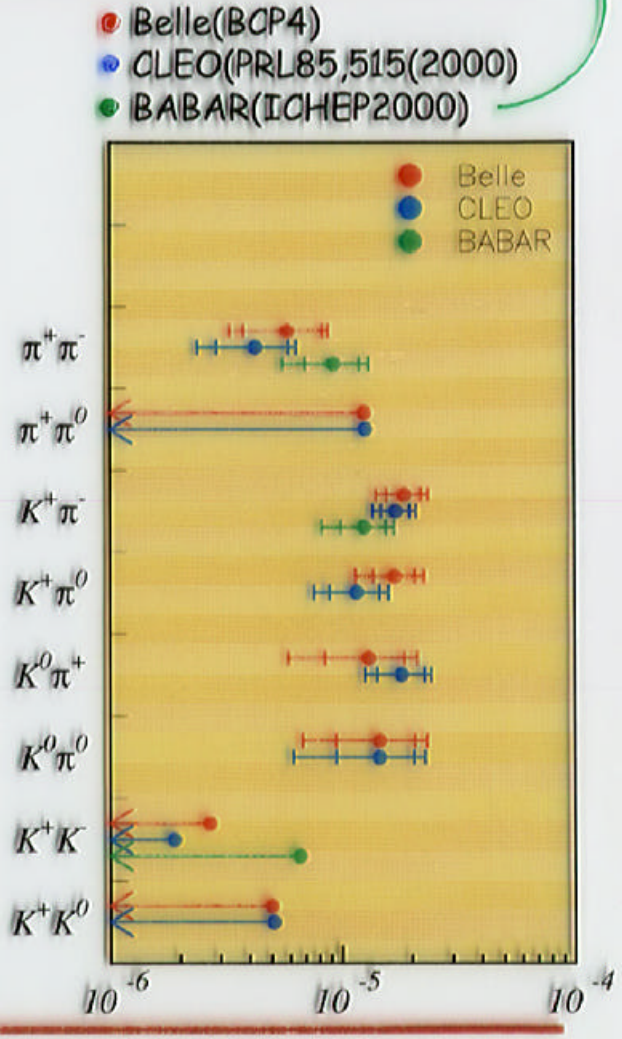
ππ/Kπ/KK Summary

Next Talk.

- Results w/ 11.1M BB

Mode	Ns	Σ	Eff (%)	Br(10^{-5})	U.L. (10^{-5})
$B^0 \to \pi^+\pi^-$	$17.7^{+7.1}_{-6.4}$	3.1	28	$0.59^{+0.24}_{-0.21} \pm 0.05$	-
$B^+ \to \pi^+\pi^0$	$9.4^{+4.8}_{-4.0}$	2.9	12	$0.71^{+0.36}_{-0.30}{}^{+0.09}_{-0.12}$	1.26
$B^0 \to K^+\pi^-$	$60.3^{+10.6}_{-9.9}$	7.8	29	$1.87^{+0.33}_{-0.30} \pm 0.16$	-
$B^+ \to K^+\pi^0$	$35.8^{+7.7}_{-7.0}$	7.5	19	$1.70^{+0.37}_{-0.33}{}^{+0.20}_{-0.22}$	-
$B^+ \to K^0\pi^+$	$10.3^{+4.3}_{-3.6}$	3.5	13	$1.31^{+0.55}_{-0.46} \pm 0.26$	-
$B^0 \to K^0\pi^0$	$8.8^{+3.7}_{-3.1}$	4.2	11	$1.46^{+0.61}_{-0.51} \pm 0.27$	-
$B^0 \to K^+K^-$	$0.2^{+3.8}_{-0.2}$	-	24		0.27
$B^+ \to K^+K^0$	$0.0^{+0.9}_{-0.0}$	-	13		0.50



Ratio of Br(ππ),Br(Kπ)

- Ratio of CP averaged ππ/Kπ branching fraction
  ⇒Indirect information for ϕ_3 (SU(3), factorization…)
  - $\dfrac{Br(B^0 \to \pi^+\pi^-)}{Br(B^0 \to K^+\pi^-)} = 0.32^{+0.13}_{-0.14}$ ππ < Kπ
  - $\dfrac{Br(B^0 \to K^+\pi^-)}{2 \cdot Br(B^0 \to K^0\pi^0)} = 0.64^{+0.25}_{-0.29}$ $K^0\pi^0$ larger than theory
  - $\dfrac{2 \cdot Br(B^+ \to K^+\pi^0)}{Br(B^+ \to K^0\pi^+)} = 2.60^{+1.07}_{-1.20}$ > 1 (likely)
  - $\dfrac{\tau(B^+) \cdot Br(B^0 \to K^+\pi^-)}{\tau(B^0) \cdot Br(B^+ \to K^0\pi^+)} = 1.51^{+0.60}_{-0.68}$

    $\left(\dfrac{Br(B^0 \to K^+\pi^-)}{Br(B^+ \to K^0\pi^+)} = 1.43^{+0.56}_{-0.64} \right)$

※ Systematic error under study

B→Kπ: Acp measurement

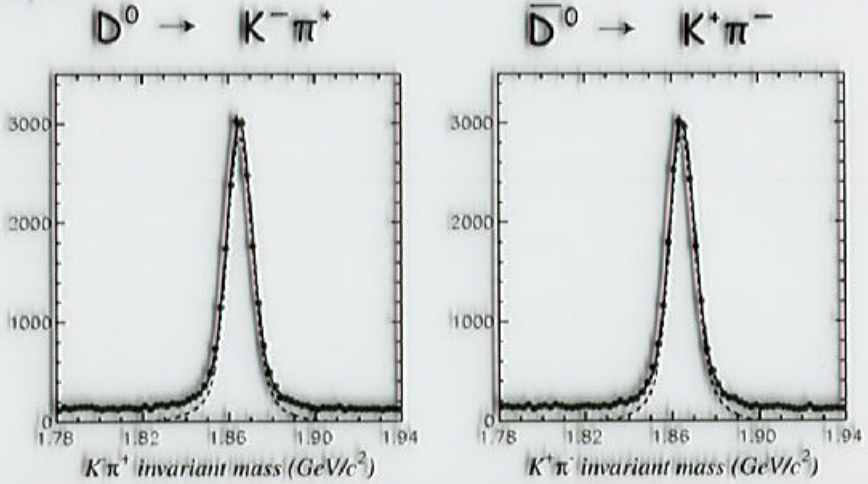
- B reconstruction and qq suppression are same as for Br. measurement.
- Require PID on both tracks to minimize double mis-identification for $K^+\pi^-/K^-\pi^+$. (double mis-ID probability = 0.46%)
  ⇒ Dilution of Acp; $\delta A/A \sim 1\%$ (systematic error.)
- Detector bias test w/ D→Kπ decays

$N(\bar{D}^0 \to K^+\pi^-) = 19055 \pm 167$

$N(D^0 \to K^-\pi^+) = 19091 \pm 172$

$\Rightarrow$ Acp = 0.001 ± 0.006

Detector bias <2%



B→Kπ: Acp Results

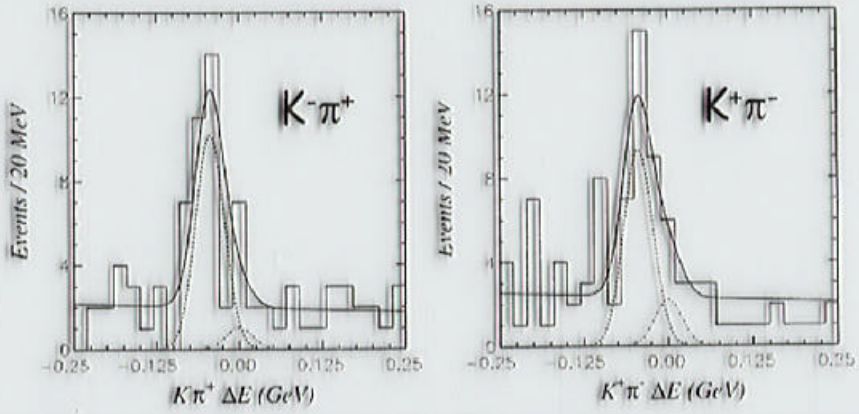
- $A_{CP}(B \to K^{\pm}\pi^{\mp})$

$N(\bar{B}^0 \to K^-\pi^+) = 27.7^{+6.8}_{-6.1}$

$N(B^0 \to K^+\pi^-) = 25.4^{+7.0}_{-6.3}$

$\Rightarrow A_{CP} = 0.043 \pm 0.175 \pm 0.021$

$-0.264 < A_{CP}(K^{\pm}\pi^{\mp}) < 0.351$ (90% CL)

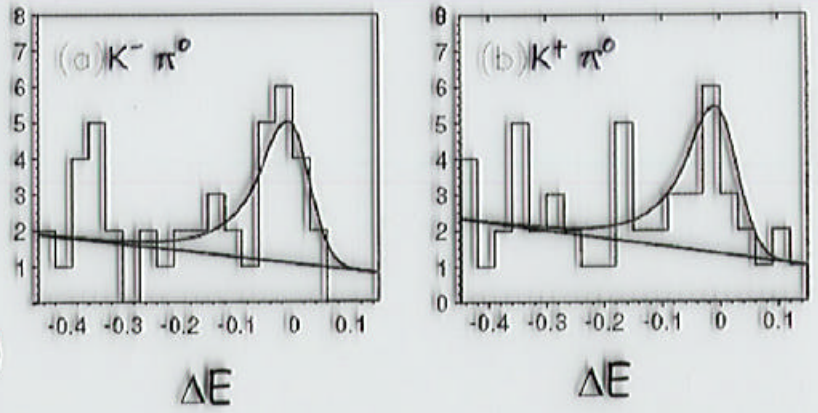


- $A_{CP}(B \to K^{\pm}\pi^0)$

$N(B^- \to K^-\pi^0) = 18.3^{+5.6}_{-4.9}$

$N(B^+ \to K^+\pi^0) = 17.6^{+5.5}_{-4.8}$

$\Rightarrow A_{CP} = 0.019^{+0.219}_{-0.191}$



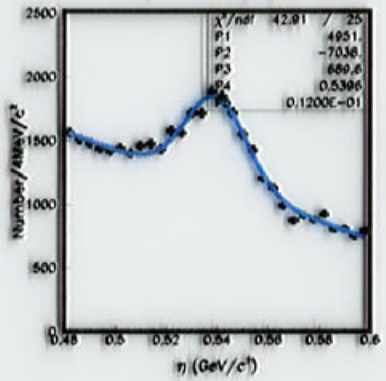
Note: A_{CP} sign convention (same as CLEO)

$$\frac{\Gamma(b \to f) - \Gamma(\bar{b} \to \bar{f})}{\Gamma(b \to f) + \Gamma(\bar{b} \to \bar{f})}$$

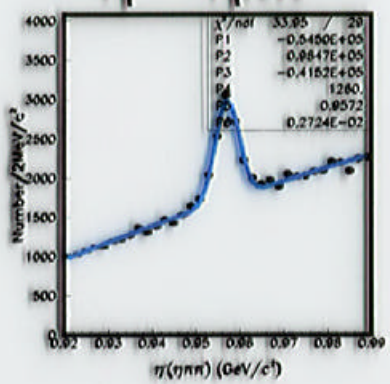
B→η′h Analysis

- η′ reconstruction
  - η′ →ηππ, η →γγ
    - $\sigma_m(\eta)$=12MeV
    - $\sigma_m(\eta')$=2.7MeV
      (w/ η mass constraint)
    - Eff(abs).=3.1% (for η′K⁺ w/ LR cut)
    - Low background
  - η′ →ργ
    - $\sigma_m(\eta')$=9.8MeV
    - Eff(abs).=2.8% (for η′K+ w/ LR cut)
    - Higher background than ηππ

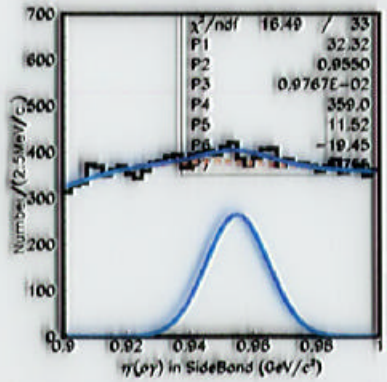
η →γγ

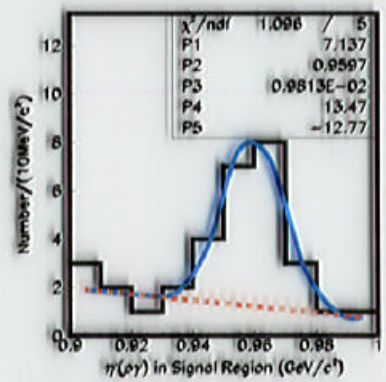


η′→ηππ



η′→ργ before(L)/after(R) signal selection

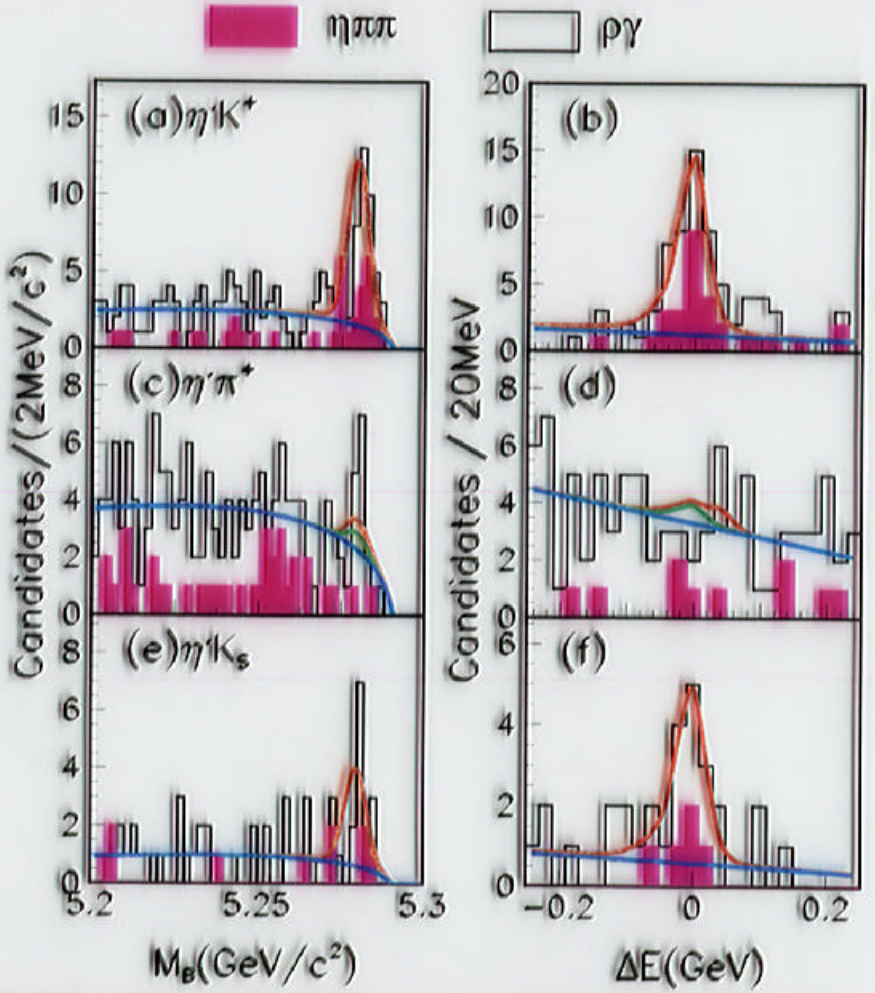




B→η′h Signals

- $\eta' K^+$:PID(K)>0.6
  $\eta' \pi^+$:PID(K)<0.4

Mode		Nfit	Σ	ε(abs)
$\eta' K^+$	$\eta\pi\pi$	$21.9^{+5.6}_{-4.9}$	8.7	3.3
	$\rho\gamma$	$23.0^{+6.7}_{-6.0}$	6.6	2.6
$\eta' \pi^+$	$\eta\pi\pi$	<3.5	-	3.67
	$\rho\gamma$	<10.4	-	2.68
$\eta' K_S$	$\eta\pi\pi$	$5.0^{+2.6}_{-1.9}$	5.3	0.82
	$\rho\gamma$	$7.9^{+4.2}_{-2.4}$	3.5	0.67

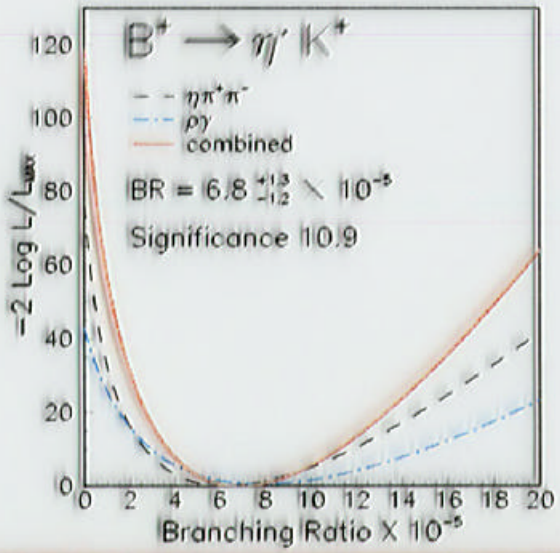


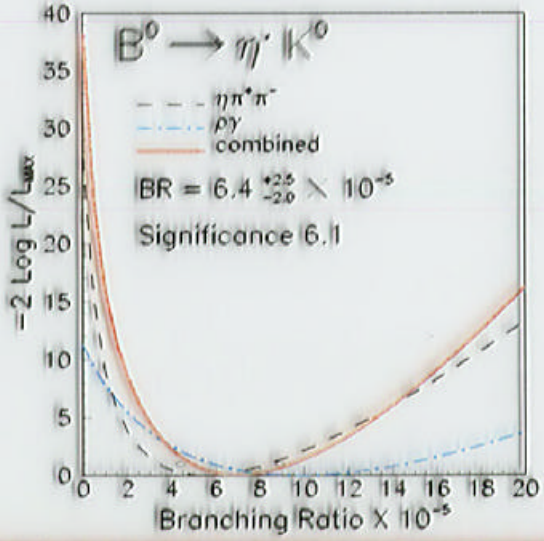
B→ η'h Results

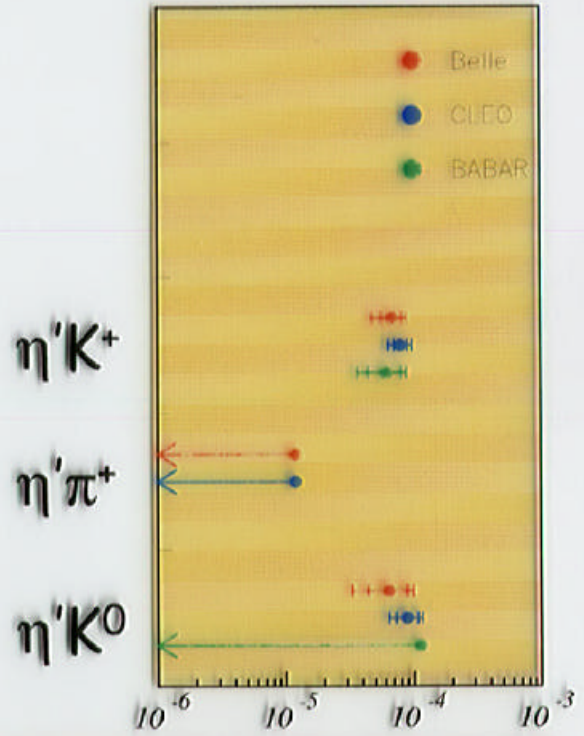
- ηππ and ργ combined

Mode	Br(10^{-5})	Signif.
$B^+ \to \eta' K^+$	$6.8^{+1.3}_{-1.2}{}^{+0.7}_{-0.9}$	10.9
$B^+ \to \eta' \pi^+$	< 1.2	-
$B^+ \to \eta' K^0$	$6.4^{+2.5}_{-2.0}{}^{+1.0}_{-1.1}$	6.1

- Belle (BCP4)
- CLEO(PRL85,520,2000)
- BABAR(ICHEP2000)







$B \to K^{(*)} l^+ l^-$ Search

- FCNC processes: $b \to s\gamma$, $b \to sll$ decays
  - forbidden in SM at tree level.
  - Occur via box diagrams or penguin loops.
  - Sensitive to non-SM physics (charged Higgs, SUSY,...).

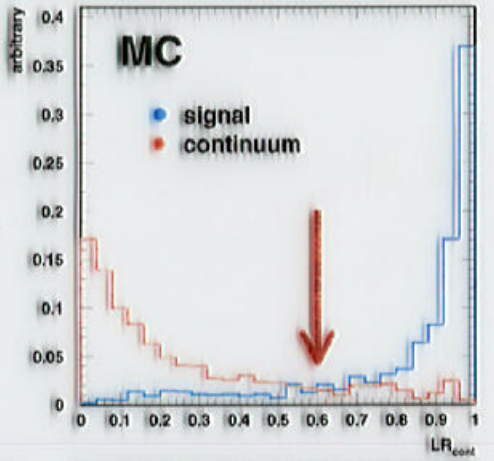
  "Low energy tool to probe physics at higher energy."

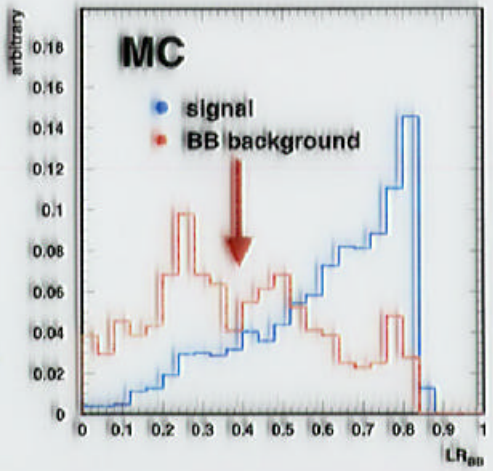
- EW penguin decays: $b \to sll$
  - Theoretically very clean ⇒More stringent test of SM.
  - Additional information from di-lepton mass dist./F-B asymmetry.

- Predicted Br. for $B \to K^{(*)} l^+ l^-$
  - $K^{(*)}ll$: $\sim(1\text{-}2.5) \times 10^{-6}$
  - Kll : $\sim 0.5 \times 10^{-6}$

$B \to K^{(*)} l^+ l^-$ Analysis

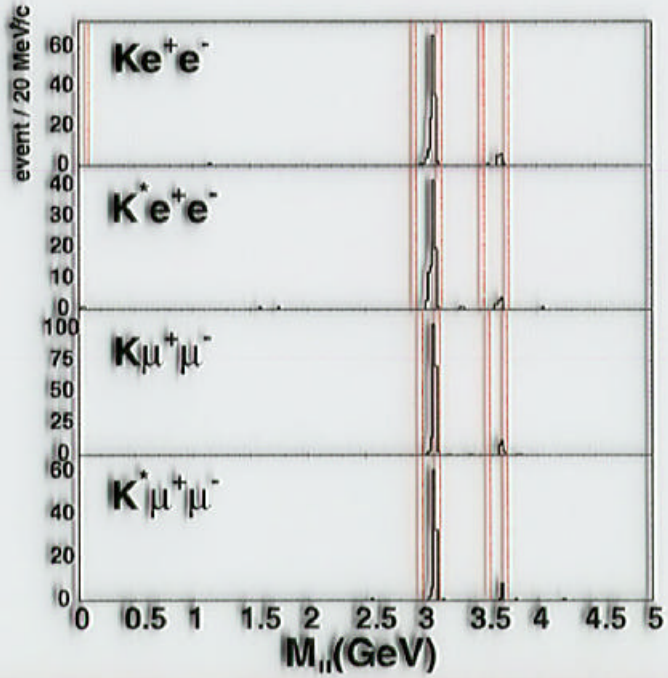
- Searched modes ($l = e, \mu$)
  - $B^0 \to K^{*0}(K^+\pi^-)\, l\, l$, $K^{*0}(K_S\pi^0)\, l\, l$
  - $B^+ \to K^{*+}(K_S\pi^+)\, l\, l$, $K^{*+}(K^+\pi^0)\, l\, l$
  - $B^0 \to K_S\, l\, l$
  - $B^+ \to K^+\, l\, l$
- Lepton selection
  - e: plab > 0.5 GeV/c
  - μ: plab > 1.0 GeV/c
- Background suppression (LR cut)
  - Continuum
    - Fisher w/ Virtual Cal. + R2
    - $\cos\theta_B$, $\cos\theta_{\text{decay axis}}$
  - BB (both B->leptonic decays)
    - Visible energy
    - $\cos\theta_B$



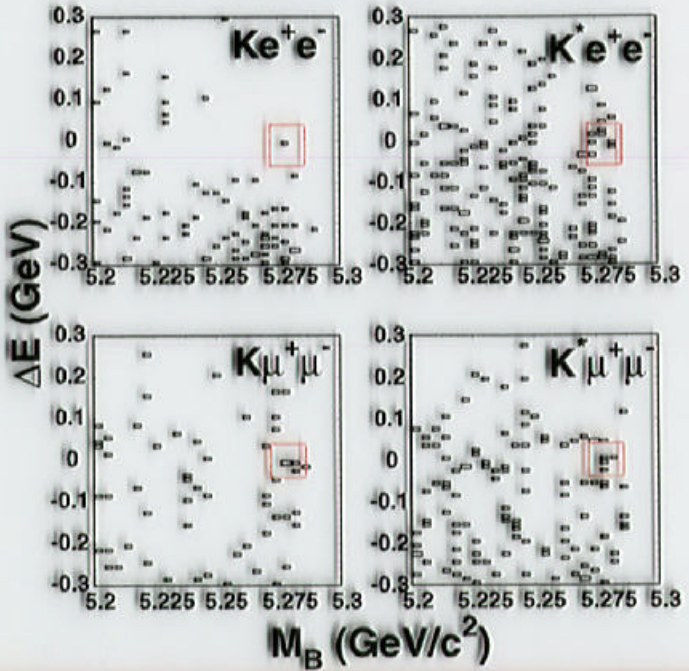


$B \to K^{(*)} l^+ l^-$ Results

- π^0 Dalitz and γ conversion veto
  Mee $\geq$ 0.1 GeV for Kee
- J/ψ, ψ' veto: $-0.15 < Mee - M\psi^{(\prime)} < 0.07$ GeV
  $-0.10 < M\mu\mu - M\psi^{(\prime)} < 0.05$ GeV



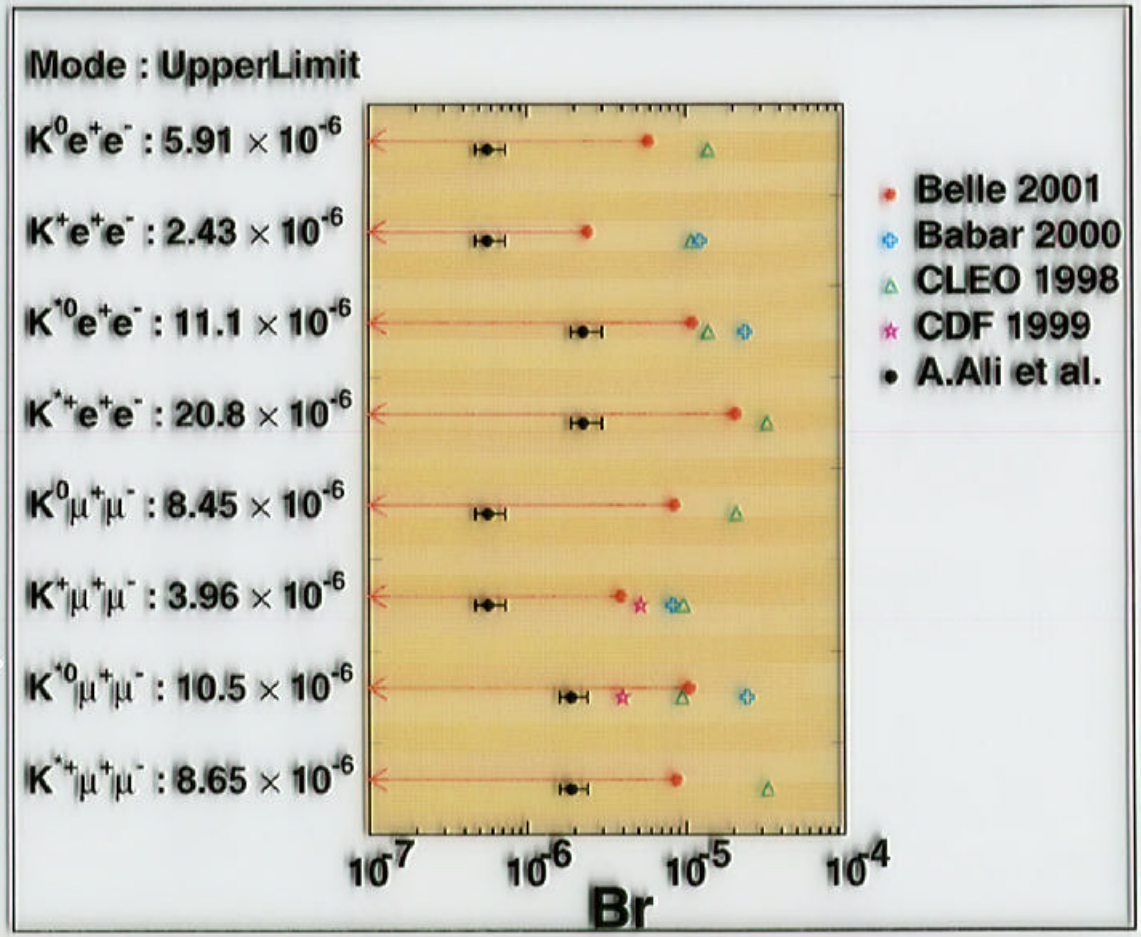
Mb-ΔE after veto



$B \to K^{(*)} l^+ l^-$ Summary

- $K^{*0}\mu\mu$ and $K^{+}\mu\mu$ modes show excess of events.
  - $K^{*0}\mu\mu$: Nobs(Nb)=4(1)
  - $K^{+}\mu\mu$: Nobs(Nb)= 8(0.6)
- Statistical significance
  - $K^{*0}\mu\mu$: 2.7σ
  - $K^{+}\mu\mu$: 2.7σ
- Improved upper limits except for $K^{*0}\mu\mu$ channel.

※Upper limits based on 0 background assumption.



Summary

- Belle has accumulated 10.5fb-1 (11.1M BB)
  ⇒Various rare decay studies have been carried out.
  w/ statistics comparable to published results by CLEO.

- Cabibbo suppressed decays: $B \to D^{(*)}K^{(*)}$
  - First observation for $B \to D^{*}K^{-}$, $D^{*0}K^{-}$, $D^{*+}K^{-}$ and $D^{0}K^{*-}$
  - $Br(D^{(*)}K)/Br(D^{(*)}\pi) \sim$ naive expectation.
- Charmless two-body decays: $B \to \pi\pi/K\pi/KK$, $B \to \eta' h$
  - Our results support;
    - $Br(\pi\pi)/Br(K\pi) < 1$
    - $Br(K^{0}\pi^{0})$: larger than theories
    - Large $Br(\eta K)$
  - We have started looking at Acp for $K\pi$ modes
- EW Penguin decays: $B \to K^{(*)}ll$ search
  - Improved upper limits except for $K^{(*)}\mu\mu$

New $\mathcal{L}_{peak}$ record! (Last evening.)
$2.47 \times 10^{33}\ cm^{-2} \cdot s^{-1}$

- Next updates: ~Summer 2001
  ⇒ **More interesting/exciting results will come soon !!**

More Topics !

More results are reported by 4 speakers...

- Radiative decays
  - $b \to s\gamma$, $B \to K^*\gamma$, $B \to$"K_2^*"γ
  - $B \to \rho\gamma$, Improved limit on $\rho\gamma/K^*\gamma$
  - $A_{CP}(K^*\gamma)$

  ⇒Y.Ushiroda's talk (today,S20-II)

- Hadronic decays into final states including vector mesons
  - $B \to \rho h/\omega h$ and $\phi K^{(*)}$

  ⇒A.Bozek's talk (today,S20-II)

- B→three charged particle final states
  - $B \to K^+h^+h^-$

  ⇒A.Garmash's talk (today,S20-III)

- Rare decays for Vub
  - $B \to \pi l\nu$, $B \to D_s\pi$ search

  ⇒H.K.Jang's talk (Thursday,S22-III)

"Stay Tuned !"