Status of the CKM fits in the Standard Model

or if you like

Brief summary of the round table

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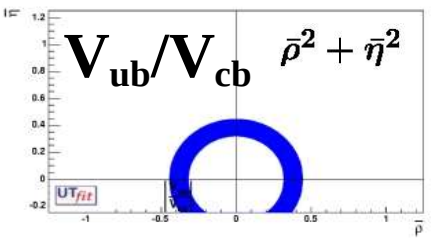
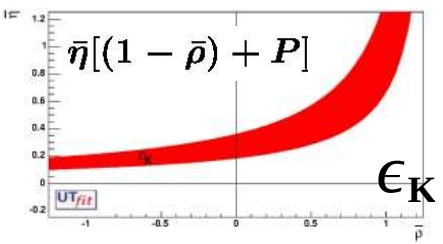
The *standard* inputs

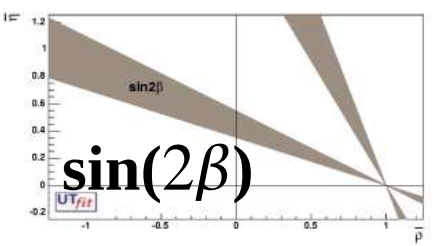
$(b \to u)/(b \to c)$	$\bar{\rho}^2 + \bar{\eta}^2$	$\bar{\Lambda}, \lambda_1, F(1), \ldots$
ϵ_K	$\bar{\eta}[(1-\bar{\rho}) + P]$	B_K
Δm_d	$(1-\bar{\rho})^2 + \bar{\eta}^2$	$f_B^2 B_B$
$\Delta m_d/\Delta m_s$	$(1-\bar{\rho})^2 + \bar{\eta}^2$	ξ
$A_{CP}(J/\psi K_S)$	$\sin 2\beta$	—

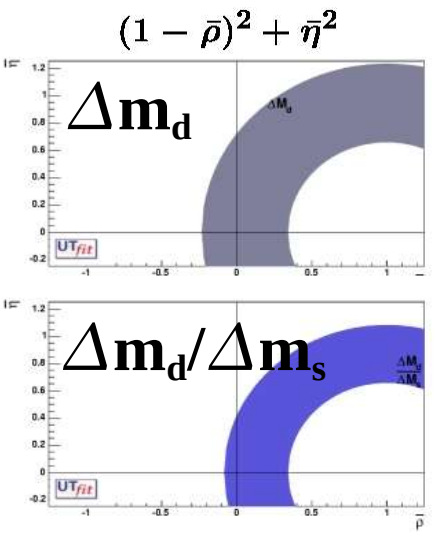
, m_t

Standard Model + OPE/HQET/ Lattice QCD ***to go from quarks to hadrons***









λ	0.2265 ± 0.020	
V_{cb} inclusive	$41.4 \pm 0.7 \pm 0.6 \cdot 10^{-3}$	average from inclusive
V_{cb} exclusive	$42.1 \pm 1.1 \pm 1.9 \cdot 10^{-3}$	average from exclusive
V_{ub} inclusive LEP	$4.09 \pm 0.62 \pm 0.47 \cdot 10^{-3}$	LEP average
V_{ub} inclusive HFAG	$4.70 \pm 0.44 \cdot 10^{-3}$	HFAG Winter 04
V_{ub} exclusive	$3.30 \pm 0.24 \pm 0.46 \cdot 10^{-3}$	
Δm_d	$0.502 \pm 0.007\ ps^{-1}$	LEP/SLD/CDF/B-Factories
Δm_s	$> 14.5\ ps^{-1}$	LEP/SLD/CDF
m_t	$168.5 \pm 4.1\ GeV$	CDF/D0
m_c	$1.3 \pm 0.1\ GeV$	
$f_{B_s}\sqrt{\hat{B}_{B_s}}$	$276 \pm 38\ MeV$	Lattice QCD
ξ	$1.24 \pm 0.04 \pm 0.06$	Lattice QCD
B_K	$0.79 \pm 0.04 \pm 0.09$	Lattice QCD
$\sin 2\beta$	0.725 ± 0.037	B-Factories

The two choices are equivalent in principle. But an important issue is the correlation among the errors:

From V. Lubicz's contribution

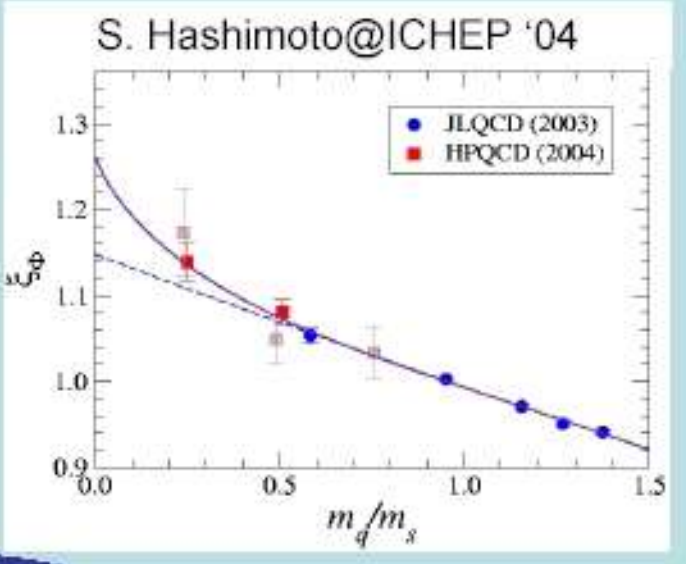
Lattice calculations are mostly done with light quark masses in the region $m_s/2 \le m_q \le m_s$

$$f_{Bs}\sqrt{B_{Bs}} = (276 \pm 38)\ \text{MeV}$$

$$f_{Bd}\sqrt{B_{Bd}} = (223 \pm 33 \pm 12)\ \text{MeV}$$

$$\xi = 1.24 \pm 0.04 \pm 0.06$$

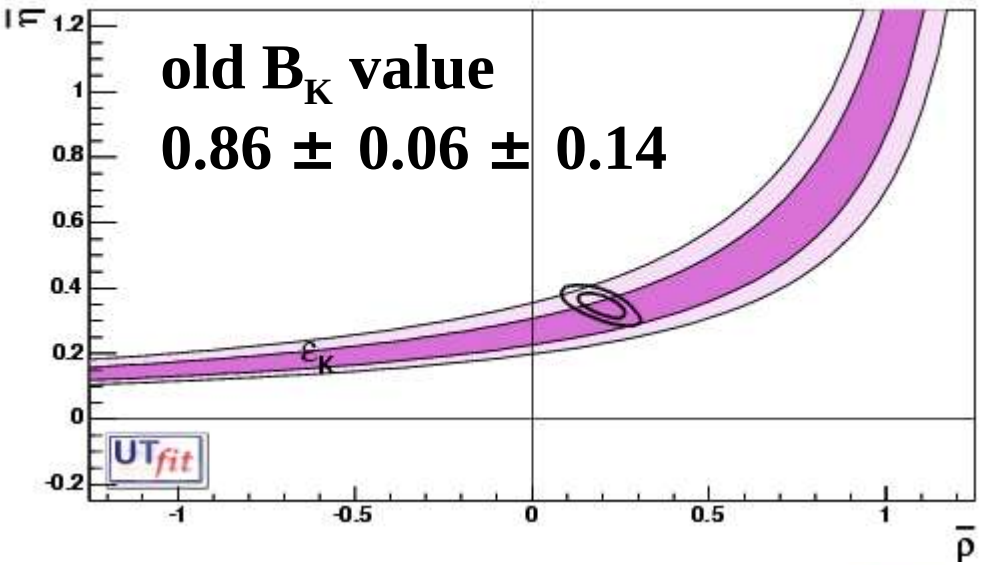
CORRELATED !!

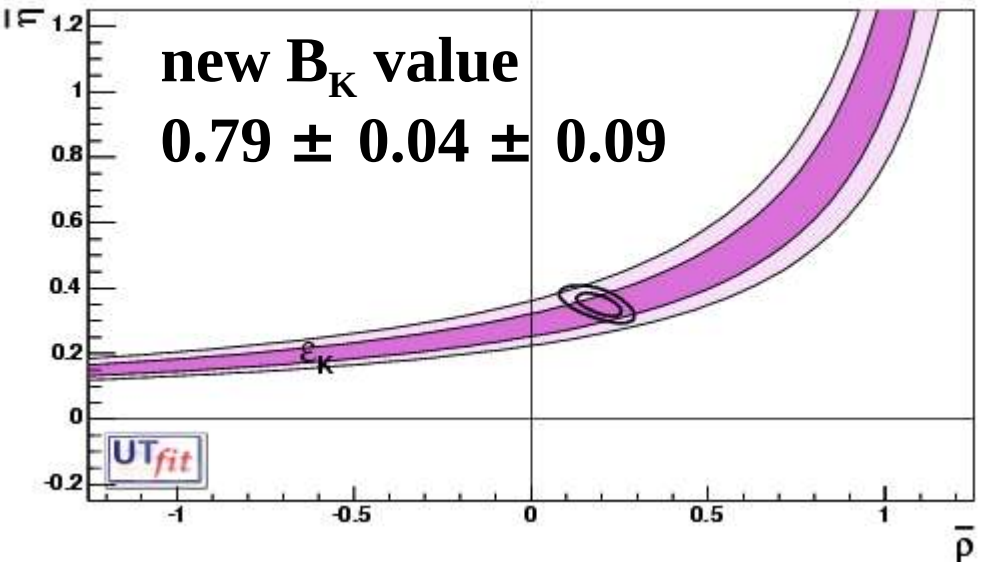


This correlation is difficult to take into account.

Use $f_{Bs}\sqrt{B_{Bs}}$ and ξ

B_K

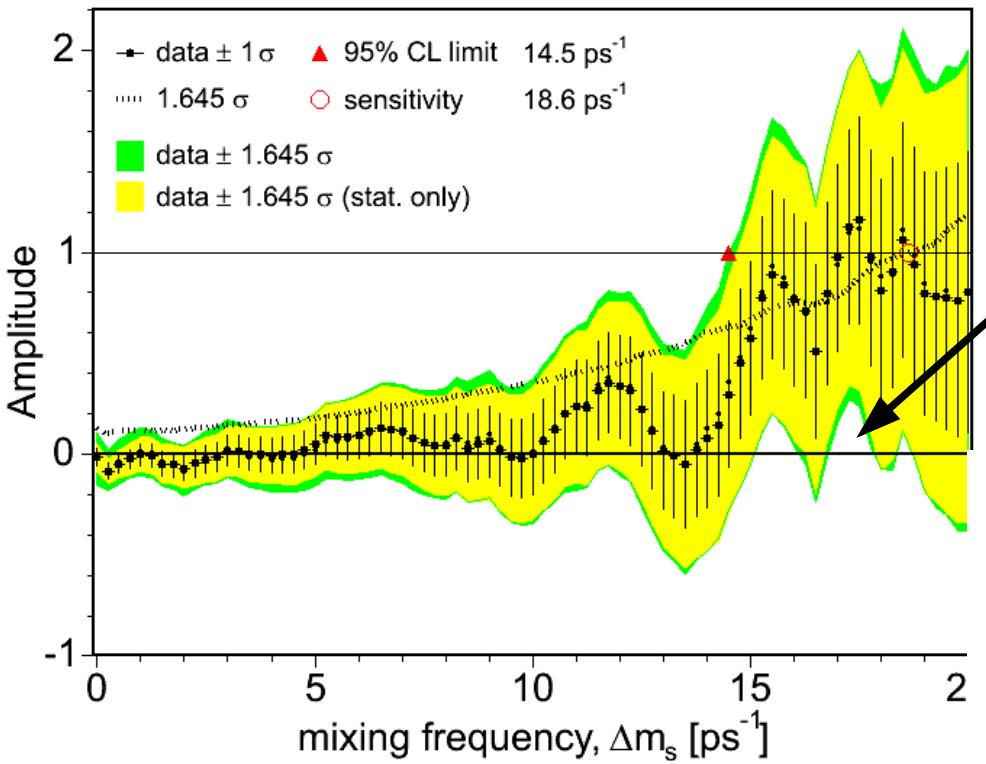

old B_K value
0.86 ± 0.06 ± 0.14
$\bar{\eta}$
$\bar{\rho}$
ε_K
UTfit


new B_K value
0.79 ± 0.04 ± 0.09
$\bar{\eta}$
$\bar{\rho}$
ε_K
UTfit

B Oscillations: Δm_s

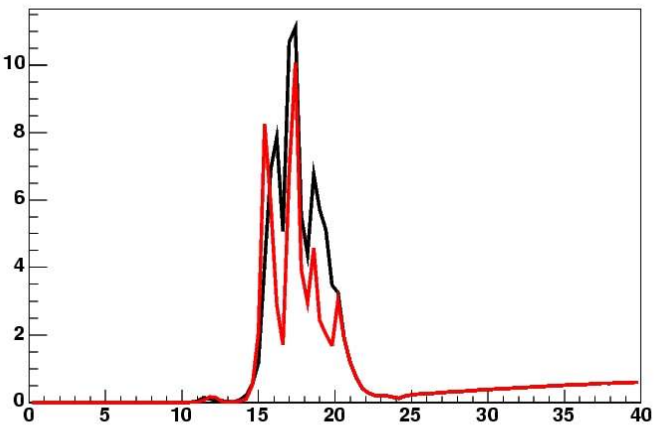
$$P_{B_q^0 \to B_q^0(\bar{B}_q^0)} = \frac{1}{2} e^{-t/\tau_q} (1 \pm A \cos \Delta m_q t)$$

World Average and CDF II



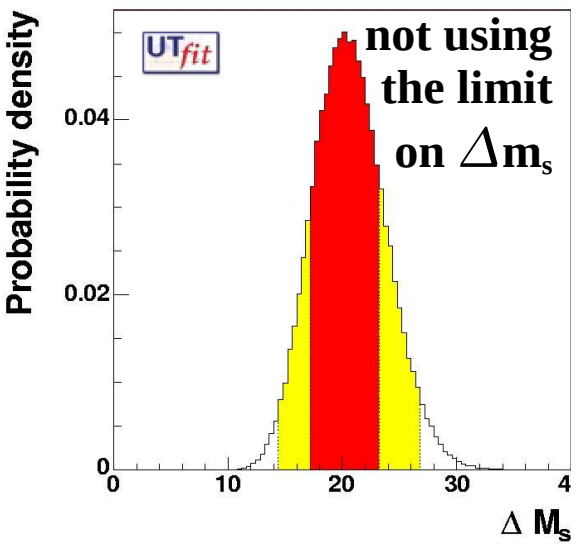
hint **of a signal**
@ $\Delta m_s \sim 17.5$ ps^{-1}
with significance ~2σ

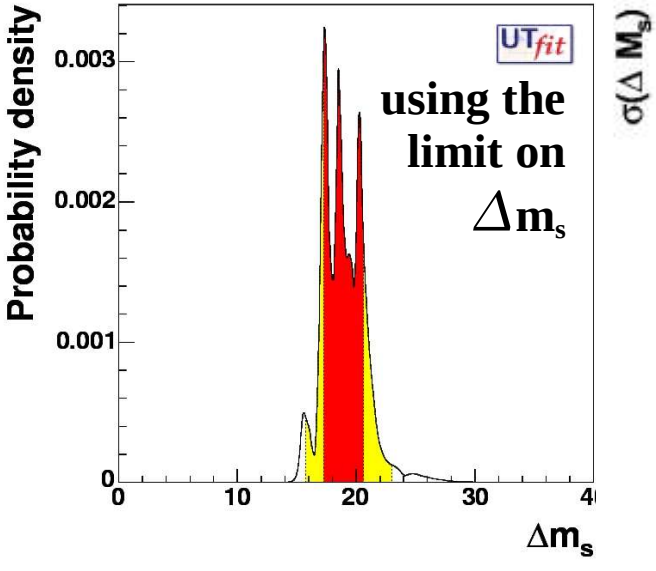
black: pre-CKM2005
red: CKM2005

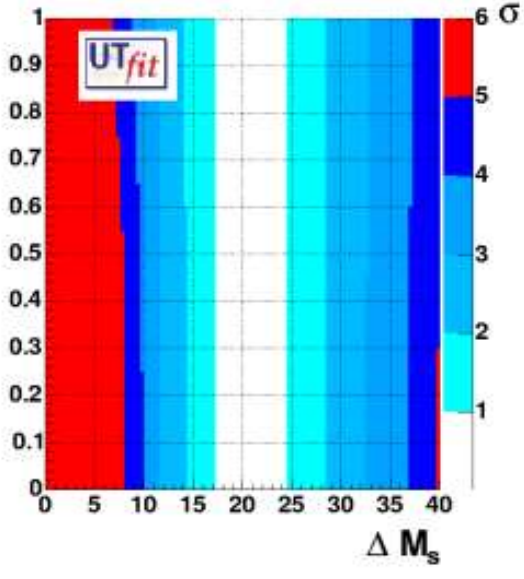


$\Delta m_s > 14.5$ ps^{-1} @ 95% CL
sensitivty @ 18.6 ps^{-1}

Indirect determination and compatibility plot for Δm_s:







$\Delta m_s = 20.5 \pm 3.2$ ps^{-1}
[14.4, 27.1] @ 95% CL

$\Delta m_s = 18.9 \pm 1.6$ ps^{-1}
[15.7, 23.0] @ 95% CL

if $\Delta m_s > 30$ ps^{-1}
new physics @ 3σ

α with SU(2) analysis: $\pi\pi$, $\rho\rho$, $\pi\rho$

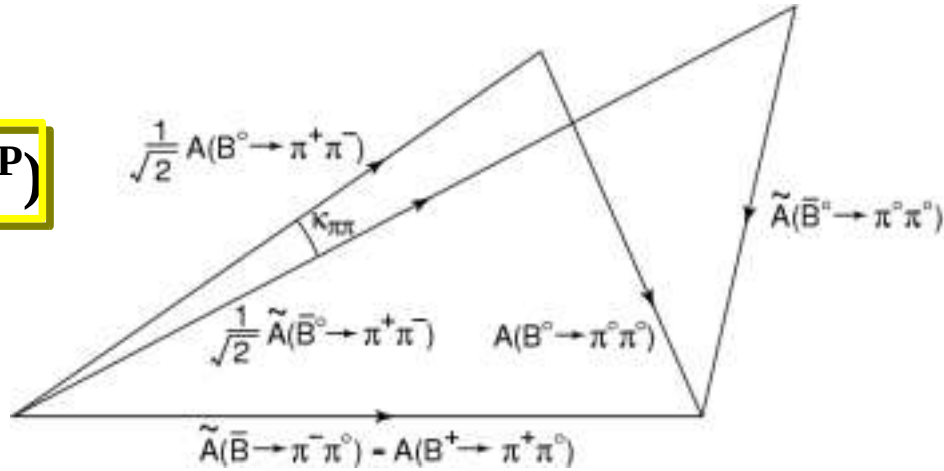
Starting from the SU(2) amplitudes:

Gronau-London, Phys. Rev. Lett. 65, 3381–3384 (1990)

$$A^{+-} = -Te^{-i\alpha} + Pe^{i\delta P}$$

$$A^{+0} = -1/\sqrt{2}\, e^{-i\alpha} (T + T_C e^{i\delta C})$$

$$A^{00} = -1/\sqrt{2}\, (T_C e^{i\delta C} e^{-i\alpha} + Pe^{i\delta P})$$



unknowns: T, P, T_C, δ_P, δ_{T_C}, α

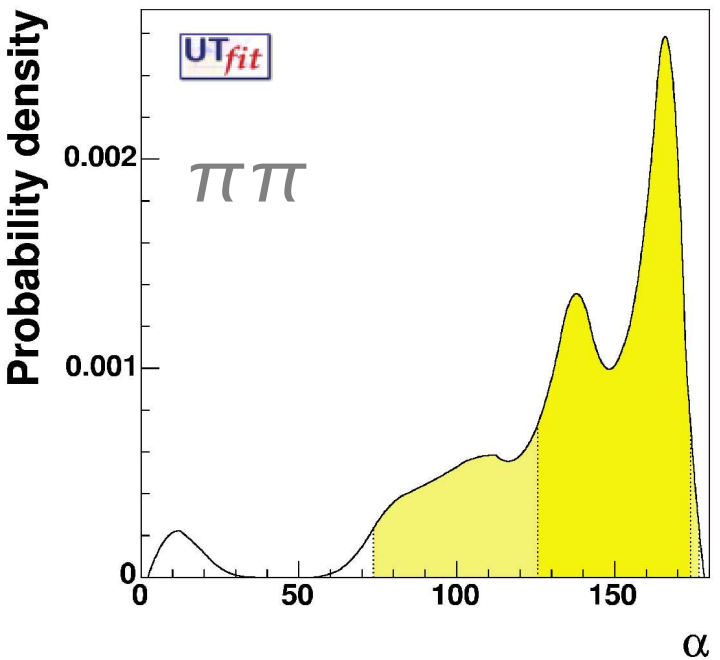
observables: 3x BR, C_{+-}, S_{+-}, C_{00}

$$A^k = T^k e^{-i\alpha} + P^k$$

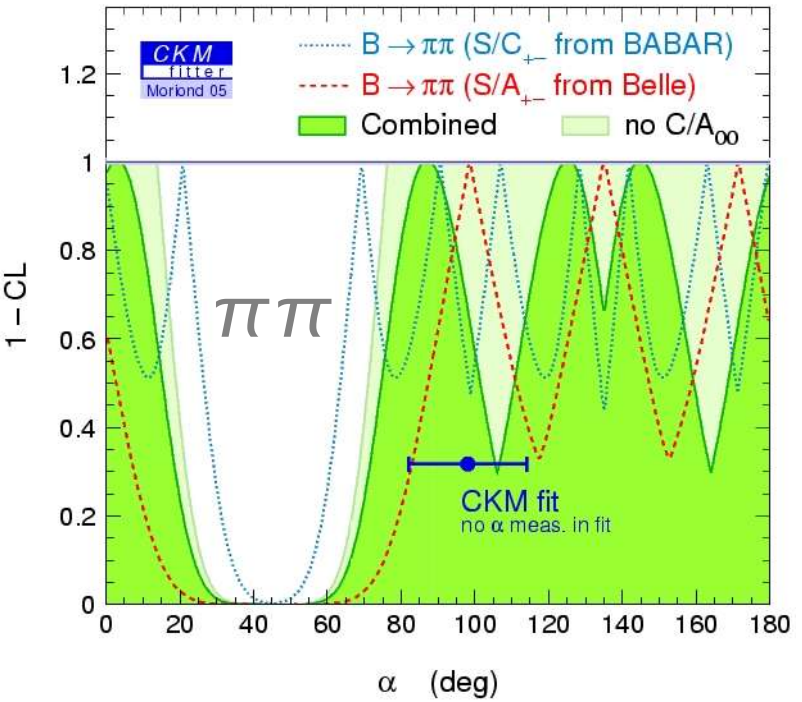
$$\bar{A}^k = T^{\bar{k}} e^{i\alpha} + P^{\bar{k}}$$

with k=+- for $\rho^+\pi^-$, -+ for $\rho^-\pi^+$, and 00 for $\rho^0\pi^0$

α from $\pi\pi$

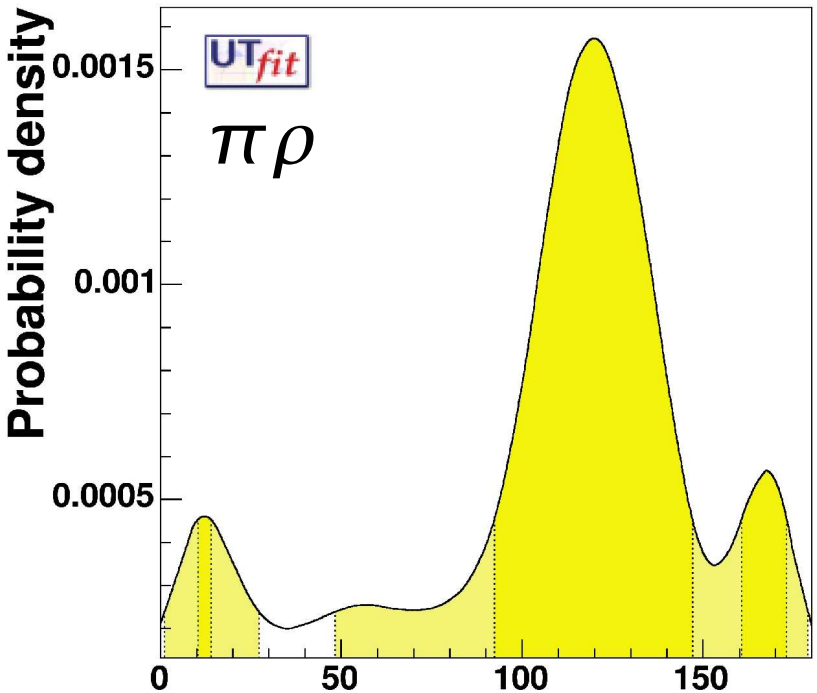


$\alpha > 74°$

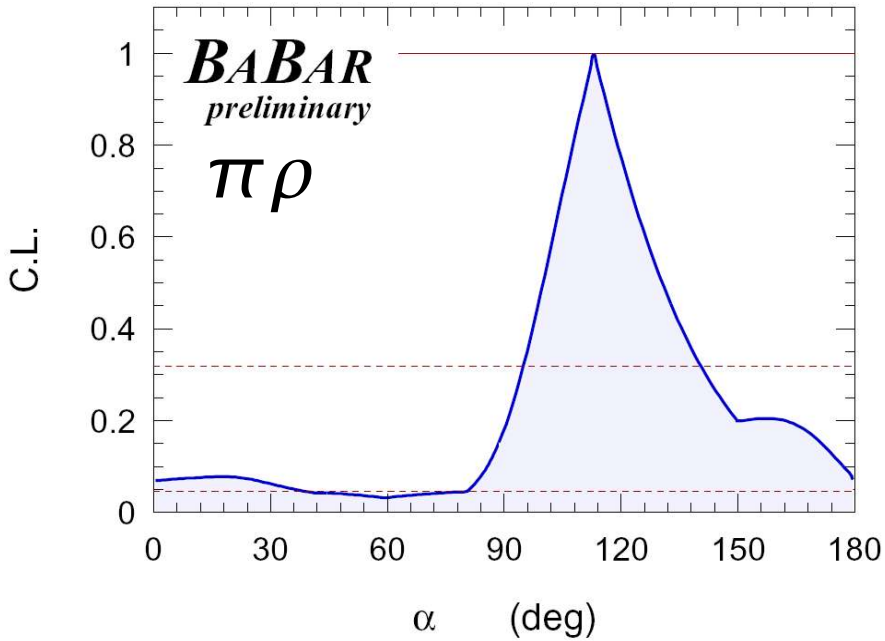


$\alpha < 23°$ **U** $\alpha > 66°$

α from $\rho\pi$

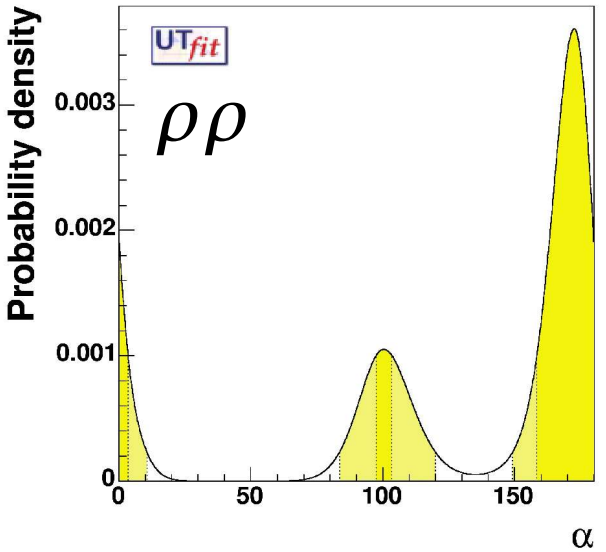


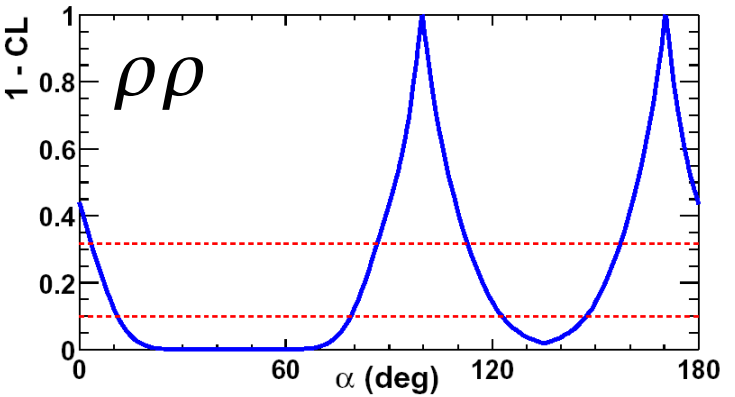
$\alpha = (120 \pm 27)°$



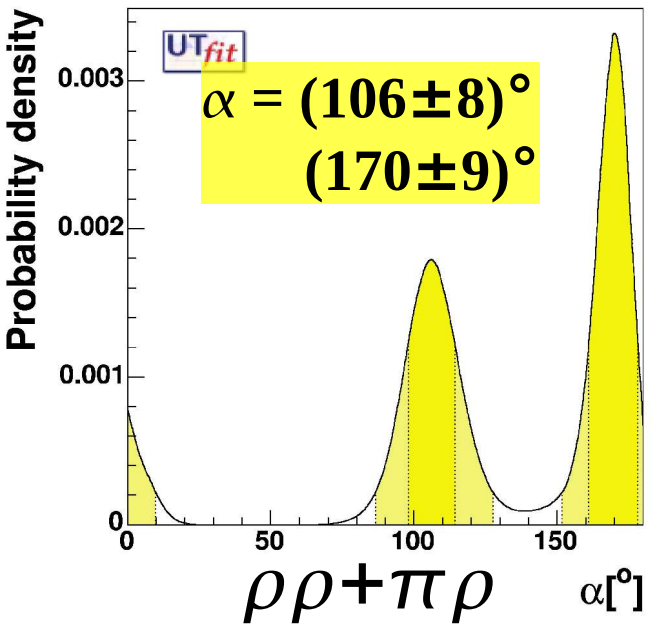
$\alpha = (113^{+27}_{-17} \pm 6)°$

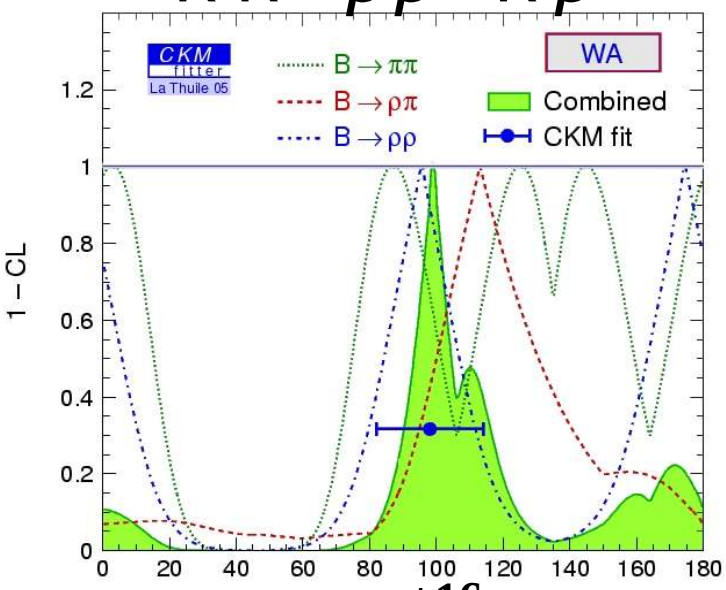
α:





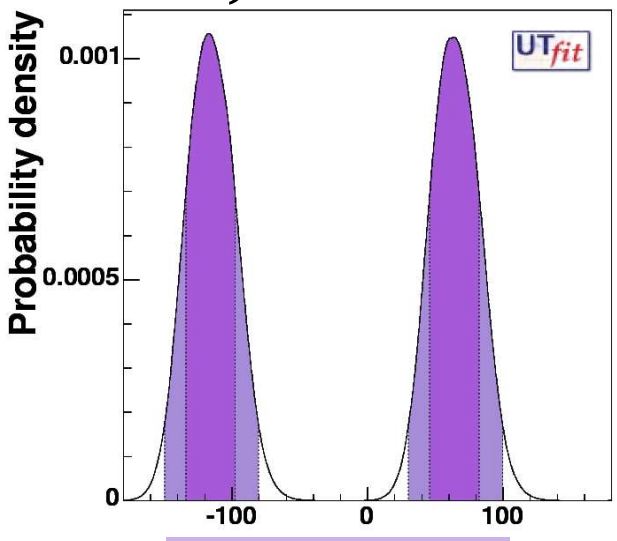
ππ+ρρ+πρ



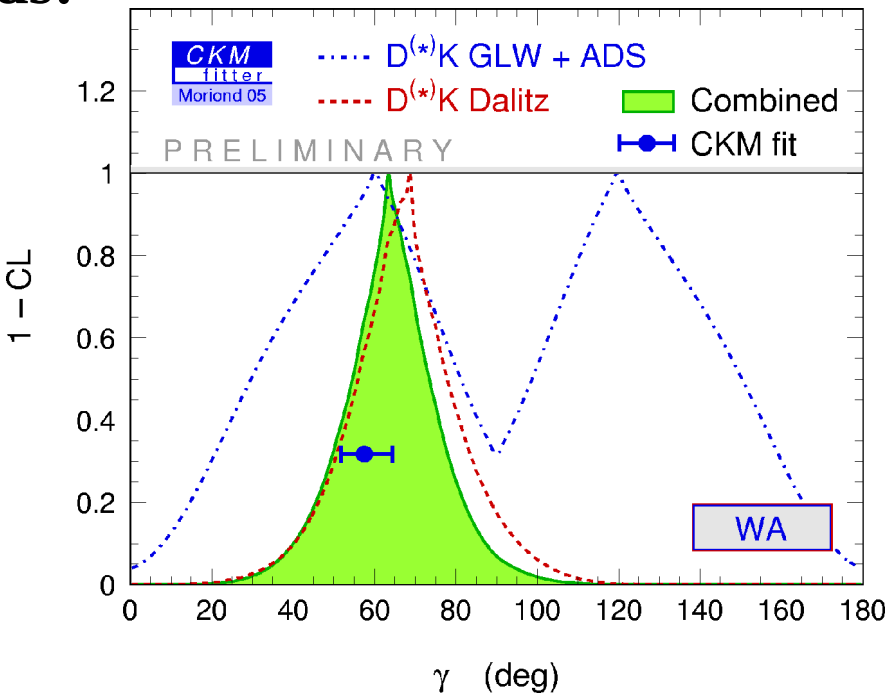


$\alpha = (101^{+16}_{-9})°$

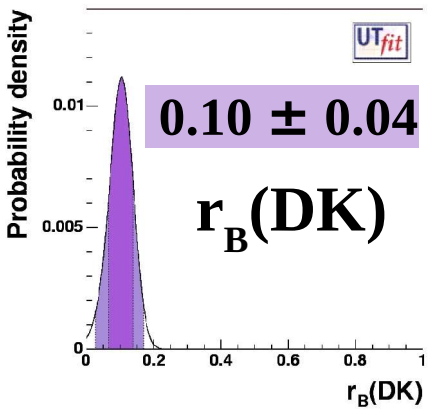
Combining all the methods: ADS, GLW and Dalitz



64° ± 18°

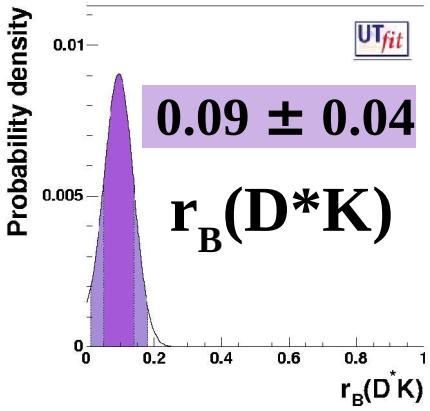


$(63^{+15}_{-13})°$



0.10 ± 0.04

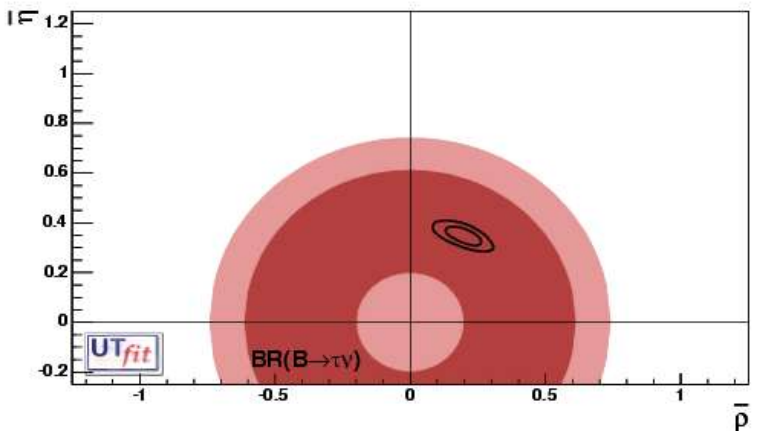
$r_B(DK)$

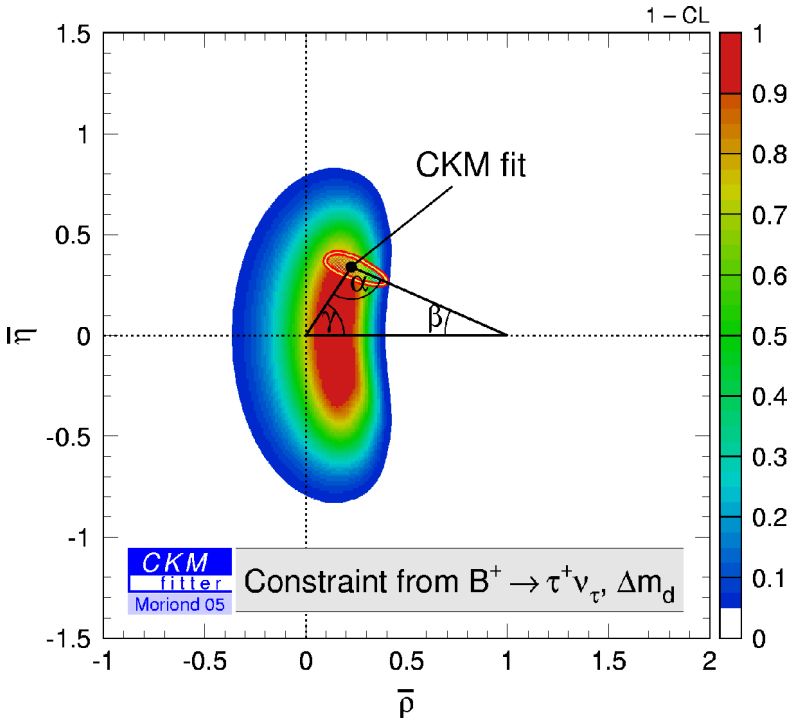


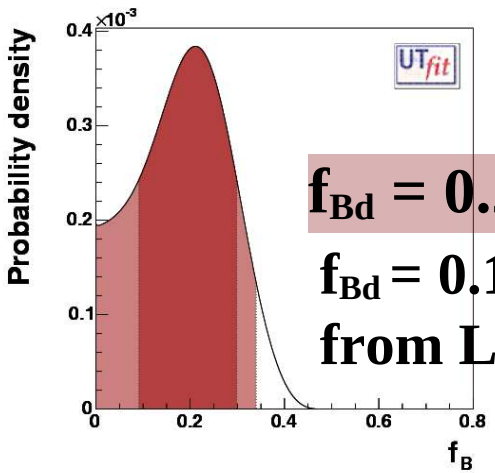
0.09 ± 0.04

$r_B(D^*K)$

$B \to \tau\nu$:

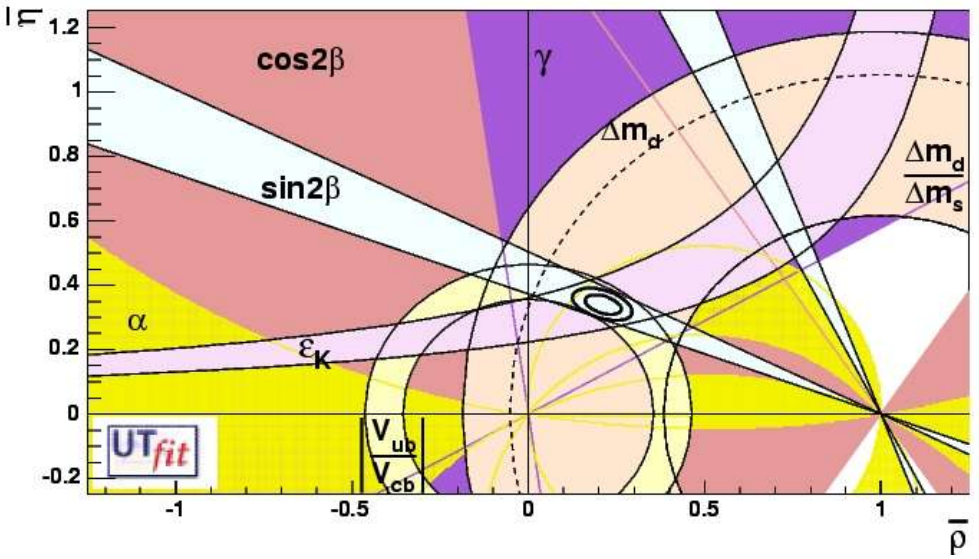


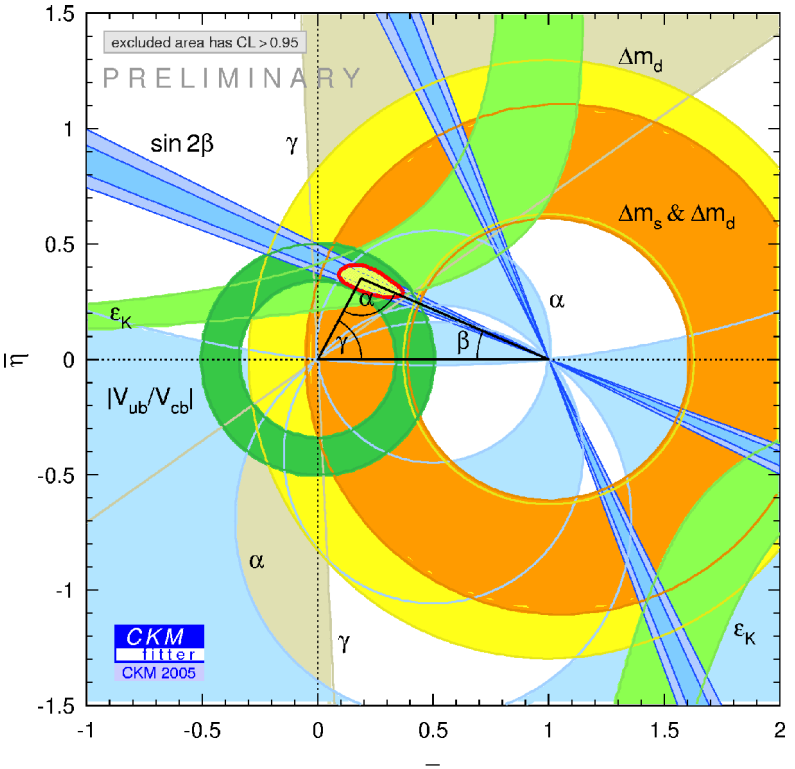




$f_{Bd} = 0.20 \pm 0.10$ GeV

$f_{Bd} = 0.192 \pm 0.026 \pm 0.009$ GeV from Lattice QCD





$\bar{\rho} = 0.210 \pm 0.035$
$[0.139, 0.276]$ @ 95% CL

$\bar{\eta} = 0.340 \pm 0.020$
$[0.300, 0.380]$ @ 95% CL

$\bar{\rho} = 0.207\ ^{+0.035}_{-0.045}$

$\bar{\eta} = 0.339\ ^{+0.026}_{-0.021}$

Conclusion:

- **New inputs: B_K, Δm_s**
- **Suggestion from Lattice experts: use $F_{Bs}\sqrt{B_{Bs}}$ and xi**
- **new result for B to tn to be seen in the fit**
- **new result for K*γ/$\rho\gamma$:**
  - **still in discussion the way to take into account theoretical uncertainties**
- **still some discrepancy in α: investigating.**
- **beautiful results from γ**

Back-up slides