A Measurement of $Br(B^0 \to K^{*0}\gamma)$ and search for $B \to K(K^*)l^+l^-$

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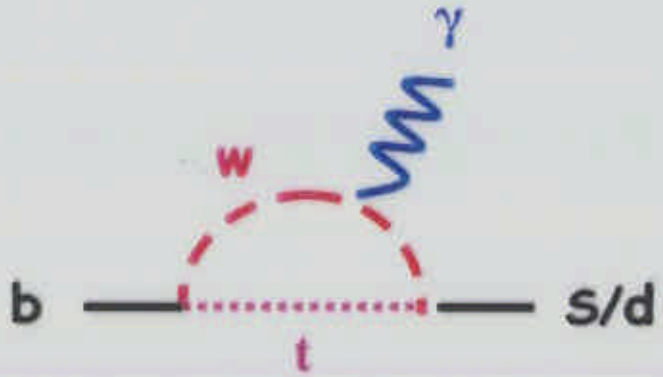
BABAR

Penguins

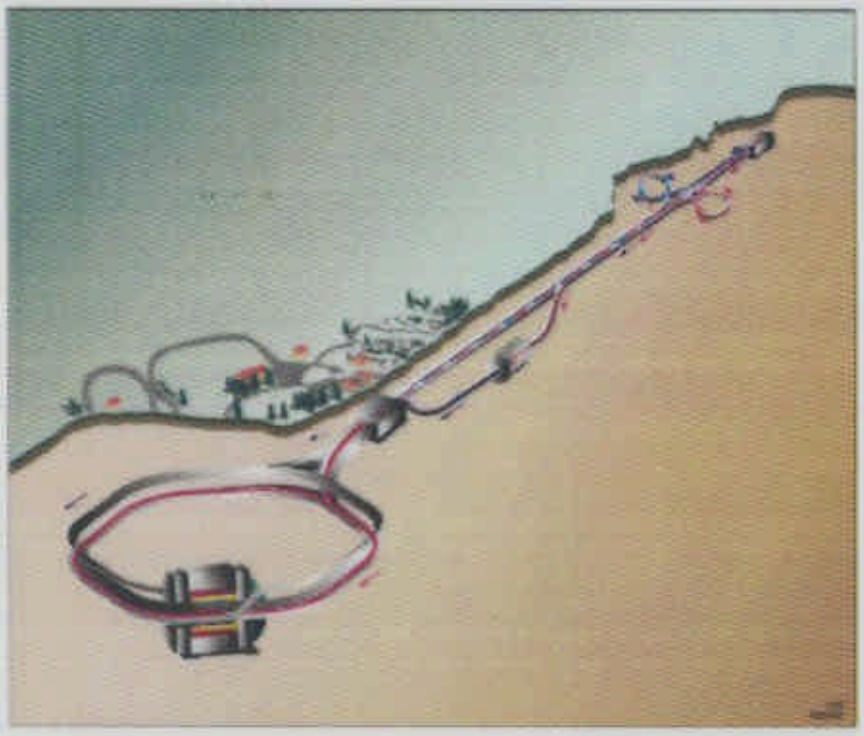


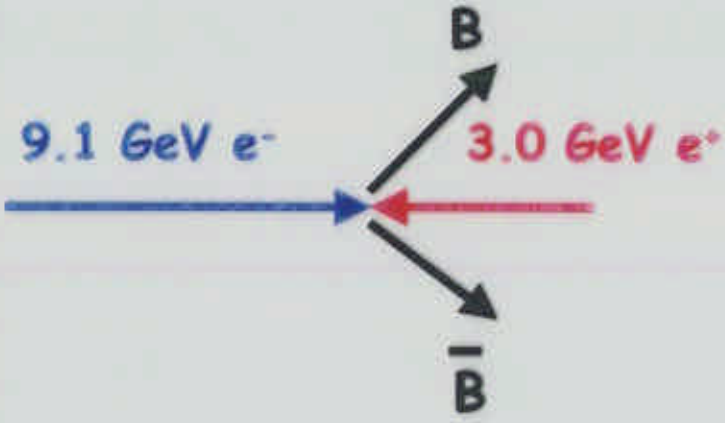
Sensitive to top quark couplings
(V_{td}, V_{ts})

Sensitive to New Physics
(eg. SUSY W -> H)

Low Energy Window to High Mass Physics

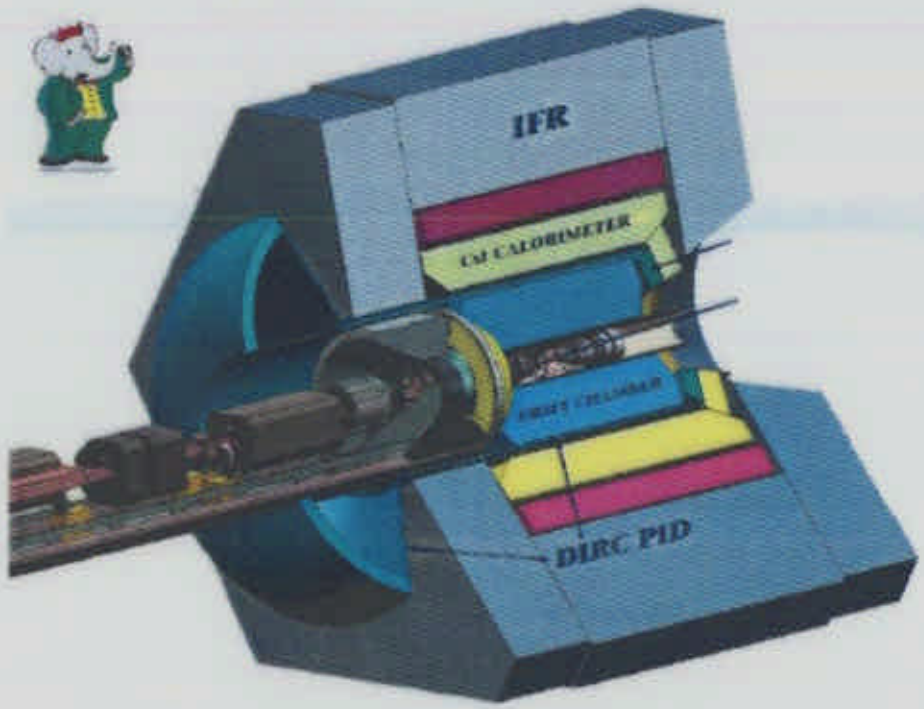
PEP II B-Factory





Peak Luminosity 2×10^{33} cm^{-2} s^{-1}

BaBar

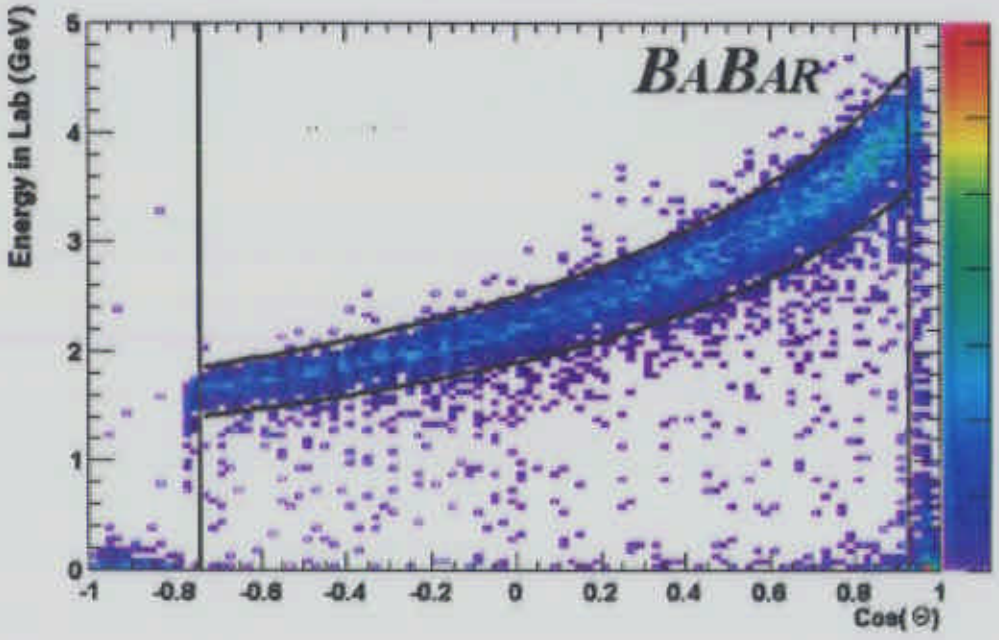


Dataset

8.6×10^6 $B\bar{B}$
(Jan 00 - July 00)

Photon Acceptance

$B^0 \to K^{*0}\gamma$ Monte Carlo



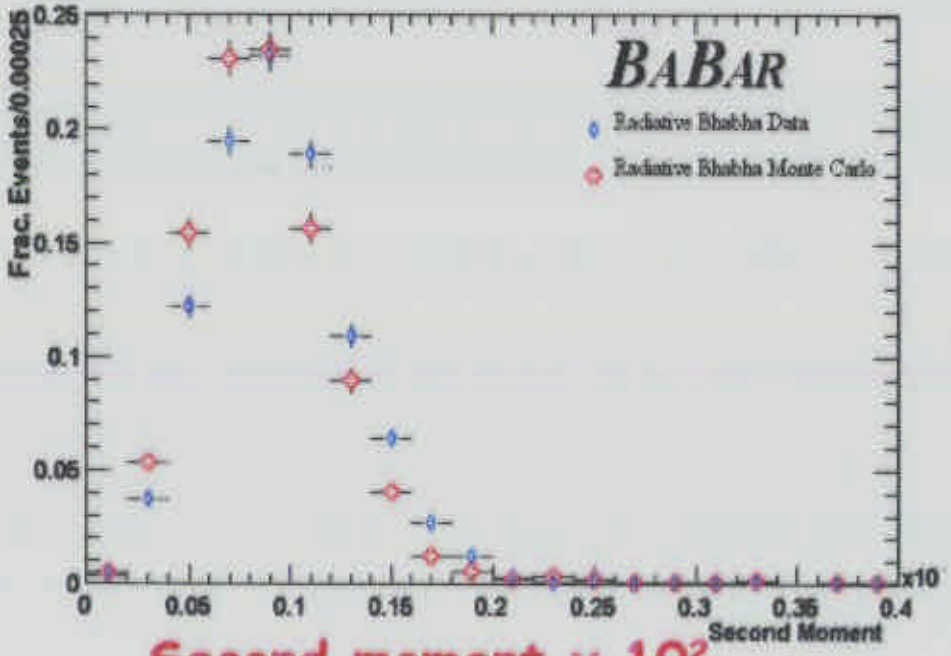
2.2 GeV < E* < 2.85 GeV
(* = CMS)

-0.73 < cos θ < 0.9
(θ = polar angle to beam in lab)

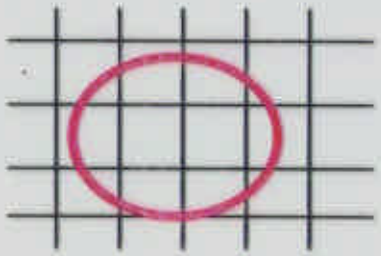
67% Acceptance

Photon Selection

e+e- -> e+e-γ data vs MC



Second moment x 10^2



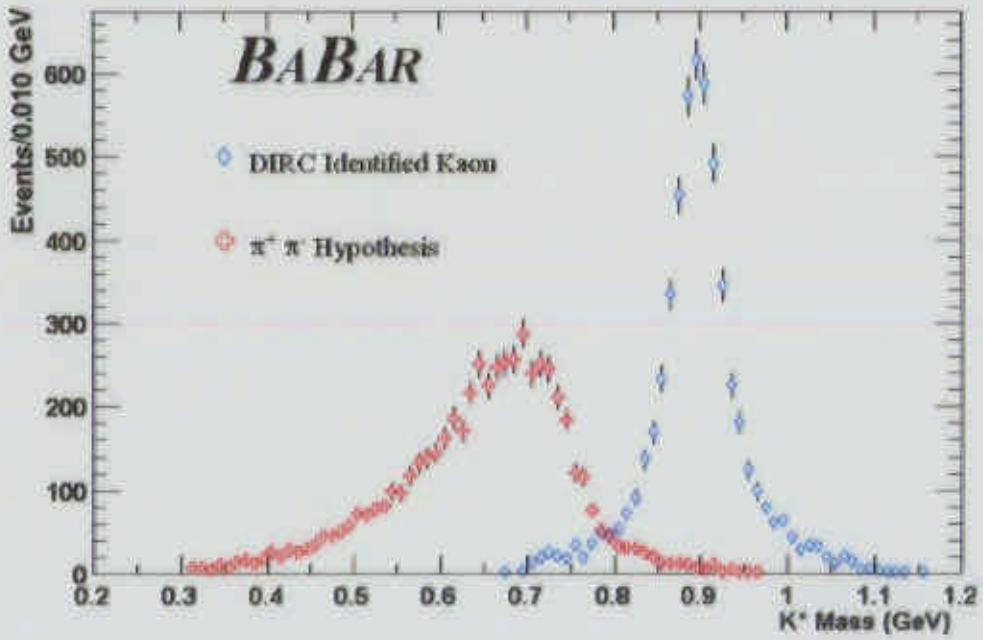
Cluster Second moment <0.002

Veto γ from π^0 η

Efficiency 88 %

K* Reconstruction

$B^0 \rightarrow K^{*0}\gamma$ Monte Carlo



K/π selection using Cerenkov detector (DIRC)

Kπ assigned correctly 97%

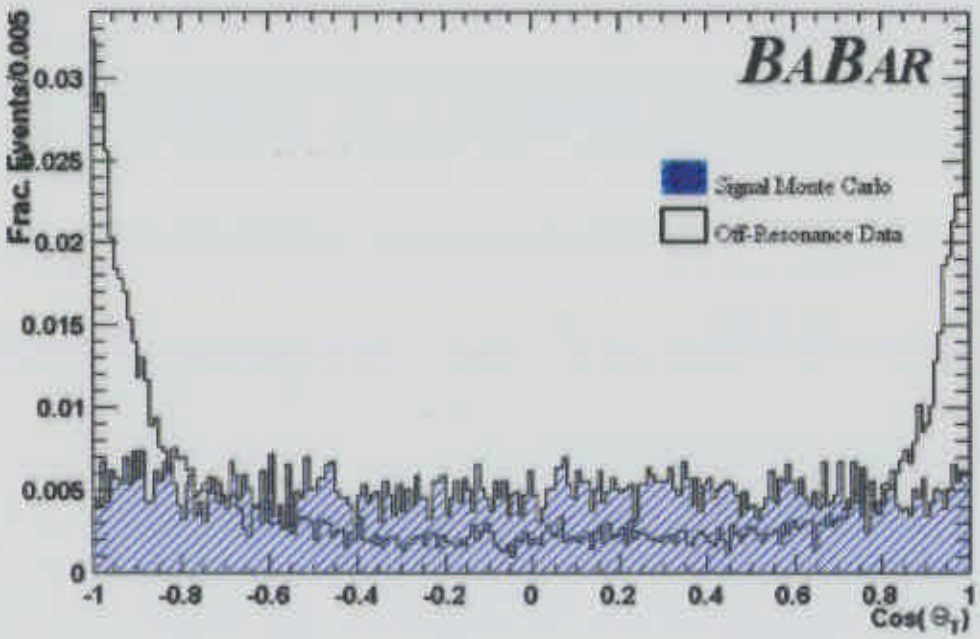
806 MeV < $M_{K\pi}$ < 986 MeV

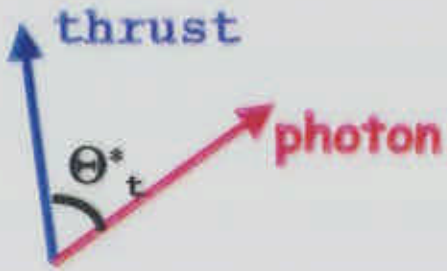
$|\cos\theta_{helicity}| < 0.7$

Efficiency 40%

Event Shape

In CMS frame backgrounds "jet-like" while BB isotropic





$|\cos\Theta^*_t| < 0.78$

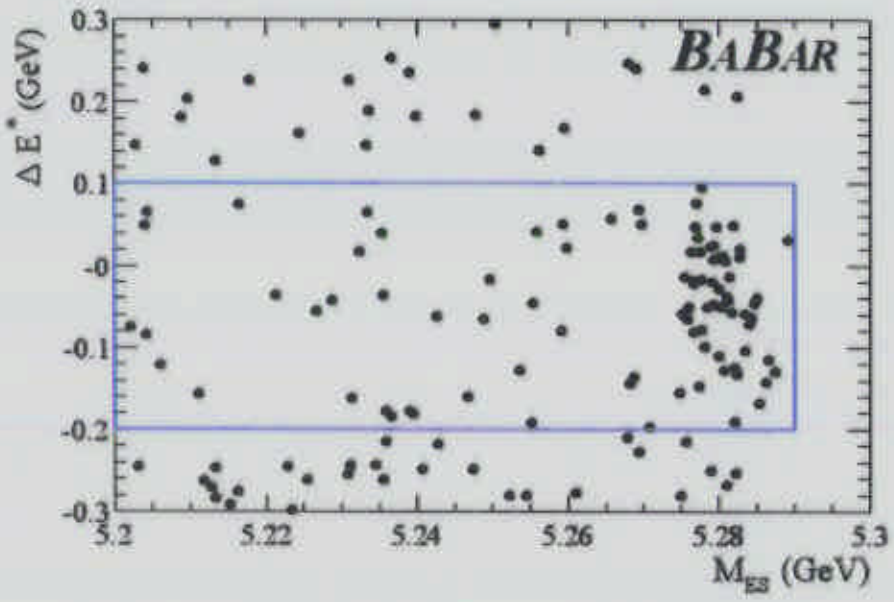
$|\cos\Theta^*_B| < 0.76$

Efficiency 69.5 %

Results

Beam energy known more precisely than particle energies

$$\Delta E^* = E_{K^*} + E_\gamma - E_{beam}$$



$$M_{ES} = (E^2_{beam} - P^2_B)^{1/2}$$

Signal Estimation

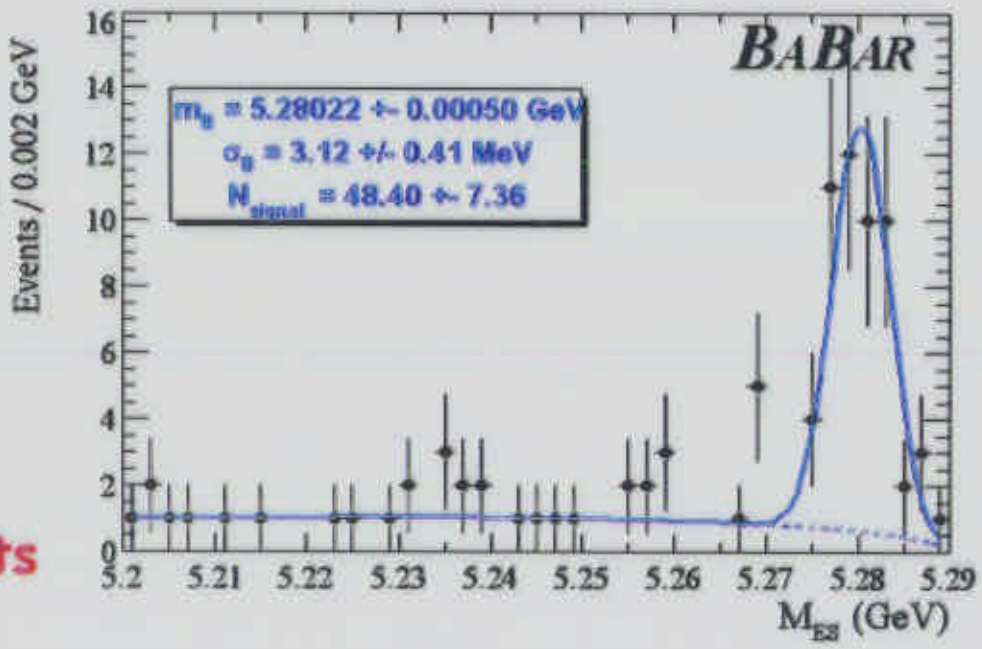
"Argus Function" for background

Gaussian for signal

Background shape determined from off-resonance data

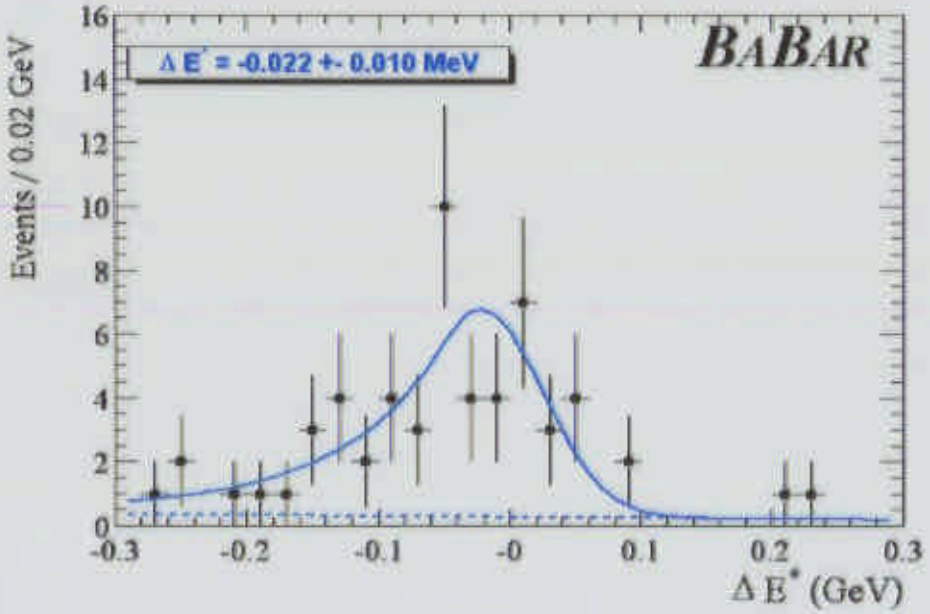
Fit with fixed background shape and floating signal mean and width

N signal = 48.40 +- 7.36 events



ΔE* Consistency

"Project" ΔE* (5.274 GeV < Mes < 5.288 GeV)



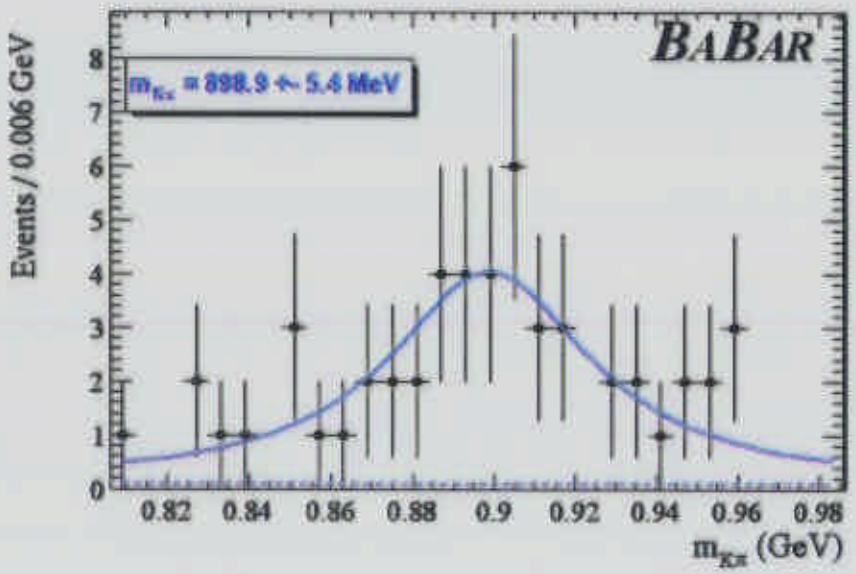
Fit "Crystal Ball" function to signal Monte Carlo and fix shape

Fit data with fixed shape and floating mean and normalization

$M_{K\pi}$ Consistency

Fit Breit Wigner function to signal Monte Carlo and fix shape

Fit data with fixed shape and floating mean and normalization



Systematics

Systematic	% Br	Data used for estimation
Track efficiency	5.0	e+e- , D* decays
Luminosity	3.6	BB
K id efficiency	3.0	D* decays
Track Resolution	3.0	$\mu+\mu-$
Energy resolution	2.5	$\gamma\gamma, \pi^0$
Background shape	2.3	off-resonance
Monte Carlo Statistics	1.9	
Energy Scale	1.0	η decays
Calorimeter Efficiency	1.0	$e+e-\gamma$
veto	1.0	off-resonance
merged π modelling	1.0	tau decays
Total	8.6	

$Br(B^0 \to K^{*0}\gamma)$ (preliminary)

BaBar (8.6×10^6 BB)

$Br(B^0 \to K^{*0}\gamma) = (5.42 \pm 0.82(stat) \pm 0.47(sys)) \times 10^{-5}$

PDG (CLEO: 9.7×10^6 BB)

$Br(B^0 \to K^{*0}\gamma) = (4.55 \pm 0.70(stat) \pm 0.34(sys)) \times 10^{-5}$

Standard Model Expectation

$Br(B^0 \to K^{*0}\gamma) = (3.3 - 6.3) \times 10^{-5}$

Signal and Backgrounds

Signal

$B^0 \to K^{*0}\gamma, K^{*0} \to K^+\pi^-$

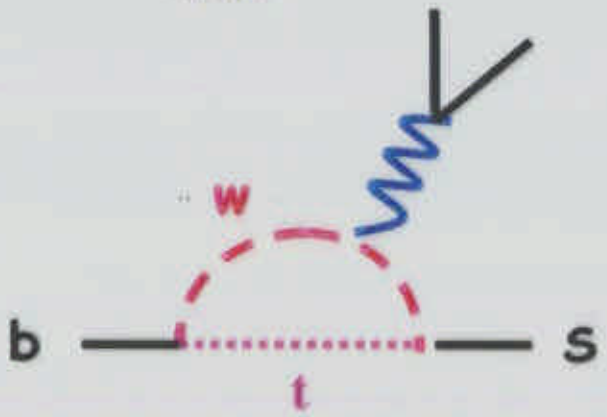
Backgrounds

50% ISR $e^+e^- \to q\bar{q}\gamma$
50% $e^+e^- \to q\bar{q} \to \pi^0 X$

Selection Criteria*	Efficiency (%)
High Energy Photon	59.1
K* reconstruction	40.0
B reconstruction	94.3
Event Shape	69.5
Total	15.6%

*optimized for $s^2/(s+b)$

Search for B -> K(K*)l^+l^-



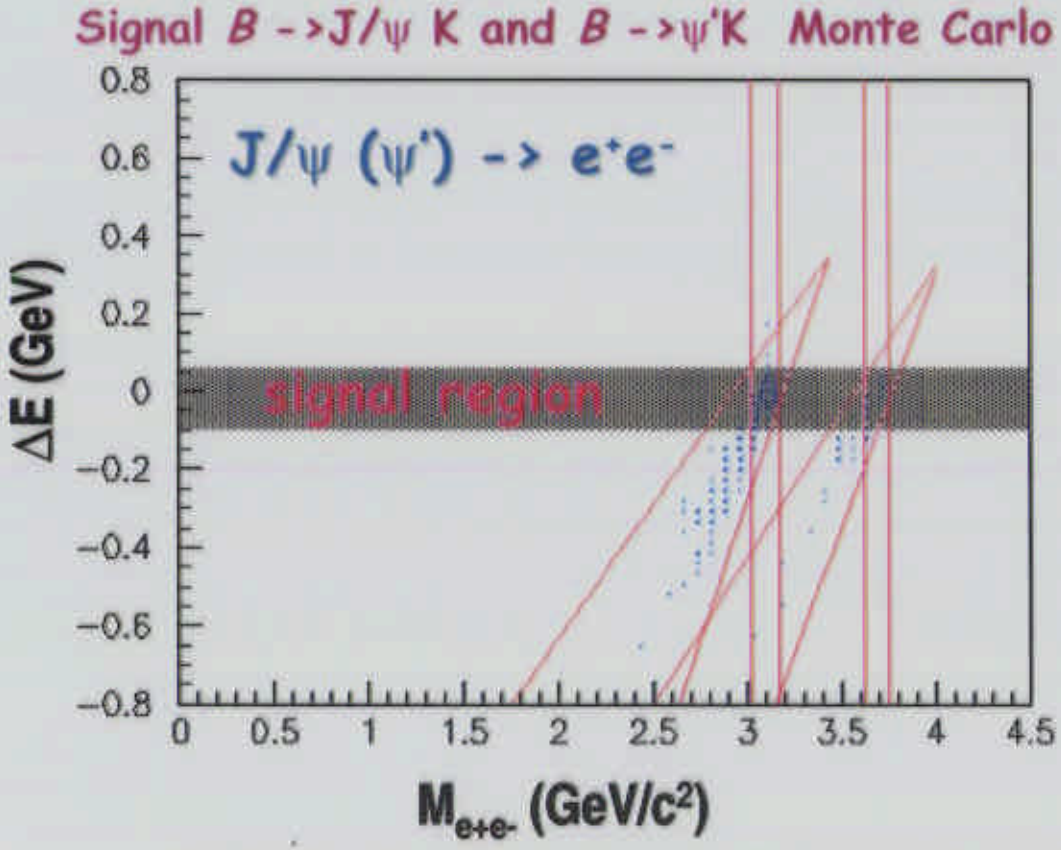
Very rare decays

Standard model expectation

Br(B -> Kl^+l^-) = 6 x 10^{-7}
Br(B -> K*l^+l^-) = 2 x 10^{-6}

Blind Analysis on subset of data 3.6 x 10^6 BB

B -> K(K*)l^+l^-: J/ψ(ψ') $K^{(*)}$ events (1)



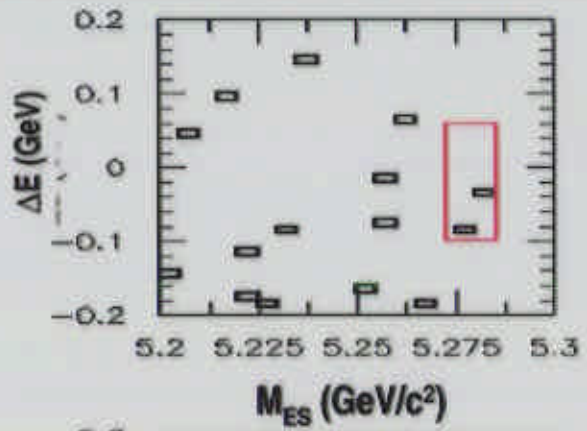
J/ψ (ψ') $K^{(*)}$ events are suppressed by using a correlated selection in the

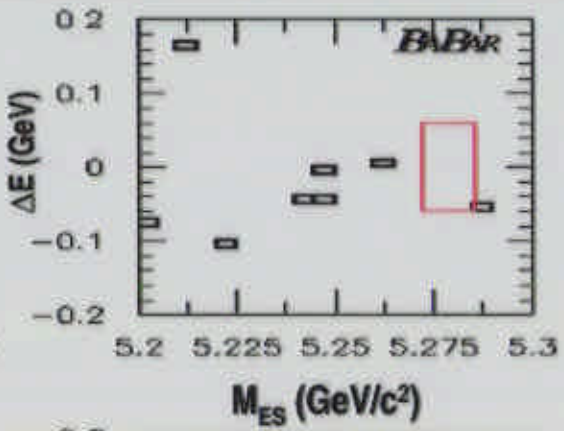
ΔE vs. $m_{l^+l^-}$ plane

- This is needed to account for bremsstrahlung and track mismeasurement

B -> K(K*)l+l- : Results (1)

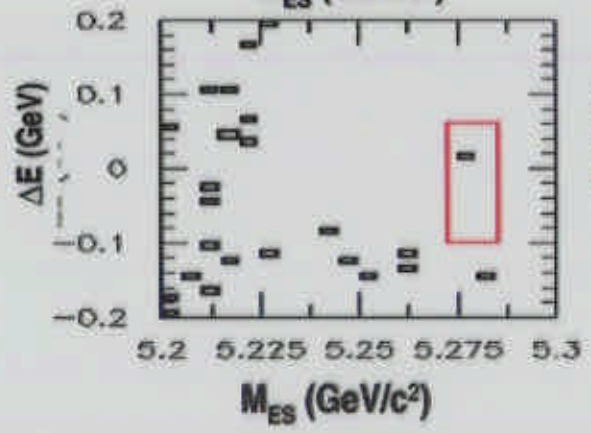
$B^+ \to K^+e^+e^-$

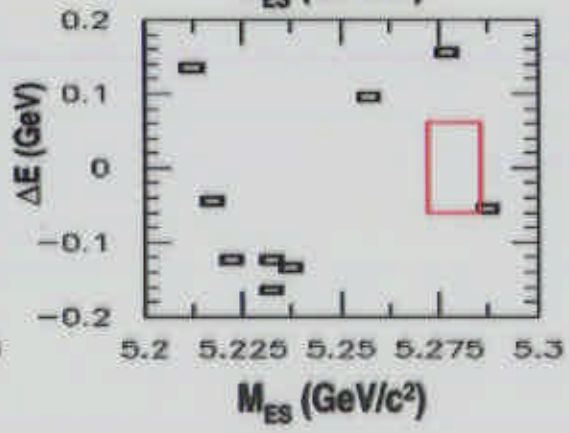




$B^+ \to K^+\mu^+\mu^-$

$B^0 \to K^{*0}e^+e^-$





$B^0 \to K^{*0}\mu^+\mu^-$

B -> K(K*)l^+l^- Results

Mode	Obs	Bkg	Efficiency (%)	limit ($\times 10^{-6}$)	PDG ($\times 10^{-6}$)
K+e+e-	2	0.20	14.2	<12.8	<1.0
K+μ+μ−	0	0.25	9.1	< 8.3	<5.2
K*e+e-	1	0.50	5.6	<24.7	<14.0
K*μ+μ−	0	0.33	3.1	<25.2	<4.0

Backgrounds from B->Xl^+ B-> Xl^-

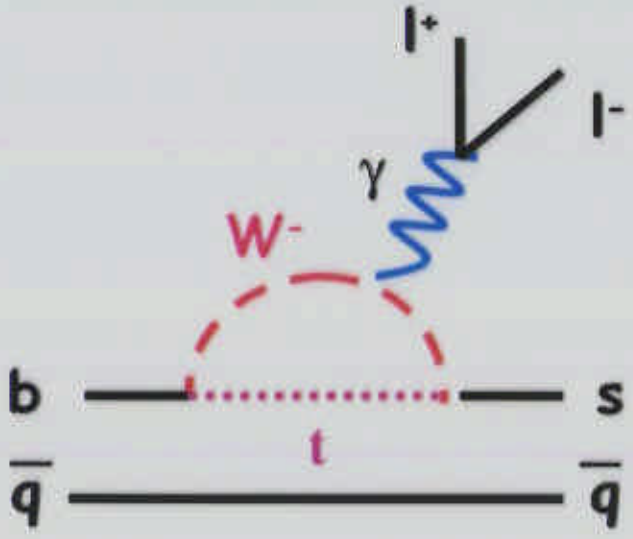
Conclusion

BaBar/PepII have made an extremely successful start

Already BaBar is competetive in measurements and searches in rare B meson decays

We look forward to much larger datasets and hope to see new physics in the B meson system

Search for B -> K(K*)l^+l^-: theoretical issues



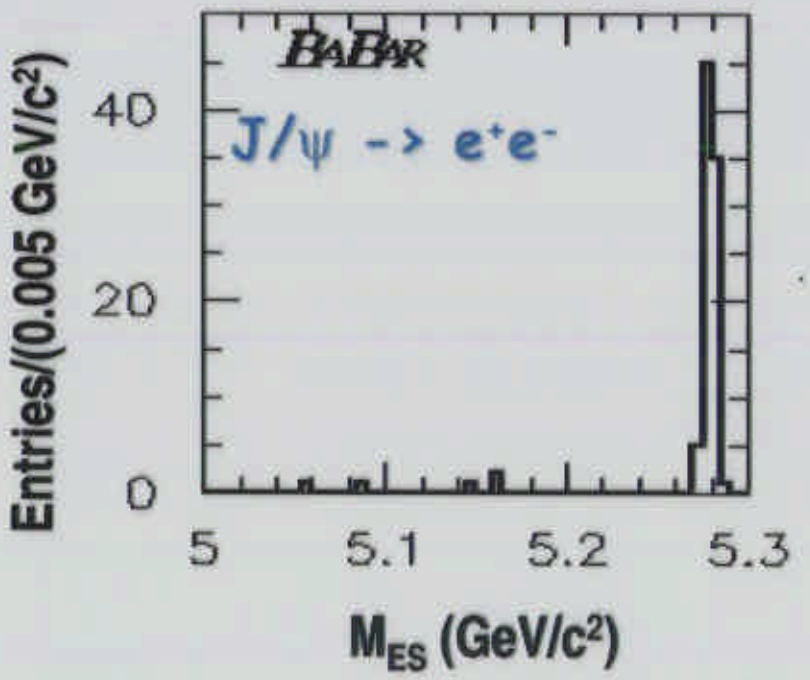
- The decays are highly suppressed in the Standard Model
- Standard model predictions*:

$Br(B \to Kl^+l^-) = 5.7 \times 10^{-7}$
$Br(B \to K^*e^+e^-) = 2.3 \times 10^{-6}$
$Br(B \to K^*\mu^+\mu^-) = 1.9 \times 10^{-6}$

*A.Ali *et al.*, Phys. Rev. D. **61**, (2000), 074024 (form factors from Light Cone QCD Sum Rules).

B -> K(K*)l^+l^-: J/ψ(ψ') $K^{(*)}$ events (2)

B ->J/ψ K and *B* ->ψ'K control samples (data)



J/ψ (ψ') $K^{(*)}$ events are also used as a control sample to verify the analysis efficiency