Direct CPV

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Kπ puzzle

Window to New Physics beyond the SM

Puzzles that may lead directly to NP

- The $K-\pi$ puzzle: is it just matrix elements calculation ?
- Anomalous like-sign-dimuon asymmetry
- $B \to \tau\nu_\tau$: loss of universality ?
- Lifetime difference and CP phase in B_s decay

Questions that may not have quick answers

- Why three generations ? *(Only three, are we sure ?)*
- Why the extreme hierarchy of masses ?
- What is the source of CP violation ?
- What about baryon asymmetry ?

Old puzzle

- Before 2004, the K π puzzle was said to be in the ratios of averaged decay rates:

Year	$R_c \equiv \frac{2\overline{\Gamma}^{0+}}{\overline{\Gamma}^{+0}}$	$R_n \equiv \frac{\overline{\Gamma}^{-+}}{2\overline{\Gamma}^{00}}$	Difference
	$\left\|\frac{P'+T'+C'+P'_{EW}}{P'}\right\|^2$	$\left\|\frac{P'+T'}{P'-C'-P'_{EW}}\right\|^2$	$\mathcal{O}(\left[\frac{C'+P'_{EW}}{P'}\right]^2)$
pre-2004	1.15 ± 0.12	0.78 ± 0.10	2.4σ
2004 ICHEP	1.00 ± 0.09	0.79 ± 0.08	1.9σ
2005 LepPho	1.10 ± 0.09	0.82 ± 0.07	1.6σ
2008 ICHEP	1.12 ± 0.07	0.99 ± 0.07	1.3σ

- It is by now clear that this puzzle is disappearing and the remaining small difference can be explained by the contributions of C′ and P'_{EW} amplitudes

Measuring direct CPV with B→Kπ

$$\mathcal{A}_t = |A_t|\, e^{i\phi_t}\, e^{i\delta_t}$$
$$\mathcal{A}_p = |A_p|\, e^{i\phi_p}\, e^{i\delta_p}$$

$$\Gamma(B \to f) = |\mathcal{A}_t + \mathcal{A}_p|^2$$
$$= |A_t|^2 + |A_p|^2 + 4|A_t||A_p| \cos(\Delta\phi + \Delta\delta),$$

$$\begin{pmatrix} \Delta\phi = \phi_t - \phi_p \\ \Delta\delta = \delta_t - \delta_p \end{pmatrix}$$

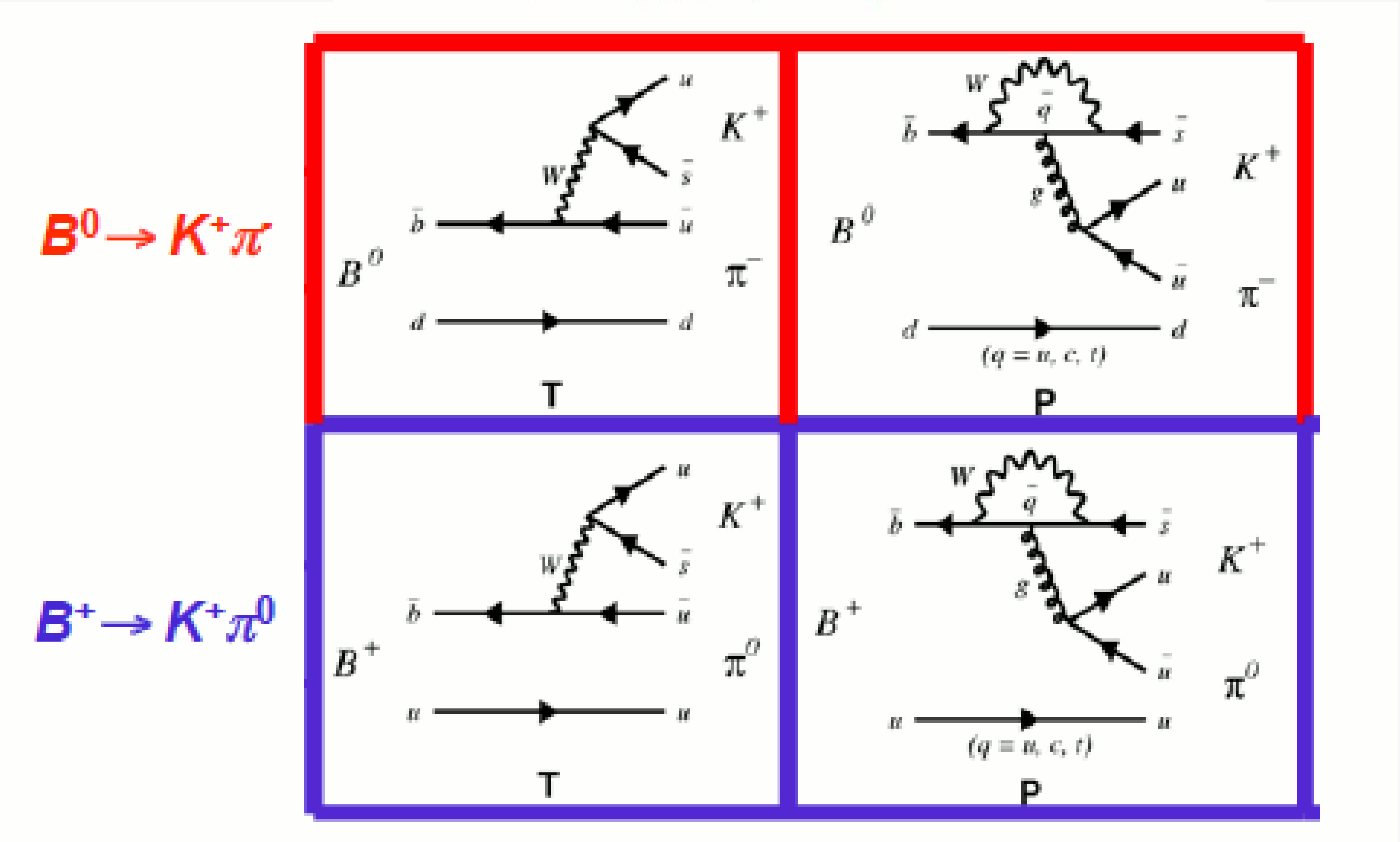
$$\bar{\mathcal{A}}_t = |A_t|\, e^{-i\phi_t}\, e^{i\delta_t}$$
$$\bar{\mathcal{A}}_p = |A_p|\, e^{-i\phi_p}\, e^{i\delta_p}$$

$$\Gamma(\bar{B} \to \bar{f}) = \left|\bar{\mathcal{A}}_t + \bar{\mathcal{A}}_p\right|^2$$
$$= |A_t|^2 + |A_p|^2 + 4|A_t||A_p| \cos(-\Delta\phi + \Delta\delta),$$

$$\Rightarrow \quad A_{CP} \equiv \frac{\Gamma(\bar{B} \to \bar{f}) - \Gamma(B \to f)}{\Gamma(\bar{B} \to \bar{f}) + \Gamma(B \to f)} \propto \sin\Delta\phi \,\sin\Delta\delta$$

Measuring direct CPV with B→Kπ

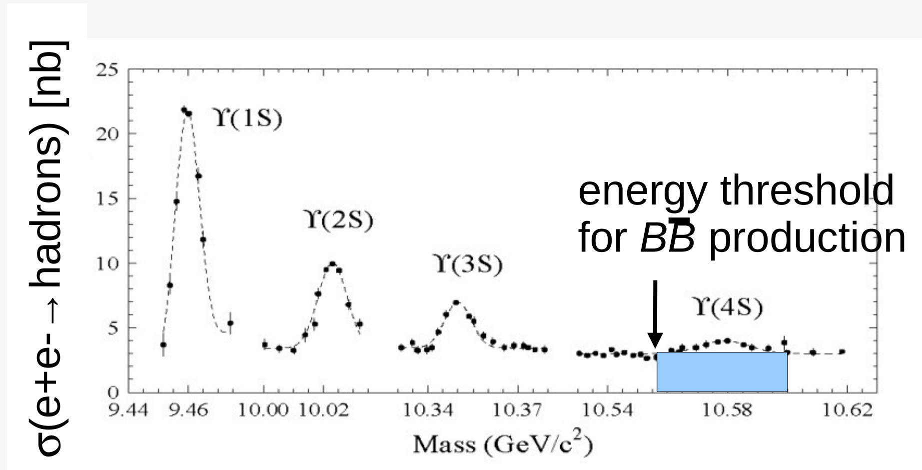
$$A_{CP} \equiv \frac{\Gamma(\bar{B} \to \bar{f}) - \Gamma(B \to f)}{\Gamma(\bar{B} \to \bar{f}) + \Gamma(B \to f)} \propto \sin\Delta\phi \, \sin\Delta\delta$$



Diagrams identical except for spectator quark ?

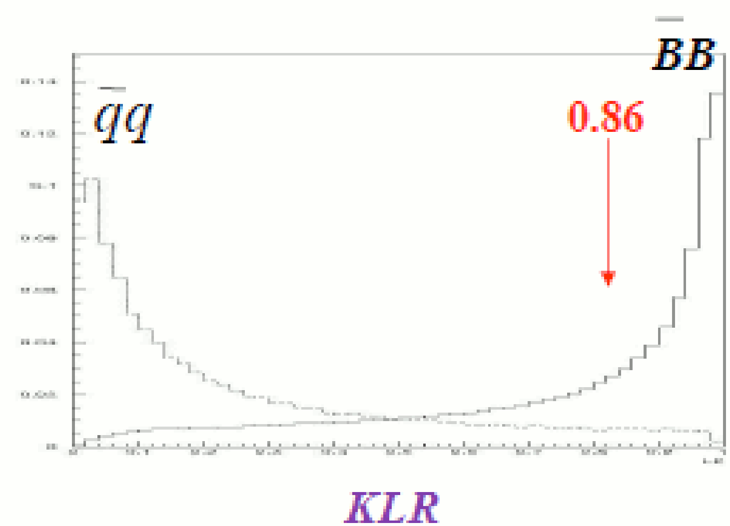
⇒ strong and weak phases are the same, A_{CP} should be the same ?

B→Kπ measurements at B-factories…



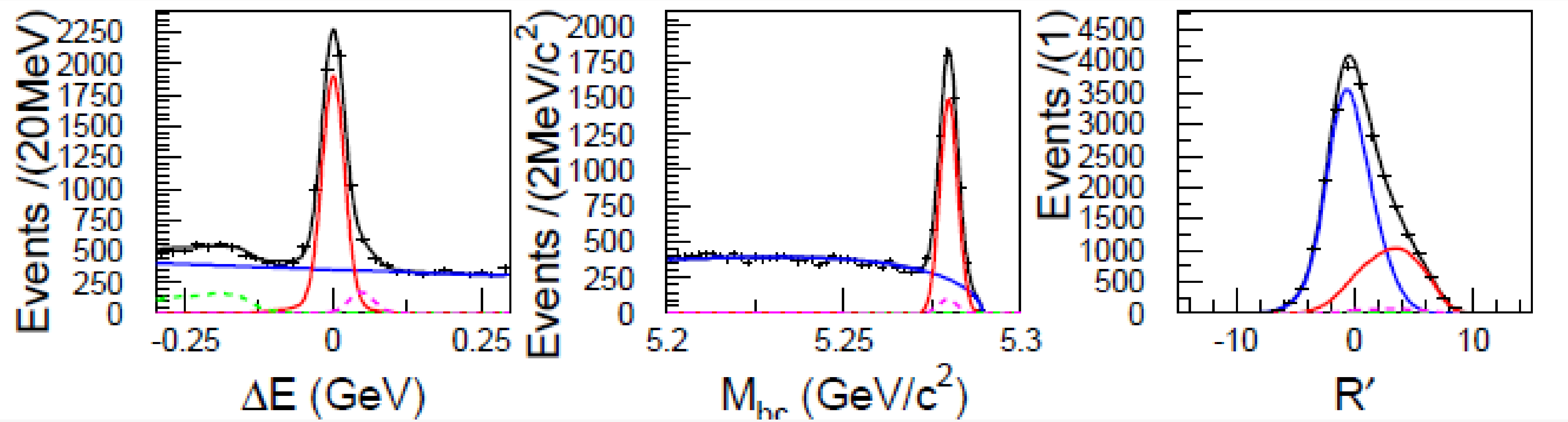
Continuum suppression:

$$KLR = \mathcal{L}_{BB}/(\mathcal{L}_{BB}+\mathcal{L}_{qq})$$

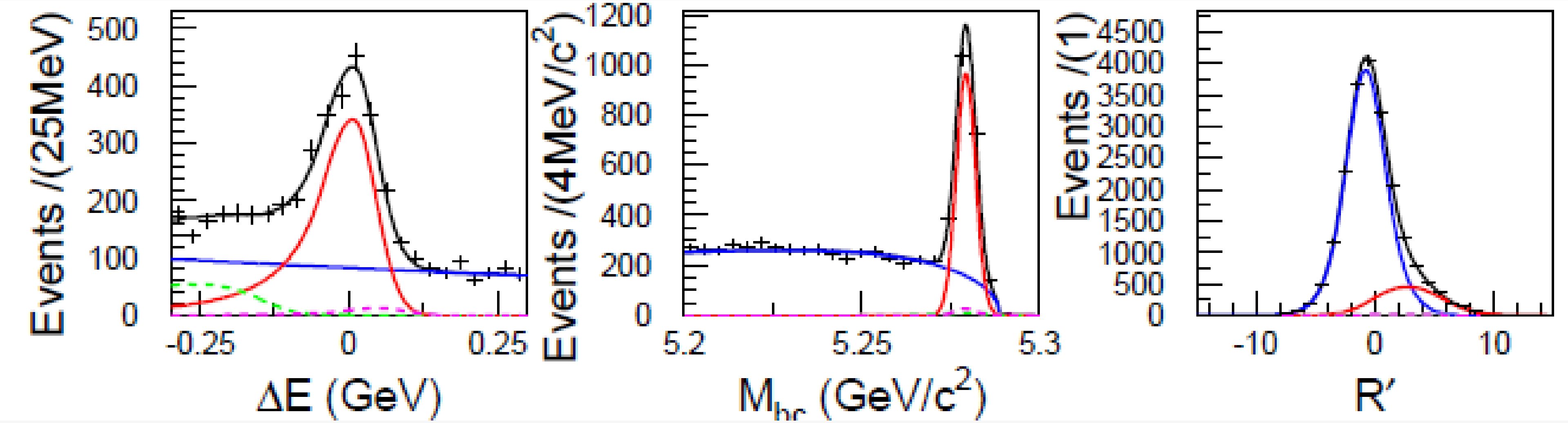


B→Kπ measurements at B-factories...

$K^{\pm}\pi^{\mp}$

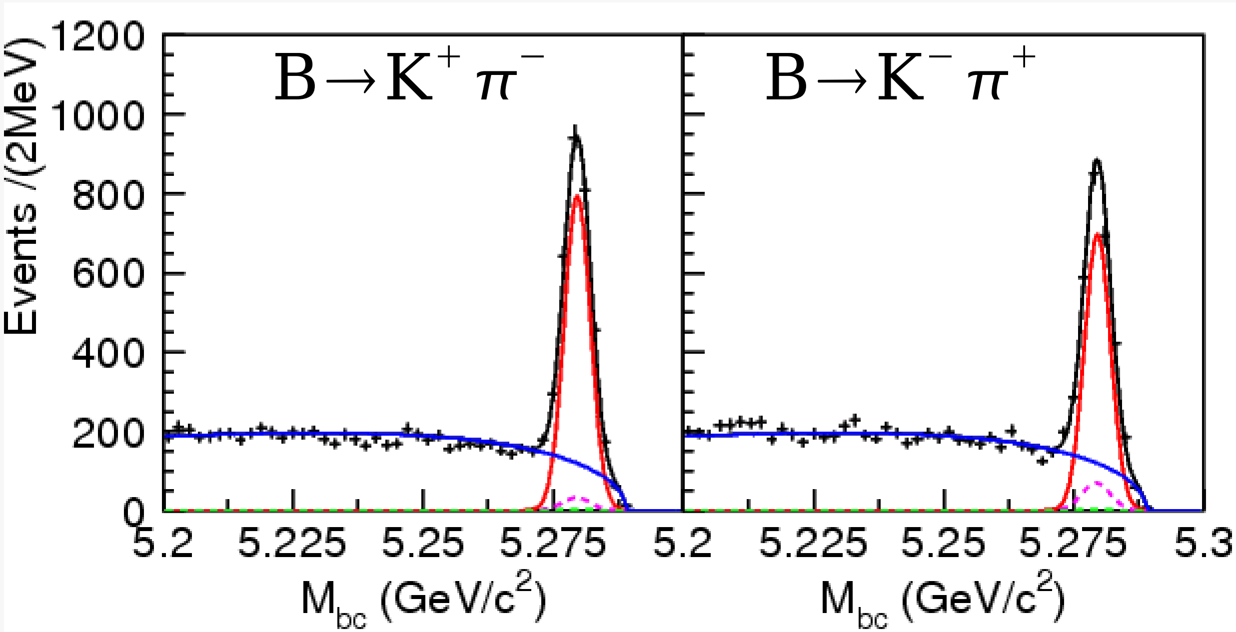


$K^{\pm}\pi^{0}$



$K\pi$ puzzle

$$\Delta A_{K\pi} = A_{CP}(K\pi^0) - A_{CP}(K\pi)$$

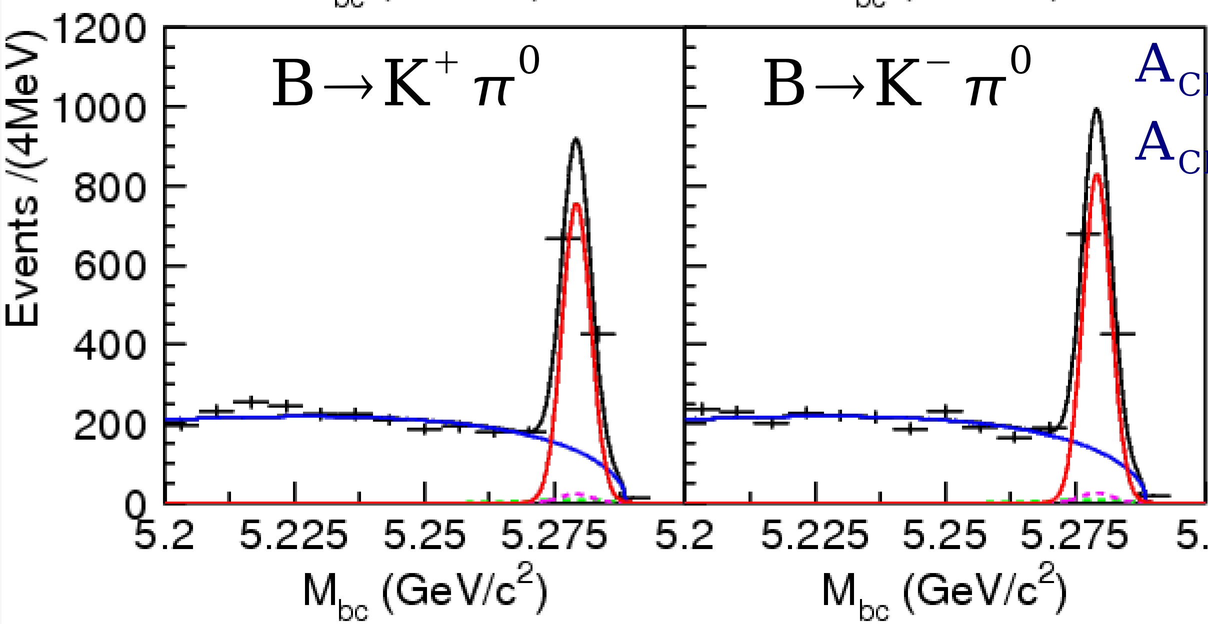


Belle Nature paper:

$\Delta A_{K\pi} = +0.164 \pm 0.037$ @ 4.4σ

Belle preliminary:

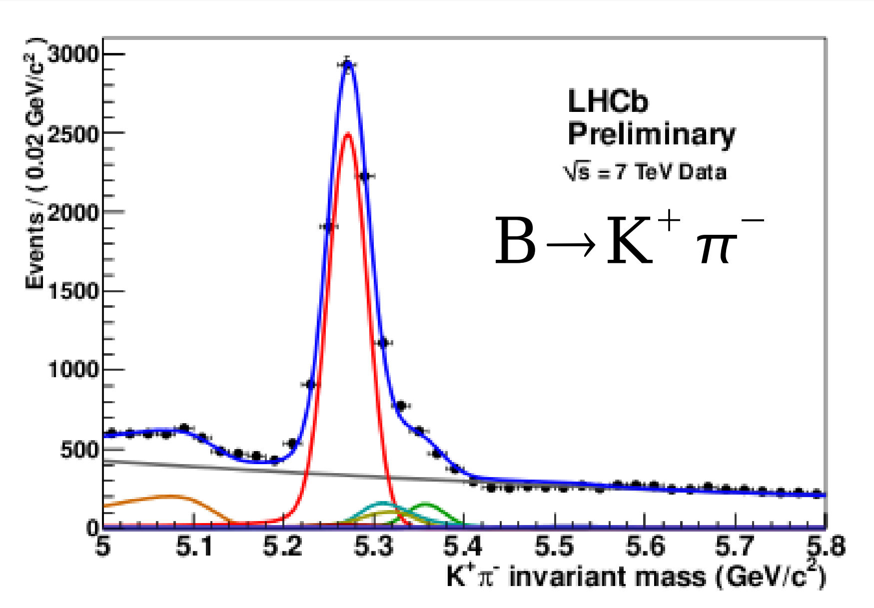
$\Delta A_{K\pi} = +0.112 \pm 0.028$ @ 4.0σ

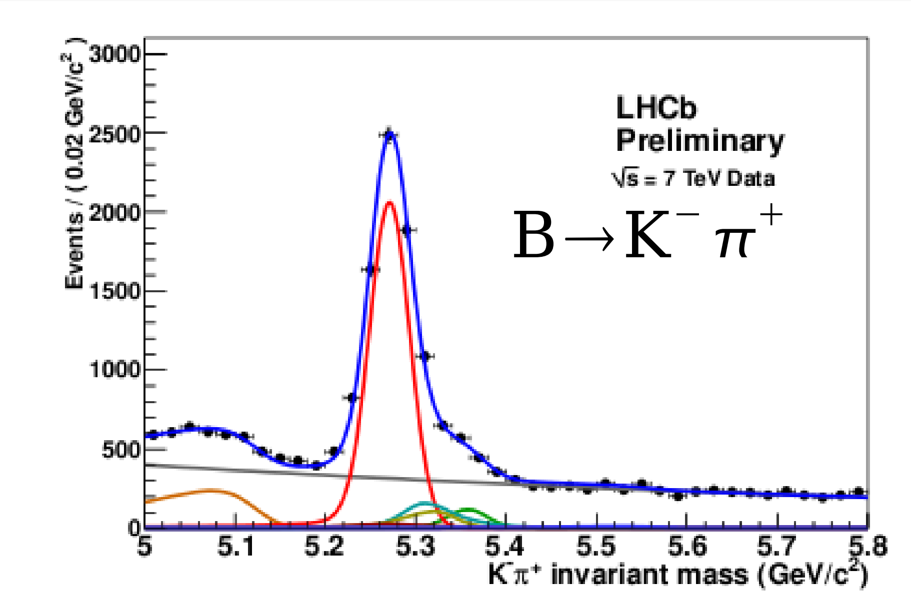


$A_{CP}(K^\pm\pi^0) = +0.043 \pm 0.024 \pm 0.002$

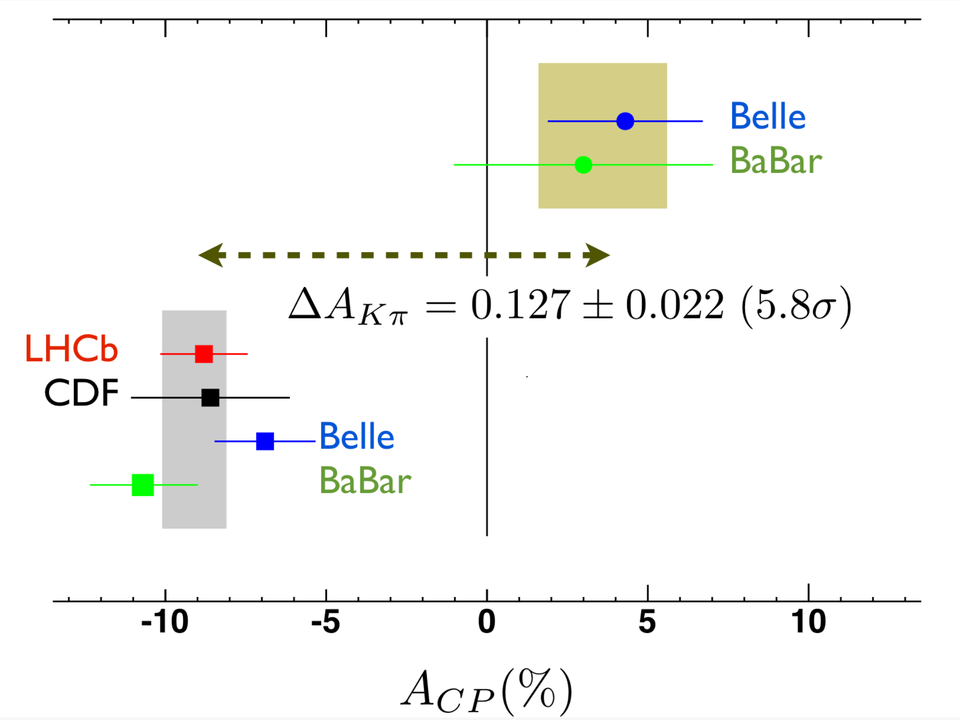
$A_{CP}(K^\pm\pi^\mp) = -0.069 \pm 0.014 \pm 0.007$

$K\pi$ puzzle [LHCb-CONF-2011-042]





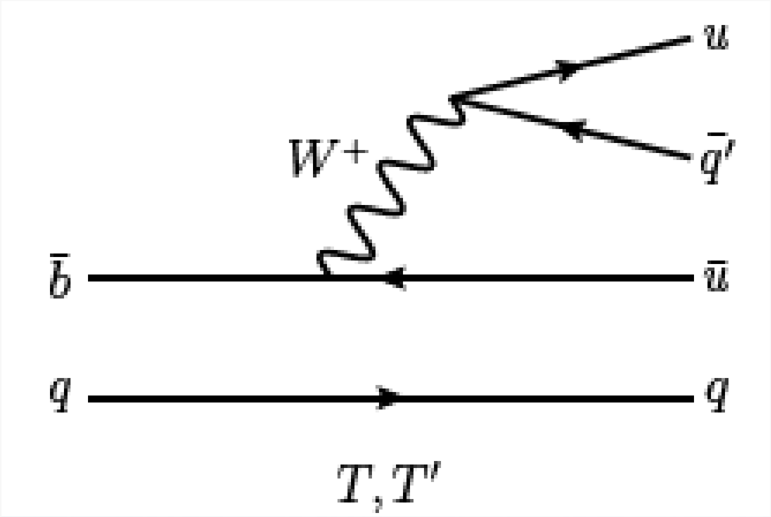
$$A_{CP}(K^{\pm}\pi^{\mp}) = -0.088 \pm 0.011 \pm 0.008$$

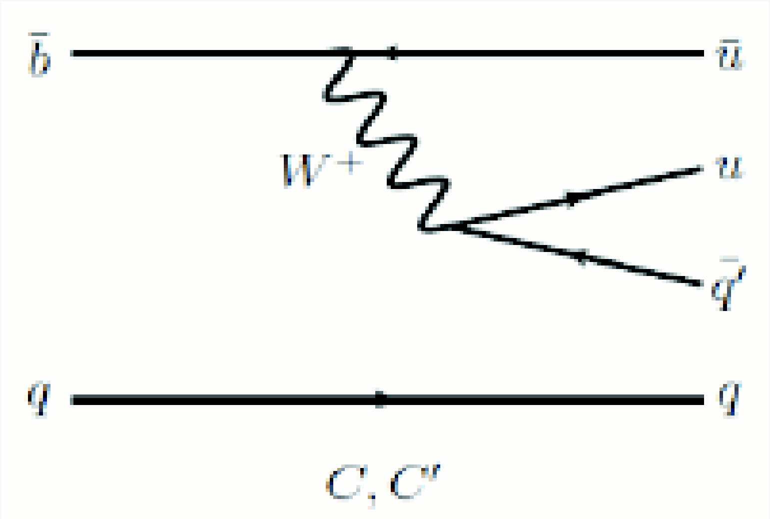


$\Delta A_{K\pi} = +0.121 \pm 0.022$ @ 5.5σ

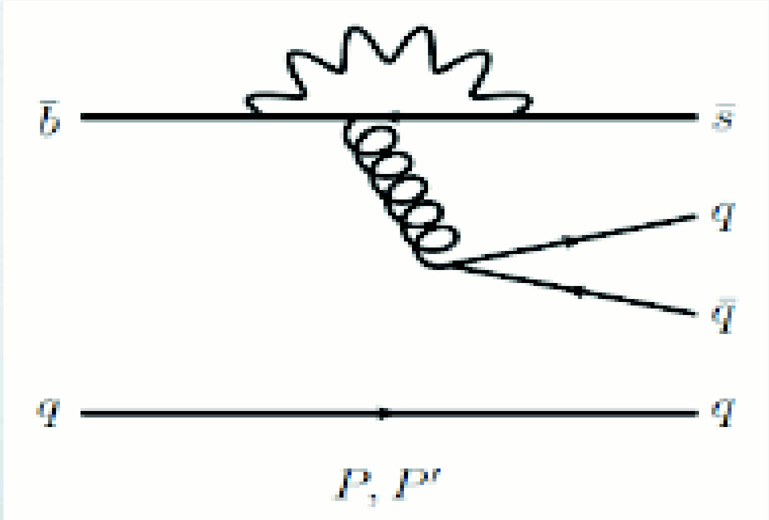
$\Rightarrow$ NEW PHYSICS !!?

Contributing diagrams

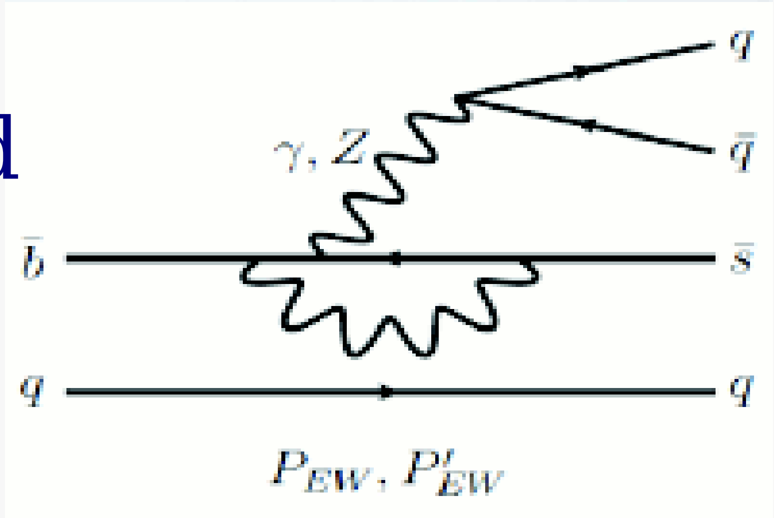




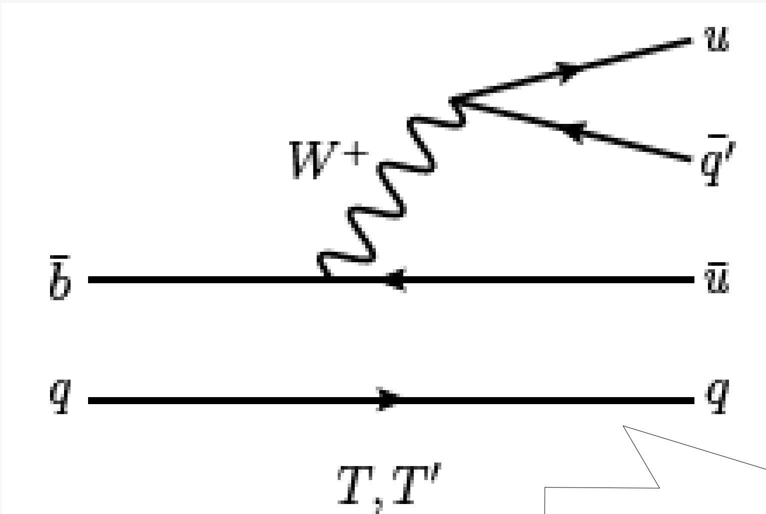
Tree

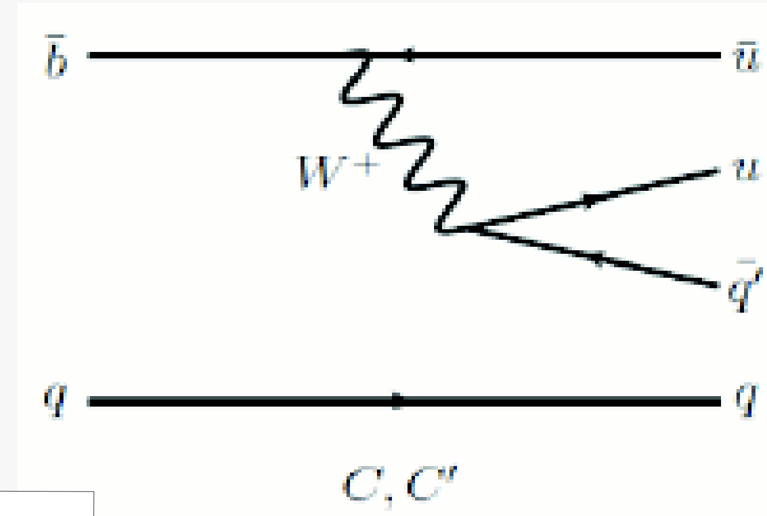


Loop mediated



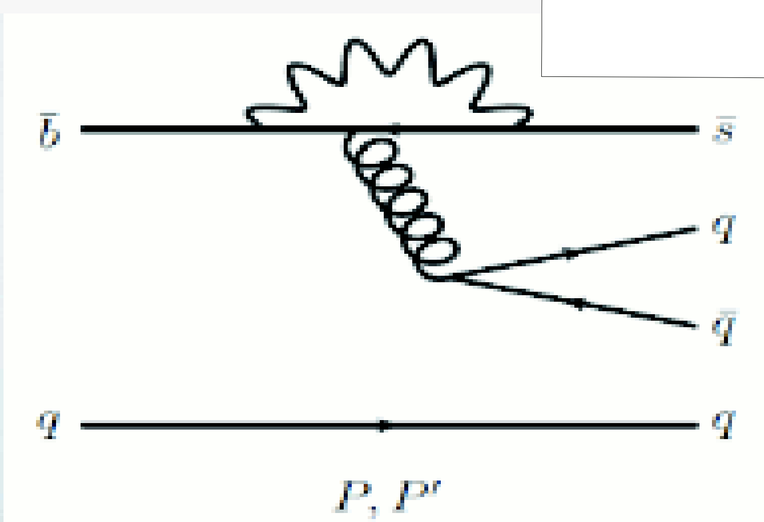
Contributing diagrams



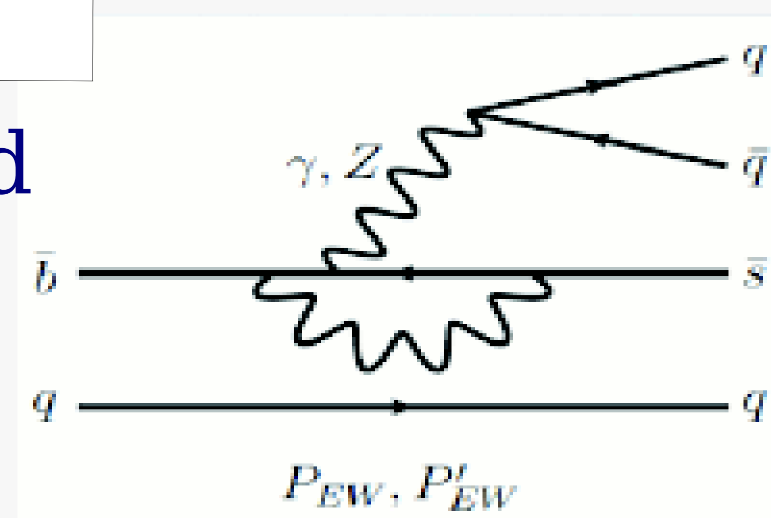


Tree

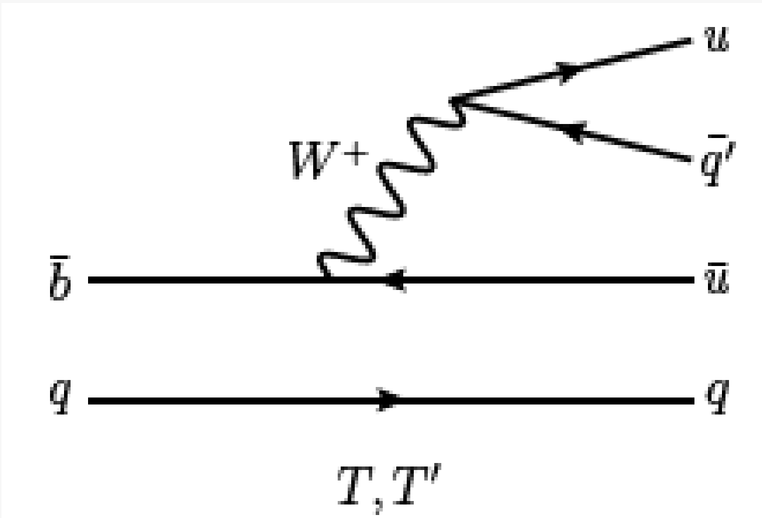
Color-allowed tree diagram
(external W emission)
$\sim A\lambda^4 e^{i\gamma}$



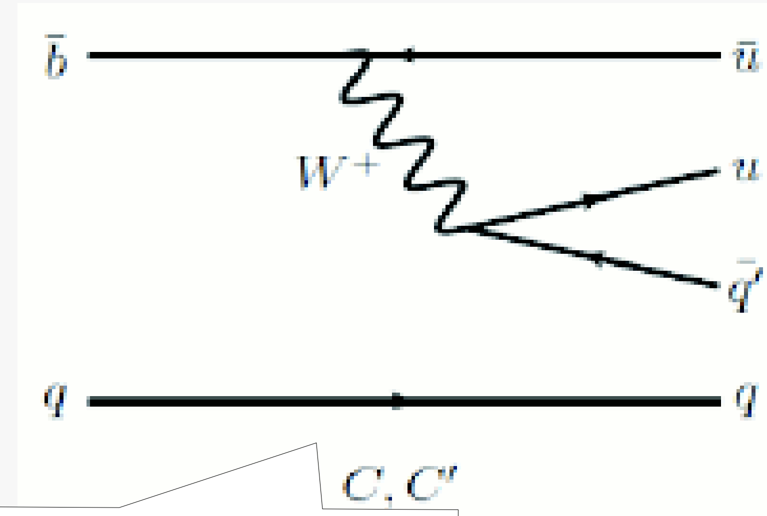
Loop
mediated



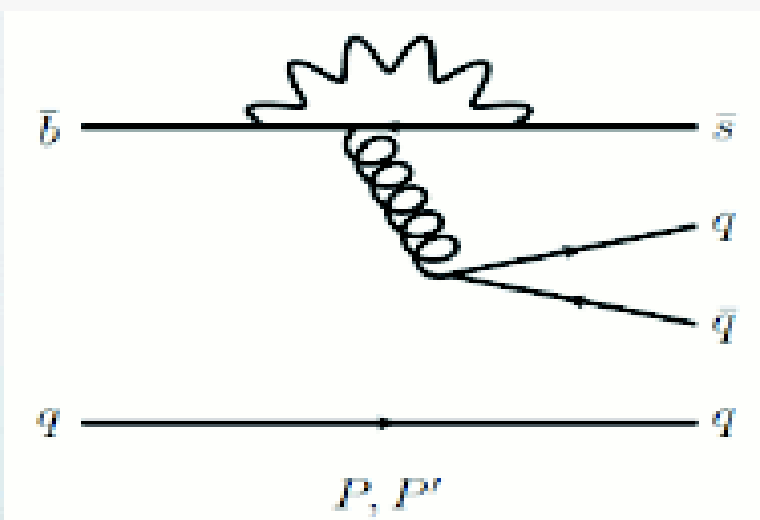
Contributing diagrams



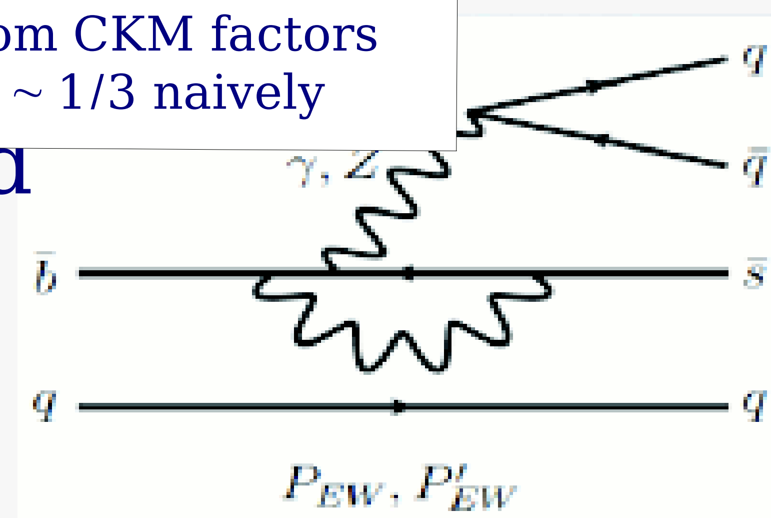
Tree



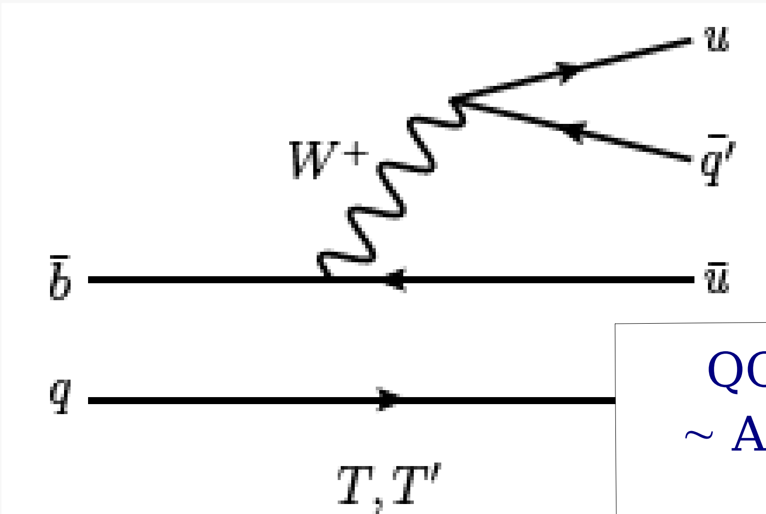
Color-suppressed tree diagram
(internal W emission)
$\sim A\lambda^4 e^{i\gamma}$ from CKM factors
from T by ~ 1/3 naively



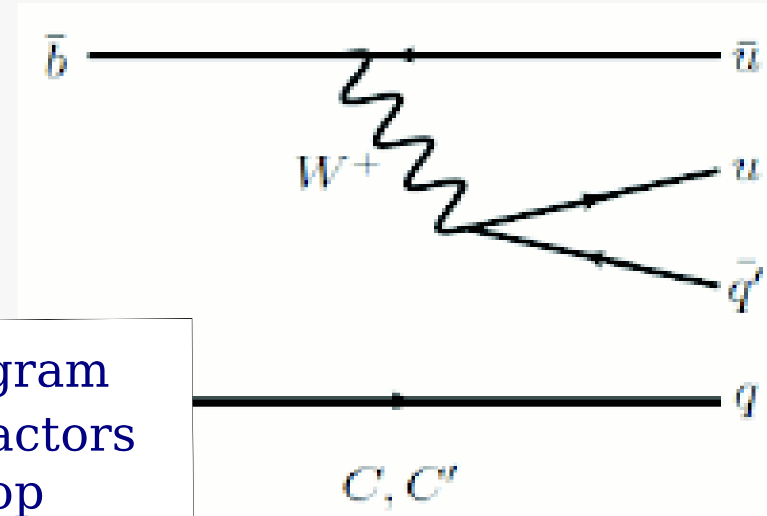
mediated



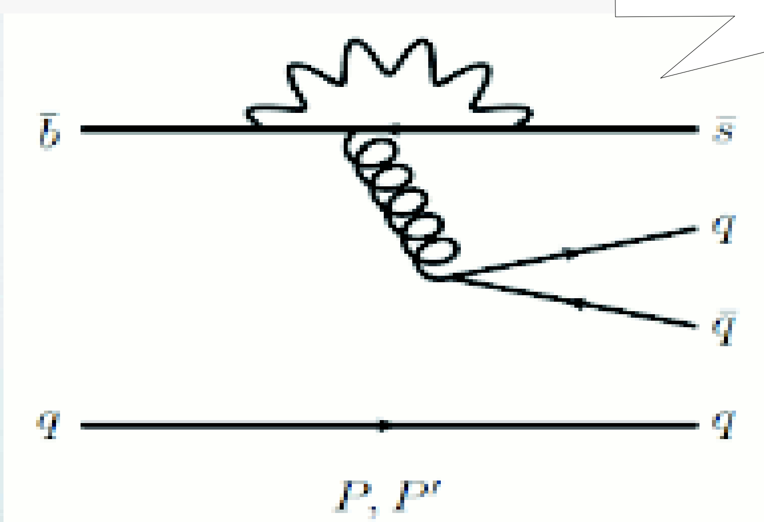
Contributing diagrams



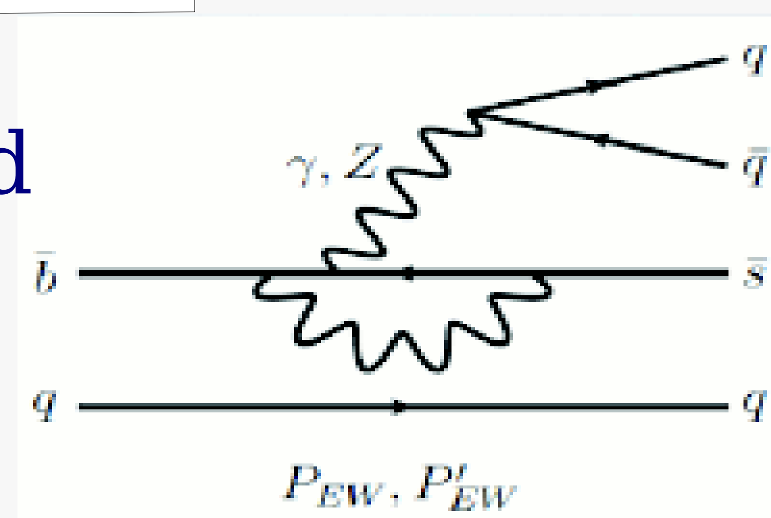
Tree



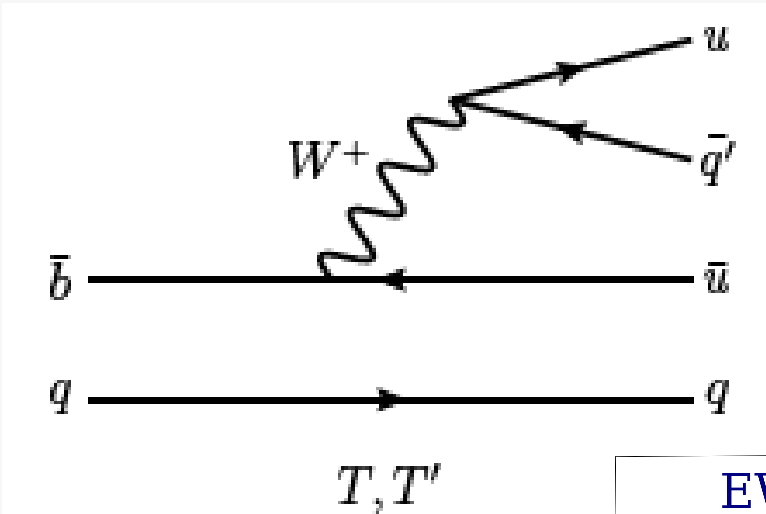
QCD-penguin diagram
~ A λ^2 from CKM factors
u, c, t in the loop
down by one loop
dominant in K π decays



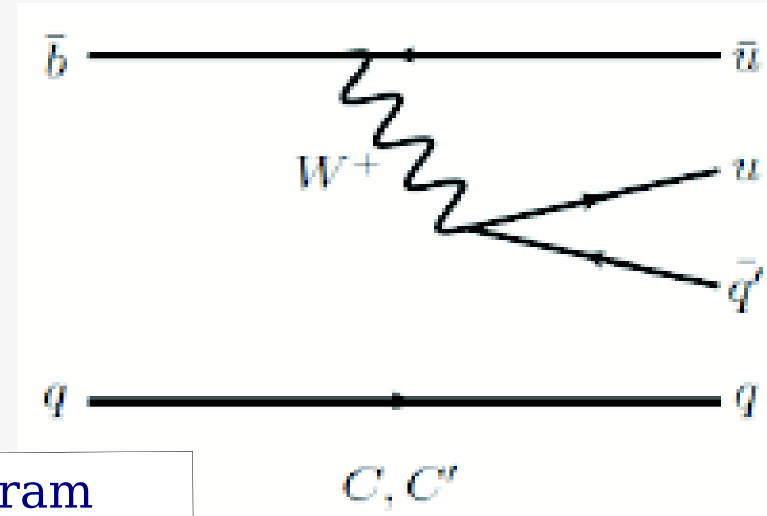
Loop mediated



Contributing diagrams

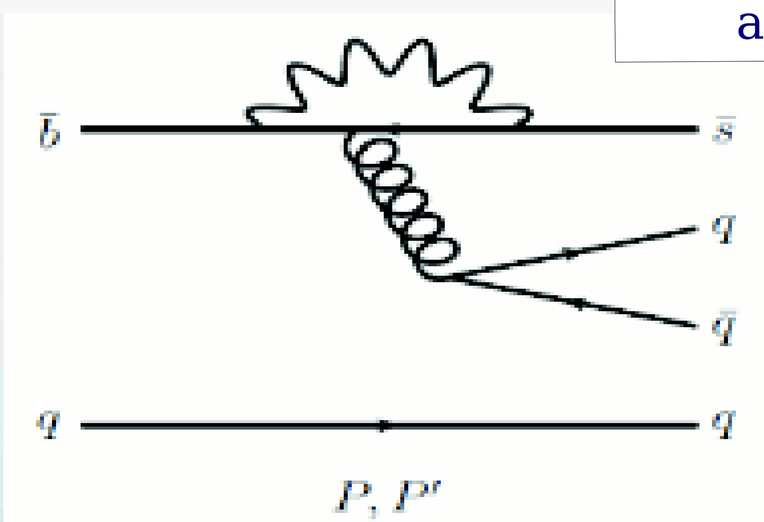


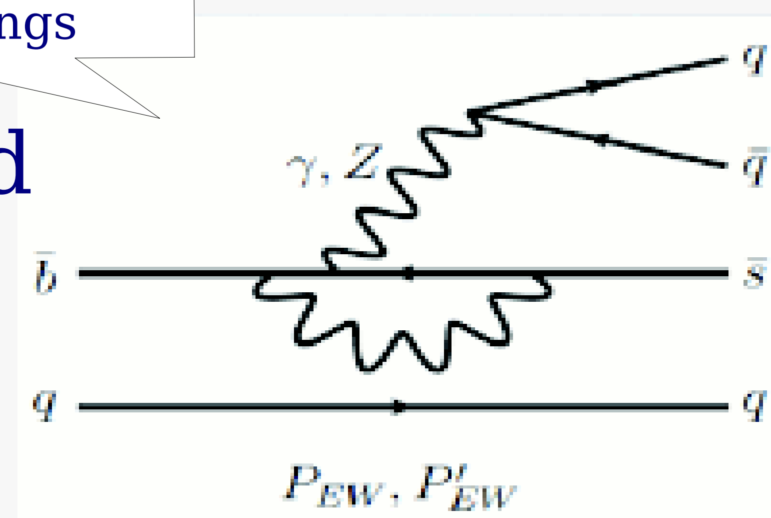
Tree



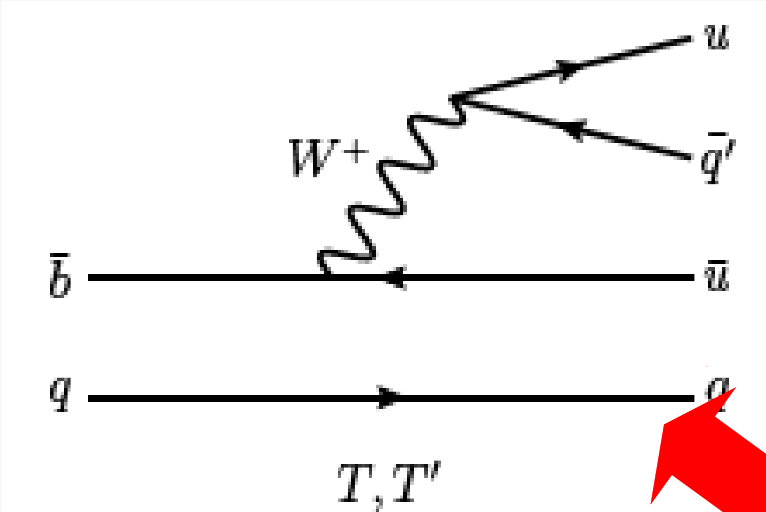
EW-penguin diagram
~ $A\lambda^2$ from CKM factors
down by one loop
and weak couplings

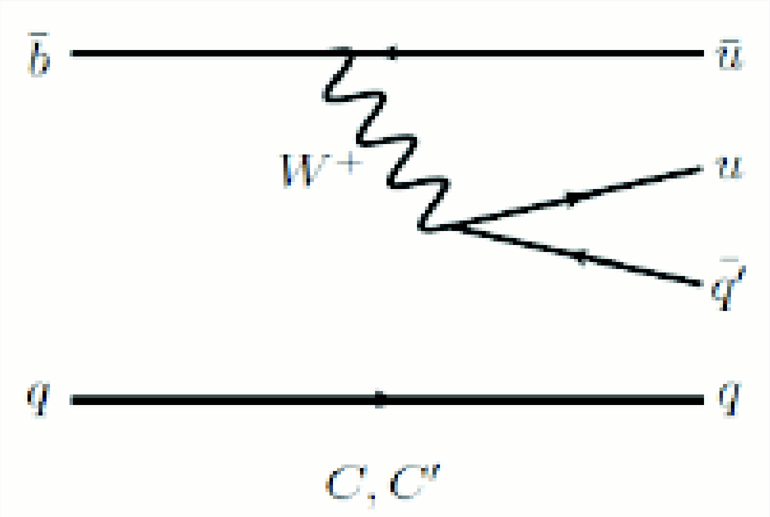
Loop mediated





Contributing diagrams

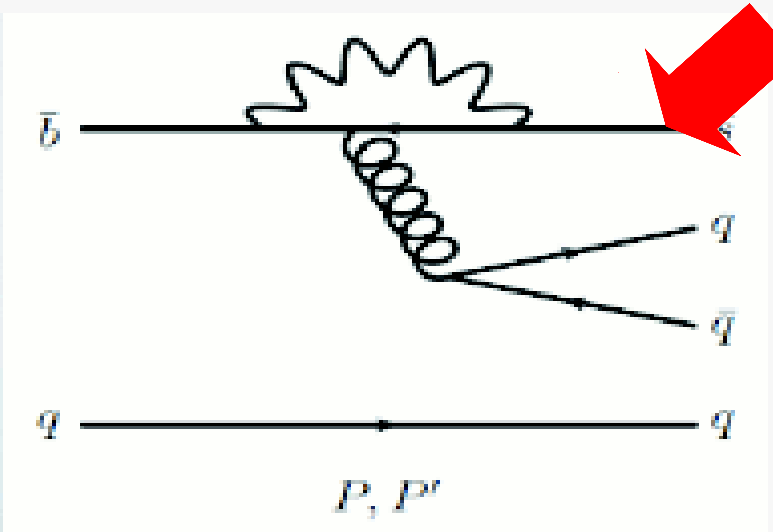


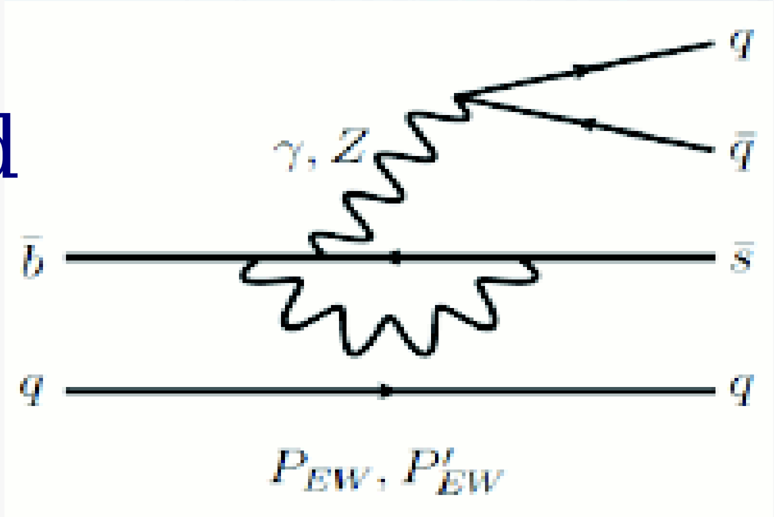


Tree

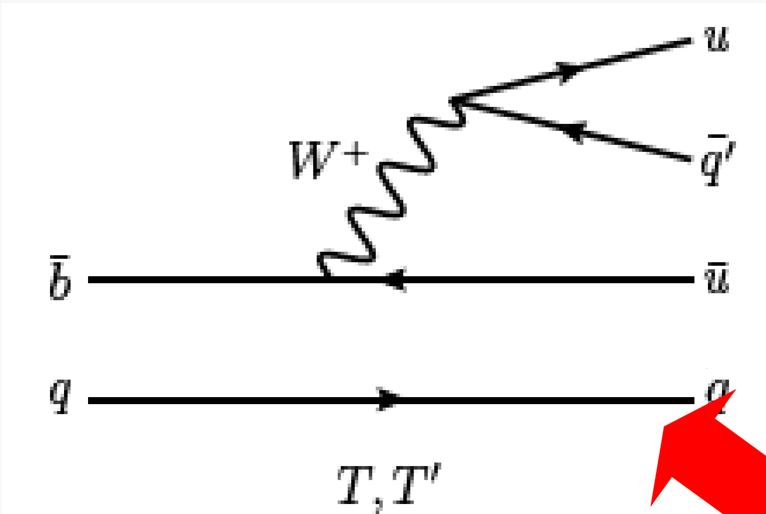
$B^0 \rightarrow \pi^- K^+$ (-+)

Loop mediated

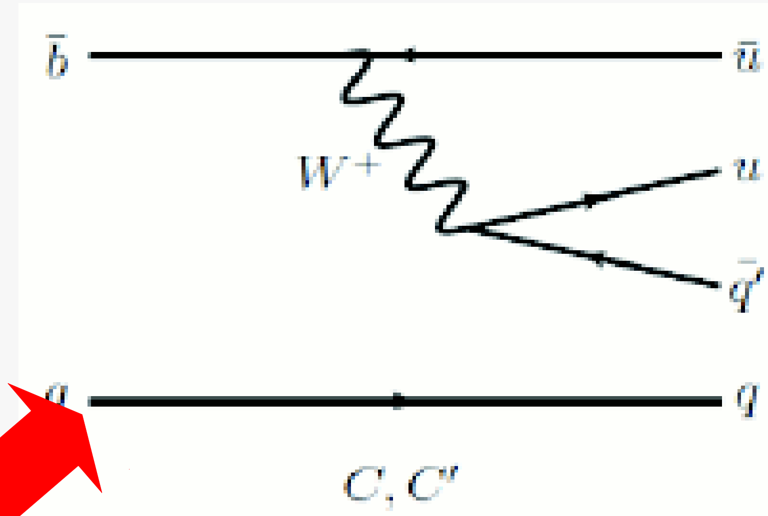




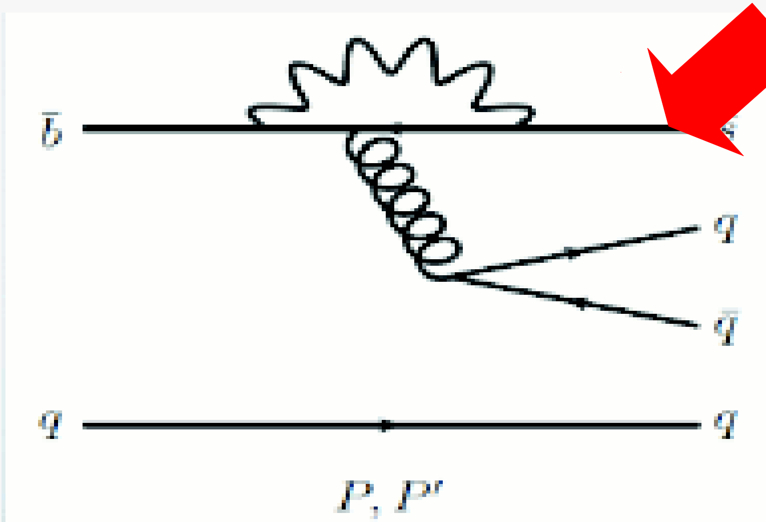
Contributing diagrams



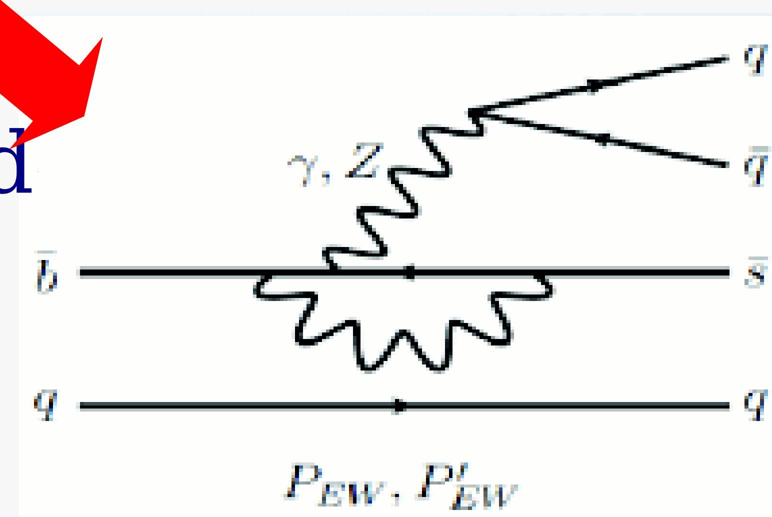
Tree



$B^+ \to \pi^0 K^+$ (0+)



Loop mediated



Perturbative predictions

Cheng-Wei Chiang
(BAS 2011.2)

Group	A_{CP}^{0+}	A_{CP}^{-+}	
2008 ICHEP	0.050 ± 0.025	-0.098 ± 0.012	
QCDF [S4]	-0.036	-0.041	Beneke, Neubert 2003
pQCD	$-0.01^{+0.03}_{-0.05}$	$-0.09^{+0.06}_{-0.08}$	Li, Mishima, Sanda 2005
SCET	-0.11 ± 0.14	-0.06 ± 0.08	Williamson, Zupan 2006

- All above predictions roughly agree with observed A_{CP}^{-+}. But all of them have the wrong sign for A_{CP}^{0+}!
- Take QCDF for example, though the inclusion of penguin annihilation amps brings up the $K\pi$ rates and get the signs of $A_{CP}(\pi^- K^+, \pi^- K^{*+}, \rho^0 K^+, \pi^+\pi^-)$ correct, they mess up with the signs of $A_{CP}(\pi^0 K^+, \eta K^+, \eta K^{*0}, \pi^0\pi^0)$. Subleading $1/m_b$ corrections to C are required. Cheng, Chua 2009

[but probably not such bad disagreement, look errors...]

Possible explanations

Cheng-Wei Chiang
(BAS 2011.2)

- Within SM: large color-suppressed amplitude (C') with a sizeable strong phase relative to T' [feasible perturbatively from NLO vertex corrections and k_T factorization breakdown].

  CC, Gronau, Rosner, Suprun 2004;
  Li, Mishima, Sanda 2005, 2009;
  CC, Zhou 2006

- Beyond SM: additional EW-penguin type of amplitude from new physics [feasible in, e.g., SUSY, FCNC Z' models, 4G, etc].

  Yoshikawa 2004; Buras et al 2004;
  Barger, CC, Langacker, Lee 2004;
  Baek et al 2005; Hou et al 2005

Conclusions from …

Cheng-Wei Chiang
(BAS 2011.2)

- The very original K π puzzle with the ratios of rates has disappeared.
- The K π puzzle with the CPA's is not seen to be a serious problem as fits within and beyond SM give similar quality.
- New physics is not strongly called for here.

The $K\pi$ puzzle

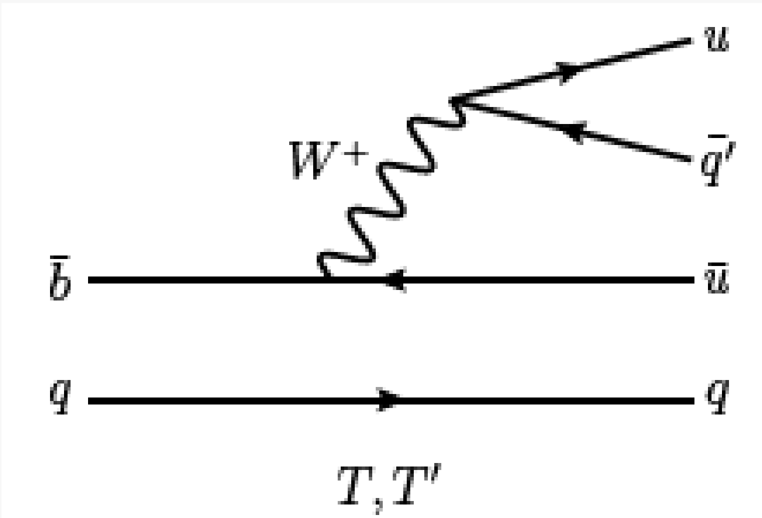
The puzzle

$$\Delta_{K\pi} = A_{CP}(B^+ \to K^+\pi^0) - A_{CP}(B^0 \to K^+\pi^-)$$
$$= 0.121 \pm 0.022 \Rightarrow 5.8\sigma \text{ from SM} (P.Chang, EPS2011)$$

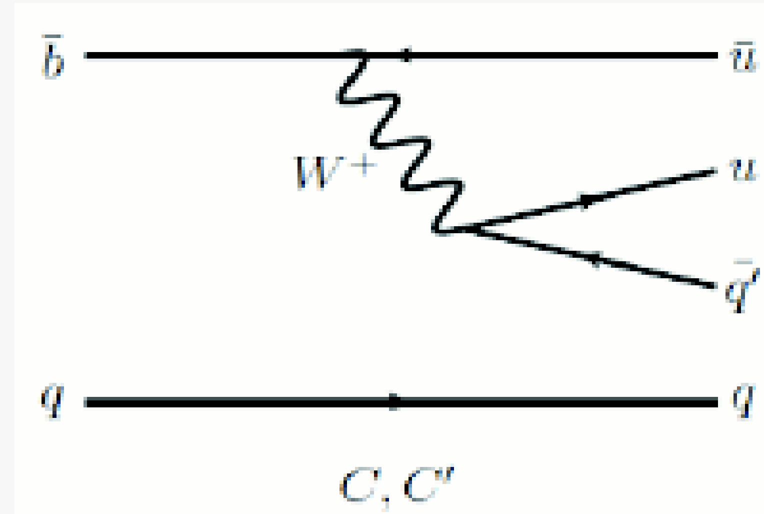
Is it just matrix element calculation ?

- C and P_{EW} corrections may be high
- QCDF: large imaginary values for C and P_{EW} amplitudes
- Evidence for large P_{EW} should have been found from $B(B^+ \to \pi K)/B(B^0 \to \pi K)$ and $B(B^+ \to \rho K)/B(B^0 \to \rho K)$; not found
- Large C $\Rightarrow$ breakdown of power-counting in SCET
  But SCET seems to hold for all other modes !
- pQCD claims that higher order corrections resolve the problem, but there is no consensus on this.

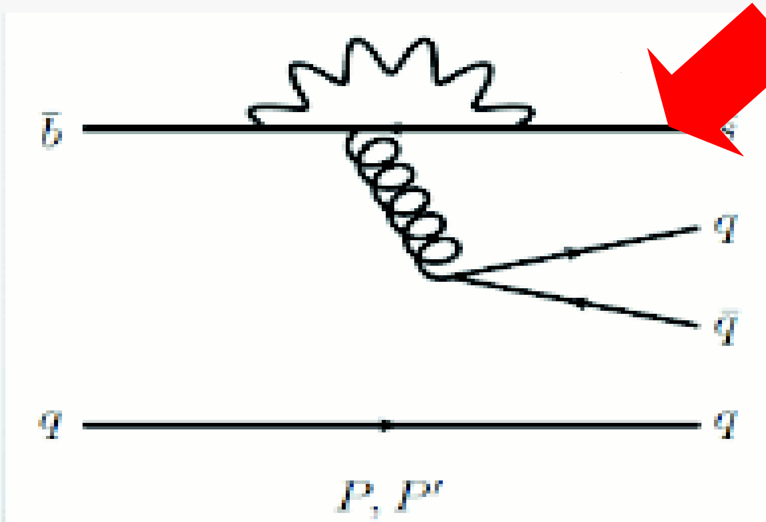
Contributing diagrams



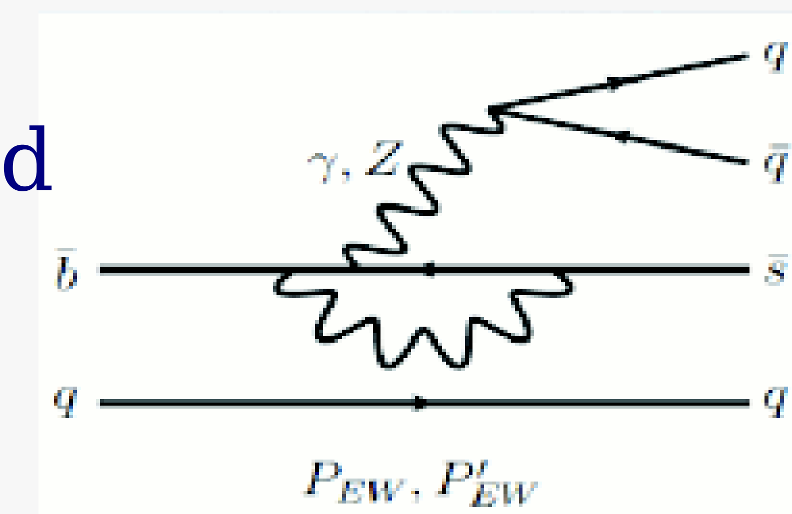
Tree



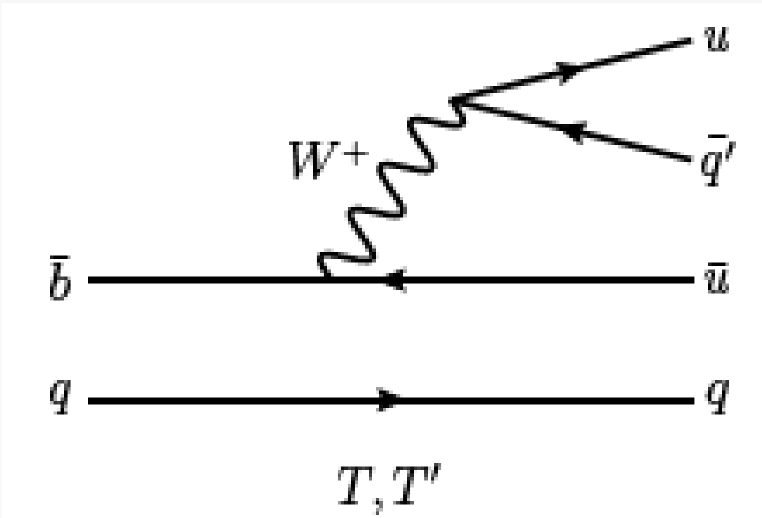
$$B^+ \rightarrow \pi^+ K^0 \; (+0)$$



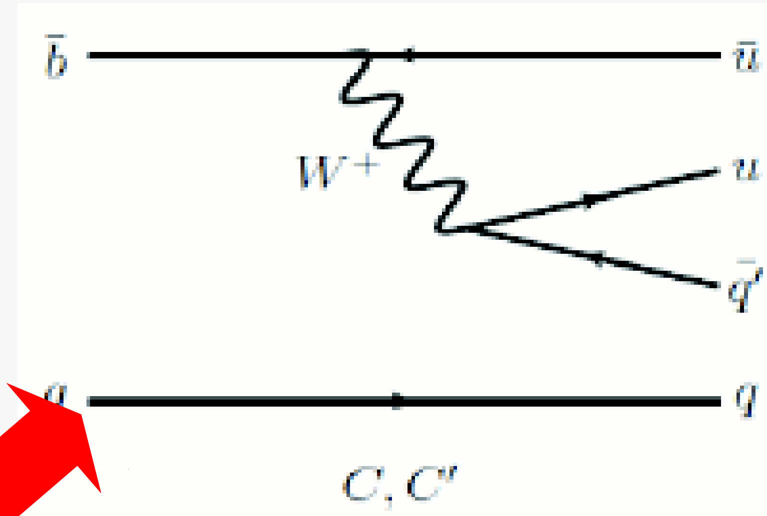
Loop mediated



Contributing diagrams

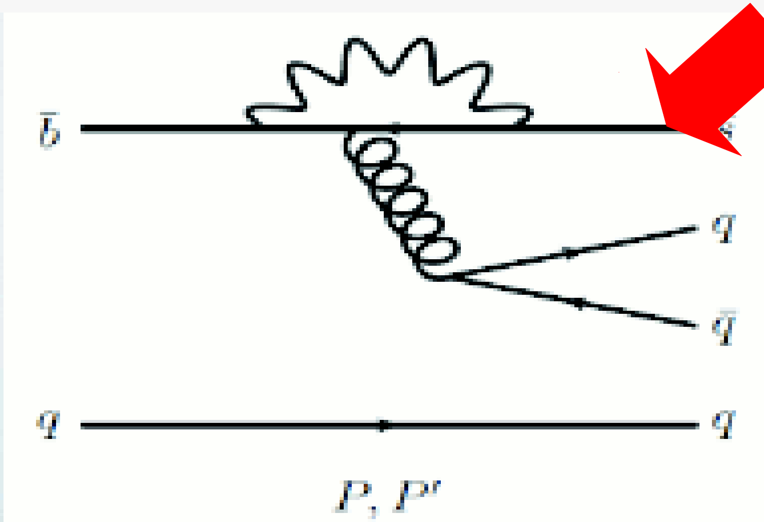


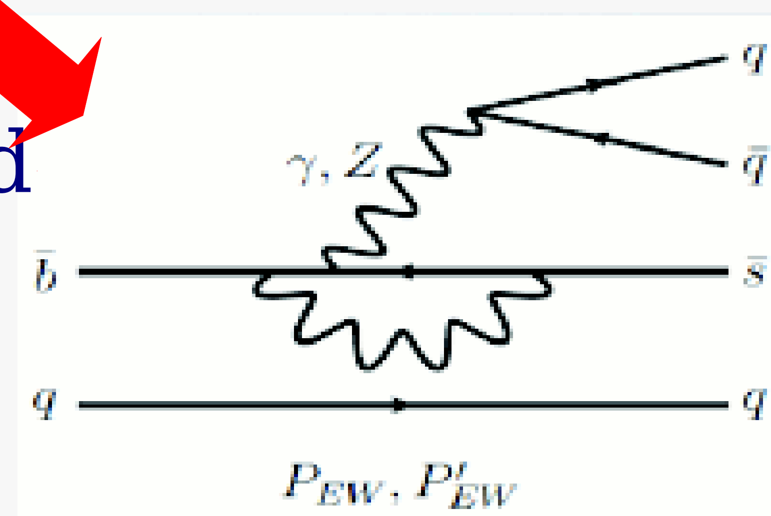
Tree



$$B^0 \rightarrow \pi^0 K^0 \ (00)$$

Loop mediated





Important component: it has the interesting diagrams C and P_{EW}

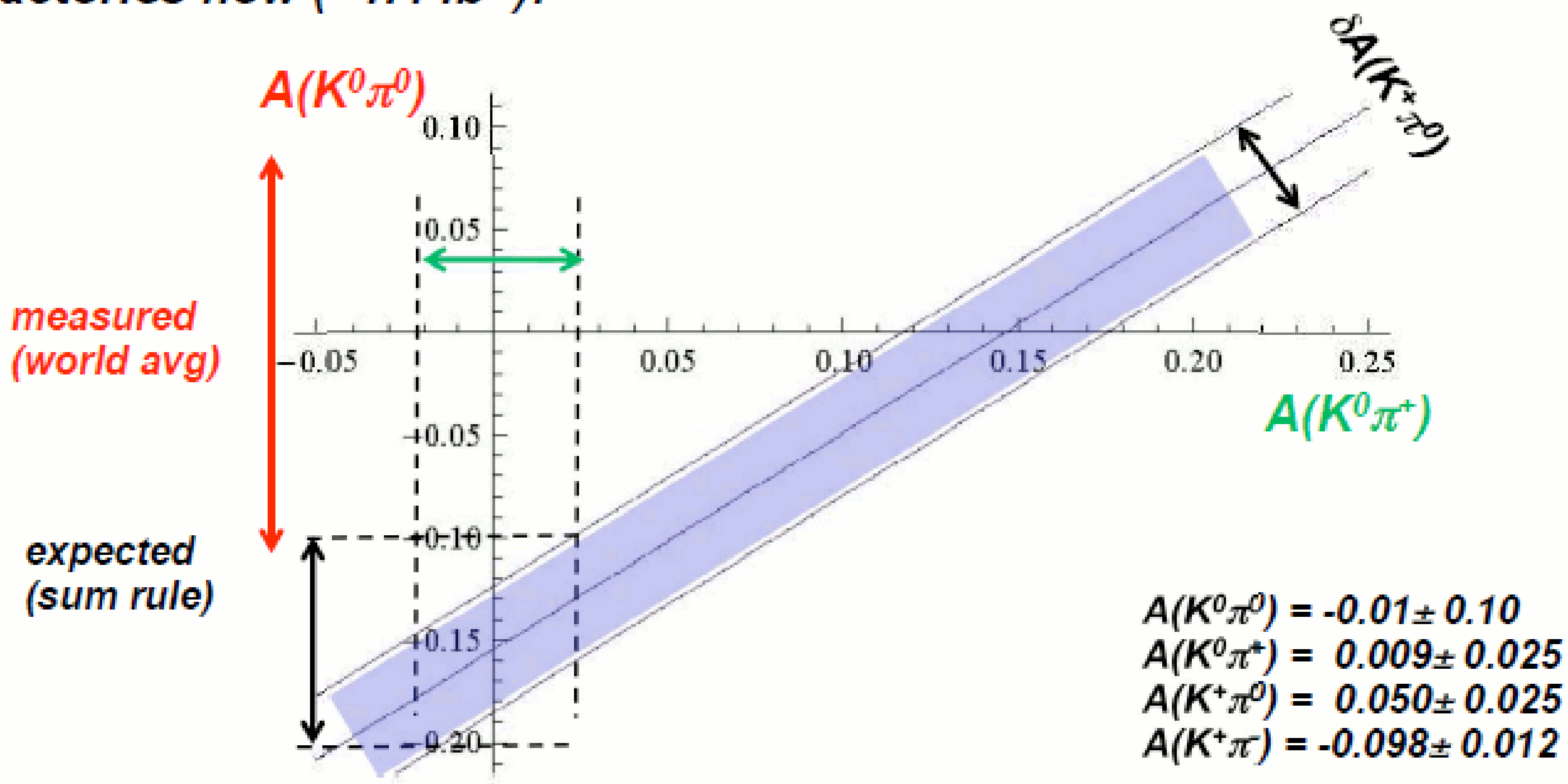
Measuring direct CPV

''Model independent'' sum rule for all four modes:

[Gronau, PLB 627, 82 (2005), Atwood & Soni, PRD 58, 036005 (1998)]

$$\mathcal{A}_{CP}(K^+\pi^-) + \mathcal{A}_{CP}(K^0\pi^+)\frac{\mathcal{B}(K^0\pi^+)}{\mathcal{B}(K^+\pi^-)}\frac{\tau_0}{\tau_+} = \mathcal{A}_{CP}(K^+\pi^0)\frac{2\mathcal{B}(K^+\pi^0)}{\mathcal{B}(K^+\pi^-)}\frac{\tau_0}{\tau_+} + \mathcal{A}_{CP}(K^0\pi^0)\frac{2\mathcal{B}(K^0\pi^0)}{\mathcal{B}(K^+\pi^-)}$$

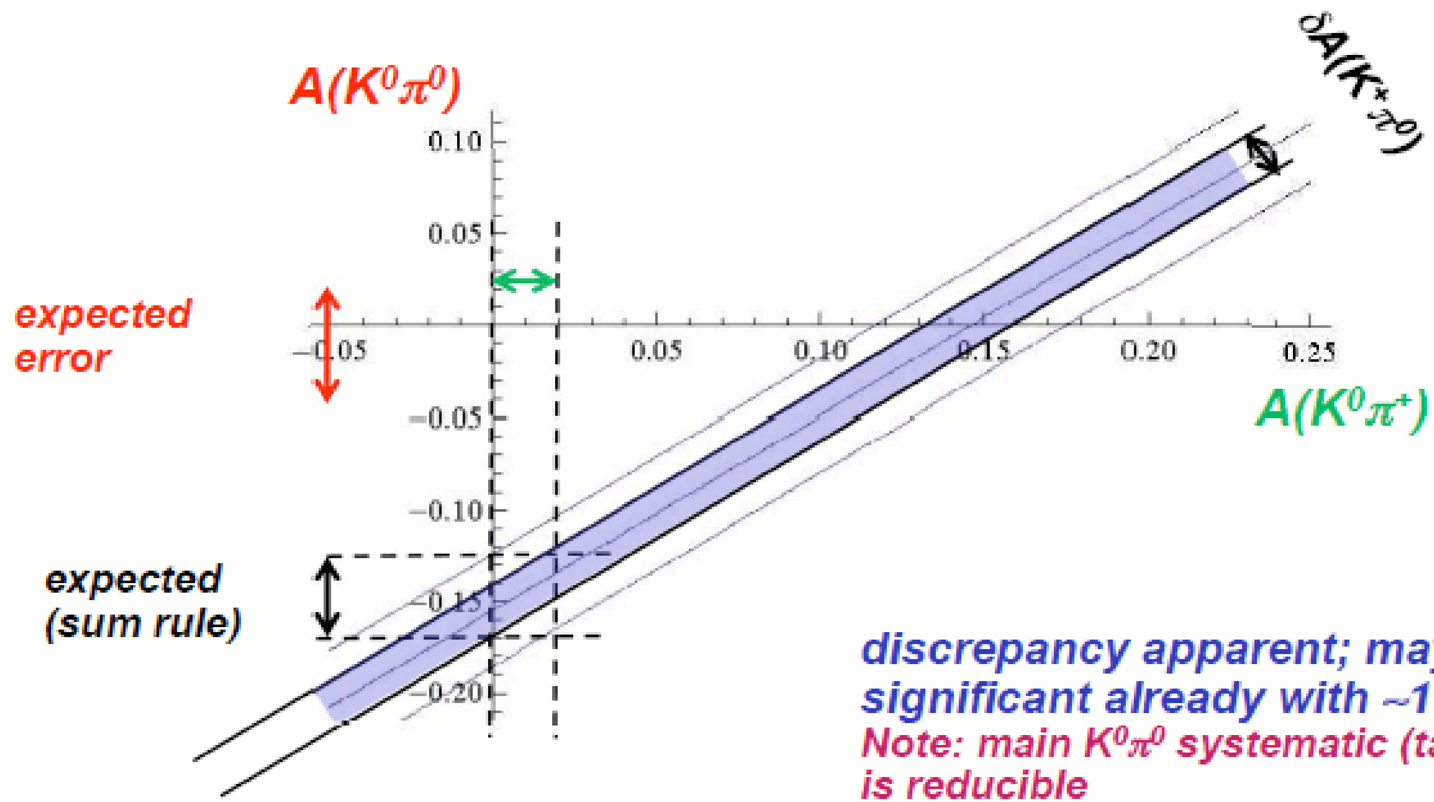
B factories now (~1.4 fb^{-1}):



Measuring direct CPV

$$\mathcal{A}_{CP}(K^+\pi^-) + \mathcal{A}_{CP}(K^0\pi^+)\frac{\mathcal{B}(K^0\pi^+)}{\mathcal{B}(K^+\pi^-)}\frac{\tau_0}{\tau_+} = \mathcal{A}_{CP}(K^+\pi^0)\frac{2\mathcal{B}(K^+\pi^0)}{\mathcal{B}(K^+\pi^-)}\frac{\tau_0}{\tau_+} + \mathcal{A}_{CP}(K^0\pi^0)\frac{2\mathcal{B}(K^0\pi^0)}{\mathcal{B}(K^+\pi^-)}$$

B factory at 50 fb^{-1}, with today's central values:



discrepancy apparent; may be significant already with ~10 ab^{-1}
Note: main $K^0\pi^0$ systematic (tag-side interference) is reducible

Where else to look for direct CPV ?

- CPV in charm provides a unique probe of New Physics
  - sensitive to NP in the up sector
  - SM charm physics is CP conserving to first approximation (2 generation dominance)

- Cabibbo Favored (CF)

$$c \to s\bar{d}u \;\; (D \to K^-\pi^+)$$

- Singly Cabibbo Suppressed (SCS)

$$c \to s\bar{s}u \;\; (D \to K^-K^+)$$
$$c \to d\bar{d}u \;\; (D \to \pi^-\pi^+)$$

- Doubly Cabibbo Suppressed (DCS)

$$c \to d\bar{s}u \;\; (D \to \pi^-K^+)$$

Direct CP Violation

- Consider CP conjugate decay amplitudes of mesons $M \rightarrow f$ and $\overline{M} \rightarrow \overline{f}$

$$A_f(M \to f) = A_f^T e^{-i\phi_f^T}[1 + r_f e^{i(\delta_f - \phi_f)}]$$

$$\overline{A}_{\overline{f}}(\bar{M} \to \bar{f}) = A_f^T e^{-i\phi_f^T}[1 + r_f e^{i(\delta_f + \phi_f)}]$$

A_f^T is a dominant tree-level amplitude with weak (CP violating) phase ϕ^T
r_f is relative magnitude of subleading amplitude containing new weak phase ϕ_f
relative strong phase δ_f

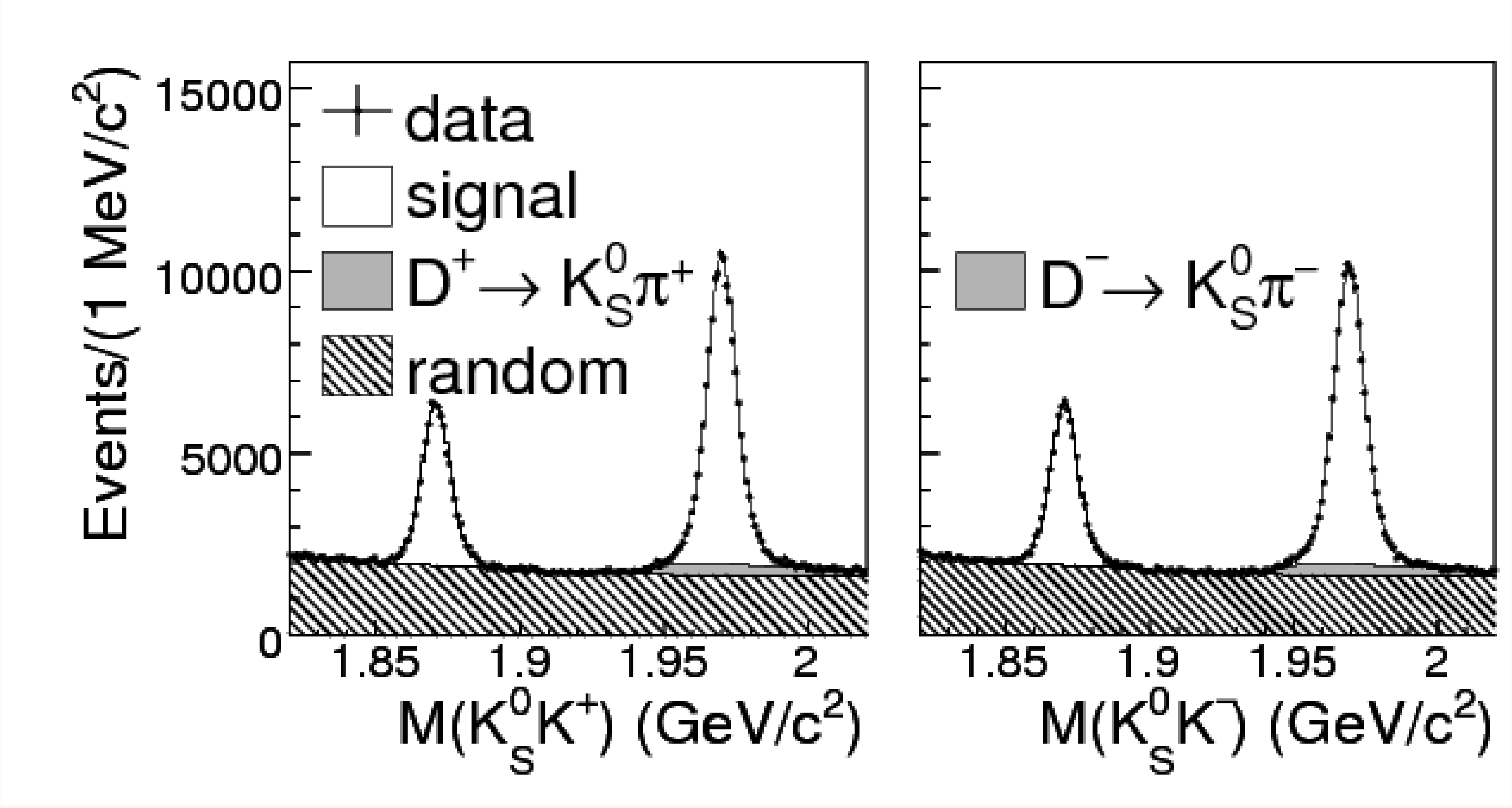
- In SM SCS D decays the subleading amplitudes are the penguins
- Direct CP asymmetry:

$$a^{\mathrm{dir}} \equiv \frac{|A_f|^2 - |\bar{A}_{\bar{f}}|^2}{|A_f|^2 + |\bar{A}_{\bar{f}}|^2} = 2r_f \sin\phi_f \sin\delta_f$$

- in charged $D_{(s)}$ decays, straightforward to measure - just the rate difference:

$$a^{\rm dir} = \frac{\Gamma(D^+ \to f) - \Gamma(D^- \to \bar{f})}{\Gamma(D^+ \to f) + \Gamma(D^- \to \bar{f})}$$

e.g., $a^{\rm dir}(K_s K^+) = (0.09 \pm 0.63)\%$ HFAG, (at Belle: $0.16 \pm 0.6\%$)



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- D^0's more complicated: must subtract indirect CPV contribution from time integrated CP asymmetries:

$$a_f \equiv \frac{\Gamma(D^0 \to f) - \Gamma(\overline{D}^0 \to f)}{\Gamma(D^0 \to f) + \Gamma(\overline{D}^0 \to f)}$$

- The indirect CP asymmetry $a^{\rm ind} = a^{\rm m} + a^{\rm i}$

a^m: CP violation in mixing CPVMIX

a^i: CP violation in the interference of decays with and without mixing CPVINT

$a^{\rm ind}$ is universal - independent of final state.

- at the B-factories:

$$a_f = a_f^{\text{dir}} + a^{\text{ind}}, \quad a^{\text{ind}} = a^m + a^i$$

- at CDF (due to cuts on proper decay times):

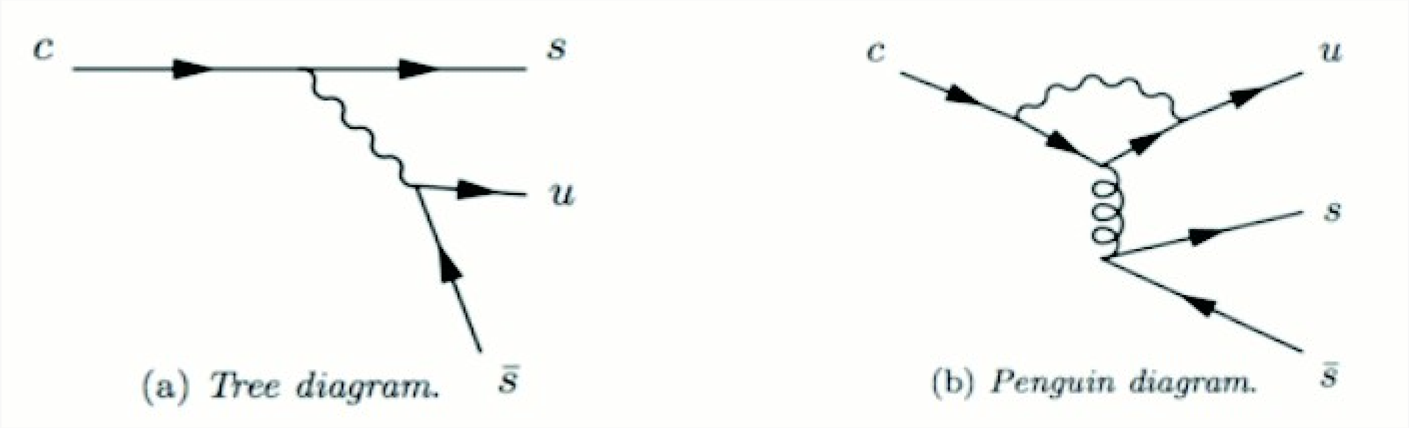
$$a_{\pi^+\pi^-} = a^{\text{dir}}_{\pi^+\pi^-} + 2.40\, a^{\text{ind}}, \qquad a_{K^+K^-} = a^{\text{dir}}_{K^+K^-} + 2.65\, a^{\text{ind}}$$

- at LHCb (due to cuts on proper decay times):

$$a_{K^+K^-} - a_{\pi^+\pi^-} = a^{\text{dir}}_{K^+K^-} - a^{\text{dir}}_{\pi^+\pi^-} + (0.1 \pm 0.01)\, a^{\text{ind}}$$

Where else to look for direct CPV ?

- Remember: need (at least) two contributing amplitudes with different strong and weak phases to get CPV.
- Singly-Cabibbo-suppressed modes with gluonic penguin diagrams very promising
  - Several classes of NP can contribute
  - ... but also non-negligible SM contribution



Difference between $A_{CP}(D^0 \to K^+ K^-)$ and $A_{CP}(D^0 \to \pi^+ \pi^-)$

- Expectation from U-spin: $A^{dir}(KK) = -A^{dir}(\pi\pi)$
- Conclusion could be softened by large U-spin violation in power corrections[Kagan]

$D^0 \rightarrow K^+K^-, \pi^+\pi^-$ measurements

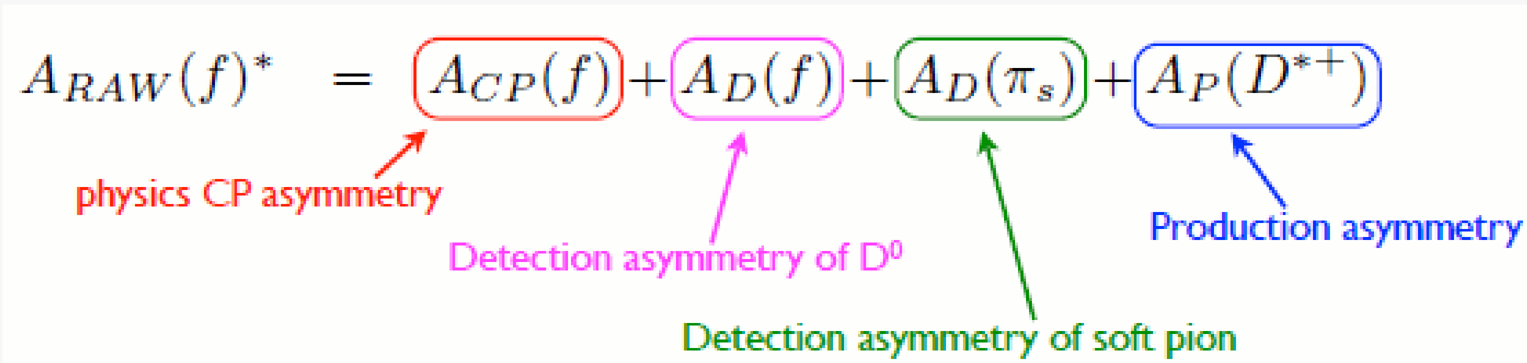
Year	Experiment	CP Asymmetry in the decay mode D0 to π+π-	[Γ(D0)-Γ(D0bar)]/[Γ(D0)+Γ(D0bar)]
2010	CDF	M.J. Morello (CDF Collab.), Preprint (CHARM 2010).	+0.0022 ± 0.0024 ± 0.0011
2008	BELLE	M. Staric et al. (BELLE Collab.), Phys. Lett. B 670, 190 2008).	+0.0043 ± 0.0052 ± 0.0012
2008	BABAR	B. Aubert et al. (BABAR Collab.), Phys. Rev. Lett. 100, 061803 (2008).	-0.0024 ± 0.0052 ± 0.0022
2002	CLEO	S.E. Csorna et al. (CLEO Collab.), Phys. Rev. D 65, 092001 (2002).	+0.019 ± 0.032 ± 0.008
2000	FOCUS	J.M. Link et al. (FOCUS Collab.), Phys. Lett. B 491, 232 (2000).	+0.048 ± 0.039 ± 0.025
1998	E791	E.M. Aitala et al. (E791 Collab.), Phys. Lett. B 421, 405 (1998).	-0.049 ± 0.078 ± 0.030
.	.	COMBOS average	+0.0020 ± 0.0022

Year	Experiment	CP Asymmetry in the decay mode D0 to K+K-	[Γ(D0)-Γ(D0bar)]/[Γ(D0)+Γ(D0bar)]
2011	CDF	A. Di Canto (CDF Collab.), Preprint (BEAUTY 2011).	-0.0024 ± 0.0022 ± 0.0010
2008	BELLE	M. Staric et al. (BELLE Collab.), Phys. Lett. B 670, 190 (2008).	-0.0043 ± 0.0030 ± 0.0011
2008	BABAR	B. Aubert et al. (BABAR Collab.), Phys. Rev. Lett. 100, 061803 (2008).	+0.0000 ± 0.0034 ± 0.0013
2002	CLEO	S.E. Csorna et al. (CLEO Collab.), Phys. Rev. D 65, 092001 (2002).	+0.000 ± 0.022 ± 0.008
2000	FOCUS	J.M. Link et al. (FOCUS Collab.), Phys. Lett. B 491, 232 (2000).	-0.001 ± 0.022 ± 0.015
1998	E791	E.M. Aitala et al. (E791 Collab.), Phys. Lett. B 421, 405 (1998).	-0.010 ± 0.049 ± 0.012
1995	CLEO	J.E. Bartelt et al. (CLEO Collab.), Phys. Rev. D 52, 4860 (1995).	+0.080 ± 0.061
1994	E687	P.L. Frabetti et al. (E687 Collab.), Phys. Rev. D 50, 2953 (1994).	+0.024 ± 0.084
.	.	COMBOS average	-0.0023 ± 0.0017

Dominated by CDF, especially for $D^0 \rightarrow \pi^+\pi^-$

K^+K^- and $\pi^+\pi^-$ values consistent with zero but have opposite sign

Formalism

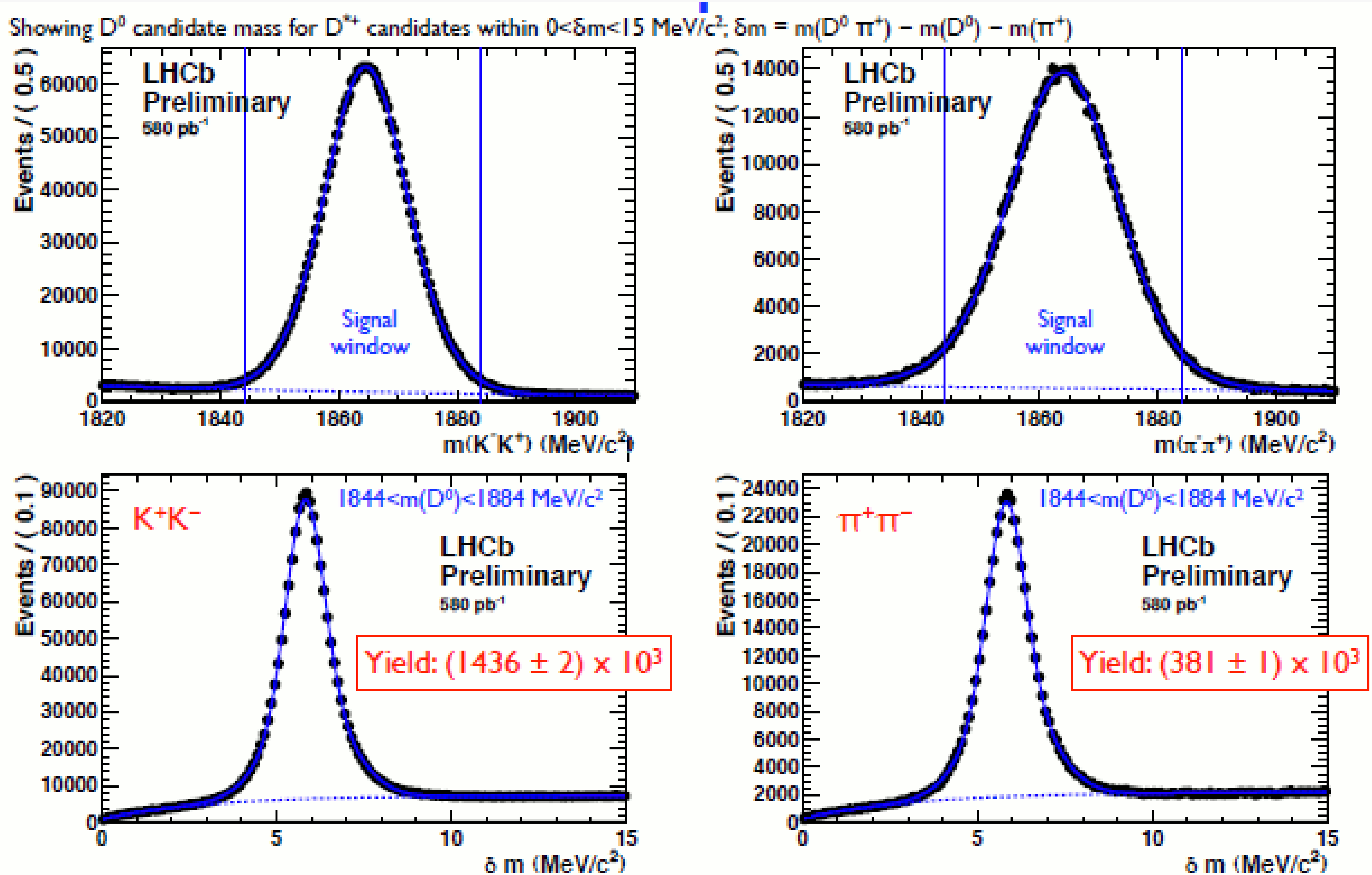


- so when we take $A_{RAW}(f)^* - A_{RAW}(f')^*$ the production and soft pion detection asymmetries will cancel. Moreover...
- No detector asymmetry for D^0 decays to (K^+K^-), $(\pi^+\pi^-)$

...i.e. all the D*-related production and detection effects cancel. This is why we measure the CP asymmetry difference: very robust against systematics.

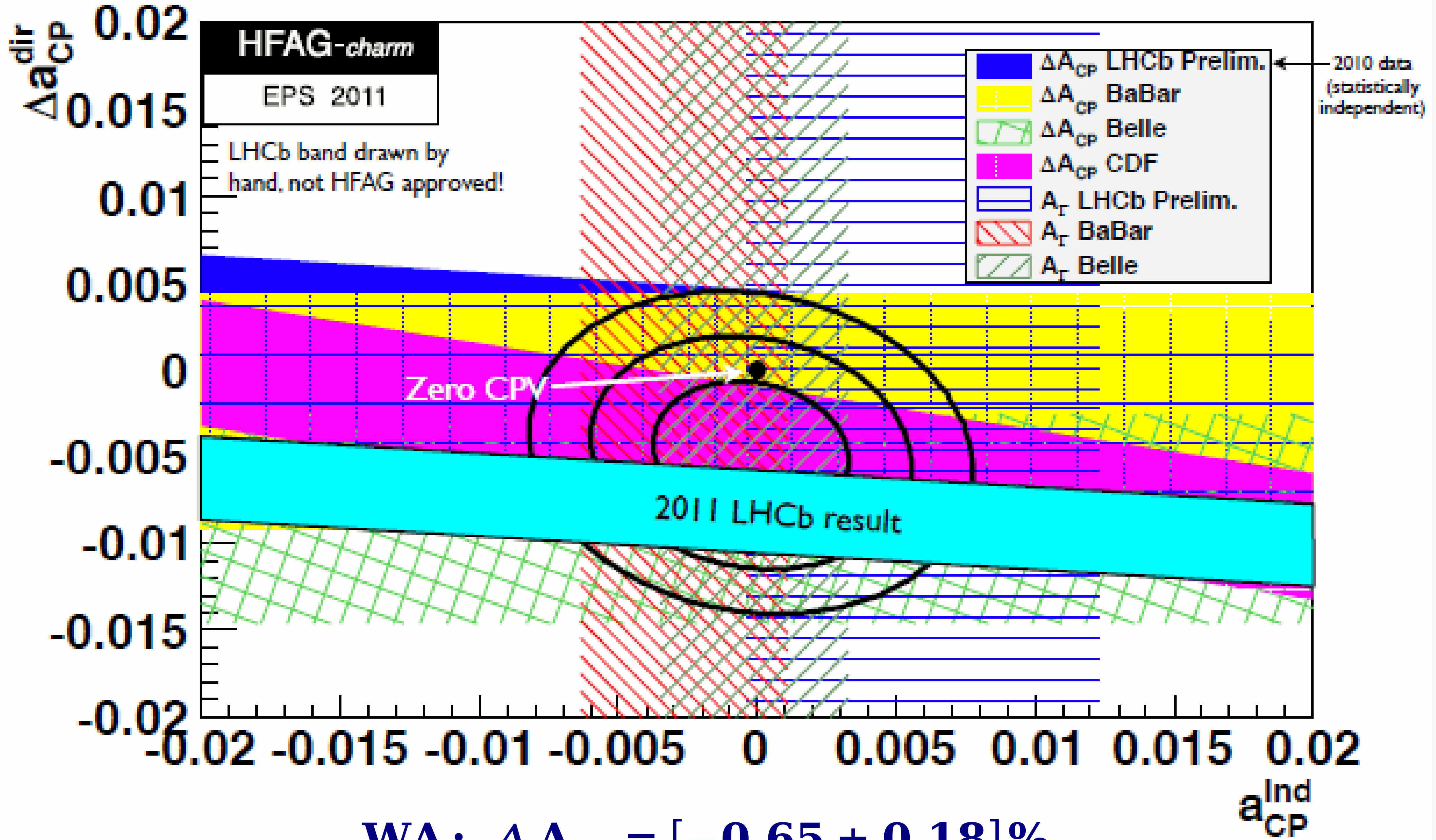
$$\Delta A_{CP} \equiv A_{CP}(K^+K^-) - A_{CP}(\pi^+\pi^-)$$

Mass spectra



Comparison with world average

LHCb: $\Delta A_{CP} = [-0.82 \pm 0.21(stat) \pm 0.11(sys)]\%$



WA: $\Delta A_{CP} = [-0.65 \pm 0.18]\%$

one order of magnitude above the naive SM expectation!

New Physics ?

is an order of magnitude enhancement of a_{dir} plausible in the SM ?
[Brod, Kagan, Zupan, arXiv: 1111.5000]

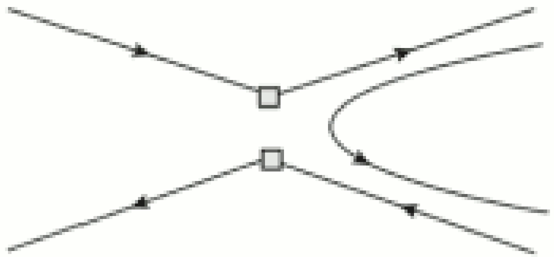
from A.Kagan's seminar

The tree amplitudes

- the tree amplitudes (in $SU(3)_F$ diagrammatic notation) are

$$A^T(K^+K^-) = V_{cs}^* V_{us}(T_{KK} + E_{KK}), \;\; A^T(\pi^+\pi^-) = V_{cd}^* V_{ud}(T_{\pi\pi} + E_{\pi\pi})$$

  - T is the "tree-amplitude" (e.g., $T_{\pi\pi} \propto f_\pi F_{D\to\pi}$ in naive factorization,...)
  - E is the "W-exchange " annihilation topology amplitude: formally subleading in $1/m_c$ - power corrections



- The PP data implies Rosner & Gronau; Cheng & Chiang; Grossman, AK & Nir

$$E_{KK} \sim T_{KK}\,, \quad E_{\pi\pi} \sim T_{\pi\pi}$$

with large relative strong phases, large $SU(3)$ breaking

  - signals breakdown of $1/m_c$ expansion - not surprising given the low charm mass scale

- below will set magnitudes of tree amplitudes equal to the measured ones

$$A^T(K^+K^-) \approx 0.8\ \mathrm{keV}, \quad A^T(\pi^+\pi^-) \approx 0.5\ \mathrm{keV}$$

The QCD penguin amplitudes

- the penguin amplitudes are

$$A^P(K^+K^-) = -V_{cb}^* V_{ub} P_{KK}\,, \quad A^P(\pi^+\pi^-) = -V_{cb}^* V_{ub} P_{\pi\pi}$$

weak phases (relative to trees): $-\gamma$ $(\pi\pi)$ and $\pi - \gamma$ (KK), and $\sin\gamma \approx 0.9$

- Difference of π in relative weak phases $\Rightarrow$

$$\mathrm{sign}[a^{\mathrm{dir}}_{K^+K^-}] = -\mathrm{sign}[a^{\mathrm{dir}}_{\pi^+\pi^-}]$$

unless $\mathrm{SU}(3)_{\mathrm{F}}$ breaking is so large that sign of strong phases differs

- in $\mathrm{SU}(3)_{\mathrm{F}}$ symmetric limit, magnitudes would be equal. Generically, expect

$$|a^{\mathrm{dir}}_{K^+K^-}| \sim |a^{\mathrm{dir}}_{\pi^+\pi^-}|$$

from A.Kagan's seminar

Summary on Standard Model penguins

- individual power corrections considered could be enhanced a factor of a few relative to leading power.
- again taking $\Delta A_{CP} \sim 4 r_f$, and a renormalization scale $\mu = 1$ GeV, we find

$$\Delta A_{CP} \sim 0.3\% \ \ (P_{f,1}), \quad \Delta A_{CP} \sim 0.2\% \ \ (P_{f,2})$$

- Of course our results are subject to very large uncertaintie:
  - extraction of tree ampltiudes E_f from data
  - use of N_c counting for penguin matrix elements
  - the modeling of Q_1 penguin contraction matrix elements additional penguin

    contractions not associated with $\log \mu$ cancellations. For example,in the partonic picture corresponding to emission of more than 1 gluon from the s and$d$-quark loops
- a cumulative uncertainty of a factor of a few is reasonable $\Rightarrow$ a Standard Model origin for the LHCb measurement is plausible

from A.Kagan's seminar

Conclusion

- A Standard Model Explanation for the LHCb measurements of ΔA_{CP} is plausible
- well motivated New pHysics explanations for the LHCb measurement can be constructed

My own conclusion:

- Don't jump too fast to conclusion...
  - Need more data to confirm these deviations...

  ....and look for others !

DCPV at Belle

- Todays news from LHCb:

first evidence of DCPV in charm
with 580/pb of 2011 data

$A_{CP}(D^0 \to K^+K^-) - A_{CP}(D^0 \to \pi^+\pi^-)$
$= (-0.82 \pm 0.21 \pm 0.11)\%$ 3.5σ

Decay	*Lumi*	A_{CP} [%]
$D^+ \to \varphi\pi^+$	$955\,fb^{-1}$	$+0.51 \pm 0.28 \pm 0.05_{\Delta A}$
$D^+ \to \eta\pi^+$	$791\,fb^{-1}$	$+1.74 \pm 1.13 \pm 0.20$
$D^+ \to \eta'\pi^+$	$791\,fb^{-1}$	$-0.12 \pm 1.12 \pm 0.20$
$D^0 \to K_s\pi^0$	$791\,fb^{-1}$	$-0.28 \pm 0.19 \pm 0.10$
$D^0 \to K_s\eta$	$791\,fb^{-1}$	$+0.54 \pm 0.51 \pm 0.16$
$D^0 \to K_s\eta'$	$791\,fb^{-1}$	$+0.98 \pm 0.67 \pm 0.14$
$D^+ \to K_s\pi^+$	$673\,fb^{-1}$	$-0.71 \pm 0.19 \pm 0.20$
$D_s^+ \to K_s\pi^+$	$673\,fb^{-1}$	$+5.45 \pm 2.50 \pm 0.33$
$D^+ \to K_sK^+$	$673\,fb^{-1}$	$-0.16 \pm 0.58 \pm 0.25$
$D_s^+ \to K_sK^+$	$673\,fb^{-1}$	$+0.12 \pm 0.36 \pm 0.22$
$D^0 \to K^+K^-$	$540\,fb^{-1}$	$-0.43 \pm 0.30 \pm 0.11$
$D^0 \to \pi^+\pi^-$	$540\,fb^{-1}$	$+0.43 \pm 0.52 \pm 0.12$

My own conclusion:

- Don't jump too fast to conclusion...
  - Need more data to confirm these deviations...
    ....and look for others !
  - Unexpected doesn't mean New Physics
- More penguins tomorrow, maybe NP there ??