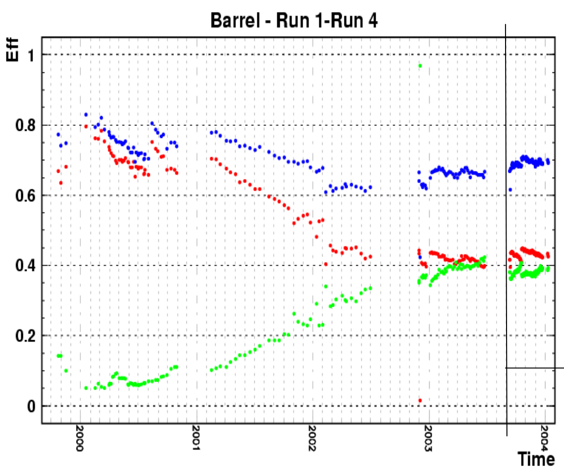
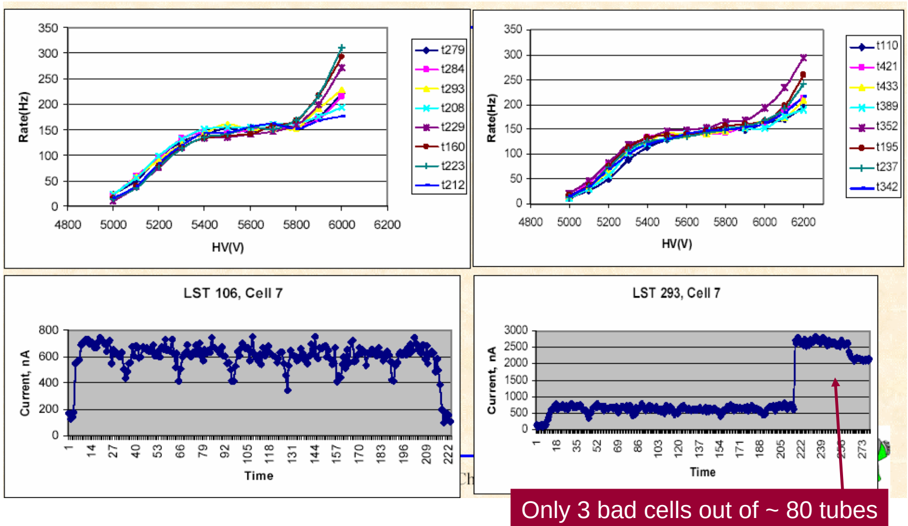
Barrel RPC Performance



- Average efficiency
- Average efficiency of chambers with efficiency >10 %
- Percentage of chambers with efficiency <10 %

Efficiency gain due to raised HV (~4%)

HV Plateaus and Source Scans



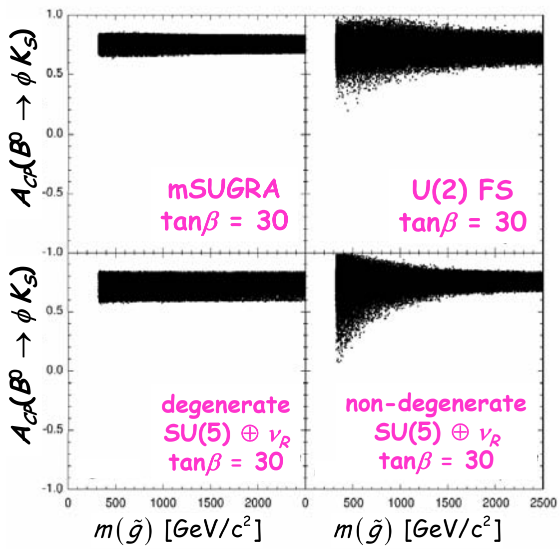
Other Recent Physics Papers

- $B^+ \to \eta\pi^+$, ηK^+, $B^0 \to \omega K^0$ 1st observations: accepted
- Color suppressed B decays: $B \to D^{*0}\eta$, $D^{*0}\omega$, $D^0\eta'$ 1st observations: accepted
- $B \to J/\psi\eta K$ 1st observation: submitted
- DG and CPT limits from $B \to J/\psi K^0$: PRL and PRD submitted
- $\sin(2\beta+\gamma)$: inclusive & exclusive $B \to D^*\pi$: 2 papers submitted
- $B \to p\bar{p}$ search accepted
- $\tau \to 3$ leptons (limits): accepted (Belle paper followed)
- $D_s(2458)$: accepted
- Mass and width of $\Upsilon(4S)$: submit to PRD

Ideas are bubbling forward…

Extensions of the SM

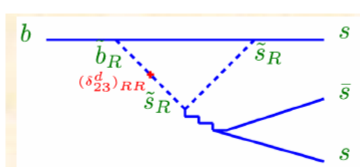
- Modify $A_{CP}(B^0 \to \phi K_S)$ through loop diagram
- Impact and/or are constrained by other $b \to s$ processes
  - EDM, ε_K, Δm_d, Δm_s, $b \to s\gamma$

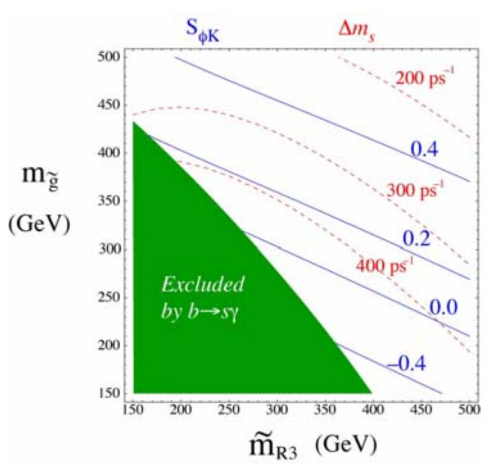


Y.Okada, 10^{36} Workshop

Big Effects are Possible

Harnik-Larson-Murayama-Pierce, hep-ph/0212180

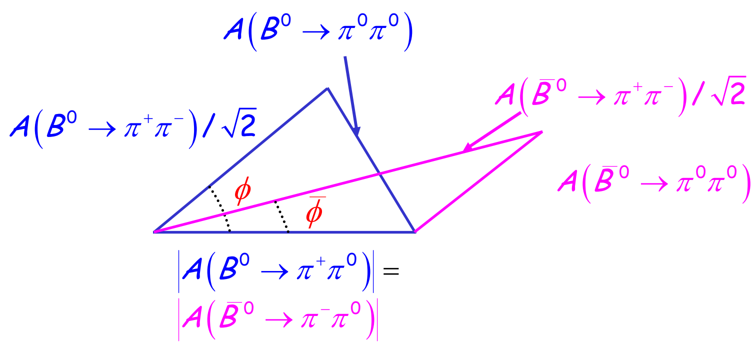




Many theorists proposing ideas

Hiller, Hiller-Atwood, Ciuchini-Silvestrini, Kahalil-Kou, Kane-Ko-Wang-Kolda-Park-Wang, Ciuchini-Franco-Masiero-Slivestrini, Hisano-Shimizu, Nir, Raidal, Kagan,…

Isospin Analysis for $\sin 2\alpha$



$\Delta I = 2$

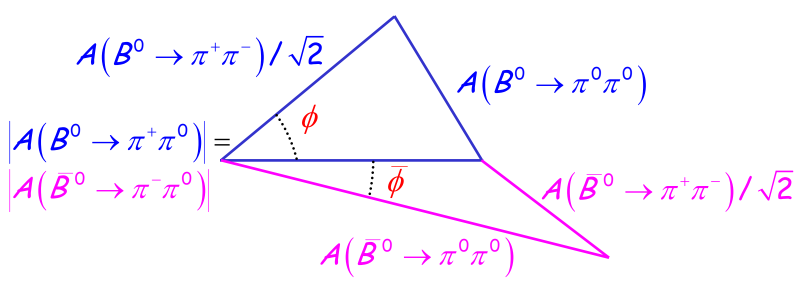
No Penguin contribution

Correction to α_{eff}

$$2\alpha - 2\alpha_{eff} = \phi - \bar{\phi}$$

Gronau-London, 1990

4-Fold Ambiguity



Correction to α_{eff}

$$2\alpha - 2\alpha_{eff} = \pm(\phi \mp \bar{\phi})$$

Improving V_{ub} Determination

Inclusive Spectra

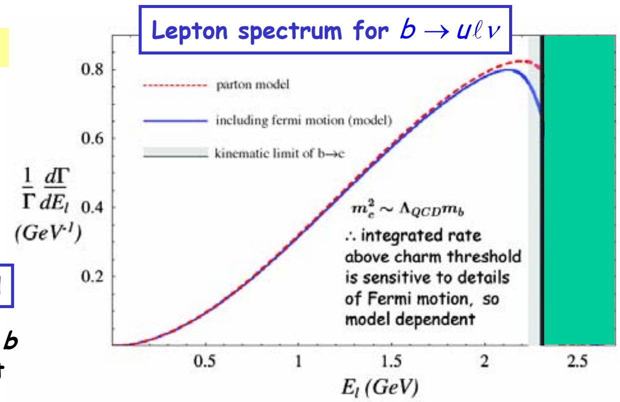
Short distance calculable; long distance hadronization depends on average properties of b quark wave function

Experimental Issue

Rejecting 100x larger b to charm backgrounds

Traditional method

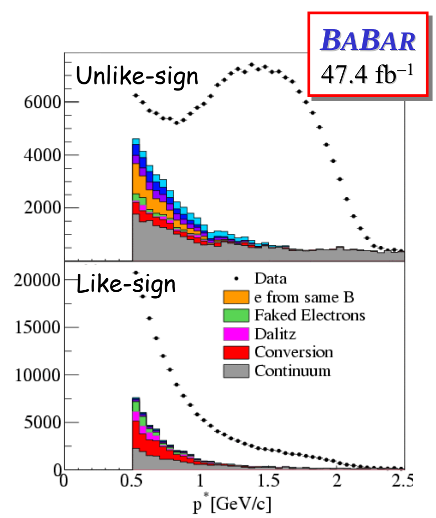
Use leptons above b to charm endpoint



M.Luke, 10^{36} Workshop

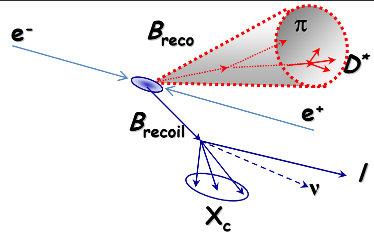
SL Decays: Leptonic Mass Moments

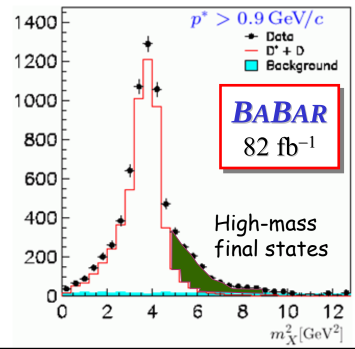
- **Events with 2 electrons**
  - One (1.4 < p^* < 2.3 GeV) used "tag" a BB event
  - Other (p^* > 0.5 GeV) used to measure the spectrum
- **Use charge correlation**
  - Unlike-sign events
    - Dominated by $B \to X_c e\nu$
  - Like-sign events
    - $D \to Xe\nu$ decays, B^0 mixing
- **Extract E_ℓ spectra and moments**
  - Move to B rest frame, correct for final state radiation



SL Decays: Hadronc Mass Moments

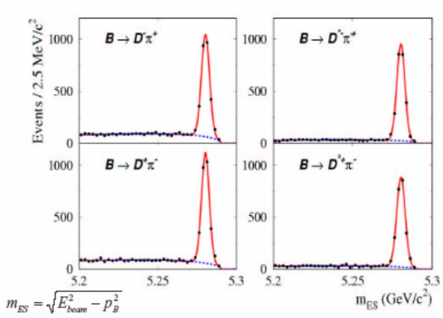
- ***Signal selection***
  - Exactly one lepton (e or μ) with $p^* > p^*_{min}$ in *B* rest frame
  - Lepton charge consistent with prompt *B* decay
  - Missing energy and missing momentum consistent with neutrino
- ***Kinematic fit to full event***
  - Resolution $\sigma(M_X)$ ~ 350 MeV
- ***Measure mass moments of system X_c as function of p^*_{min}***



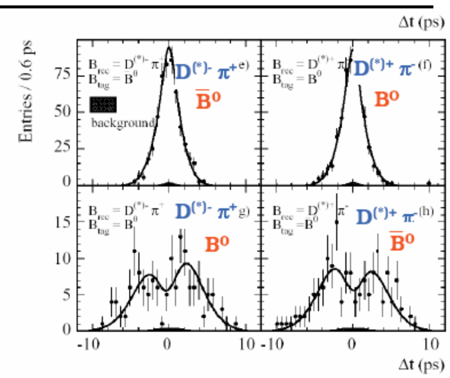


BABAR
82 fb^{-1}

Full Reconstruction of $B^0 \rightarrow D^{(*)}\pi$



$m_{ES} = \sqrt{E^2_{beam} - p^2_B}$



Large sample, very few background

N(Dπ) = 5207 ± 87 (purity=85%)

N(D*π) = 4746 ± 78 (purity=94%)

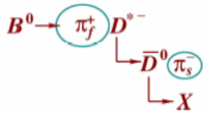
$a = 2r\sin(2\beta+\gamma)\cos(\delta) = -0.022 \pm 0.038 \pm 0.020$

$a^* = 2r^*\sin(2\beta+\gamma)\cos(\delta^*) = -0.068 \pm 0.038 \pm 0.020$

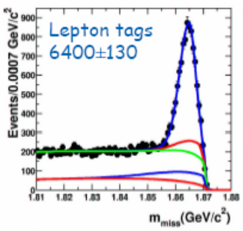
measurement limited by the statistics

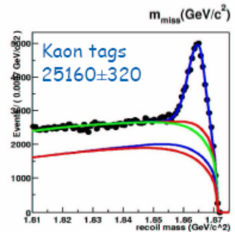
BABAR
82 fb^{-1}

Partial Reconstruction of $B^0 \to D^{(*)}\pi$

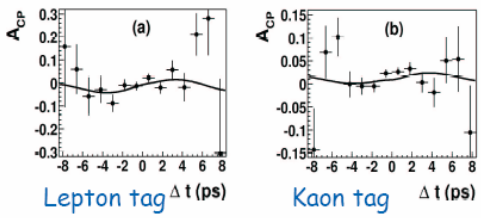


- no attempt to reconstruct D^0
- more events but more background





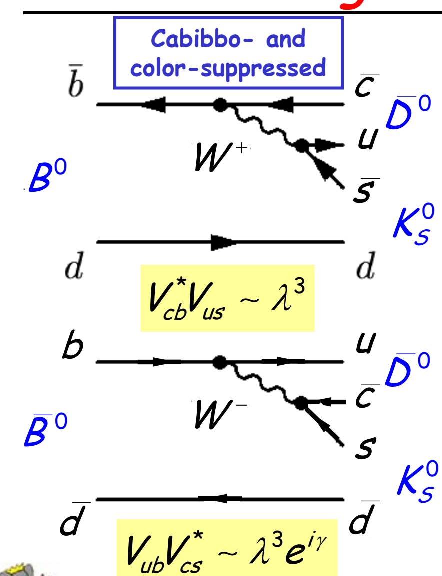
$$A_{CP}^{rec} = \frac{N(B^0_{tag}, B^0 \to D^{*\pm}\pi^{\mp})(t) - N(\bar{B}^0_{tag}, B^0 \to D^{*\pm}\pi^{\mp})(t)}{N(B^0_{tag}, B^0 \to D^{*\pm}\pi^{\mp})(t) + N(\bar{B}^0_{tag}, B^0 \to D^{*\pm}\pi^{\mp})(t)}$$



$$a^* = 2r\sin(2\beta+\gamma)\cos(\delta^*) = -0.063 \pm 0.024 \pm 0.014$$

Deviates from 0 at 2.3 σ

More Promising?



BF estimate

$$\lambda^2 BF\left(B^0 \to D^0\pi^0\right) \sim 1\times10^{-5}$$

Belle, PRL 90, 141803 (2003)

$$BF\left(\bar{B}^0 \to D^0\bar{K}^0\right) = \left(5.0^{+1.3}_{-1.2} \pm 0.6\right)\times10^{-5}$$
$$BF\left(\bar{B}^0 \to D^0\bar{K}^{*0}\right) = \left(4.8^{+1.1}_{-1.0} \pm 0.5\right)\times10^{-5}$$

Some Issues

- **Multiple ambiguities in extracting γ**
- **DCSD decays on the tagging side of event**
- **Many other modes possible, and required, to meet statistical limitations**

$b \to s l^+ l^-$ precision

New Physics – Kl^+l^-, sl^+l^- [%]		e^+e^- [ab^{-1}]			Hadronic b [1 yr]	
Measurement	Goal	3	10	50	LHCb	BTeV
$\mathcal{B}(B\to K\mu^+\mu^-)$ / $\mathcal{B}(B\to Ke^+e^-)$	SM: 1	~8	~4	~2	-	-
$A_{CP}(B\to K^*\ell^+\ell^-)$: all	SM: <5	~6	~3	~1.5	~1.5	~2
$A_{CP}(B\to K^*\ell^+\ell^-)$: high mass	SM: <5	~12	~6	~3	~3	~4
$A^{FB}(B\to K^*\ell^+\ell^-)$: s_0 $A^{FB}(B\to K^*\ell^+\ell^-)$: A_{CP}	SM: ± 5	~20	~9	9	~12	
$A^{FB}(B\to s\ell^+\ell^-)$: $\hat{s}_0$		27	15	6.7		
$A_{FB}(B\to s\ell^+\ell^-)$: C_9, C_{10}		36-55	20-30	9-13		

$b \to s l^+ l^-$ precision

New Physics – Kl^+l^-, sl^+l^- [%]		e^+e^- [ab^{-1}]			Hadronic b [1 yr]	
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$A_{CP}(B\to K^*\ell^+\ell^-)$: high mass	SM: <5	~12	~6	~3	~3	~4
$A^{FB}(B\to K^*\ell^+\ell^-)$: s_0 $A^{FB}(B\to K^*\ell^+\ell^-)$: A_{CP}	SM: ± 5	~20	~9	9	~12	
$A^{FB}(B\to s\ell^+\ell^-)$: $\hat{s}_0$		27	15	6.7		
$A_{FB}(B\to s\ell^+\ell^-)$: C_9, C_{10}		36-55	20-30	9-13		

Discovery potential at Super *B* for non-SM physics

PEP-II Upgrades for 5 x 10^{35}

- Replace present RF with 952 MHz frequency over period of time.
- Use 8 x 3.5 GeV with up to 15.5 A x 6.8 A.
- New LER and HER vacuum chambers with antechambers for higher power (x 4).
- Keep present LER arc magnets but add magnets to soften losses; replace HER magnets as well.
- New bunch-by-bunch feedback for 6900 bunches (every bucket) at 1 nsec spacing. (Presently designing feedback system being 0.6-0.8 nsec spacing.)
- Push β_y^* to 1.5 mm: need new IR (SC quadrupoles) with 15 mrad crossing angle and crab cavities

Physics Capabilities: Angle Projections

Unitarity Triangle Angles [degrees]	e^+e^- [ab^{-1}]			Hadronic b [1yr]	
Measurement	3	10	50	LHCb	BTeV
$\alpha(\pi\pi)$ ($S_{\pi\pi}$, $B\to\pi\pi$ BR's+ isospin)	6.7	3.9	2.1	-	-
$\alpha(\rho\pi)$ (Isospin, Dalitz) (syst $\geq 3°$)	3, 2.3	1.6, 1.3	1, 0.6	2.5 -5	4
α ($\rho\rho$) (penguin, isospin, stat+syst)	2.9	1.5	0.72		
$\beta(J/\psi K_S)$ (all modes)	0.3	0.17	0.09	0.57	0.49
$\gamma(B\to D^{(*)}K)$ (ADS)		2-3		~10	<13
γ(all methods)		1.2-2			

Theory: α ~ 5%, β ~ 1%, γ ~ 0.1%

CP Violation in b→s penguins

Rare Decays, New Physics, CPV [%]		e^+e^- [ab^{-1}]			Hadronic b [1yr]	
Measurement	Goal	3	10	50	LHCb	BTeV
$S(B^0 \to \phi K_S)$	SM: <5	16	8.7	3.9	16 (?)	7 (?)
$S(B^0 \to \phi K_S + \phi K_L)$	SM: <5					
$S(B \to \eta' K_s)$	SM: <5	5.7	3	1		
$S(B \to K_s \pi^0)$	SM: <5	8.2	5	4		
$S(B \to K_s \pi^0 \gamma)$	SM: <2	11.4	6	4		
$A_{CP}(b \to s\gamma)$	SM: <0.5	2.4	1	0.5		
$A_{CP}(B \to K^* \gamma)$	SM: <0.5	0.59	0.32	0.14	-	-
CPV in mixing (|q/p|)		<0.6			-	-

CP Violation in b→s penguins

Rare Decays, New Physics, CPV [%]		e^+e^- [ab^{-1}]			Hadronic b [1yr]	
Measurement	Goal	3	10	50	LHCb	BTeV
$S(B^0 \to \phi K_S)$	SM: <0.25	16	8.7	3.9	16 (?)	7 (?)
$S(B^0 \to \phi K_S + \phi K_L)$	SM: <0.25					
$S(B \to \eta' K_s)$	SM: <0.3	5.7	3	1		
$S(B \to K_s \pi^0)$	SM: <0.2	8.2	5	4		
$S(B \to K_s \pi^0 \gamma)$	SM: <0.1	11.4	6	4		
$A_{CP}(b \to s\gamma)$	SM: <0.5	2.4	1	0.5		
$A_{CP}(B \to K^* \gamma)$	SM: <0.5	0.59	0.32	0.14	-	-
CPV in mixing (|q/p|)		<0.6			-	-

Discovery potential at Super *B* for non-SM physics

More Rare decays precision

Rare Decays - New Physics		e^+e^- [ab^{-1}]			Hadronic b [1 yr]	
Measurement	**Goal**	**3**	**10**	**50**	**LHCb**	**BTeV**
$\Gamma(b \to d\gamma)$ / $\Gamma(b \to s\gamma)$					-	-
$\mathcal{B}(B \to D^{(*)}\tau\nu)$	SM:8×10^{-3}	10.2%	5.6%	2.5%	-	-
$\mathcal{B}(B \to s\nu\nu)$ ($K^{-,0}, K^{*-,0}$)	SM: ~5% 1 excl: 4×10^{-6}			~3σ	-	-
$\mathcal{B}(B \to \text{invisible})$		$<2 \times 10^{-6}$	$<1 \times 10^{-6}$	$<4 \times 10^{-7}$	-	-
$\mathcal{B}(B_d \to \mu\mu)$		-	-		1-2 evts	1-2 evts
$\mathcal{B}(B_d \to \tau\tau)$		-	-		-	-
$\mathcal{B}(\tau \to \mu\gamma)$			$<10^{-8}$		-	-

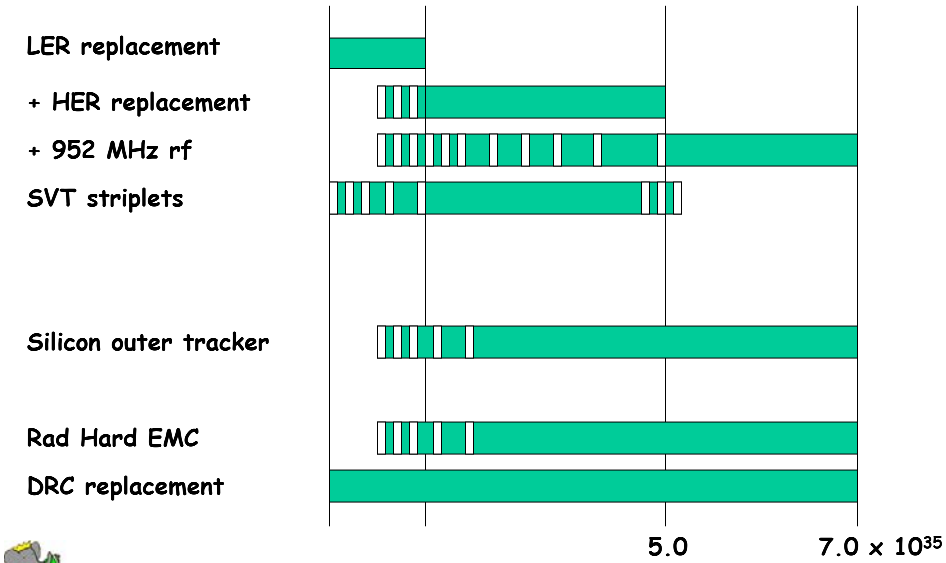
More Rare decays precision

Rare Decays - New Physics		e^+e^- [ab^{-1}]			Hadronic b [1 yr]	
Measurement	**Goal**	**3**	**10**	**50**	**LHCb**	**BTeV**
$\Gamma(b \to d\gamma)$ / $\Gamma(b \to s\gamma)$					-	-
$\mathcal{B}(B \to D^{(*)}\tau\nu)$	SM:8×10^{-3}	10.2%	5.6%	2.5%	-	-
$\mathcal{B}(B \to s\nu\nu)$ ($K^{-,0}, K^{*-,0}$)	SM: ~5% 1 excl: 4×10^{-6}			~3σ	-	-
$\mathcal{B}(B \to \text{invisible})$		$<2 \times 10^{-6}$	$<1 \times 10^{-6}$	$<4 \times 10^{-7}$	-	-
$\mathcal{B}(B_d \to \mu\mu)$		-	-		1-2 evts	1-2 evts
$\mathcal{B}(B_d \to \tau\tau)$		-	-		-	-
$\mathcal{B}(\tau \to \mu\gamma)$			$<10^{-8}$		-	-

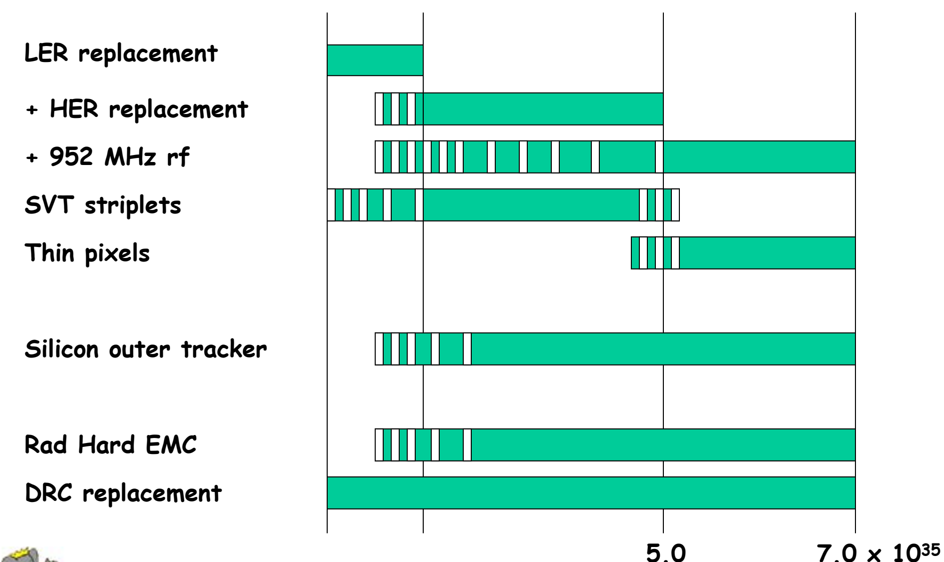
Discovery potential at Super *B* for non-SM physics

Discovery potential at Super *B* for non-SM physics

Upgrade Plan: Initial Project



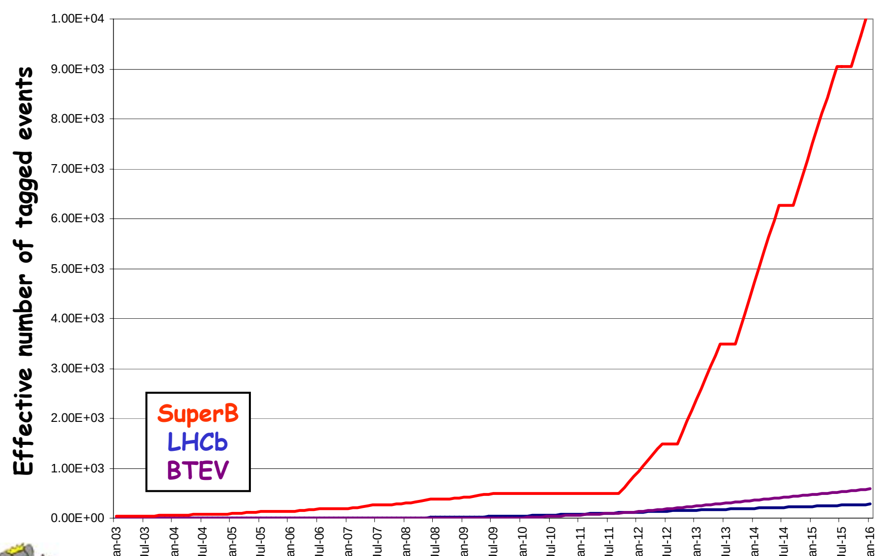
Ultimate Project Reach



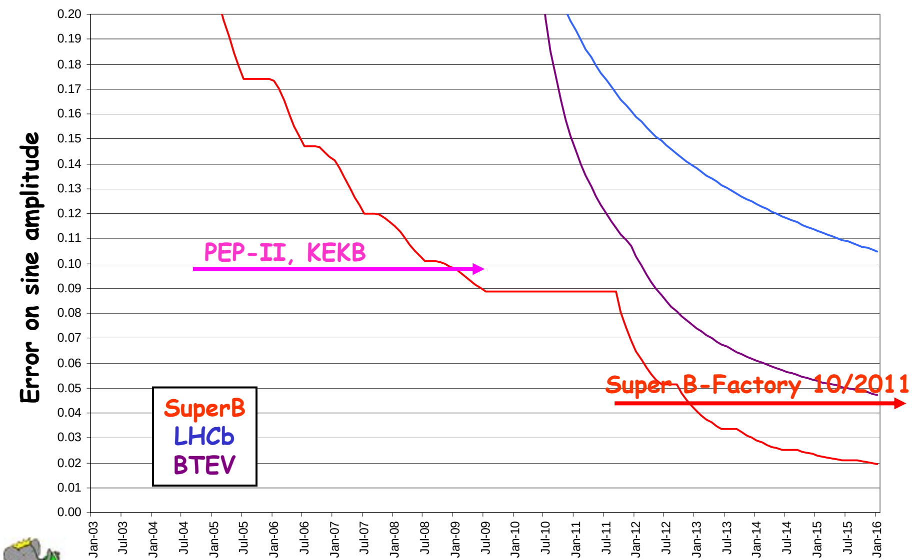
Projecting Physics Reach

- ***Working assumptions for projections***
  - LHCb:
    - Start in Jan 2008 with 50% of design for 2 years
  - BTEV:
    - Start in Jan 2010 with 50% of design for 2 years
  - Rolling start for Super *B* Factory:
    - Oct 2011 = 2.5×10^{35}
    - Oct 2012 = 5×10^{35}
    - Oct 2013 = 7×10^{35} with replacement of inner SVT by thin pixel device

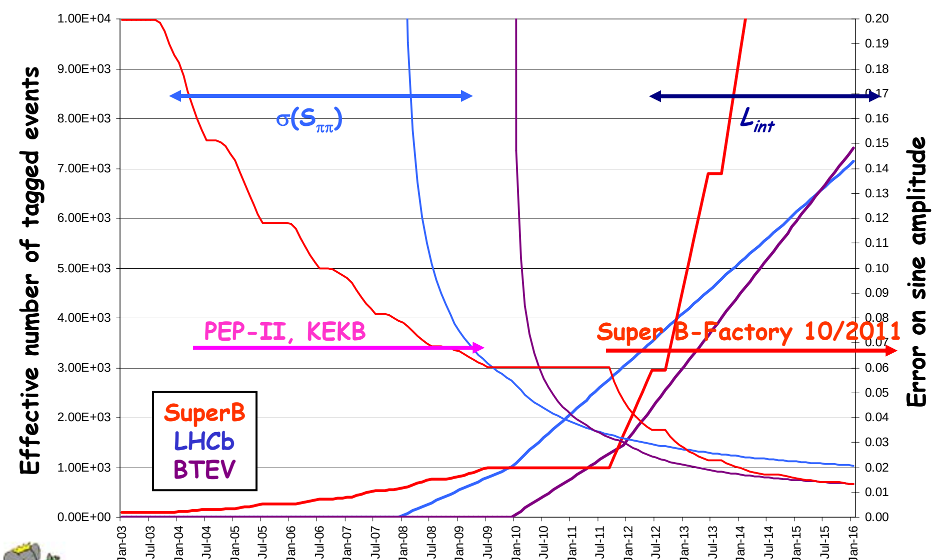
Tagged Sample Projections for φK^0



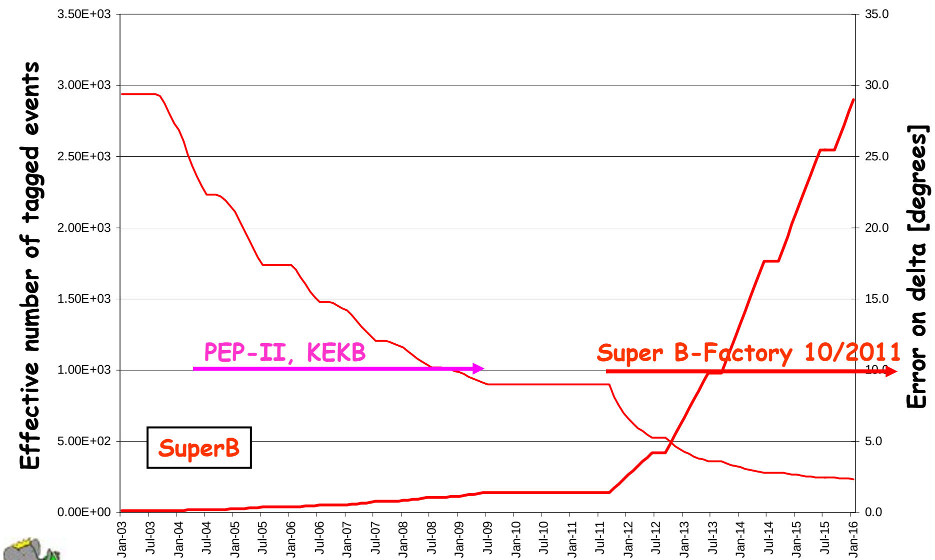
Error Projections for φK^0



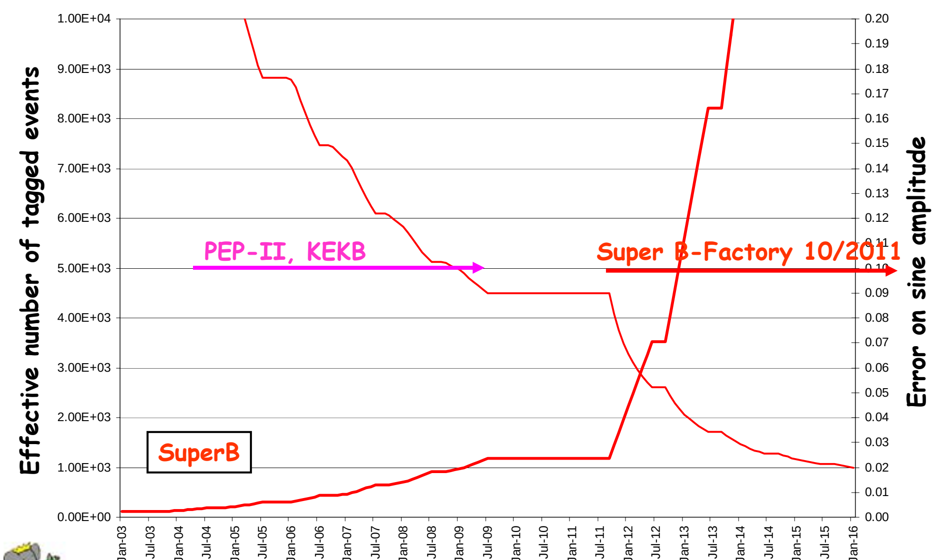
Projections for $\pi^+\pi^-$



Projections for 2-Body Isospin Analysis



Projections for $\rho^+\rho^-$



Projections for $K^*\gamma$