Selected Topics on Hadronic B Decays from BaBar

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for The BaBar Collaboration

Outline

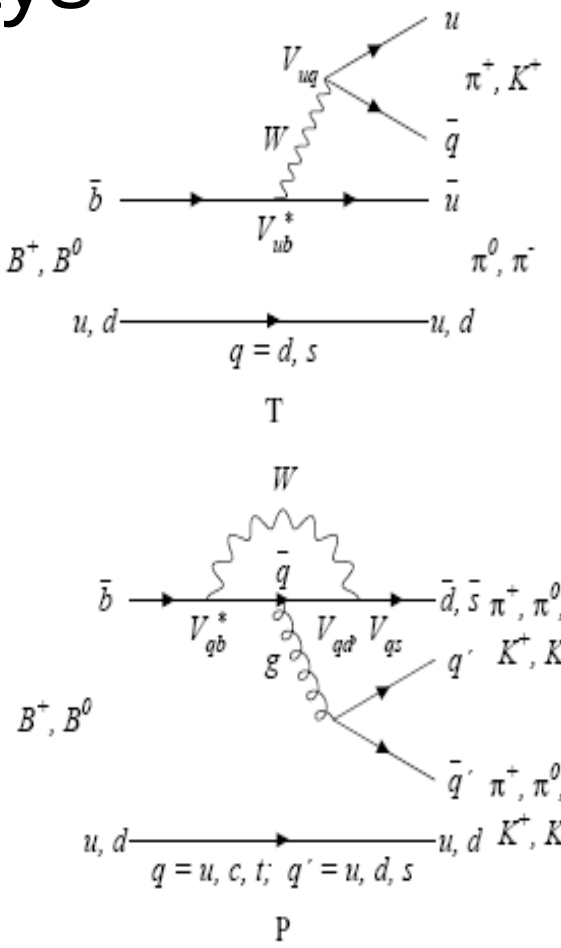
- The talk will focus on charmless hadronic B decays.
  - Topics to be presented are mainly time-integrated analyses (BF and A_{CP}) of the following modes.
    - B -> $K^+\pi^-\pi^+$
    - B -> $K^+\pi^-\pi^0$
    - B^0 -> PP with $\eta^{(\prime)}$
    - B -> PV with isoscalar mesons
    - B^0 -> AP with b_1
  - Following topics can be found in other talks.
    - B -> VV, VA, VT => See Gao's talk
    - Time-dependent CP analyses => See Martinez-Vidal's talk

Charmless hadronic B decays

- Dominated by “Tree” and/or “Penguin” diagrams.
  - Tree (T): CKM-suppressed b -> u transition
  - Penguin (P): One-loop b -> s, d gluonic transitions
- Tree-Penguin Interference can cause direct CP asymmetry (Acp).

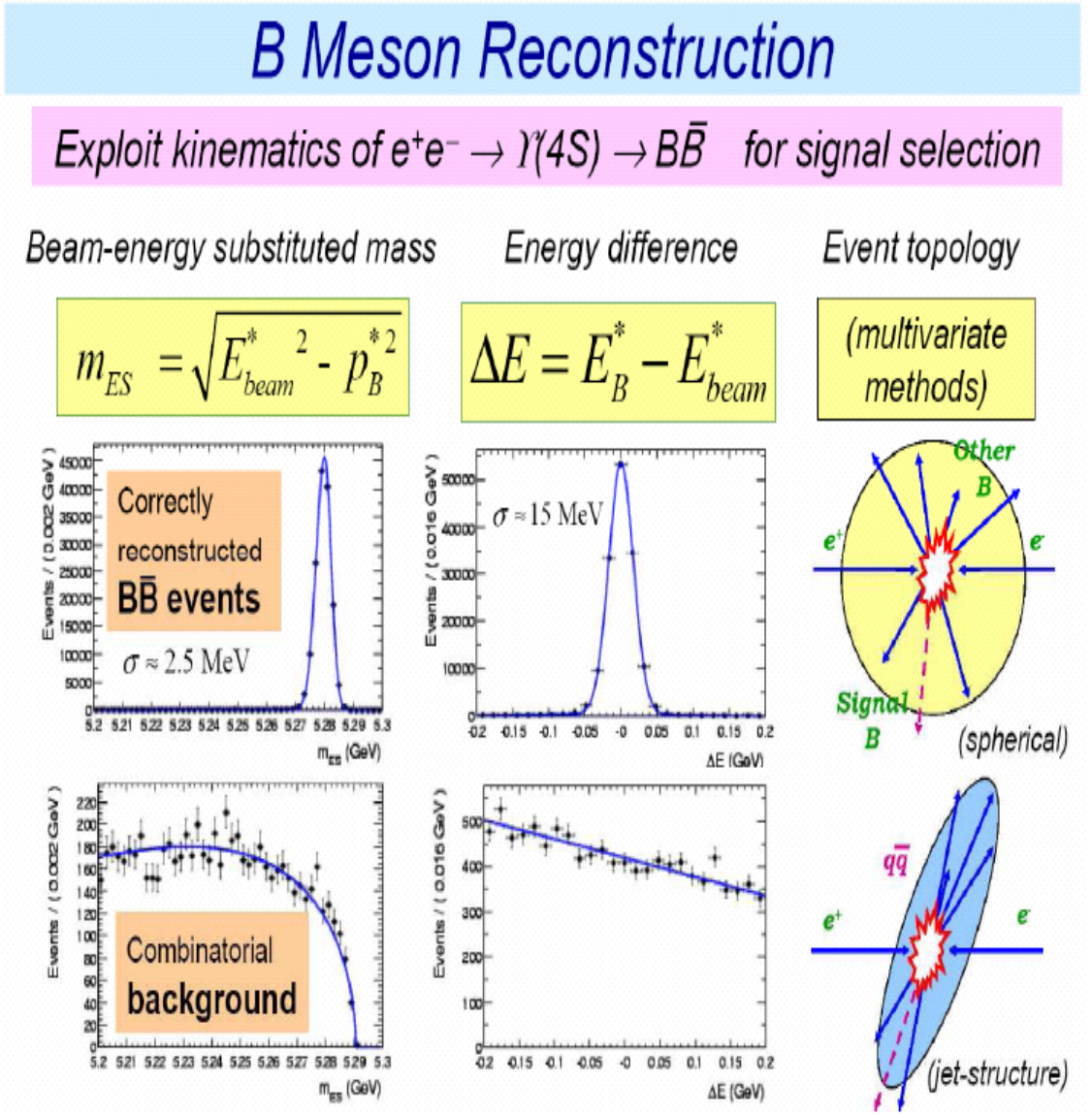
$$\mathcal{A}_{CP} = \frac{2|A_T/A_P|\sin\delta\sin\gamma}{1+2|A_T/A_P|\cos\delta\cos\gamma+|A_T/A_P|^2}$$

- Information on CKM angle $\gamma = \arg(V_{ub})$ may be accessible.
- Absence of CKM-favored b -> c transition makes possible to access rare decay processes.
  - Good place to test Standard Model (SM) precisely.
  - Disagreements between measurements and predictions, ”puzzles”, could indicate new physics (NP).
  - Searching for and resolving “puzzles” is an improtant issue.



Typical analysis procedure

- Select B candidates based on m_{ES} and ΔE
- Discriminate e^+e^- -> qq (q= u, d, s, c) continuum bkg. based on event topology.
- Extract the information by applying maximum-likelihood fit utilizing
  - m_{ES}, ΔE and/or resonance mass
  - event topology
  - angular correlation
  - Dalitz plot variables



Puzzles in charmless hadronic B decays

- $\Delta A_{CP}(K\pi)$ puzzle

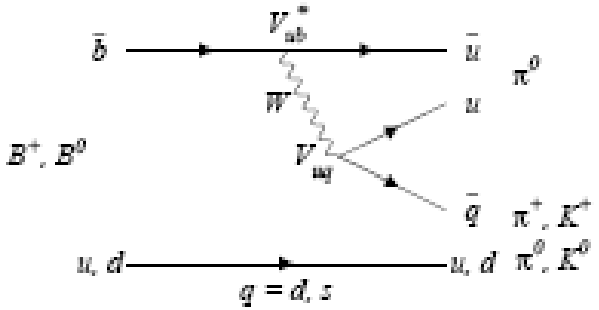
$\Delta A_{CP}(B \to K\pi)$ puzzle

$$\begin{aligned}\Delta\mathcal{A}_{CP}(K\pi) &\equiv \mathcal{A}_{CP}(K^+\pi^0) - \mathcal{A}_{CP}(K^+\pi^-) \neq 0 \\ &= +0.164 \pm 0.037 \ (\sim 4.4\sigma \text{ from [2]}) \\ &= +0.147 \pm 0.028 \ (\sim 5.3\sigma \text{ using HFAG})\end{aligned}$$

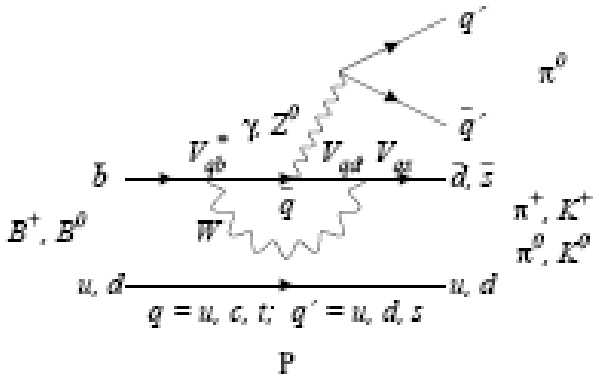
Mode	BaBar [1]	Belle [2]	HFAG
$K^+\pi^-$	$-0.107 \pm 0.018 \pm {}^{0.007}_{0.004}$	$-0.094 \pm 0.018 \pm 0.008$	-0.097 ± 0.012
$K^+\pi^0$	$+0.030 \pm 0.039 \pm 0.010$	$+0.07 \pm 0.03 \pm 0.01$	$+0.050 \pm 0.025$

[1] PRL 99, 021603 (2007); PRD 76, 091102 (2007)
[2] Nature 452, 332 (2008)

- $\Delta A_{CP}(K\pi) = 0$ is expected, but not.
  - Both decays are dominated by Tree (T) and gluonic Penguin (P) contributions.
- $K^+\pi^0$ mode has additional contributions.
  - Color-suppressed Tree (C)
  - Electroweak Penguin (P_{EW})
  - Both expected to be small in SM.
- Unexpected enhancements in C and/or P_{EW}? New physics?
  - Important to look at A_{CP} in B^+ decays with similar decay topology.
  - $B^+ \to \rho^0(\to \pi^+\pi^-)\, K^+$



C



P

Dalitz plot analysis of $B^+ \to K^+\pi^-\pi^+$ (1)

- Isobar model fit
  - Incorporating $m^2(K^+\pi^-)$, $m^2(\pi^+\pi^-)$, m_{ES}, $\Delta E/\sigma_{\Delta E}$, q_B (B-meson charge)
  - LASS parameterization for $K\pi$ S-wave $(K\pi)_0^{*0}$
    - Nucl. Phys. B296, 493 (1988)
- Evidence for large $A_{CP}(\rho^0 K^+)$

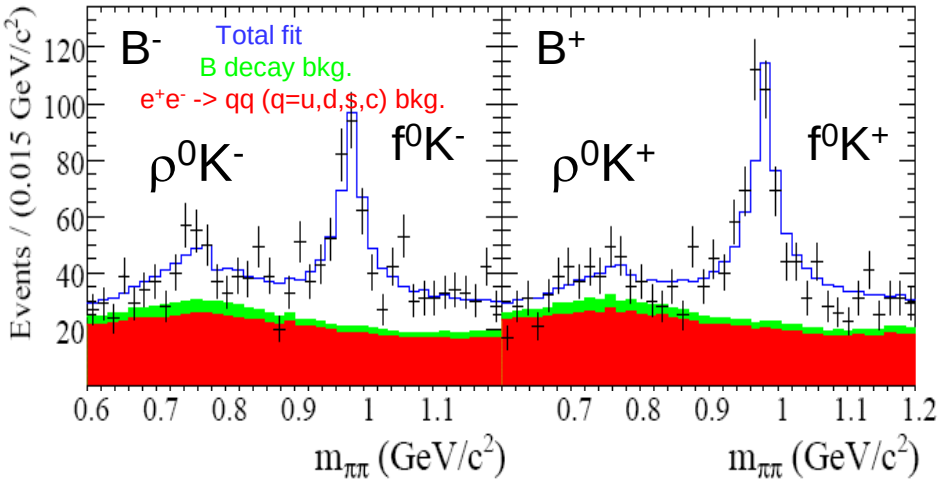
  A_{CP} = +0.44 +- 0.10 +- 0.04 +0.05/-0.13 (model)
  - 3.7σ statistically (>3σ incl. sys.)
  - Sizable as expected in SM, unlike $A_{CP}(\pi^0 K^+)$
- A_{CP}~ 0 in other modes and in total.
  - $A_{CP}(f_0(1270)K^+)$ is at 3.5σ, but has large model uncertainties.
  - No A_{CP} in the penguin-dominant modes of $K^{*0}(892)\pi^+$, $(K\pi)_0^{*0}\pi^+$, $K_2^{*0}(1430)\pi^+$
    - Consistent with SM
- Measured BFs are consistent with the previous measurements generally.

BF($K^+\pi^-\pi^+$) = (54.4 +- 1.1 +- 4.5 +- 0.7 (model)) x 10^{-6}
  - Compatible with the Belle measurement:

    (48.4 +- 1.1 +- 3.6) x 10^{-6} [PRL 96, 251803 (2006)]

arXiv:0803.4451 [hep-ex] (to be published in PRD)

383.2M BB (347.5 /fb)



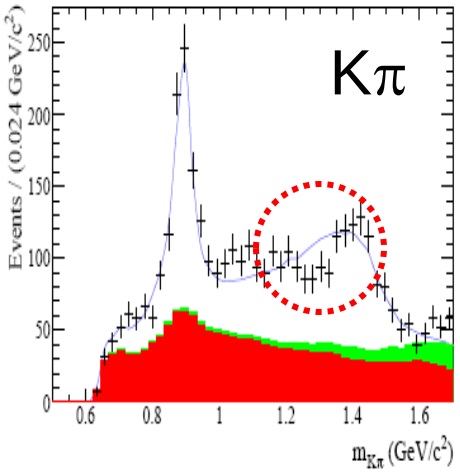
Mode	$\mathcal{B}(B^+ \to \text{Mode})(10^{-6})$	A_{CP} (%)	DCPV Sig.
$K^+\pi^-\pi^+$ Total	$54.4 \pm 1.1 \pm 4.5 \pm 0.7$	$2.8 \pm 2.0 \pm 2.0 \pm 1.2$	
$K^{*0}(892)\pi^+;\ K^{*0}(892) \to K^+\pi^-$	$7.2 \pm 0.4 \pm 0.7^{+0.3}_{-0.5}$	$+3.2 \pm 5.2 \pm 1.1^{+1.2}_{-0.7}$	0.9σ
$(K\pi)_0^{*0}\pi^+;\ (K\pi)_0^{*0} \to K^+\pi^-$	$24.5 \pm 0.9 \pm 2.1^{+7.0}_{-1.1}$	$+3.2 \pm 3.5 \pm 2.0^{+2.7}_{-1.9}$	1.2σ
$\rho^0(770)K^+;\ \rho^0(770) \to \pi^+\pi^-$	$3.56 \pm 0.45 \pm 0.43^{+0.38}_{-0.15}$	$+44 \pm 10 \pm 4^{+5}_{-13}$	3.7σ
$f_0(980)K^+;\ f_0(980) \to \pi^+\pi^-$	$10.3 \pm 0.5 \pm 1.3^{+1.5}_{-0.4}$	$-10.6 \pm 5.0 \pm 1.1^{+3.4}_{-1.0}$	1.8σ
$\chi_{c0}K^+;\ \chi_{c0} \to \pi^+\pi^-$	$0.70 \pm 0.10 \pm 0.10^{+0.06}_{-0.02}$	$-14 \pm 15 \pm 3^{+1}_{-5}$	0.5σ
$K^+\pi^-\pi^+$ nonresonant	$2.4 \pm 0.5 \pm 1.3^{+0.3}_{-0.8}$	—	—
$K_2^{*0}(1430)\pi^+;\ K_2^{*0}(1430) \to K^+\pi^-$	$1.85 \pm 0.41 \pm 0.28^{+0.54}_{-0.08}$	$+5 \pm 23 \pm 4^{+18}_{-7}$	0.2σ
$\omega(782)K^+;\ \omega(782) \to \pi^+\pi^-$	$0.09 \pm 0.13 \pm 0.02^{+0.03}_{-0.04}$	—	—
$f_2(1270)K^+;\ f_2(1270) \to \pi^+\pi^-$	$0.50 \pm 0.15 \pm 0.07^{+0.13}_{-0.09}$	$-85 \pm 22 \pm 13^{+22}_{-2}$	3.5σ
$f_X(1300)K^+;\ f_X(1300) \to \pi^+\pi^-$	$0.73 \pm 0.21 \pm 0.47^{+0.02}_{-0.08}$	$+28 \pm 26 \pm 13^{+7}_{-5}$	0.6σ

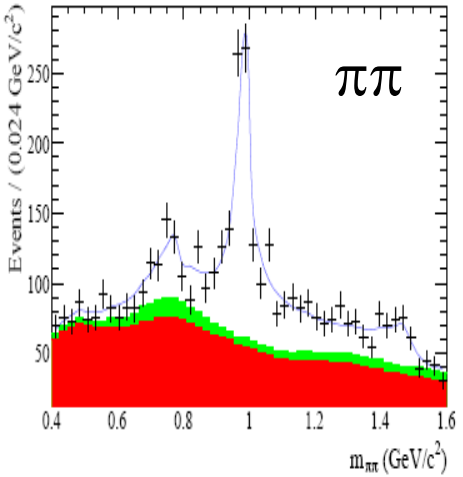
Dalitz plot analysis of $B^+ \to K^+\pi^-\pi^+$ (2)

- $K\pi$ and $\pi\pi$ dynamics
  - Good fits require
    - $K_2^{*0}(1430)\pi^+$, $f_2(1270)K^+$, $f_X(1300)K^+$
  - $f_X(1300)$ seems consistent with $f_0(1500)$
    - m = (1479 +- 8) MeV/c^2
    - Γ = (80 +- 19) MeV/c^2

    Consistent with Belle measurements
    - m = (1449 +- 13) MeV/c^2
    - Γ = (126 +- 25) MeV/c^2

    Their implication is $f_0(1370)$
  - A better model in m($K\pi$)=1.2-1.4 GeV/c^2?
    - Fit model includes $(K\pi)_0^{*0}$ and $K_2^{*0}(1430)$
    - No better alternative models were found.
  - Model for $K\pi$ S-wave is different between BaBar and Belle.
    - BqBar: effective range + constant NR.
    - Belle: NR with variation in magnitude.
    - Measured BFs are generally consistent.





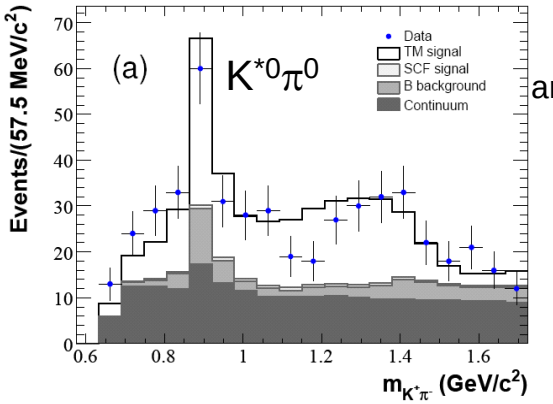
Mode	Fit Fraction (%)
$K^+\pi^-\pi^+$ Total	
$K^{*0}(892)\pi^+;\ K^{*0}(892) \to K^+\pi^-$	$13.3 \pm 0.7 \pm 0.7\,^{+0.4}_{-0.9}$
$(K\pi)_0^{*0}\pi^+;\ (K\pi)_0^{*0} \to K^+\pi^-$	$45.0 \pm 1.4 \pm 1.2\,^{+12.9}_{-0.2}$
$\rho^0(770)K^+;\ \rho^0(770) \to \pi^+\pi^-$	$6.54 \pm 0.81 \pm 0.58\,^{+0.69}_{-0.26}$
$f_0(980)K^+;\ f_0(980) \to \pi^+\pi^-$	$18.9 \pm 0.9 \pm 1.7\,^{+2.8}_{-0.6}$
$\chi_{c0}K^+;\ \chi_{c0} \to \pi^+\pi^-$	$1.29 \pm 0.19 \pm 0.15\,^{+0.12}_{-0.03}$
$K^+\pi^-\pi^+$ nonresonant	$4.5 \pm 0.9 \pm 2.4\,^{+0.6}_{-1.5}$
$K_2^{*0}(1430)\pi^+;\ K_2^{*0}(1430) \to K^+\pi^-$	$3.40 \pm 0.75 \pm 0.42\,^{+0.99}_{-0.13}$
$\omega(782)K^+;\ \omega(782) \to \pi^+\pi^-$	$0.17 \pm 0.24 \pm 0.03\,^{+0.05}_{-0.08}$
$f_2(1270)K^+;\ f_2(1270) \to \pi^+\pi^-$	$0.91 \pm 0.27 \pm 0.11\,^{+0.24}_{-0.17}$
$f_X(1300)K^+;\ f_X(1300) \to \pi^+\pi^-$	$1.33 \pm 0.38 \pm 0.86\,^{+0.04}_{-0.14}$

Constraint on $\gamma/(\rho,\eta)$ from Dalitz plot analysis of B -> K$\pi\pi$

- Dalitz plot analysis can provide amplitude information.
- Magnitudes and relative phases of B -> $K^*\pi$ + c.c. are of particular interest.
  - To constrain the CKM parameters (ρ,η) (or γ if neglecting P_{EW})
    - Ciuchini, Pierini, Silvestrini (CPS method): PRD 74, 051301(R) (2006)
    - Gronau, Pirjol, Soni, Zupan (GPSZ method): PRD 75, 014002 (2007)
  - $K^{*0}(892)\pi^+$ and $K_0^{*0}(1430)\pi^+$ from $B^+ \to K^+\pi^-\pi^+$
  - Much more information from $B^0 \to K^+\pi^-\pi^0$, $K^0_S\pi^+\pi^-$

Dalitz plot analysis of $B^0 \to K^+\pi^-\pi^0$ (1)

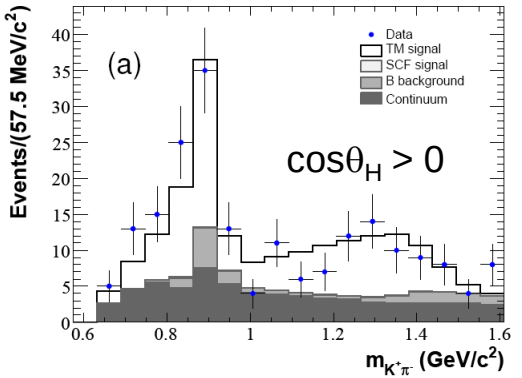
- Some numbers are updated in May 2008.
  - Corrected and improved errors on phases.
  - Minute corrections on $(K\pi)^{0*}$ BFs.
- Fits found 4 minima of –log(LH).
  - Substantial difference in phases, but not so in the other parameters.
  - Results are averaged over the solutions.
- First observation of $B^0 \to K^{*0}(892)\pi^0$
  - BF = (3.6 +- 0.7 +- 0.4) x 10^{-6} (5.6σ incl. sys.)
- Total $B^0 \to K^+\pi^-\pi^0$ BF and A_{CP}
  - BF = (35.7 +2.6/-1.5 +- 2.2) x 10^{-6}
  - A_{CP}= -0.030 +0.045/-0.051 +- 0.055
- No significant charge asymmetries.
  - Neither in decay rates nor in interferences.
- Sizable $K\pi$ S-P interference can be seen.



arXiv:0711.4417v2 [hep-ex]
(submitted to PRD)

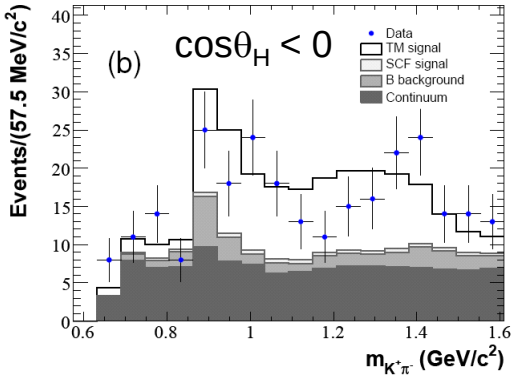
BaBar Preliminary
231.8M BB (210.6 /fb)

Assuming
BF($K^{*0} \to K^+\pi^-$) = 2/3



Including
sub-decay BFs

isobar j	FF_j (%)	$\mathcal{B}_j$ (10^{-6})	A_{CP}^j
$K^{*+}(892)\pi^-$	$11.8^{+2.5}_{-1.5} \pm 0.6$	$4.2^{+0.9}_{-0.5} \pm 0.3$	$-0.19^{+0.20}_{-0.15} \pm 0.04$
$K^{*0}(892)\pi^0$	$6.7^{+1.3+0.7}_{-1.5-0.6}$	$2.4 \pm 0.5 \pm 0.3$	$-0.09^{+0.21}_{-0.24} \pm 0.09$
$(K\pi)_0^{*+}\pi^-$	$26.3^{+3.1+2.1}_{-3.8-2.9} \pm 4.9$	$9.4^{+1.1+1.4}_{-1.3-1.1} \pm 1.8$	$+0.17^{+0.11}_{-0.16} \pm 0.09 \pm 0.20$
$(K\pi)_0^{*0}\pi^0$	$24.3^{+3.8+3.7}_{-2.6-3.0} \pm 6.7$	$8.7^{+1.1+1.8}_{-0.9-1.3} \pm 2.2$	$-0.22 \pm 0.12^{+0.13}_{-0.11} \pm 0.27$
$\rho^-(770)K^+$	$22.5^{+2.2}_{-3.7} \pm 1.2$	$8.0^{+0.8}_{-1.3} \pm 0.6$	$+0.11^{+0.14}_{-0.15} \pm 0.07$
N.R.	$12.4 \pm 2.6^{+1.3}_{-1.2}$	$4.4 \pm 0.9 \pm 0.5$	$+0.23^{+0.19+0.11}_{-0.27-0.10}$
Total	$102.3^{+7.1}_{-4.0} \pm 4.1$	$35.7^{+2.6}_{-1.5} \pm 2.2$	$-0.030^{+0.045}_{-0.051} \pm 0.055$



Dalitz plot analysis of $B^0 \to K^+\pi^-\pi^0$ (2)

- Magnitudes and relative phases of $K^*\pi$ modes
  - Can be used to constrain (ρ,η).
- GPSZ method using the measurements in
  - $B^0 \to K^+\pi^-\pi^0$
  - $B^0 \to K^0_S\pi^+\pi^-$
    - A time-dependent Dalitz plot anslysis arXiv:0708.2097 [hep-ex]
  - $\eta = \tan\Phi_{3/2}(\rho - 0.24 +- 0.03)$
- Updated $K^+\pi^-\pi^0$ results sharpened the 1σ range.
  - $20 < \Phi_{3/2} < 115$ deg. (previous)
  - $39 < \Phi_{3/2} < 112$ deg. (updated)

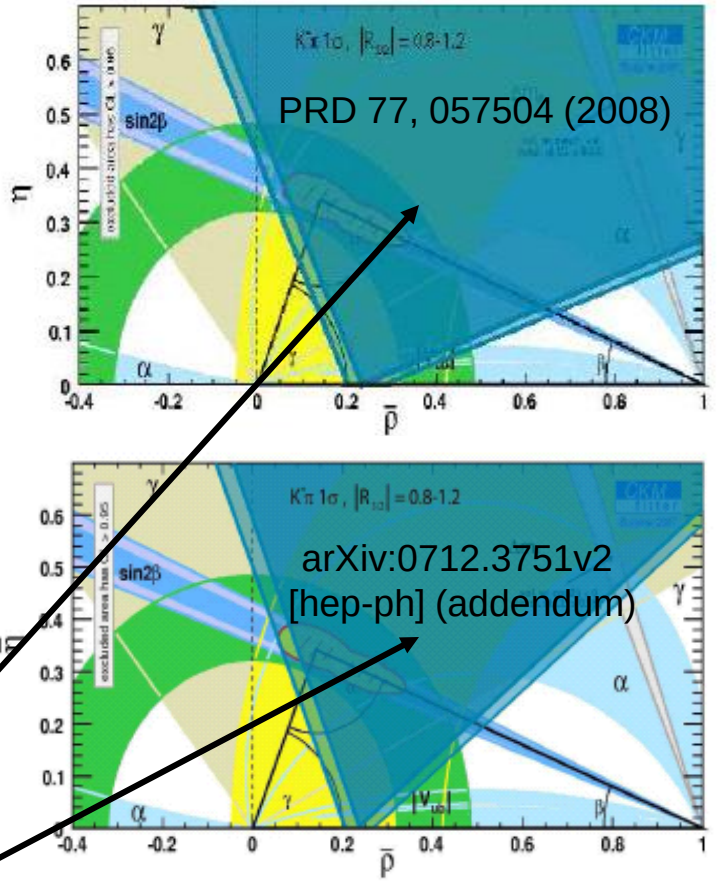


FIG. 2: Constraint in the $\bar{\rho} - \bar{\eta}$ plane following from Eqs. (1) and (3). The dark shaded region marked $K^*\pi$ 1σ corresponds to the experimental error on $\Phi_{3/2}$ given by the 1σ range (3), while the light shaded region includes also the error ± 0.03 in (1). Also shown are CKMfitter constraints obtained using $|V_{ub}|/|V_{cb}|, \beta, \alpha, \gamma$ and Δm_d [8].

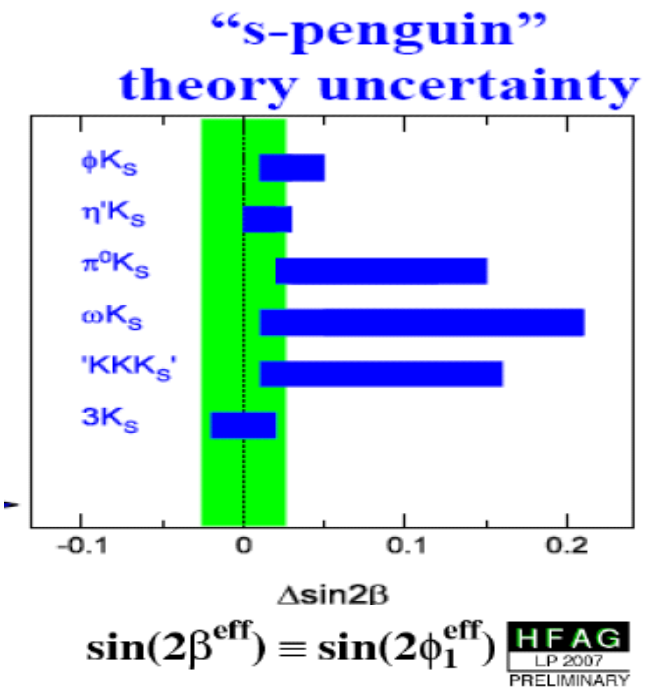
Puzzles in charmless hadronic B decays

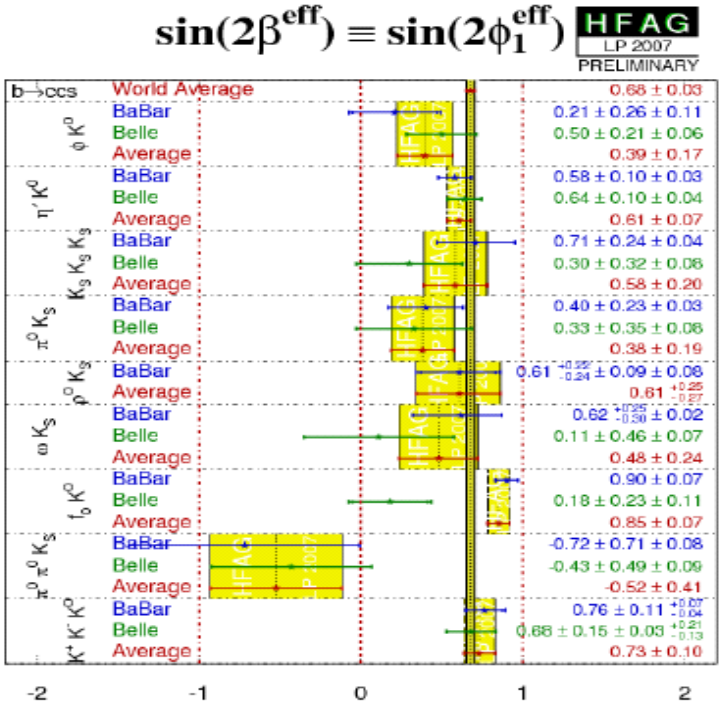
- $\Delta A_{CP}(K\pi)$ puzzle
- ΔS puzzle

ΔS puzzle

$$\Delta S \equiv S(b \to q\bar{q}s) - S(b \to c\bar{c}s)$$
$$= \sin 2\beta^{\text{eff}} - \sin 2\beta \geq 0$$

- ΔS ~ 0 is expected in SM to a good approximation.
  - Theories indicate ΔS ≥ 0.
  - Measurements indicate ΔS ≤ 0.
- ΔS puzzle is coupled to $\Delta A_{CP}(K\pi)$ puzzle
  - No satisfactory models to solve both the puzzles at the same time.
  - New physics?
- ΔS is getting closer to zero in measurements over the past years.
  - Stay tuned for updates..





Puzzles in charmless hadronic B decays

- $\Delta A_{CP}(K\pi)$ puzzle
- ΔS puzzle
- Polarization puzzle
  - Longitudinal polarization
    - Dominant in charmless B -> VV decays within SM.
    - Confirmed in tree-level b -> u transition.
  - Transverse polarization
    - Seen large contributions in b -> s, d Penguin transitions.
    - New physics?
  - See Gao's talk for the discussion.

Puzzles in charmless hadronic B decays

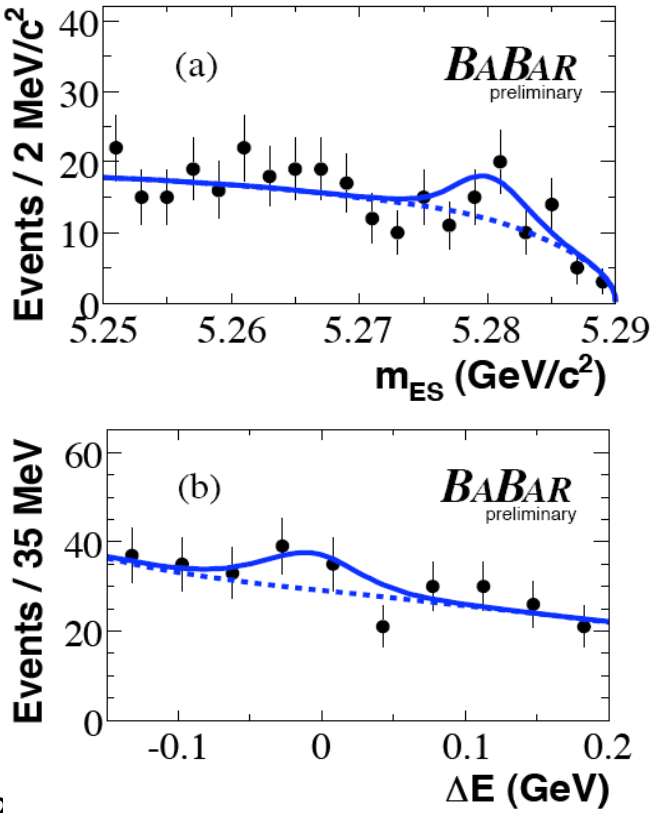
- $\Delta A_{CP}(K\pi)$ puzzle
- ΔS puzzle
- Polarization puzzle
- Any other puzzles?
  - Need to test the theoretical understanding precisely and systematically.
    - Need to measure precisely and as many modes as possible.
  - Recent contributions from BaBar
    - B -> PP with $\eta^{(\prime)}$
    - B -> PV with isoscalar mesons
    - B -> AP with b_1

Updates on searches for B^0 -> $\eta^{(\prime)}\pi^0$, $\eta^{(\prime)}\eta$, $\eta'\eta'$, ηK^0

- Using the following sub-decays
  - η -> $\gamma\gamma$ ("$\eta_{\gamma\gamma}$"), $\pi^+\pi^-\pi^0$; η' -> $\eta_{\gamma\gamma}\pi^+\pi^-$, $\rho^0\gamma$
  - ω -> $\pi^+\pi^-\pi^0$; K^0_S for K^0
- No clear signals are seen yet.
  - 3.1σ significance for $\eta'\pi^0$
  - UL(ηK^0) is tightened.
    - Previous: BF = (1.8 +0.7/-0.6 +- 0.1 < 2.9) x 10^{-6}

      PRD 74, 051106 (2006): 324 M BB (288.5 /fb)
    - Remains puzzling patterns on BF(ηK).

BaBar Preliminary



Mode	$\mathcal{S}$ [σ]	$\mathcal{B}$ [10^{-6}] (UL @90% CL)	
$\eta\pi^0$	2.2	$0.9 \pm 0.4 \pm 0.1$	(< 1.5)
$\eta'\pi^0$	3.1	$0.9 \pm 0.4 \pm 0.1$	(< 1.5)
$\eta'\eta$	1.4	$0.5 \pm 0.4 \pm 0.1$	(< 1.2)
$\eta\eta$	2.4	$0.8 \pm 0.4 \pm 0.1$	(< 1.4)
$\eta'\eta'$	1.3	$0.9^{+0.8}_{-0.7} \pm 0.1$	(< 2.1)
ηK^0	2.6	$0.9^{+0.5}_{-0.4} \pm 0.1$	(< 1.6)

arXiv:0804.242?
(submitted to PRD)
459 M BB (418 /fb)
New
465 M BB (423.5 /fb)

B^0 -> ηK^0

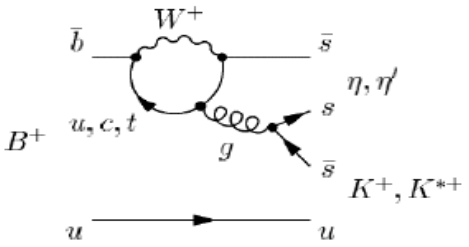
BF(η(')K) puzzle?

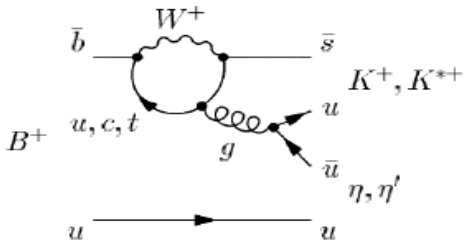
- Expected BF(ηK) ~ BF(η'K), but BF(ηK) << BF(η'K).
  - First reported by CLEO.
    - PRL 81, 1786 (1998)
  - Can be explained by the gss-gqq interference due to the η-η' mixing.
    - Lipkin, PLB 254, 247 (1991)
    - Destructive (constructive) for ηK (η'K)
  - Violation of a BF sum rule remains?
    - Lipkin, PLB 633, 540 (2006)

    BF(η' K^+) + BF(ηK^+) ≤ BF($\pi^0 K^+$) + BF($\pi^+ K^0$)
    - HFAG

    (70.2 +- 2.5) + (2.7 +- 0.3) >> (12.9 +- 0.6) + (23.1 +- 1.0)
  - Can be explained by the additional gluonic charming penguin.
    - Williamson, Zupan, PRD 74 014003 (2006)
- Further improvements would be expected.

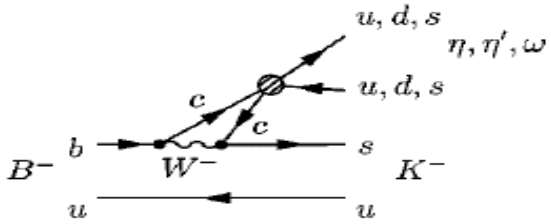
Mode	BaBar	Belle	HFAG
ηK^0	< 1.6	< 1.9	< 1.9
ηK^+	$3.7 \pm 0.4 \pm 0.1$	$1.9 \pm 0.3 \,^{+\,0.2}_{-\,0.1}$	2.7 ± 0.3
$\eta' K^0$	$66.6 \pm 2.6 \pm 2.8$	$58.9 \,^{+\,3.6}_{-\,3.5} \pm 4.3$	64.9 ± 3.1
$\eta' K^+$	$70.0 \pm 1.5 \pm 2.8$	$69.2 \pm 2.2 \pm 3.7$	70.2 ± 2.5





$$\eta' \cong \frac{1}{\sqrt{2}}(\eta_q + \eta_s)$$

$$\eta \cong \frac{1}{\sqrt{2}}(\eta_q - \eta_s)$$



"Charming penguin"

Updates on searches for B -> $\eta\rho^+$, $\pi^0\omega$, $\eta^{(\prime)}\omega$, $\eta^{(\prime)}\phi$

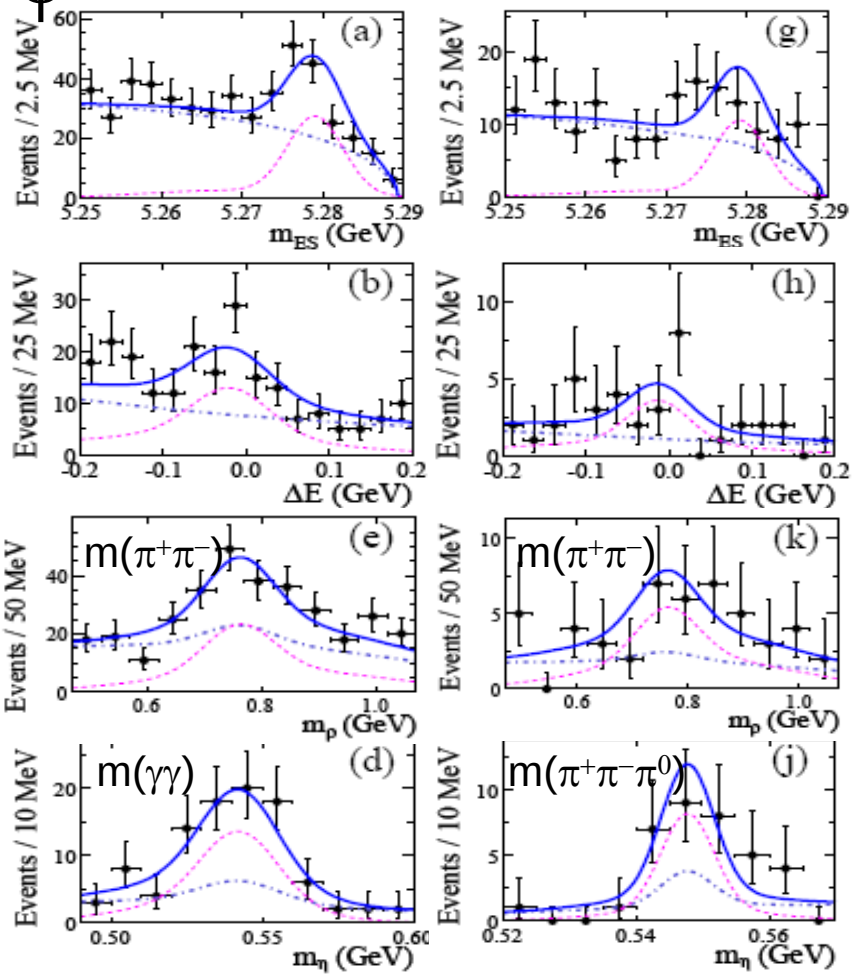
- 9σ observation of B^+ -> $\eta\rho^+$
  - BF = (9.9 +- 1.2 +- 0.8) x 10^{-6}
  - A_{CP}= 0.13 +- 0.11 +- 0.02
- 3σ level evidences for B^0 -> $\eta^{(\prime)}\omega$
- No clear signals for B^0 -> $\pi^0\omega$ and $\eta^{(\prime)}\phi$

	Mode	$\mathcal{S}$ [σ]	$\mathcal{B}$ [10^{-6}] (UL @90% CL)	
[1]	$\eta\rho^+$	9.0	$9.9 \pm 1.2 \pm 0.8$	
[1]	$\pi^0\omega$	0.3	$0.07 \pm 0.26 \pm 0.02$	(< 0.5)
[2]	$\eta\omega$	3.5	$1.0\ ^{+0.4}_{-0.3} \pm 0.1$	(< 1.6)
[2]	$\eta'\omega$	3.1	$1.0\ ^{+0.5}_{-0.4} \pm 0.1$	(< 1.7)
[2]	$\eta\phi$	1.7	$0.22\ ^{+0.19}_{-0.15} \pm 0.01$	(< 0.52)
[2]	$\eta'\phi$	1.3	$0.5 \pm 0.4 \pm 0.1$	(< 1.2)

[1] arXiv:0804.2422 (submitted to PRD) 459 M BB (418 /fb)

[2] New 465 M BB (423.5 /fb)

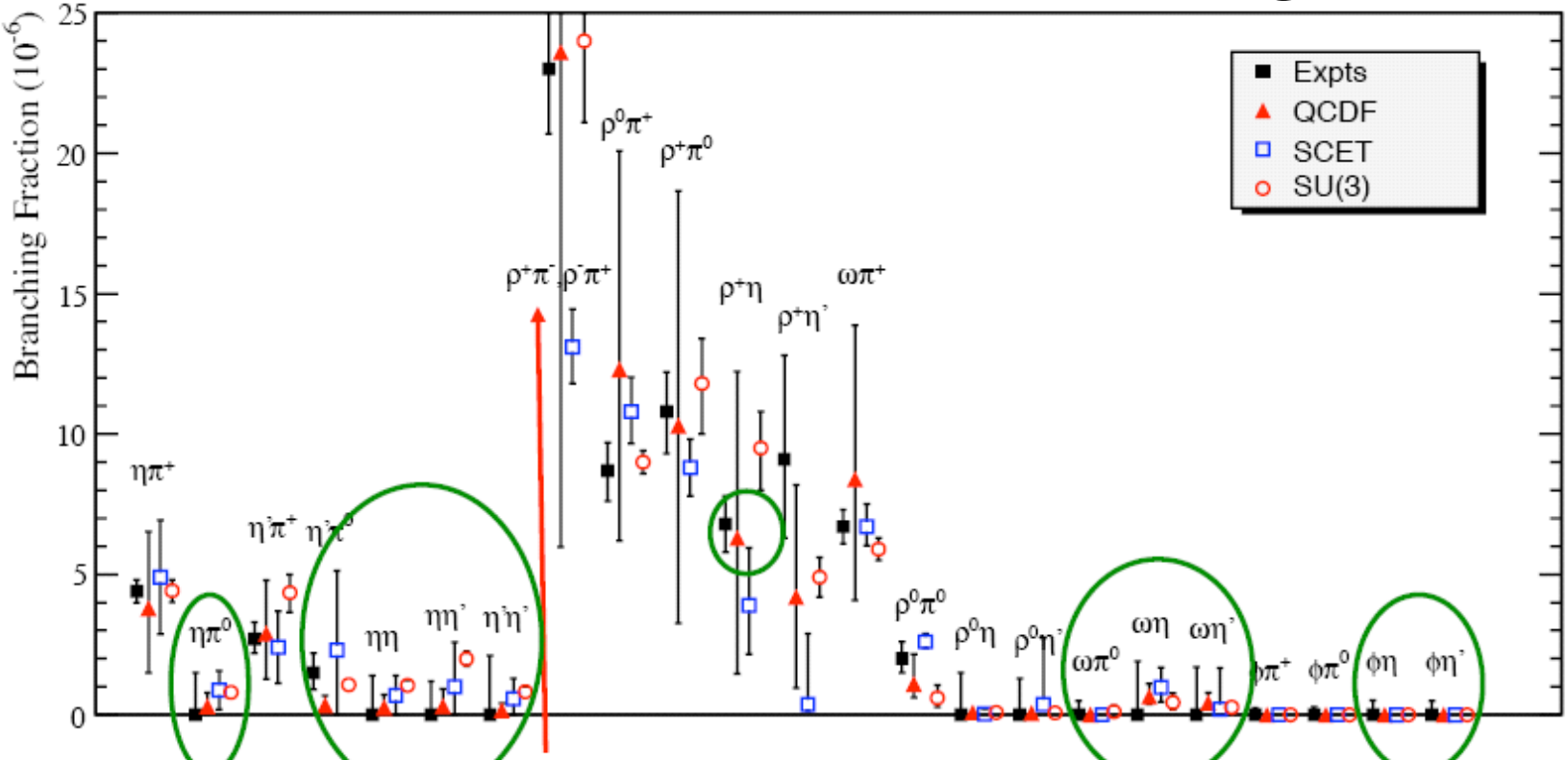
BaBar Preliminary



$\eta(->\gamma\gamma)\rho^+$ $\eta(->3\pi)\rho^+$

B -> PP and PV with isoscalar mesons: measurements vs. predictions

W. T. Ford @ FPCP08



- Big QCDF errors X_A (annihilation), X_H (interaction with spectator)
  - SCET error smaller, disagrees with experiment.
- Many modes not yet seen (but consistent with theoretical estimates)

B -> PP and PV with isoscalar mesons: constraints on ΔS

- Measured BFs can be used as inputs to constrain ΔS.
  - Giving the information on "Tree"-pollution.
  - $\eta^{(\prime)}\pi^0$, $\eta^{(\prime)}\eta$ and $\eta'\eta'$ for $\Delta S(\eta' K^0)$
    - Grossman, Ligeti, Nir, Quinn (GLNQ): PRD 68, 015004 (2003)
    - Gronau, Rosner, Zupan (GRZ): PLB 596, 107 (2004)
  - $\omega\pi^0$, $\eta^{(\prime)}\omega$ and $\eta^{(\prime)}\phi$ for $\Delta S(\phi K^0)$
    - GLNQ method
- Interesting to see further updates.

Based on previous measurements
GRZ: PRD 74, 093003 (2006)

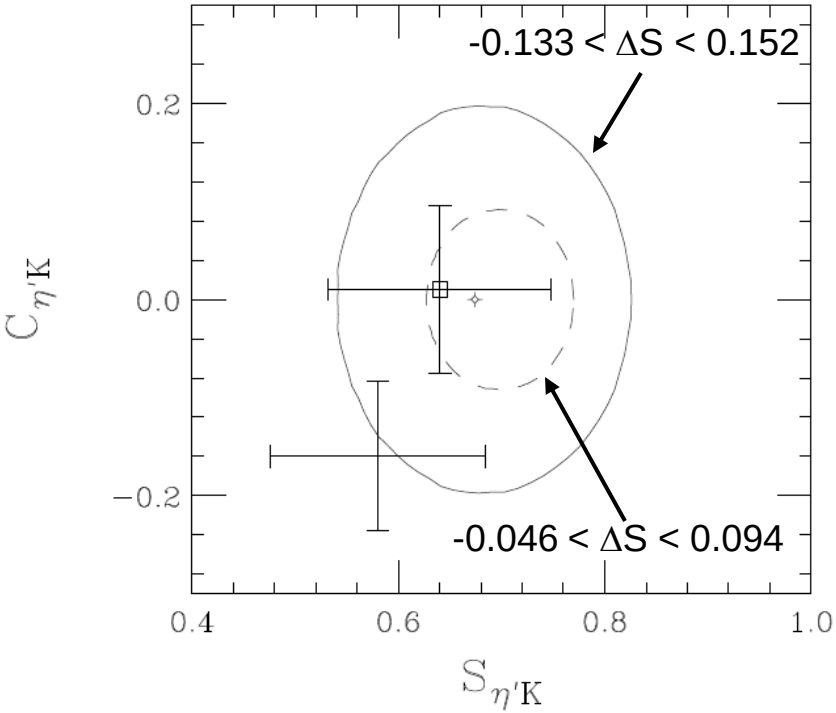


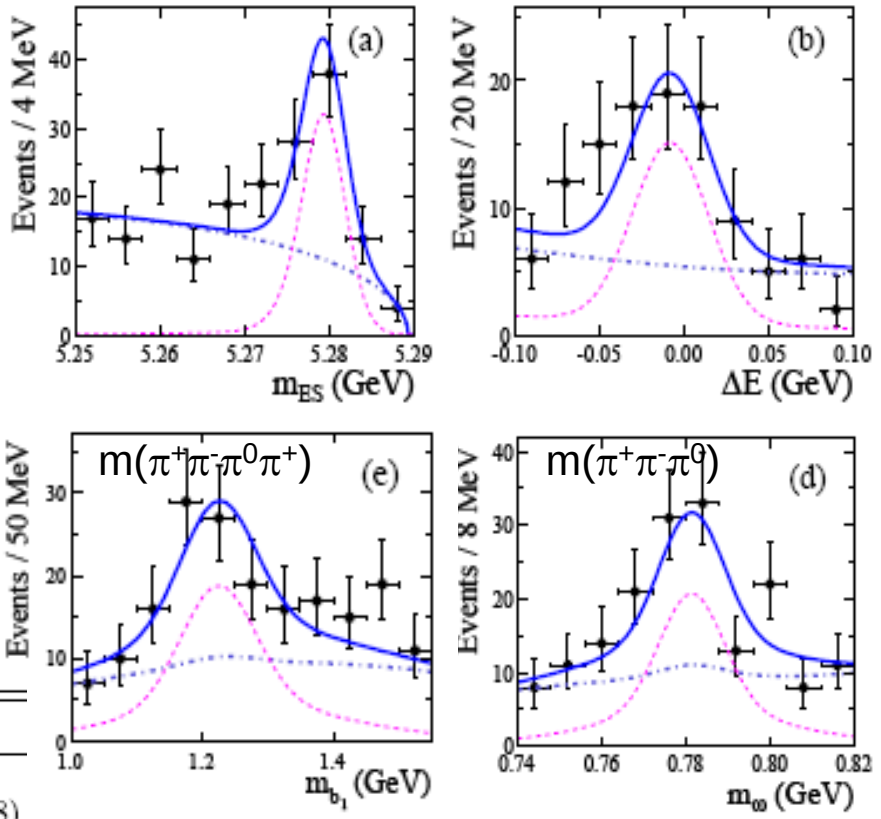
Figure 1: Regions in the $(S_{\eta' K},\ C_{\eta' K})$ plane satisfying limits on the ratio $|A'_C/A'_P|$ and bounds (13) (region enclosed by the solid curve) or (14) (region enclosed by the dashed curve). The small plotted point denotes $(S_{\eta' K},\ C_{\eta' K}) = (\sin 2\beta,\ 0)$. The points with experimental errors denote values from BaBar [9] (plain point) and Belle [11] (small square).

New searches for B -> b_1K^0 and $b_1\pi^0$

- Reconstructing b_1 -> $\omega(->3\pi)\pi$
  - In PDG, listed parameters are
    - m = 1229.5 +- 3.2 MeV/c^2
    - Γ = 142 +- 9 MeV/c^2
  - In the fits, b_1 and ω masses are allowed to vary.
  - BF(b_1 -> $\omega\pi$) = 1 is assumed for BF calculations.
- 6.3σ observation of B^+ -> $b_1{}^+K^0$
  - BF = (9.6 +- 1.7 +- 0.9) x 10^{-6}
  - A_{CP}= -0.03 +- 0.15 +- 0.02
- 3.4σ evidence for B^0 -> $b_1{}^0K^0$
- No evidence for the π^0 modes.

arXiv:0805.1217 [hep-ex] (submittted to PRD)
465M BB (424 /fb)

BaBar Preliminary

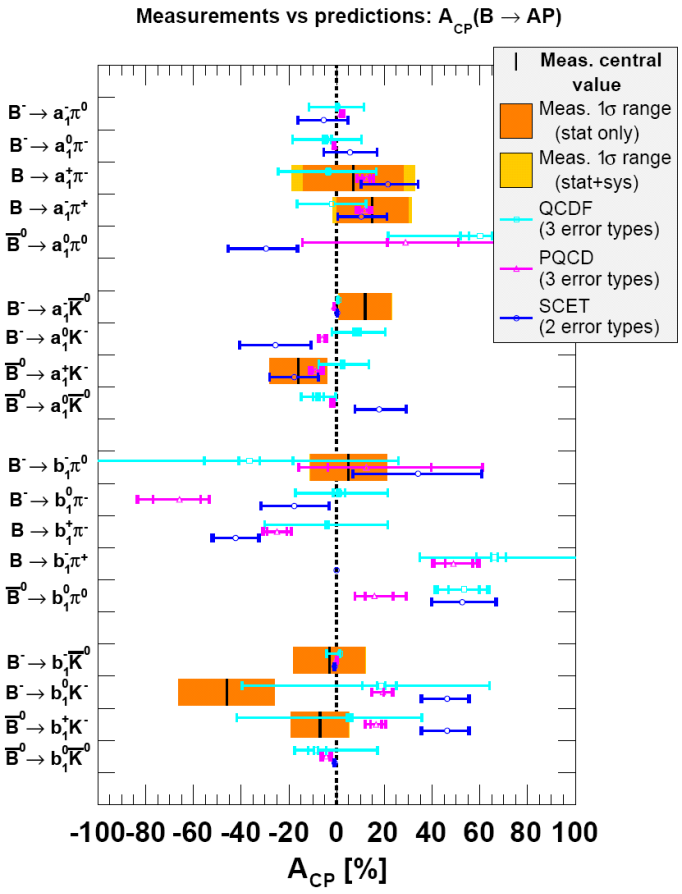


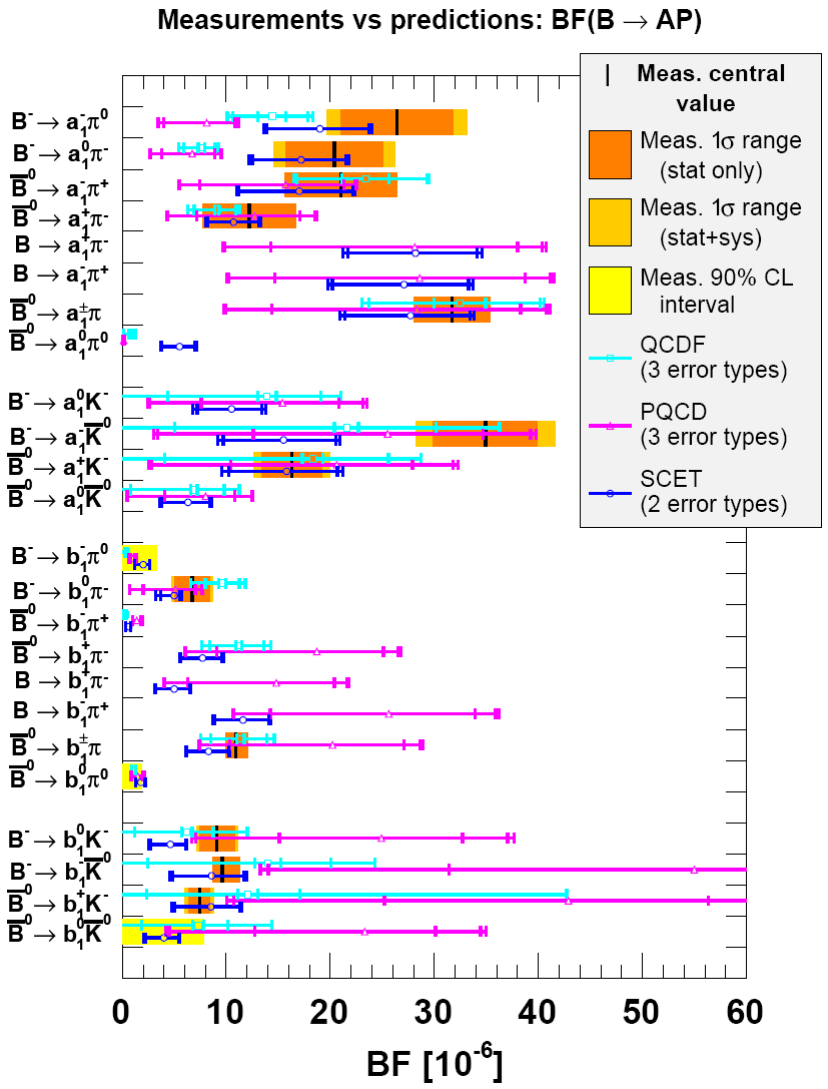
B^+ -> $b_1{}^+K^0$

Mode	N (ev.)	Y_S (ev.)	Bias (ev.)	ϵ (%)	$\mathcal{S}$ (σ)	$\mathcal{B}$ (10^{-6})
$b_1^+K^0$	9841	164^{+27}_{-25}	15±7	3.4	6.3	$9.6 \pm 1.7 \pm 0.9$
$b_1^0K^0$	5420	58^{+19}_{-17}	5±3	2.2	3.4	$5.1 \pm 1.8 \pm 0.5$ (< 7.8)
$b_1^+\pi^0$	28787	71^{+35}_{-32}	8±4	7.7	1.6	$1.8 \pm 0.9 \pm 0.2$ (< 3.3)
$b_1^0\pi^0$	10554	6^{+19}_{-16}	−2±2	4.8	0.5	$0.4 \pm 0.8 \pm 0.2$ (< 1.9)

B -> AP: measurements vs. predictions

- Wang, Li, Lu, arXiv:0806.2510 [hep-ph]
  - Several discrepancies can be seen.





B -> AP: measurements vs. predictions

- Wang, Li, Lu, arXiv:0806.2510 [hep-ph]
  - Several discrepancies can be seen.
  - Particularly interesting measures are

    $R_1 = BF(B^- \to a_1^- \overline{K}^0) / BF(\overline{B}^0 \to a_1^+ K^-) \times \tau_0/\tau_-$

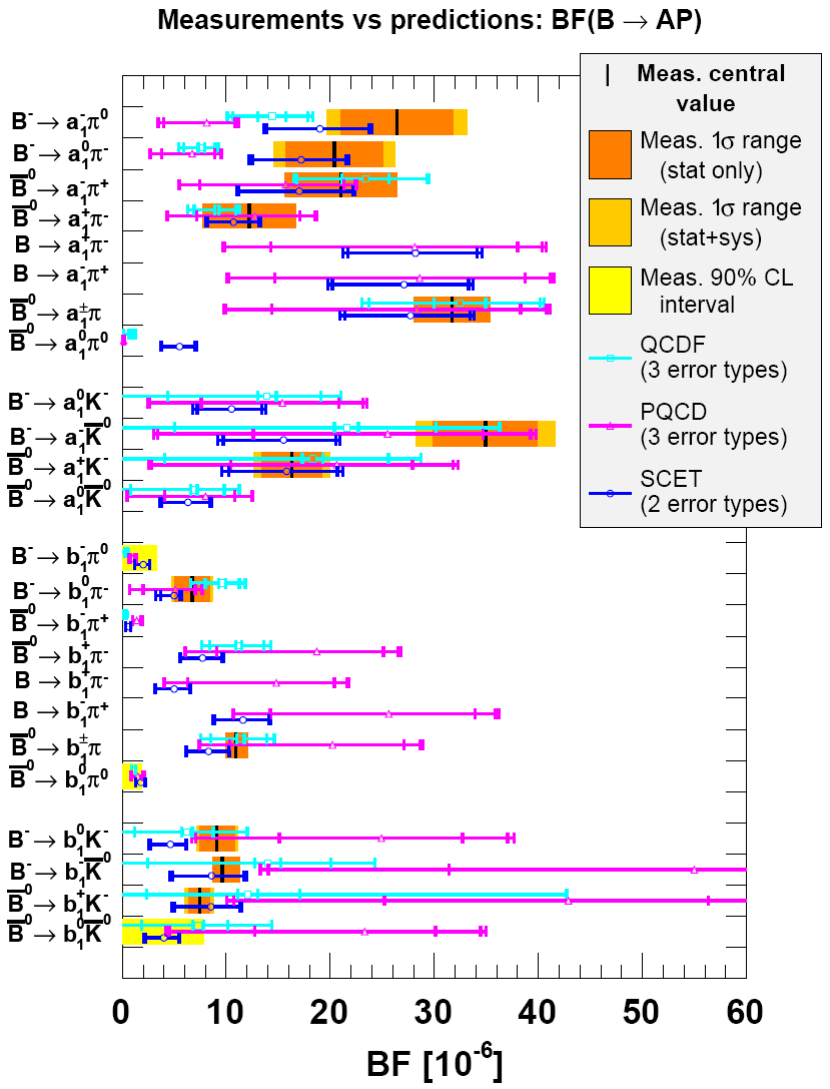
    $= 1.00$ (QCDF), 1.16 (PQCD), 0.91 (SCET)

    $= 2.00 \pm 0.59$ (Meas.)

    $R_2 = BF(B^- \to b_1^0 K^-) / BF(\overline{B}^0 \to b_1^+ K^-) \times \tau_0/\tau_-$

    $= 0.50$ (QCDF), 0.54 (PQCD), 0.50 (SCET)

    $= 1.15 \pm 0.34$ (Meas.)
- Very interesting to see improved or new measurements.



Summary

- Dalitz plot analyses of B -> $K^+\pi^-\pi^+$ and $K^+\pi^-\pi^0$ are updated.
  - Evidence of $A_{CP}(\rho^0 K^+)$
  - Observation of B^0 -> $K^{*0}(892)\pi^0$
  - Amplitudes of $K^*\pi$ and the constraint on CKM parameters.
- Quite a few updates on B -> PP and PV with isoscalar mesons and new measurements on B -> $b_1\pi^0$ and $b_1 K^0$.
  - Observations of B^+ -> $\eta\rho^+$ and $b_1{}^+K^0$
  - 3σ level evidences for B^0 -> $\eta^{(\prime)}\omega$, $\eta^{\prime}\pi^0$ and $b_1{}^0K^0$
  - Improved measurements would help to resolve puzzles
- Charmless hadronic B decays provide rich field to test SM and to probe NP.