Status of global fit section

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Section outline (I):

- Section: Introduction and goals [MB] 2p
- Section: Methodology
  - Subsection: CKMfitter [RI] 2p
  - Subsection: UTfit [MB] 2p
  - Subsection: Scanning method [GE] 2p

Section outline (II):

- Section: Experimental Inputs
  - Subsection: B-factories results: β, α, γ, $2\beta+\gamma$, V_{ub}, V_{cb}, Δm_d, $B(B \to \tau\nu)$, radiative penguins (?) 4p
  - Subsection: Non-B-factories results (briefly on their threatment): ε_K, Δm_s 2p
    - For the moment, in the draft, I did not include: A_s^{SL}, TD $B_s \to J/\psi\phi$, $\Delta\Gamma_s$ *(as they go in the new physics fit that will not be included here. It might go in the NP benchmark chapter)*
    - We should aim to have a table to summarise all the inputs for the SM fit *(Kevin mentioned earlier the necessity of a complete reference table for all inputs [MB])*

Experimental Inputs:

V_{ub}/V_{cb}: currently auto-produced:

will be taken from the relative sections

coordinate with the relative editors for Lattice QCD inputs

Δm_d, Δm_s: currently from PDG/HFAG and Tevatron

from the relative sections and Tevatron&LHCb

(HFAG to be contacted for this)

α, γ: currently auto-produced:

will be taken from the relative sections

sin2β: UTfit take into account the theory uncertainties

will that be done in the sin2β section?

I think we should consider this issue

cos2β, cos(2β+γ): auto-produced

will be taken from the relative sections

B to $\tau\nu$: HFAG

will be taken from the relative section

dedicated subsection in the result section of our chapter

Section outline (III):

- Section Theoretical Inputs
  - Subsection Derivation of hadronic observables 2p
  - Subsection Lattice QCD inputs 4p
- Section Results from the global fits 4p
  - Subsection B to $\tau\nu$ 2p
- Section Conclusions 1-2p

total: 36-38 pages

Lattice Inputs:

the basic set of inputs:

f_Bs = 239 ± 10 MeV
f_Bs/f_Bd = 1.23 ± 0.03
B_Bs/B_Bd = 1.06 ± 0.04
B_Bs = 0.87 ± 0.04
B_K = 0.731 ± 0.036

numbers here just to give you an idea

f_Bd = f_Bs/(f_Bs/f_Bd)
*Xi = (f_bs/f_Bd)*sqrt(BBs/BBd)*
*Dmd = [f_Bs / (f_Bs/f_Bd)] * [sqrt(B_Bs) / sqrt(B_Bs/B_Bd)]*
Dms = f_Bs sqrt(B_Bs)
taunu = f_Bs/ (f_Bs/f_Bd)

Lattice Inputs:

BK, f_Bs, f_Bs/f_Bd, B_Bs, B_Bs/B_Bd

1) The ratio f_Bs/f_Bd and the value of f_Bs, being related to the "slope" and the "intercept" of the decay constant as a function of the light quark mass, can be assumed to be uncorrelated among each other, to a (presumably) good extent. Similarly, we can assume that the ratio B_Bs/B_Bd is uncorrelated with B_Bs.

2) We can also assume that the lattice results for the decay constants (f_Bs, f_Bs/f_Bd) on one side and for the bag parameters (B_Bs, B_Bs/B_Bd) on the other side are uncorrelated among each other.

3) this choice uses at most the input from the Bs sector which do not suffer, in the lattice approach, of the systematic uncertainty related to the chiral extrapolation.

Lattice Inputs:

- After Mainz we settled for having a table for each lattice input with all the numbers from the lattice collaborations
  - each global fit would average them in their preferred way
  - I produced five tables (I've now included them in svn in case will be needed in the future)

Table 1: f_{Bs} (MeV)

Collaboration	value (stat)(syst) (MeV)	UTfit	CKMfitter	Scanning method
FNAL/MILC '08 [1]	243(6)(9)	yes	?	?
HPQCD '09 [2]	231(5)(14)	yes	?	?
average		239(10) [3]	?	?

Table 3: $\hat{B}_{Bs}$

Collaboration	value (stat)(syst)	UTfit	CKMfitter	Scanning method
HPQCD '09 [2]	1.33(6)	yes	?	?
average		1.33(6)	?	?

Table 4: B_{Bs}/B_{Bd}

Collaboration	value (stat)(syst)	UTfit	CKMfitter	Scanning method
HPQCD '09 [2]	1.05(7)	yes	?	?
average		1.06(4) [5]	?	?

Table 2: f_{Bs}/f_{Bd}

Collaboration	value (stat)(syst)	UTfit	CKMfitter	Scanning method
FNAL/MILC '08 [1]	1.245(43)	yes	?	?
HPQCD '09 [2]	1.226(26)	yes	?	?
average		1.23(3) [4]	?	?

Table 5: $\hat{B}_K$

Collaboration	value (stat)(syst)	UTfit	CKMfitter	Scanning method
ALVdW 09 [6]	0.724(8)(28)	yes	?	?
RBC/UKQCD [7]	0.738(8)(25)	yes	?	?
ETMC [8]	0.730(30)(30)	yes	?	?
average		0.731(36) [10]	?	?

References

[1] C. Bernard *et al.*, PoS **LATTICE2008** (2008) 278 [arXiv:0904.1895 [hep-lat]].

[2] E. Gamiz, C. T. H. Davies, G. P. Lepage, J. Shigemitsu and M. Wingate [HPQCD Collaboration], Phys. Rev. D **80** (2009) 014503 [arXiv:0902.1815 [hep-lat]].

[3] J. Laiho, E. Lunghi and R. S. Van de Water, Phys. Rev. D **81** (2010) 034503 arXiv:0910.2928 [hepph]

[4] UTfit average taken from the two collaborations [1,2]. since no average for this ratio is available from [3]. The uncertainty 0.03 is taken equal to the smaller of the two errors.

[5] UTfit gets this average starting from [3] that gives the averages for B_{Bs} and B_{Bd} separately. Being [2] the only one that contributes to that ratio, UTfit would be fine with moving to the HPQCD number.

[6] C. Aubin, J. Laiho and R. S. Van de Water, Phys. Rev. D **81** (2010) 014507 [arXiv:0905.3947 [hep-lat]].

[7] C. Kelly, P. A. Boyle and C. T. Sachrajda [RBC Collaboration and UKQCD Collaboration], PoS **LAT2009** (2009) 087 [arXiv:0911.1309 [hep-lat]].

[8] V. Bertone *et al.* [ETM Collaboration], PoS **LAT2009** (2009) 258 [arXiv:0910.4838 [hep-lat]].

[9] M. Constantinou *et al.* [ETM Collaboration], arXiv:1009.5606 [hep-lat].

[10] for B_K UTfit uses Lubicz's talk at Lattice 2009:
V. Lubicz, arXiv:1004.3473 [heplat]
There is a new average result available for the K parameters coming from a wider lattice community called FLAG. For the moment they do not use the result ETMC result [8] because it was not published yet, but a ETMC article [9] has been submitted for publication so FLAG is going to include it in the published version of their article and UTfit will be moving to this reference from the FLAG collaboration:
G. Colangelo *et al.*, arXiv:1011.4408 [hep-lat].

Itoh-san
in email discussion

I got a conclusion that the inputs to be used for the averaging should be based on Nf=2+1 only. Hashimoto told me that Nf=2 and 2+1 calculations are completely different and should not be mixed in the averaging. Also he suggested me to use "publication level" results only for the averaging.

From this viewpoint, the inputs used in PRD81 are well selected, while the numbers used in 1008.1593 are averaged by mixing both Nf=2 and 2+1 calculations and with conference-level results. This is the reason why I did not propose CKMfitter's average.

The remaining problem was that the original averaged numbers in PRD81 did not have the systematic error separated from the total error, but this was basically solved by using their updates on the web.

So, in spite that the average is based on "less" inputs compared with 1008.1593, it can be a kind of compromised and agreeable choice by all of us, I think.

Gerald's talk at the BaBar CM

Introduction

- We have 3 different global fits
  - ➔ for sensible comparison we need to use common inputs
  - ➔ lattice parameters fall into this category
- Originally, Itoh san was suggesting the lattice averages from the recent publication hep-ph/1008.1593 by Lenz, Nierste + CKMfitter group
  - ➔ these averages are based on all unquenched (2, 2+1) lattice results
- Recently, Itoh san suggested to use the lattice averages by J.Laiho, E.Lunghi and R. van de Water

  http://krone.physik.unizh.ch/~lunghi/webpage/LatAves/index.html
  - ➔they use only 2+1 results and include new measurements

Gerald's talk at the BaBar CM

Issues

- In the lattice average web page, some measurements are excluded, though they are 2+1 calculations, why?
- In the lattice average web page, theory errors in some cases are much smaller, why?
- Theory errors and statistical errors are treated in a Bayesian way, this causes conflicts with our frequentist approach
  ➔ overall errors seem to become too small

personal view and ongoing HN discussion

- In the lattice average web page, some measurements are excluded, though they are 2+1 calculations, why?
  - some conference contributions. Anyway I think we should check for updates at the lattice conference in July
  - older estimates (2001-2003) uses a different value for the light quark mass (a higher value): this might have no effect for Bs parameters, but it can have a bigger effect on Bd parameters
  - same collaboration: for example HPQCD is used with their results in 2003 and 2009: in their 2009 paper they keep saying that they are updating numbers, so I would not use also their 2003 results without getting in touch with the authors and asking specific prescriptions

personal view and ongoing HN discussion

- In the lattice average web page, theory errors in some cases are much smaller, why?
  - I would say that the question should be the opposite: that is why in 1008.1593, theory errors are bigger? I think this depends on the method used: *the Rfit model*

Table 1: f_{Bs} (MeV)

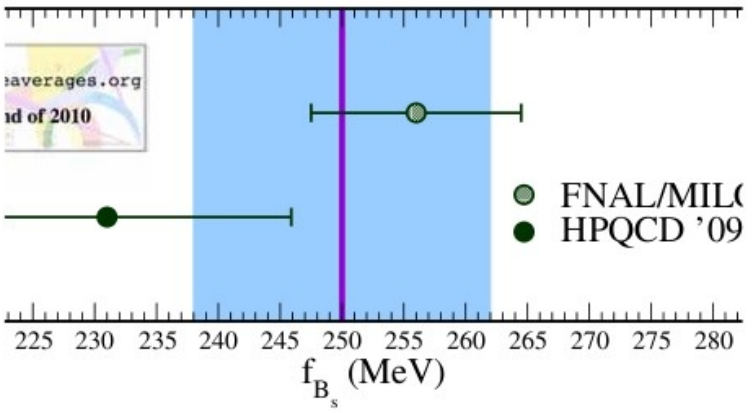
Collaboration	value (stat)(syst) (MeV)	UTfit	CKMfitter	Scanning method
FNAL/MILC '08 [1]	243(6)(9)	yes	?	?
HPQCD '09 [2]	231(5)(14)	yes	?	?
average		239(10) [3]	?	?

Gerald's talk at the BaBar CM

f_{Bs}

Lattice average web page

	f_{Bs}	$(\delta f_{Bs})_{stat}$	$(\delta f_{Bs})_{sys}$
FNAL/MILC'10	256	6	6
HPQCD'09	231	5	14
Average	250	5.4	10.7



hep-ph/1008.1593

Collaboration	N_f	$f_{B_s} \pm \sigma_{stat} \pm \sigma_{Rfit}$
CP-PACS01	2	$242 \pm 9^{+53}_{-34}$
MILC02	2	$217 \pm 6^{+58}_{-31}$
JLQCD03	2	$215 \pm 9^{+19}_{-15}$
ETMC09	2	$243 \pm 6 \pm 15$
HPQCD03	2+1	$260 \pm 7 \pm 39$
FNAL-MILC09	2+1	$243 \pm 6 \pm 22$
HPQCD09	2+1	$231 \pm 5 \pm 30$
Our average		$231 \pm 3 \pm 15$

Lattice average web page ignores two 2+1 results and includes one new result

Conclusions and to-do list:

personal view

- **the lattice inputs: still some discussion, but I see the light at the end of the tunnel:**
  - if we agree on the Laiho et al, numbers with separate statistical and systematical errors, I would contact them as soon as possible to understand their timing and their plans for updates in the near future.
  - I would keep the input tables for the moment in the draft: they could be useful for future reference (especially if we communicate with Laiho et al. privately: to be reproducible having given input values and given method)
  - keep an eye on Lattice 2011

Conclusions and to-do list:

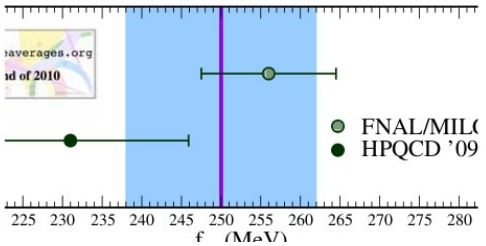
- **Need to assign sessions to editors and start writing**
  - no real show-stoppers:
    we can write and discuss at the same time ☺
- **Need to compile the input table**
  - I can try to do it
- **Keep an eye on the other section discussions to remind them we need a final number from them**
  - β, α, γ, $2\beta+\gamma$, V_{ub}, V_{cb},
  - Δm_s from HFAG to include LHCb

Back up slides

f_{Bs}

Lattice average web page

	f_{Bs}	$(\delta f_{Bs})_{stat}$	$(\delta f_{Bs})_{sys}$
FNAL/MILC'10	256	6	6
HPQCD'09	231	5	14
Average	250	5.4	10.7



hep-ph/1008.1593

Collaboration	N_f	$f_{B_s} \pm \sigma_{stat} \pm \sigma_{Rfi}$
CP-PACS01	2	$242 \pm 9^{+53}_{-34}$
MILC02	2	$217 \pm 6^{+58}_{-31}$
JLQCD03	2	$215 \pm 9^{+19}_{-15}$
ETMC09	2	$243 \pm 6 \pm 15$
HPQCD03	2+1	$260 \pm 7 \pm 39$
FNAL-MILC09	2+1	$243 \pm 6 \pm 22$
HPQCD09	2+1	$231 \pm 5 \pm 30$
Our average		$231 \pm 3 \pm 15$

Lattice average web page ignores two 2+1 results and includes one new result

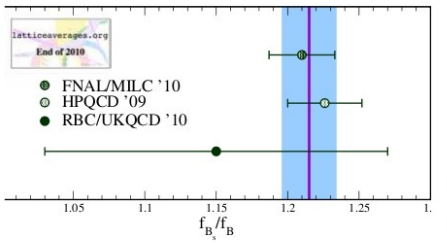
f_{Bs}/f_{Bd}

Lattice average web page

	f_{Bs}/f_{bd}	$(\delta f_{Bs}/f_{Bd})_{stat}$	$(\delta f_{Bs}/f_{Bd})_{sys}$
FNAL/MILC'10	1.21	0.01	0.02
HPQCD'09	1.226	0.02	0.017
RBC/UKQCD'10	1.15	0.07	0.1
Average	1.215	0.012	0.0147

Lattice average web page ignores one 2+1 results and includes one new result

hep-ph/1008.1593



Collaboration	N_f	$f_{B_s}/f_{Bd} \pm \sigma_{stat} \pm \sigma_{Rfit}$
CP-PACS01	2	$1.179 \pm 0.018 \pm 0.023$
MILC02	2	$1.16 \pm 0.01^{+0.08}_{-0.04}$
JLQCD03	2	$1.13 \pm 0.03^{+0.17}_{-0.02}$
ETMC09	2	$1.27 \pm 0.03 \pm 0.04$
FNAL-MILC09	2+1	$1.245 \pm 0.028 \pm 0.049$
HPQCD09	2+1	$1.226 \pm 0.020 \pm 0.033$
RBC/UKQCD10	2+1	$1.15 \pm 0.05 \pm 0.20$
Our average		$1.209 \pm 0.007 \pm 0.023$

B_{Bs} and B_{Bd}/B_{Bs}

Lattice average web page

	B_{Bs}	$(\delta B_{Bs})_{stat}$	$(\delta B_{Bs})_{sys}$
HPQCD'09	1.326	0.04	0.03

Lattice average web page ignores two 2+1 results

hep-ph/1008.1593

Collaboration	N_f	$\hat{\mathcal{B}}_{B_s} \pm \sigma_{stat} \pm \sigma_{Rfit}$
JLQCD03	2	$1.299 \pm 0.034^{+0.122}_{-0.095}$
HPQCD06	2+1	$1.168 \pm 0.105 \pm 0.140$
RBC/UKQCD07	2+1	$1.21 \pm 0.05 \pm 0.05$
HPQCD09	2+1	$1.326 \pm 0.04 \pm 0.03$
Our average		$1.28 \pm 0.02 \pm 0.03$

Lattice average web page

	B_{Bs}/B_{Bd}	$(\delta B_{Bs}/B_{Bd})_{stat}$	$(\delta B_{Bs}/B_{Bd})_{sys}$
HPQCD'09	1.2	0.02	0.03

Lattice average web page ignores one 2+1 result from 2010

hep-ph/1008.1593

Collaboration	N_f	$\mathcal{B}_{B_s}/\mathcal{B}_{Bd} \pm \sigma_{stat} \pm \sigma_{Rfit}$
JLQCD03	2	$1.017 \pm 0.016^{+0.076}_{-0.017}$
HPQCD09	2+1	$1.053 \pm 0.020 \pm 0.030$
RBC/UKQCD10	2+1	$0.96 \pm 0.02 \pm 0.03$
Our average		$1.006 \pm 0.010 \pm 0.030$

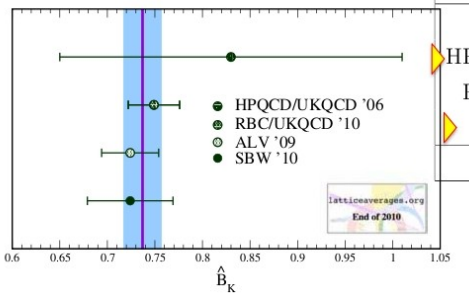
B_K

Lattice average web page

	B_K	$(\delta B_K)_{stat}$	$(\delta B_K)_{sys}$
Aubin et al '09	0.724	0.008	0.029
HPQCD/UKQCD '06	0.83	0.02	0.18
RBC/UKQCD'10	0.749	0.007	0.026
SEOUL,BNL, Wash '10	0.724	0.012	0.043
Average	0.737	0.0056	0.0192

Lattice average web page ignores one 2+1 results and includes two new results

hep-ph/1008.1593



Collaboration	N_f	$\mathcal{B}_K(2\,\mathrm{GeV}) \pm \sigma_{stat} \pm \sigma_{Rfit}$
JLQCD08	2	$0.537 \pm 0.004 \pm 0.072$
HPQCD/UKQCD06	2+1	$0.618 \pm 0.018 \pm 0.179$
RBC/UKQCD07	2+1	$0.524 \pm 0.010 \pm 0.052$
ALVdW09	2+1	$0.527 \pm 0.006 \pm 0.049$
Our average		$0.527 \pm 0.0031 \pm 0.049$

$B_K = 0.724 \pm 0.004 \pm 0.067$

old discussion

BK comes from Lubicz's talk at Lattice 2009:

V.~Lubicz, arXiv:1004.3473 [hep-lat]

B-physics parameters:

J.~Laiho, E.~Lunghi and R.~S.~Van de Water,
Phys.\ Rev.\ D {\bf 81} (2010) 034503
arXiv:0910.2928 [hep-ph]

exclusive Vub and BSM B-physics parameters

V.~Lubicz and C.~Tarantino,
Nuovo Cim.\ {\bf 123B} (2008) 674
arXiv:0807.4605 [hep-lat]

old discussion

mainly two reasons for amending the Laiho et al paper:
they exclude all Nf=2 results
they do not analyse the details on the systematics of the various analyses they include

the case: form factor f+(0) of Kl3 where ETMC calculation with Nf=2 has a systematic error well more under control then the Nf=2+1 calculation from RBC-UKQCD. The authors Laiho et al agreed in Lattice 2010 and CKM2010 that both should be considered but no new average has been presented.

old numbers

angles:

Sin2β from B → J/ψK^0

+ theory error from CPS:

sin2β = 0.655 ± 0.024 HFAG

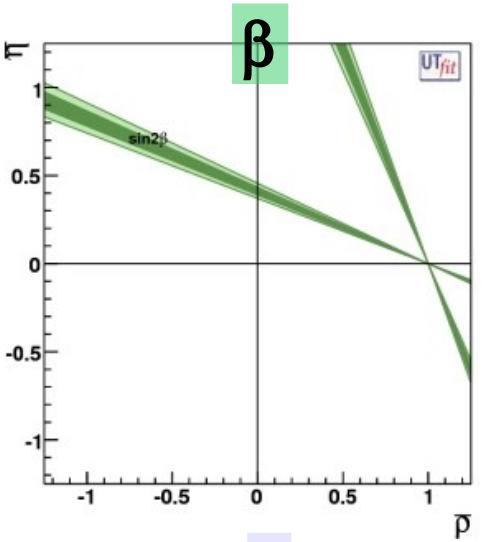
α combined: isospin ππ/ρρ and ρπ

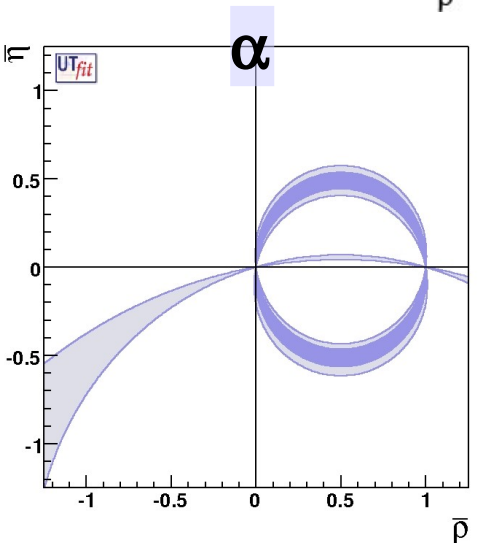
α = (91 ± 6)°

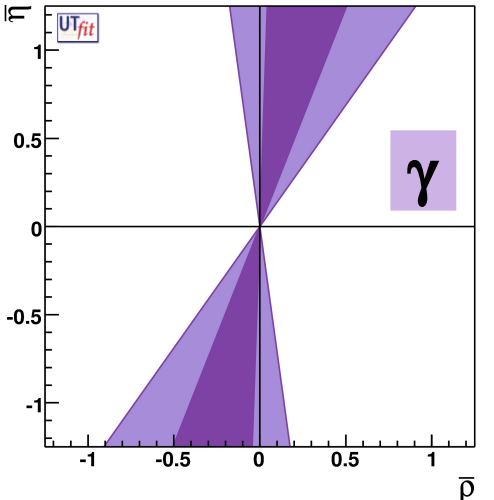
γ combined: GLW/ADS/Dalitz

both charged and neutrals

γ = (74 ± 11)° U (-106 ± 11)°



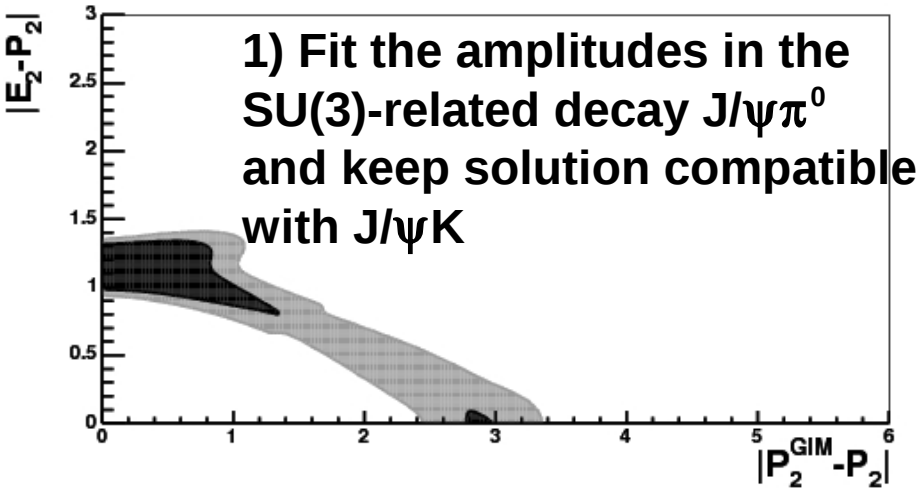




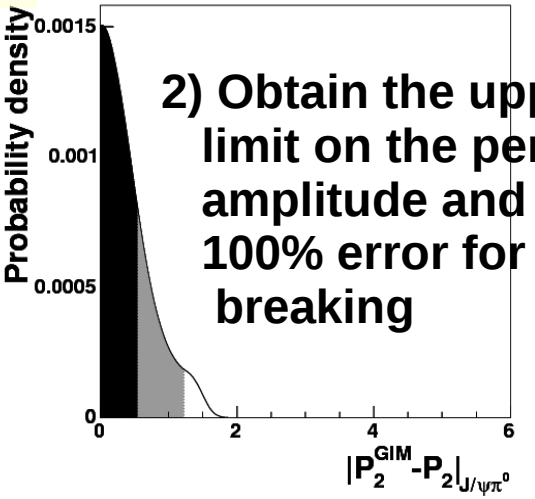
Theory error on sin2β:

A.Buras, L.Silvestrini
Nucl.Phys.B569:3-52(2000)

Channel	Cl.	E_1	E_2	EA_2	A_2	P_1	P_2	P_3	P_1^{GIM}	P_2^{GIM}	P_3^{GIM}	P_4	P_4^{GIM}
		$V^*_{cb}V_{cs}$	$\frac{1}{N}$	$\frac{1}{N^2}$	$\frac{1}{N}$	$\frac{1}{N}$	$\frac{1}{N^2}$	$V^*_{tb}V_{ts}$ $\frac{1}{N}$	$\frac{1}{N^2}$	$V^*_{ub}V_{us}$ $\frac{1}{N^3}$	$\frac{1}{\sqrt{3}}$	$\frac{1}{N^3}$	
$B_d \to J/\psi K^0$	C	–	λ^2	–	–	–	λ^2	–	–	λ^4	–	–	–
$B_d \to \pi^0 J/\psi$	D	–	λ^3	λ^3	–	–	λ^3	–	–	λ^3	–	$[\lambda^3]$	$[\lambda^3]$
		$V^*_{cb}V_{cd}$						$V^*_{tb}V_{td}$			$V^*_{ub}V_{ud}$		

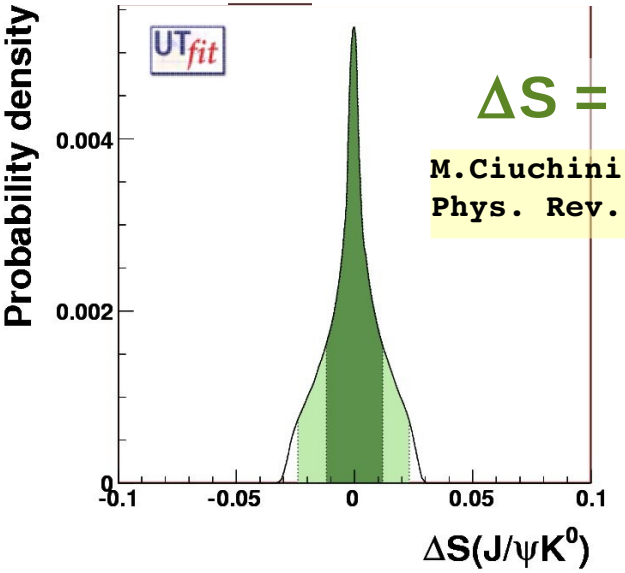


1) Fit the amplitudes in the SU(3)-related decay $J/\psi\pi^0$ and keep solution compatible with $J/\psi K$



2) Obtain the upper limit on the penguin amplitude and add 100% error for SU(3) breaking

3) Fit the amplitudes in $J/\psi K^0$ imposing the upper bound on the CKM suppressed amplitude and extract the error on sin2β

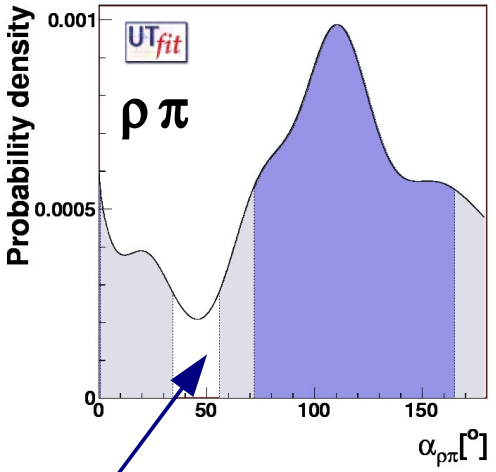


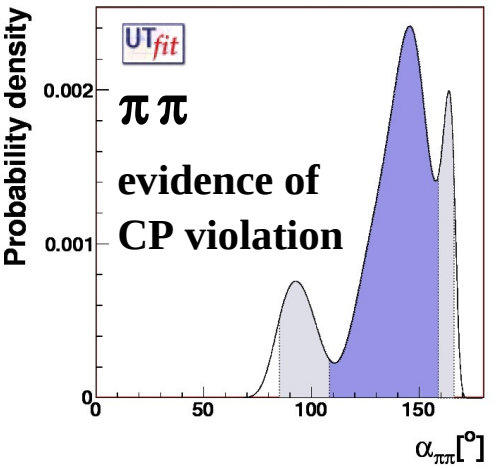
$\Delta S = 0.000 \pm 0.012$

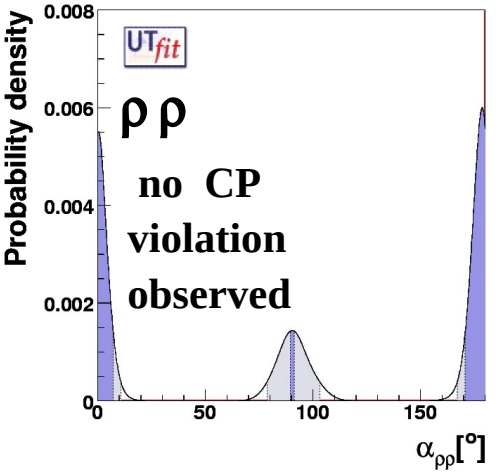
M.Ciuchini, M.Pierini, L.Silvestrini
Phys. Rev. Lett. 95, 221804 (2005)

old numbers

α extraction from the three analyses

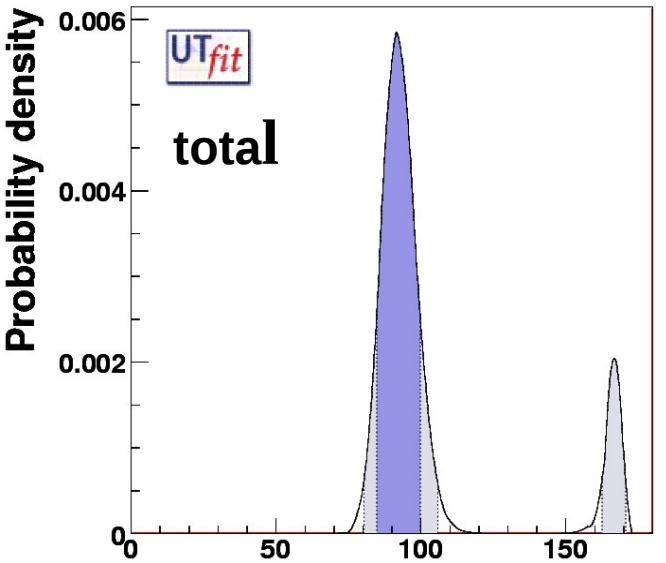


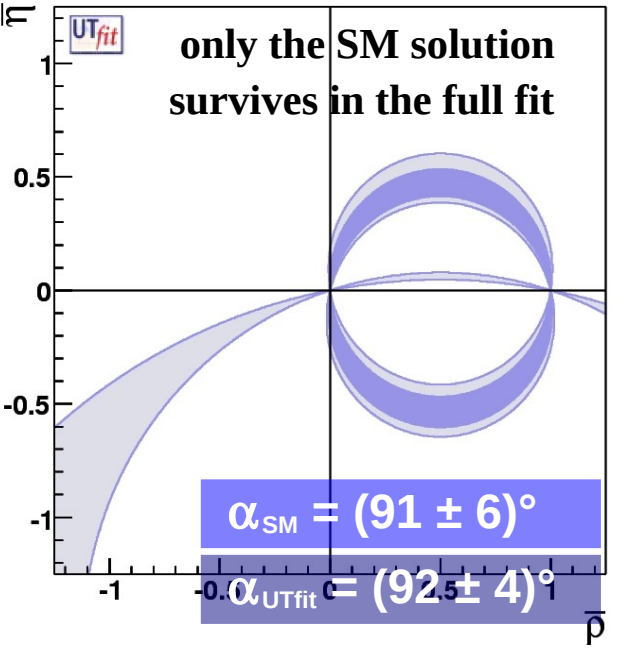


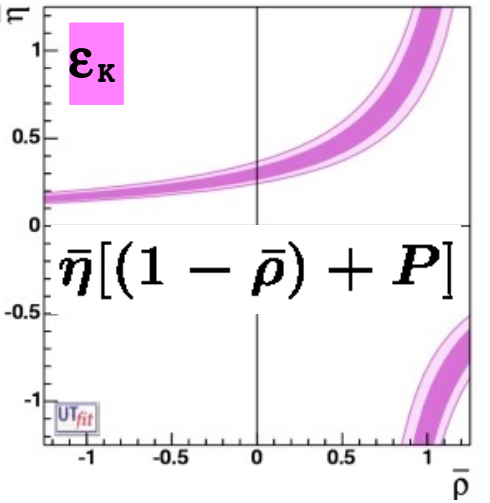


$A = A(\rho^+\pi^-) + A(\rho^-\pi^+) + 2A(\rho^0\pi^0)$
$= (T^{+-} + T^{-+} + 2T^{00})\, e^{2i\alpha}$
$\rightarrow R = \bar{A}/A = e^{2i\alpha}$

no parameterization involved







Buras, Guadagnoli, Isidori

ε_K corrected for measured phase, Im A_0 and LD contributions

- **$F_K = 156.0 \pm 1.3$ MeV**
- **$B_K = 0.731 \pm 0.036$** **Lubicz @ Lattice09**

this decreases the SM prediction for ε_K by ~6%