Aspetti teorici della Fisica del Sapore

Two Important Experimental Novelties:

CDF

$$\Delta m_s = (17.77 \pm 0.10 \pm 0.07)\ \text{ps}^{-1}$$

Belle: $(1.79\ ^{+0.56}_{-0.49}\ ^{+0.39}_{-0.46}) \times 10^{-4}$

BaBar: $(0.88\ ^{+0.68}_{-0.67}\ 0.11) \times 10^{-4}$

Average: $(1.31 \pm 0.48) \times 10^{-4}$

$$\sin 2\beta_{\text{measured}} = 0.726 \pm 0.037 \;\Rightarrow\; 0.675 \pm 0.026$$

STANDARD MODEL

1) Generalities
2) Predictions vs Postdictions
3) Lattice vs angles
4) V_{ub} inclusive, V_{ub} exclusive vs sin 2β
5) Experimental determination of lattice parameters

Flavor Physics Beyond the SM

N(N-1)/2 angles and (N-1)(N-2) /2 phases

N=3 3 angles + 1 phase KM

the phase generates complex couplings i.e. <u>CP violation;</u>

6 masses +3 angles +1 phase = 10 parameters

V_{ud}	V_{us}	V_{ub}
V_{cd}	V_{cs}	V_{cb}
V_{tb}	V_{ts}	V_{tb}

NO Flavour Changing Neutral Currents (FCNC) at Tree Level (FCNC processes are good candidates for observing NEW PHYSICS)

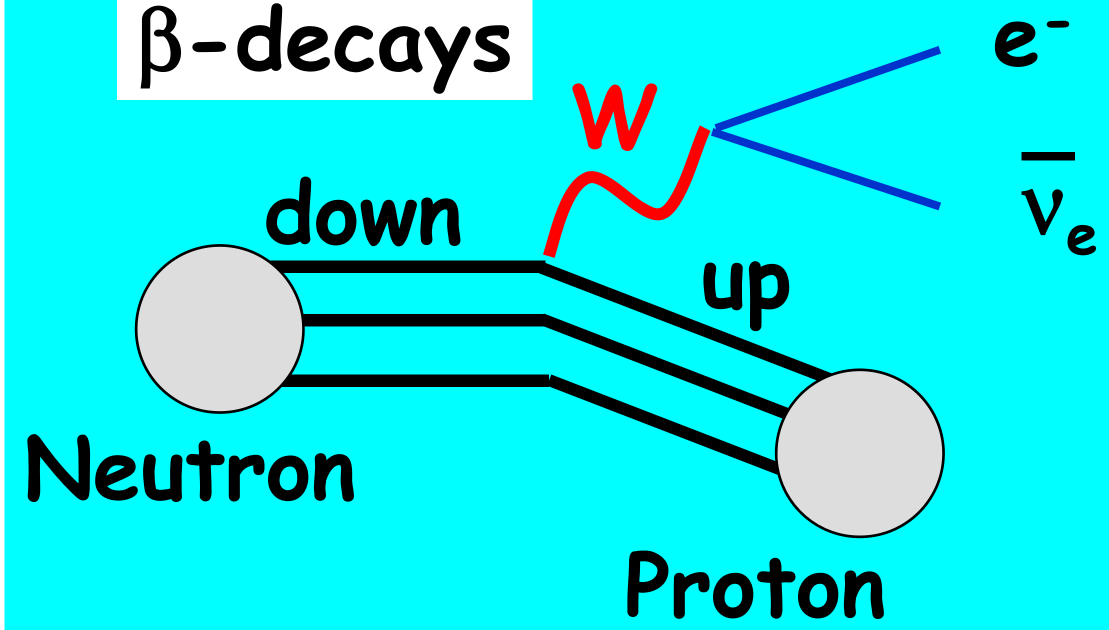
CP Violation is natural with three quark generations (Kobayashi-Maskawa)

With three generations all CP phenomena are related to the same unique parameter (δ)

V_{ud}	V_{us}	V_{ub}
V_{cd}	V_{cs}	V_{cb}
V_{td}	V_{ts}	V_{tb}

Quark masses & Generation Mixing

β-decays



$|V_{ud}|$

$|V_{ud}| = 0.9735(8)$

$|V_{us}| = 0.2196(23)$

$|V_{cd}| = 0.224(16)$

$|V_{cs}| = 0.970(9)(70)$

$|V_{cb}| = 0.0406(8)$

$|V_{ub}| = 0.00409(25)$

$|V_{tb}| = 0.99(29)$
(0.999)

The Wolfenstein Parametrization

$1 - 1/2\,\lambda^2$	λ	$A\,\lambda^3(\rho - i\,\eta)$
$-\lambda$	$1 - 1/2\,\lambda^2$	$A\,\lambda^2$
$A\,\lambda^3 \times (1 - \rho - i\,\eta)$	$-A\,\lambda^2$	1

V_{ub}

$+\,O(\lambda^4)$

V_{td}

$\lambda \sim 0.2 \quad A \sim 0.8$

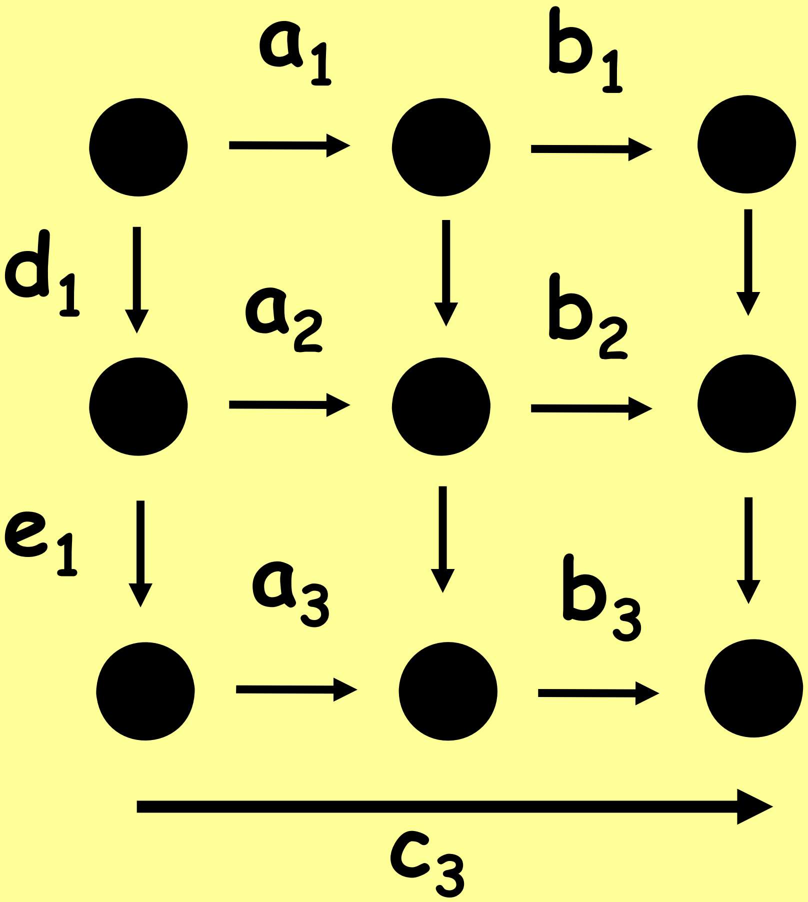
$\eta \sim 0.2 \quad \rho \sim 0.3$

$\sin\theta_{12} = \lambda$

$\sin\theta_{23} = A\,\lambda^2$

$\sin\theta_{13} = A\,\lambda^3(\rho - i\,\eta)$

The Bjorken-Jarlskog Unitarity Triangle



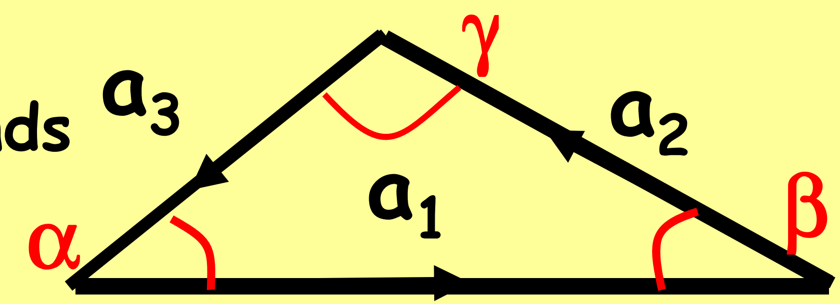
$|V_{ij}|$ is invariant under phase rotations

$a_1 = V_{11} V_{12}^* = V_{ud} V_{us}^*$

$a_2 = V_{21} V_{22}^*$ $\quad a_3 = V_{31} V_{32}^*$

$a_1 + a_2 + a_3 = 0$
$(b_1 + b_2 + b_3 = 0$ etc.)

Only the orientation depends on the phase convention



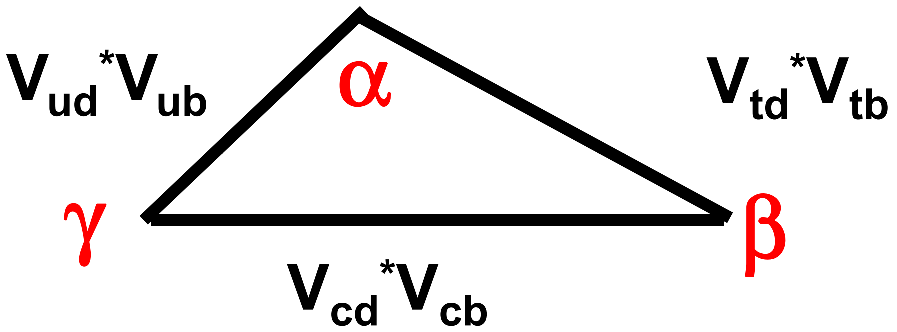
Physical quantities correspond to invariants under phase reparametrization i.e. $|a_1|, |a_2|, \dots, |e_3|$ and the area of the Unitary Triangles

$$J = \mathrm{Im}\,(a_1 a_2^*) = |a_1\ a_2| \,\mathrm{Sin}\,\beta$$

a precise knowledge of the moduli (angles) would fix J

$$\not{CP} \propto J$$

$$V_{ud}^* V_{ub} + V_{cd}^* V_{cb} + V_{td}^* V_{tb} = 0$$

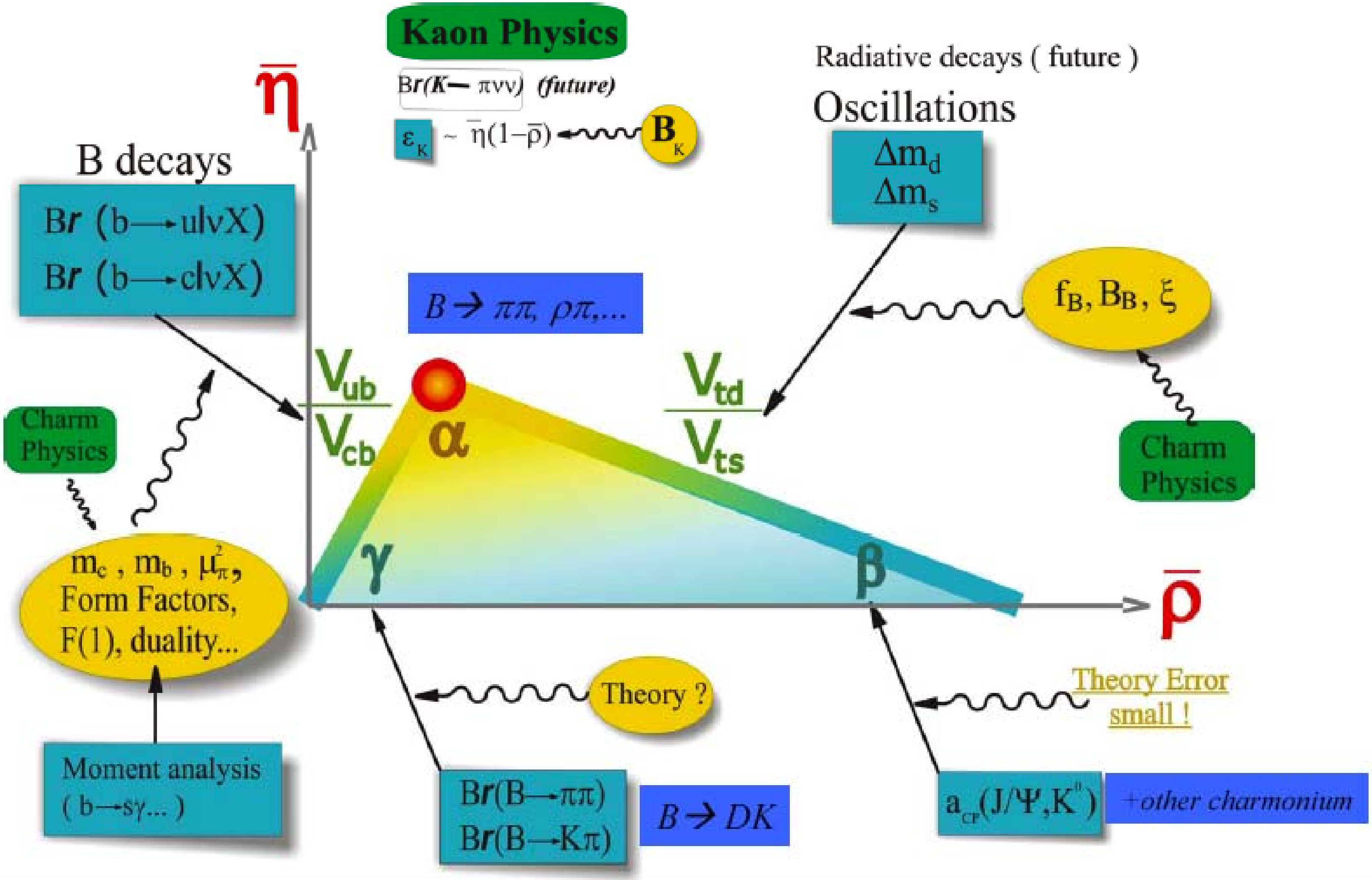


$$\gamma = \delta_{CKM}$$

Visualization of the unitarity of the CKM matrix

Unitarity Triangle in the (ρ–η) plane

From A. Stocchi ICHEP 2002



SEVERAL UNITARITY TRIANGLE ANALYSES, USING METHODS BASED ON THE "BAYESIAN" APPROACH, HAVE BEEN MADE DURING THE LAST DECADE

- ε_K
- Δm_s
- Δm_d
- V_{ub}/V_{cb}

Constraints on the allowed values of

ρ

η A

λ

Measure	V_{CKM}	Other NP parameters
$\Gamma(b \to u)/\Gamma(b \to c)$	$\bar{\rho}^2 + \bar{\eta}^2$	$\bar{\Lambda}, \lambda_1, F(1), \ldots$
ε_K	$\eta[(1-\bar{\rho}) + \ldots]$	B_K
Δm_d	$(1-\bar{\rho})^2 + \bar{\eta}^2$	$f_{B_d}^2 B_{B_d}$
$\Delta m_d / \Delta m_1$	$(1-\bar{\rho})^2 + \bar{\eta}^2$	ξ
$A_{CP}(B_d \to J/\psi K_s)$	$\sin 2\beta$	$-$

$$Q^{EXP} = V_{CKM} \times \langle H_F | \hat{O} | H_I \rangle$$

For details see:
UTfit Collaboration
hep-ph/0501199
hep-ph/0509219
hep-ph/0605213
hep-ph/0606167
http://www.utfit.org

sin 2β is measured directly from $B \to J/\psi K_s$ decays at Babar & Belle

$$A_{J/\psi K_s}(t) = \frac{\Gamma(B_d^0 \to J/\psi K_s, t) - \Gamma(\bar{B}_d^0 \to J/\psi K_s, t)}{\Gamma(B_d^0 \to J/\psi K_s, t) + \Gamma(\bar{B}_d^0 \to J/\psi K_s, t)}$$

$$A_{J/\psi K_s} = \sin 2\beta \;\; \sin(\Delta m_d t)$$

DIFFERENT LEVELS OF THEORETICAL UNCERTAINTIES (STRONG INTERACTIONS)

1) First class quantities, with reduced or negligible uncertainties

$$A_{CP}(B \to J/\psi K_s) \quad \gamma \ from \ B \to DK$$
$$K^0 \to \pi^0 \nu \bar{\nu}$$

2) Second class quantities, with theoretical errors of O(10%) or less that ... reliably estimated

$$\varepsilon_K \quad \Delta M_{d,s}$$
$$\Gamma(B \to c, u), \quad K^+ \to \pi^+ \nu \bar{\nu}$$

3) Third class quantities, for which theoretical predictions are model dependent (BBNS, charming, etc.)

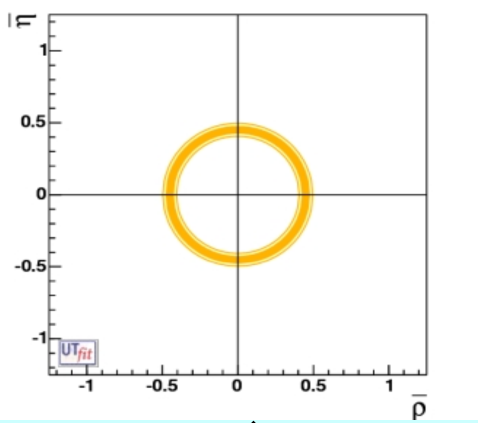
$$B \to K \pi \quad B \to \pi^0 \pi^0$$
$$B \to \phi K_s$$

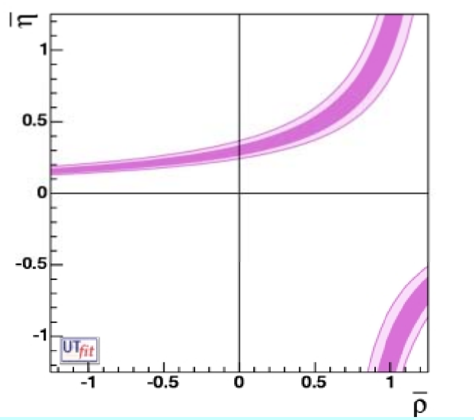
In case of discrepacies we cann... tell whether is *new physics or* *we must blame the model*

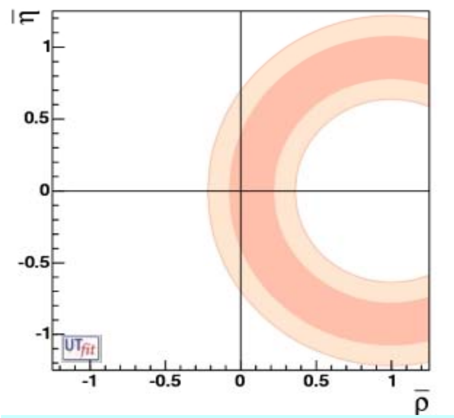
Classical Quantities used in the Standard UT Analysis

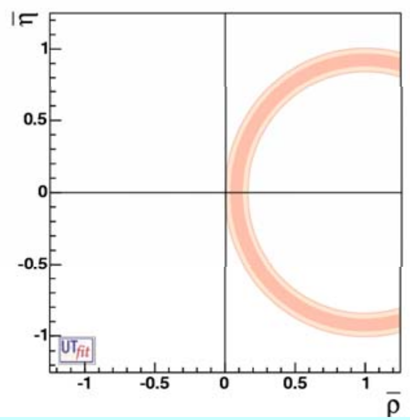
levels @
68% (95%) CL

V_{ub}/V_{cb}	ε_K	Δm_d	$\Delta m_d/\Delta m_s$







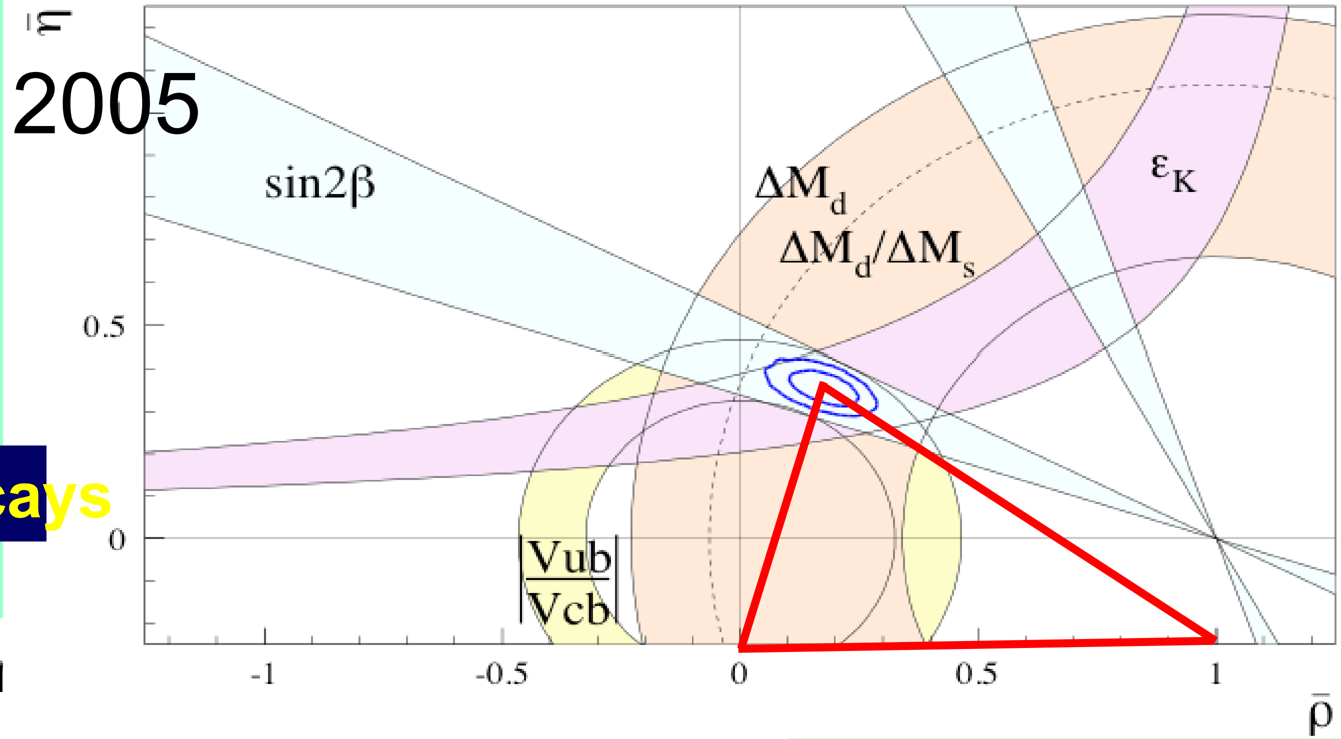


UT-LATTICE

Inclusive vs Exclusive
Opportunity for lattice QCD
see later

NEW !! before
Only a lower bound

Unitary Triangle SM



semileptonic decays

Experimental co

Meas.	$V_{CKM} \times$other	$(\bar\rho, \bar\eta)$
$\frac{b\to u}{b\to c}$	$\|V_{ub}/V_{cb}\|^2$	$\bar\rho^2+\bar\eta^2$
Δm_d	$\|V_{td}\|^2 f^2_{B_d} B_{B_d}$	$(1-\bar\rho)^2+\bar\eta^2$
$\frac{\Delta m_d}{\Delta m_s}$	$\left\|\frac{V_{td}}{V_{ts}}\right\|^2 \xi^2$	$(1-\bar\rho)^2+\bar\eta^2$
ϵ_K	$f(A,\bar\eta,\bar\rho,B_K)$	$\propto \bar\eta(1-\bar\rho)$
$A(J/\psi K^0)$	$sin2\beta$	$\frac{2\bar\eta(1-\bar\rho)}{\sqrt{\bar\eta^2+(1-\bar\rho)^2}}$

K^0 - $\overline{K}^0$ mixing

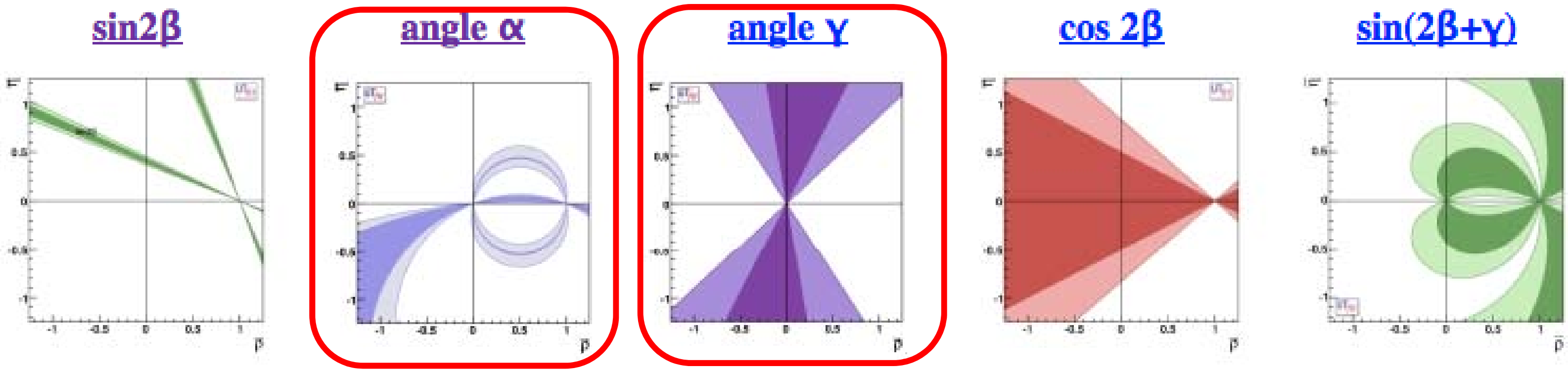
$B^0_{d,s}$ - $\overline{B}^0_{d,s}$ mixing

B_d Asymmetry

New Quantities used in the UT Analysis

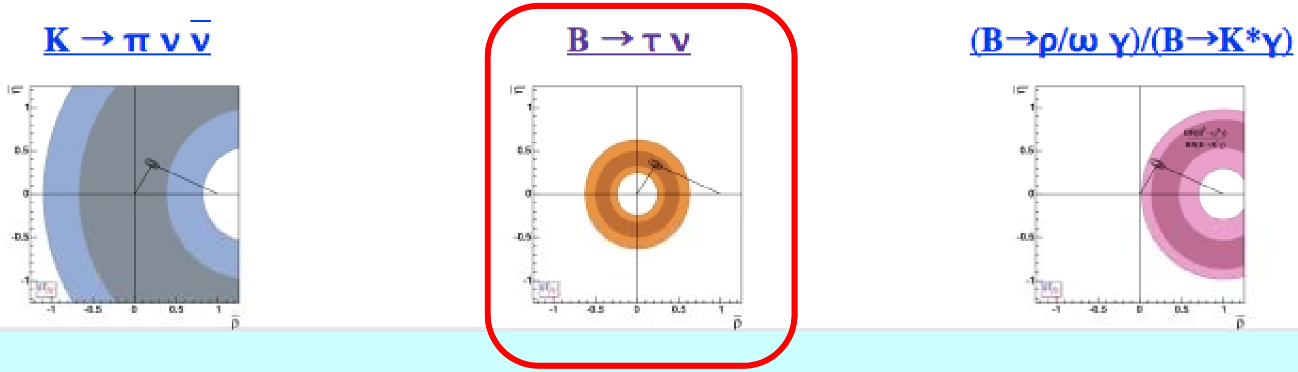
UT-ANGLES

Several new determinations of UT angles are now available, thanks to the results coming from the B-Factory experiments

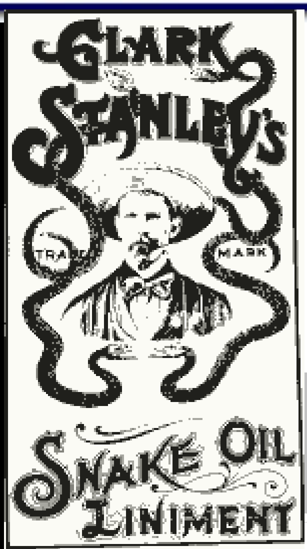


New Constraints from B and K rare decays (not used yet)

New bounds are available from rare B and K decays. They do not still have a strong impact on the global fit and they are not used at present.



THE COLLABORATION



M.Bona, M.Ciuchini, E.Franco, V.Lubicz,

G.Martinelli, F.Parodi,M.Pierini,

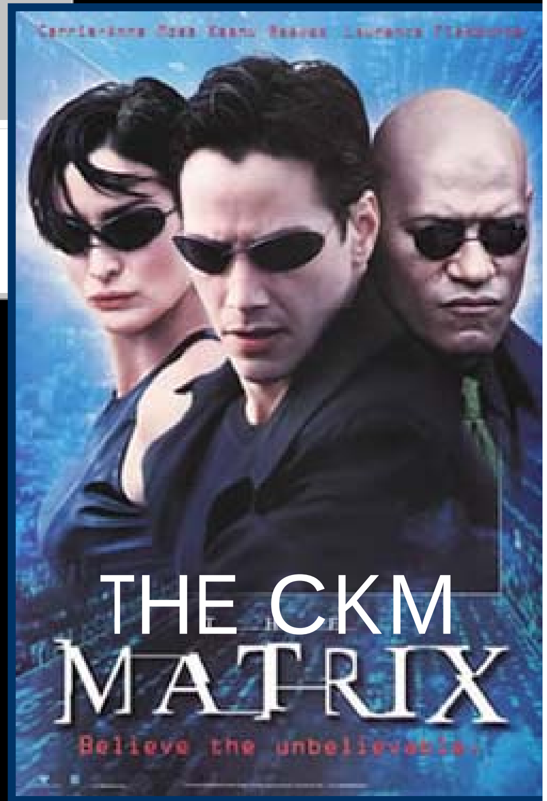
P.Roudeau, C.Schiavi,L.Silvestrini,

V. Sordini, A.Stocchi, V.Vagnoni

Roma, Genova, Annecy, Orsay, Bologna

2006 ANALYSIS

- New quantities e.g. B -> DK included
- Upgraded exp. numbers (after ICHEP)
  - CDF & Belle new measurements

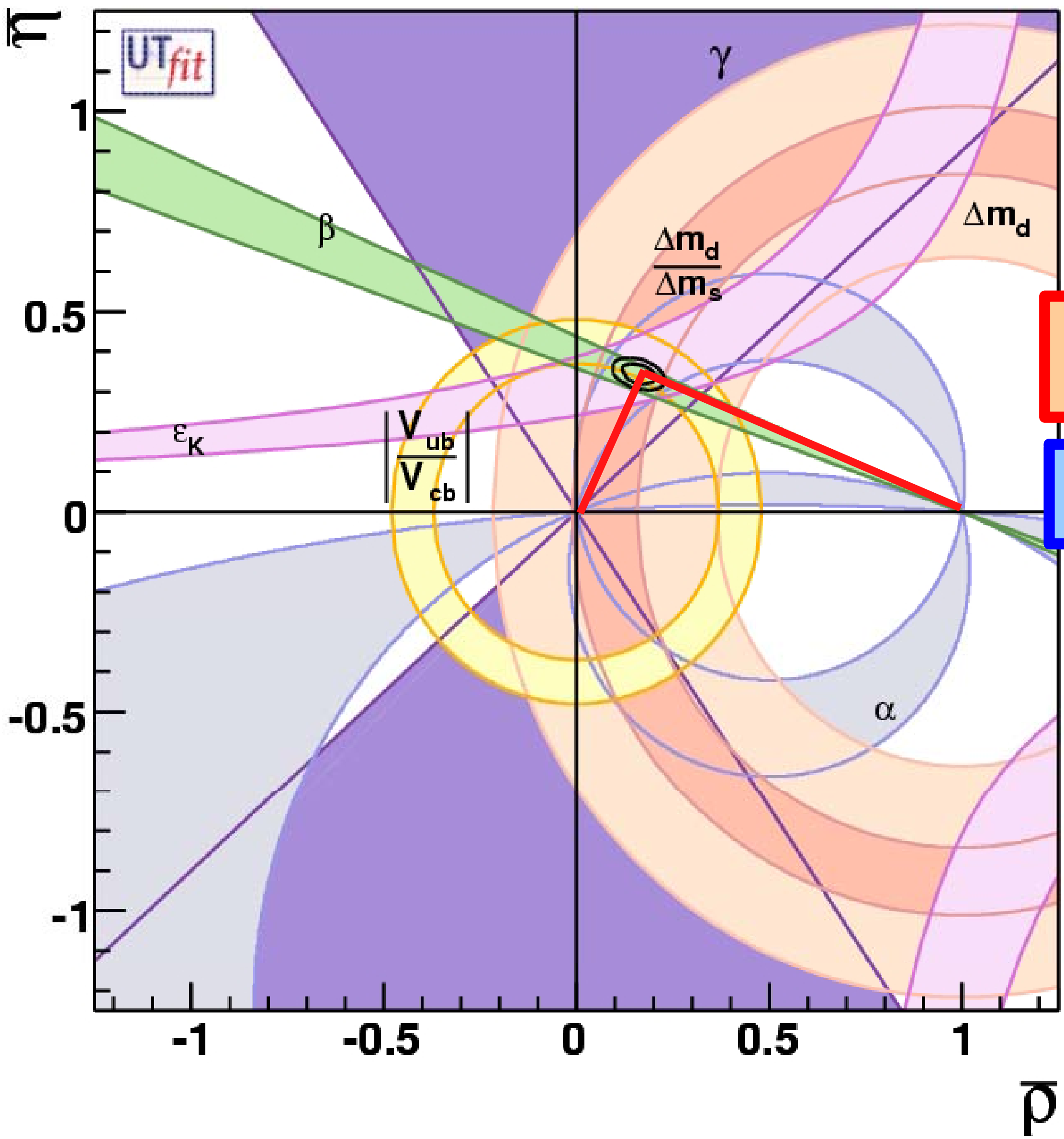


www.utfit.org

Results for ρ and η & related quantities

With the constraint fromΔm_s

contours @ 68% and 95% C.L.



$\rho = 0.163 \pm 0.028$

$\eta = 0.344 \pm 0.016$

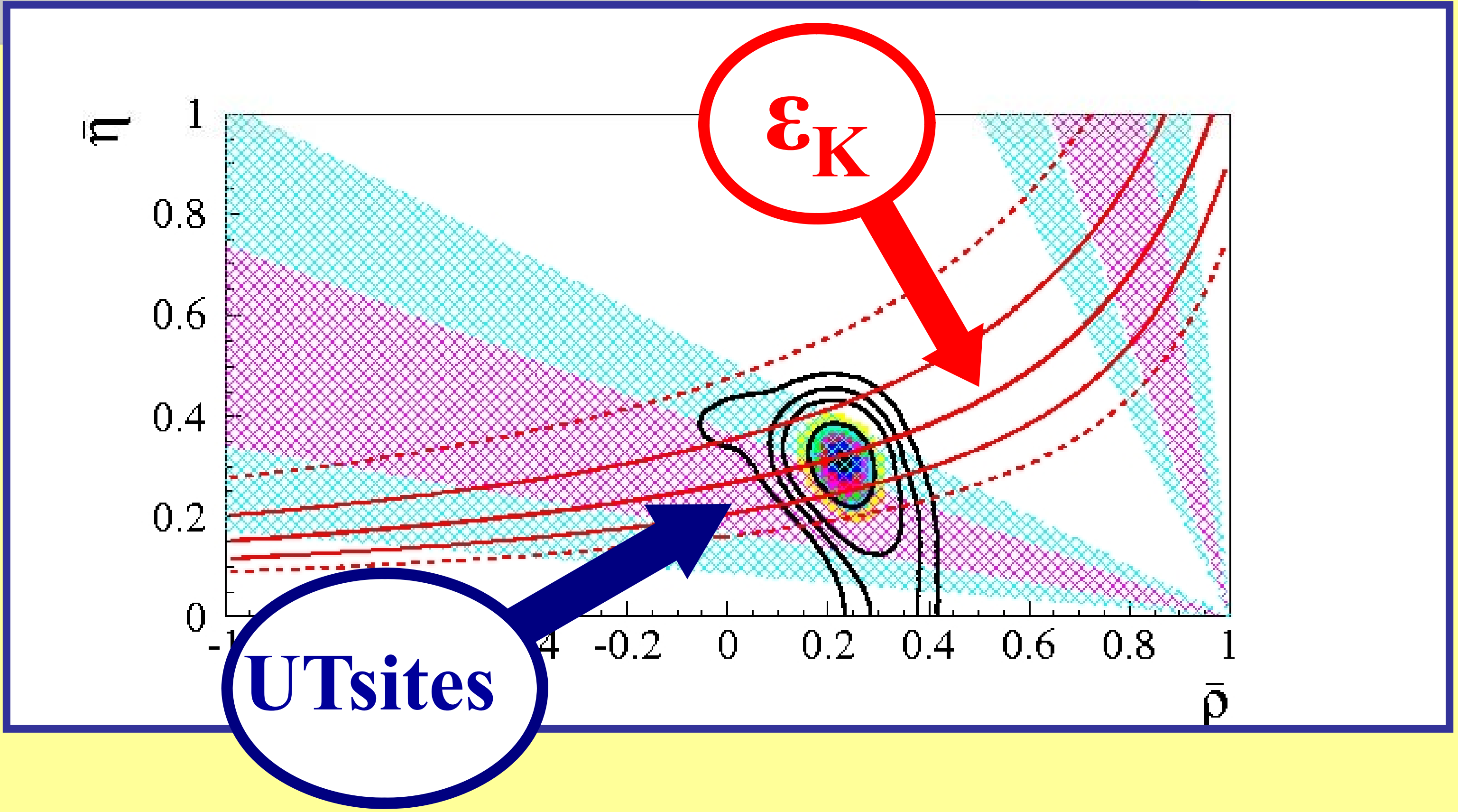
$\alpha = (92.7 \pm 4.2)^0$

$\sin 2\beta = 0.701 \pm 0.022$

A closer look to the analysis:

1) **Predictions vs Postdiction**
2) **Lattice vs angles**
3) **V_{ub} inclusive, V_{ub} exclusive vs sin 2β**
4) **Experimental determination of lattice parameters**

CKM origin of CP Violation in $K^0 - \bar{K}^0$ Mixing



Ciuchini et al. ("pre-UTFit"),2000

Comparison of sin 2 β from direct measurements (Aleph, Opal, Babar, Belle and CDF) and UT analysis

$$\sin 2\beta_{measured} = \mathbf{0.675 \pm 0.026}$$

$$\sin 2\beta_{UTA} = 0.755 \pm 0.040$$

correlation (tension) with V_{ub}, see later

$$\sin 2\beta_{UTA} = 0.698 \pm 0.066$$

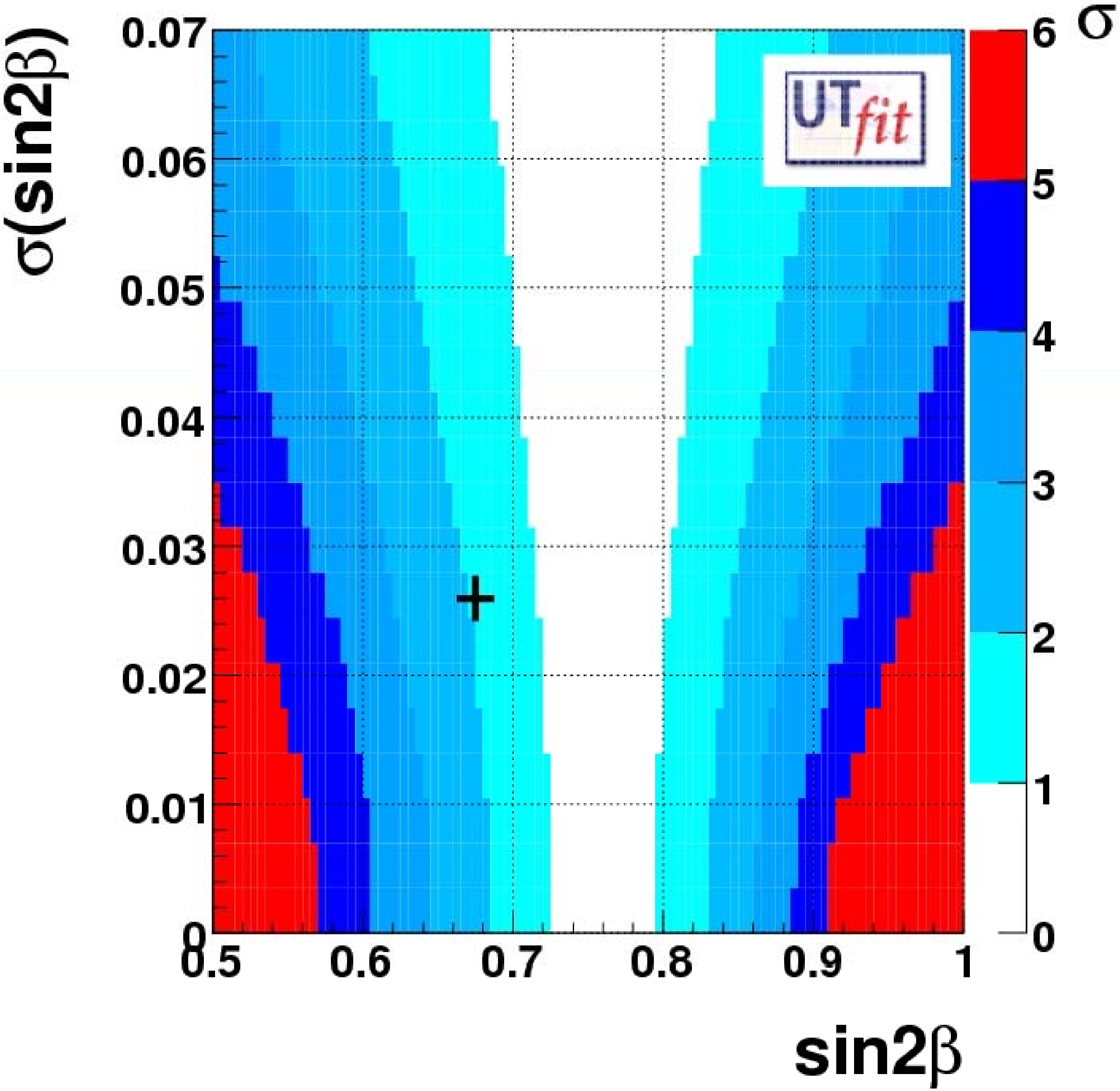
prediction from Ciuchini et al. (2000)

$$\sin 2\beta_{UTA} = 0.65 \pm 0.12$$

Prediction 1995 from Ciuchini,Franco,G.M.,Reina,Silvestrini

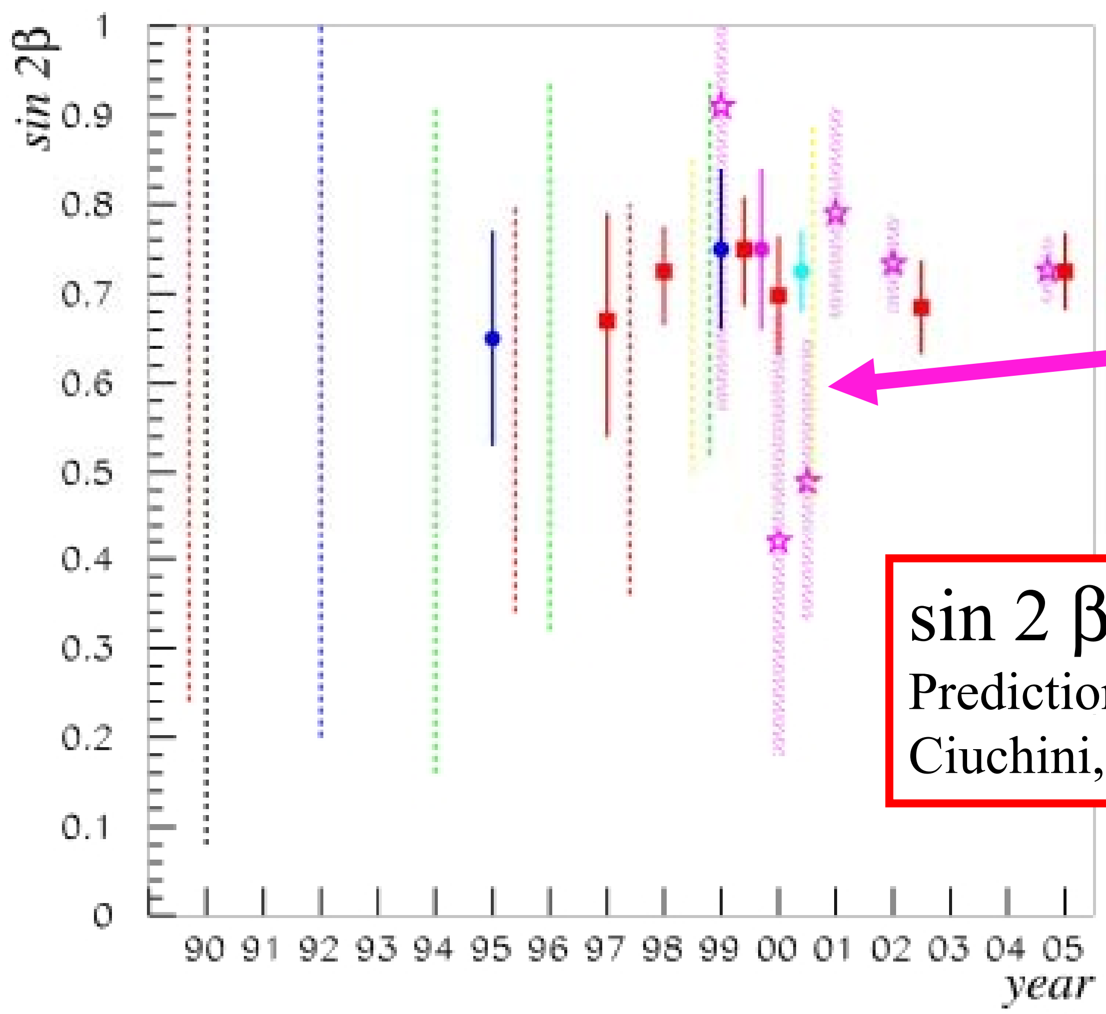
$$\sin 2\beta_{tot} = 0.701 \pm 0.022$$

Very good agreement
no much room for physics beyond the SM !!



σ(sin2β)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.5
0.6
0.7
0.8
0.9
1
sin2β
σ
6
5
4
3
2
1
0
UTfit

Theoretical predictions of Sin 2 β in the years



predictions exist since '95

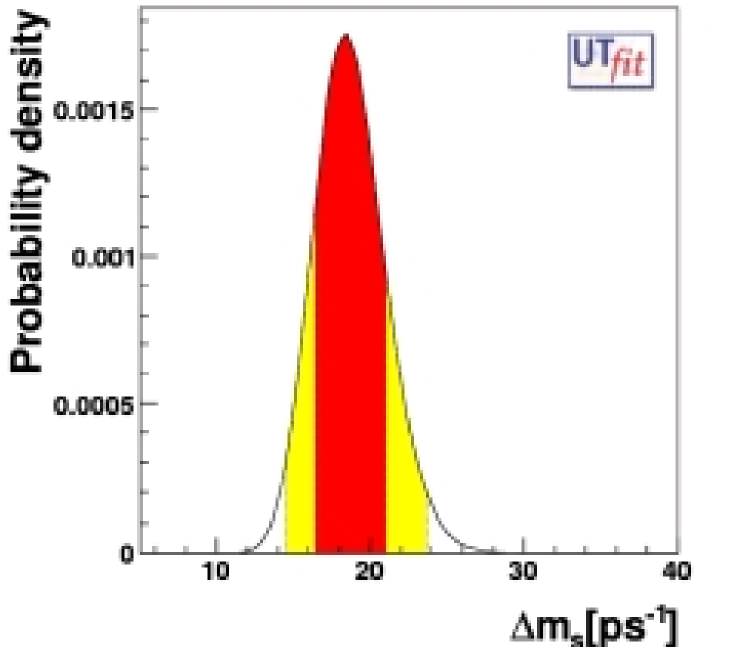
experiments

$\sin 2\beta_{UTA} = 0.65 \pm 0.12$

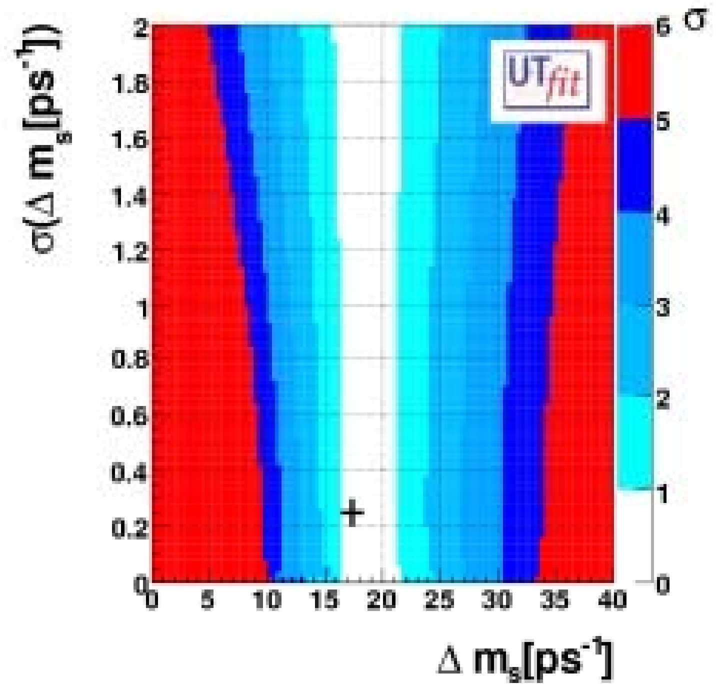
Prediction 1995 from

Ciuchini,Franco,G.M.,Reina,Silvestrini

NEWS from NEWS (Standard Model)



Δm_s Probability Density



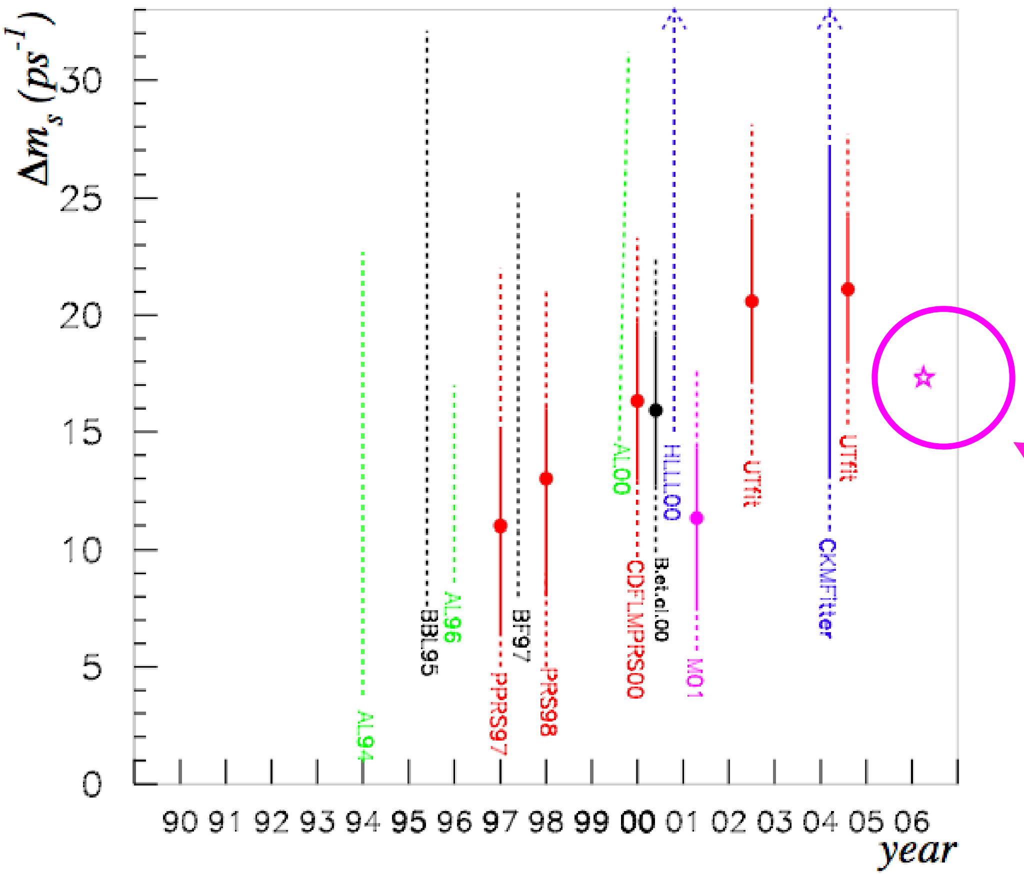
$$\Delta m_s = (16.3 \pm 3.4)\ ps^{-1}$$

Ciuchini et. al. 2000

$$\Delta m_s = 18.4 \pm 2.4\, ps^{-1} \qquad INDIRECT$$

$$\Delta m_s = 17.77 \pm 0.12\, ps^{-1} \qquad DIRECT$$

Theoretical predictions of Δm_s in the years



predictions exist since '97

CDF

A GREAT SUCCESS OF (QUENCHED) LATTICE QCD CALCULATIONS

A closer look to the analysis:

1) Predictions vs Postdictions
2) Lattice vs angles
3) V_{ub} inclusive, V_{ub} exclusive vs sin 2β
4) Experimental determination of lattice parameters

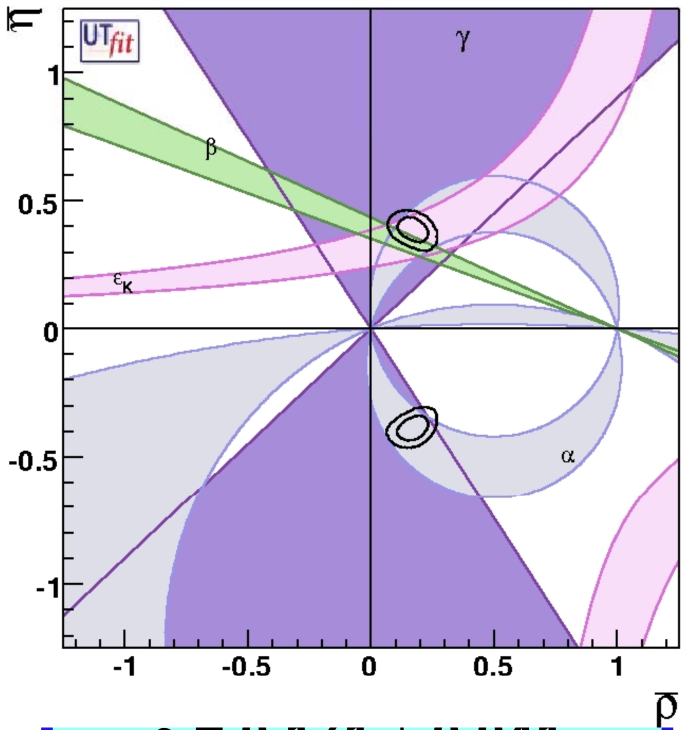
The UT-angles fit does not depend on theoretical calculations (treatement of errors is not an issue)

Comparable accuracy due to the precise sin2β value and substantial improvement due to the new Δm_s measureme

<u>Crucial to improve measurements of the angles, in particular</u> (tree level NP-free determination)

Still imperfect agreement in $\bar{\eta}$ du to sin2β and V_{ub} tension

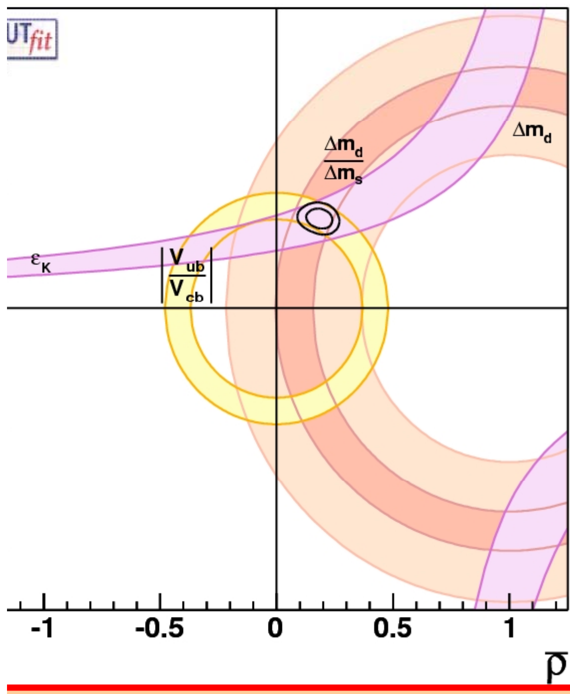
UT-angles



$\rho = 0.171 \pm 0.041$

$\eta = 0.387 \pm 0.031$

UT-lattice



$\rho = 0.188 \pm 0.036$

$\eta = 0.371 \pm 0.027$

ANGLES VS LATTICE

A closer look to the analysis:

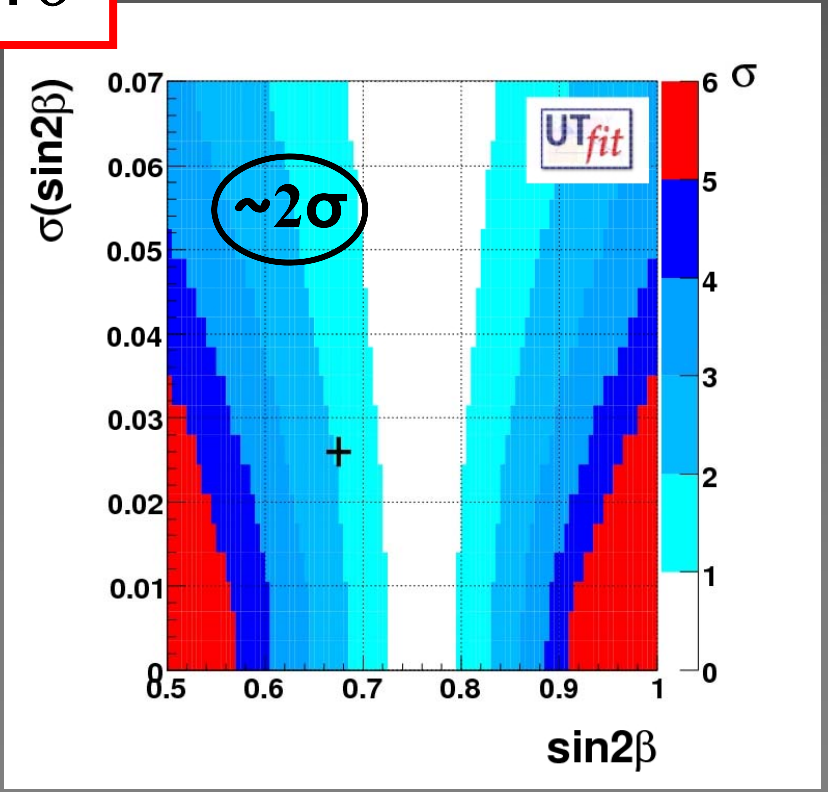
1) Predictions vs Postdictions
2) Lattice vs angles
3) V_{ub} inclusive, V_{ub} exclusive vs sin 2β
4) Experimental determination of lattice parameters

Correlation of $\sin 2\beta$ with V_{ub}

$\sin 2\beta_{measured} = 0.675 \pm 0.026$

$\sin 2\beta_{UTA} = 0.755 \pm 0.040$

Although compatible, these results show that there is a ``tension" . This is due to the correlation of Vub with $\sin 2\beta$



V_{UB} PUZZLE

$\lvert V_{ub}\rvert \times 10^4$	excl.	35.0	4.0	Lattice QCDSR
$\lvert V_{ub}\rvert \times 10^4$	incl.	44.9	3.3	HQET+Model
$\lvert V_{ub}\rvert \times 10^4$	average	40.9	2.5	

Inclusive: uses non perturbative parameters most **not** from lattice QCD (fitted from the lepton spectrum)

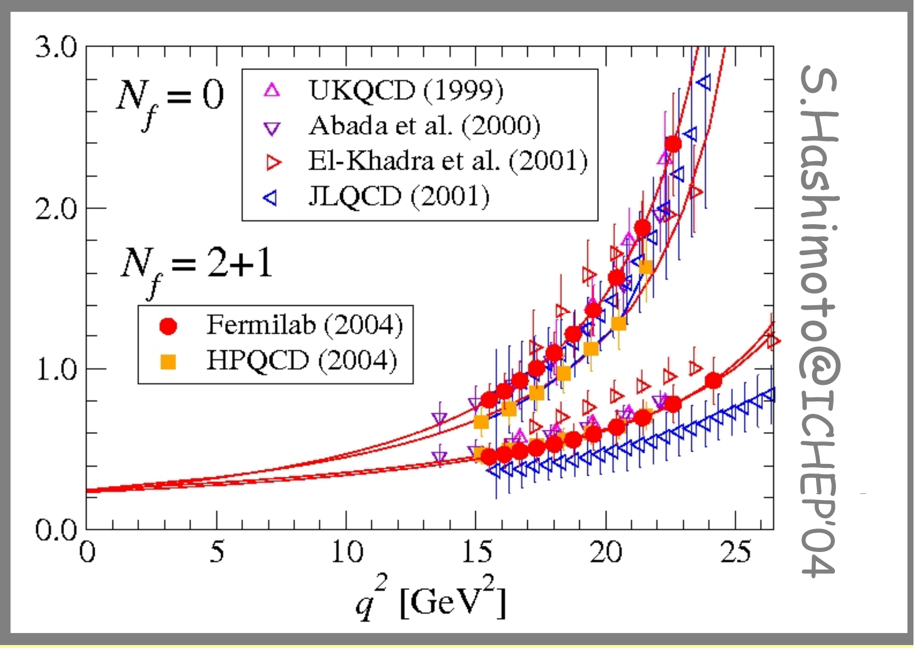
$$\bar{\Lambda} \quad \lambda_1 \sim \frac{\bar{b}\vec{D}^2 b}{2m_b} \quad \lambda_2 \sim \frac{\bar{b}\sigma_{\mu\nu}G^{\mu\nu}b}{2m_b}$$

Exclusive: uses non perturba

form factors

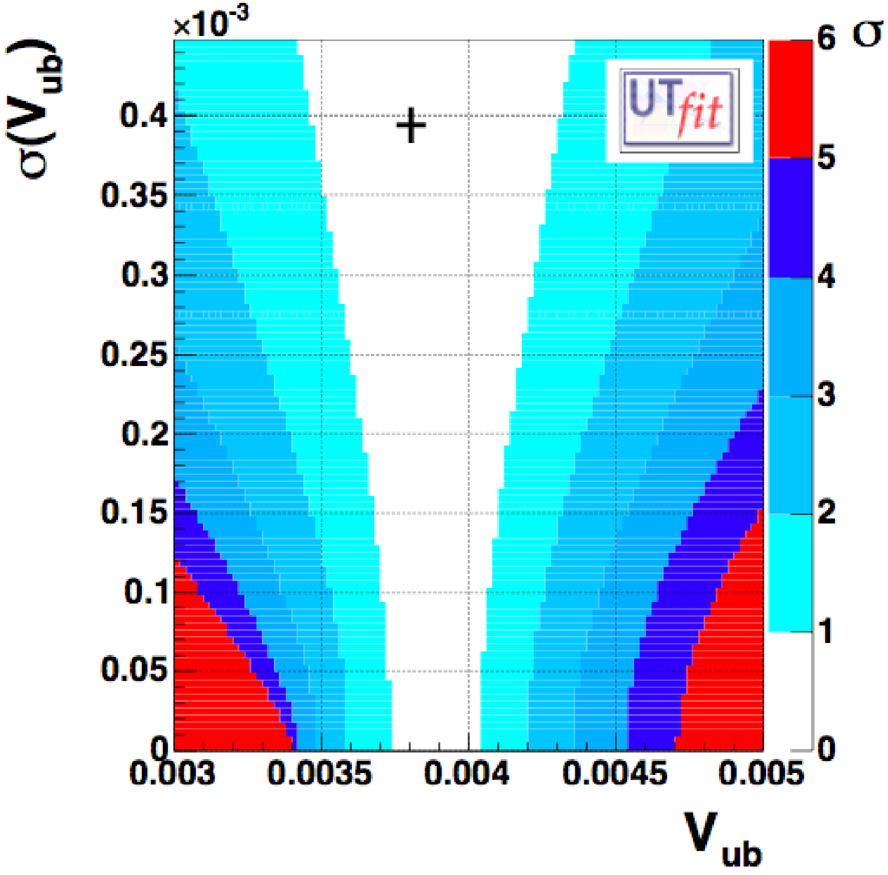
from LQCD and QCDSR

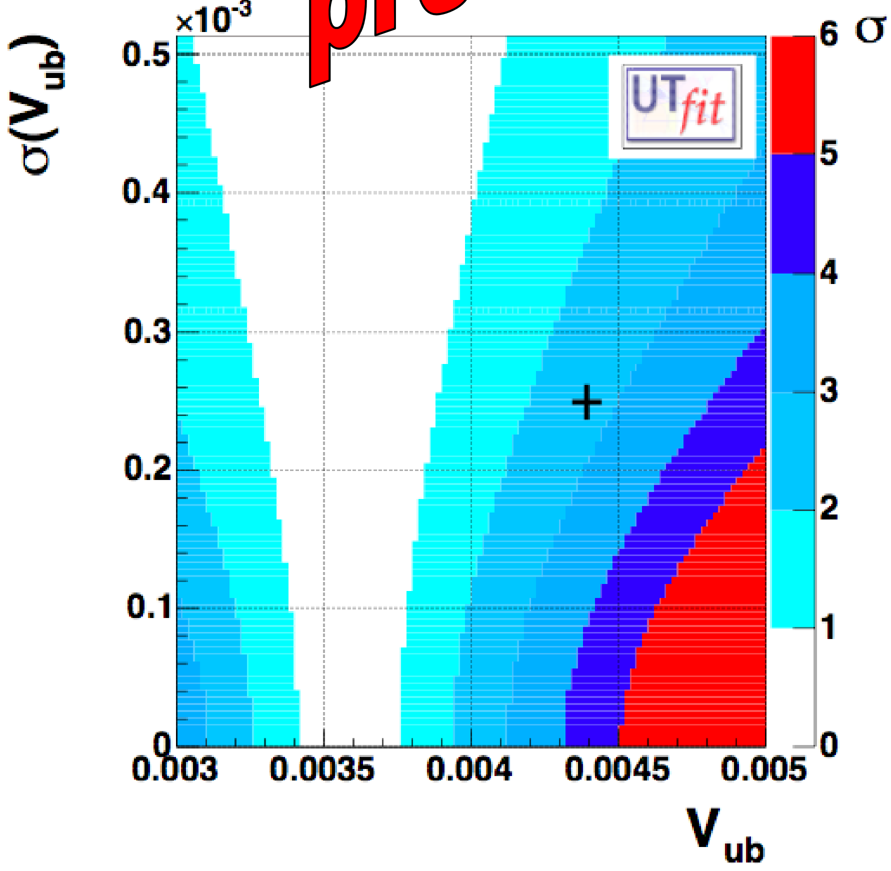
$$f^+(q^2) \quad V(q^2) \quad A_{1,2}(q^2)$$



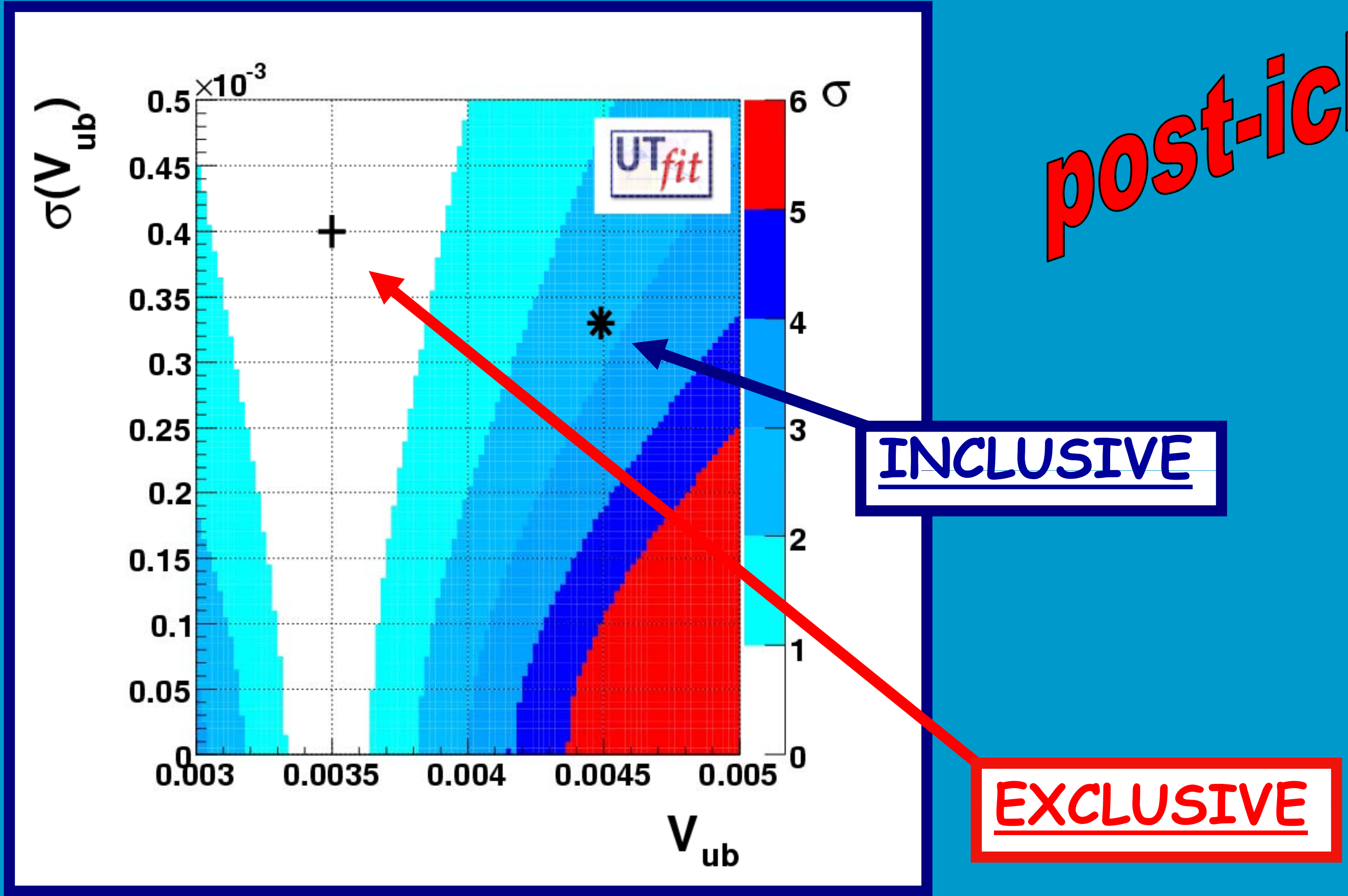
1) Use only exclusive and predict inclusive
2) Use only inclusive and predict exclusive

pre-ichep





Tension between inclusive Vub and the rest of the fit



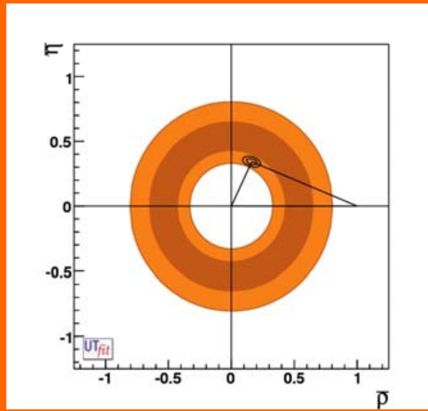
post-ichep

$B \to \tau \nu_\tau$

BaBar: $(0.88 \,^{+0.68}_{-0.67} \pm 0.11) \times 10^{-4}$

Belle: $(1.79 \,^{+0.56}_{-0.49} \,^{+0.39}_{-0.46}) \times 10^{-4}$

Average: $(1.31 \pm 0.48) \times 10^{-4}$



Potentially large NP contributions (i.e. MSSM at large tanβ, Isidori & Paradisi)

f_B = (190 ± 14) MeV [UTA]
V_{ub} = (36.7 ± 1.5) 10^{-4} [UTA]

$$BR(B \to \tau \nu_\tau) = (0.89 \pm 0.16) \times 10^{-4}$$

(Best SM prediction)

f_B = (189 ± 27) MeV [LQCD]
V_{ub} = (35.0 ± 4.0) 10^{-4} [Exclusive]

$$BR(B \to \tau \nu_\tau) = (0.84 \pm 0.30) \times 10^{-4}$$

(Independent from other NP effects)

f_B = (189 ± 27) MeV [LQCD]
V_{ub} = (44.9 ± 3.3) 10^{-4} [Inclusive]

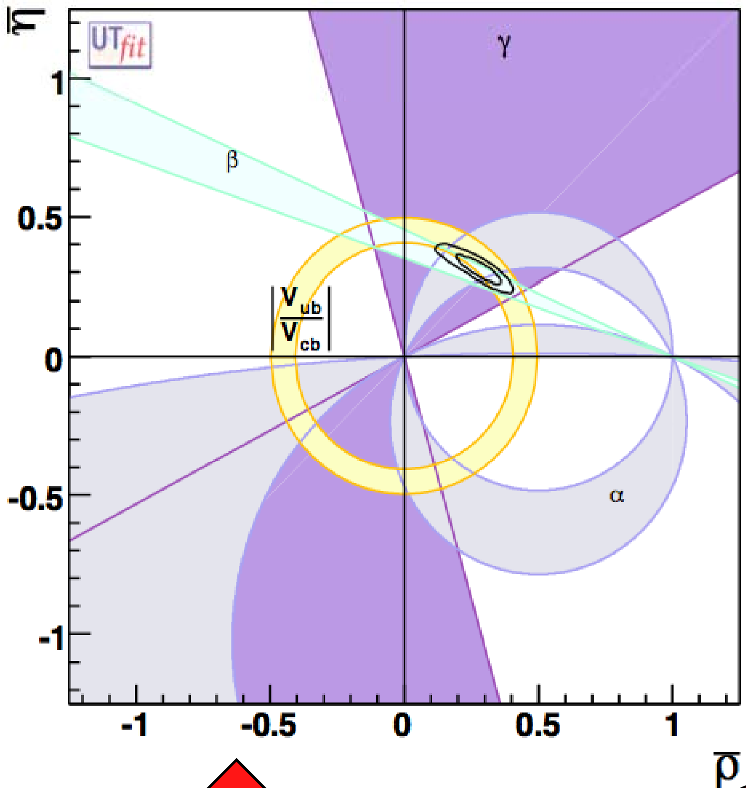
$$BR(B \to \tau \nu_\tau) = (1.39 \pm 0.44) \times 10^{-4}$$

From BR($B \to \tau \nu_\tau$) and V_{ub}(UTA): $f_B = (237 \pm 37)$ MeV

Hadronic Parameters From UTfit

1) Predictions vs Postdictions
2) Lattice vs angles
3) V_{ub} inclusive, V_{ub} exclusive vs sin 2β
4) Experimental determination of lattice parameters

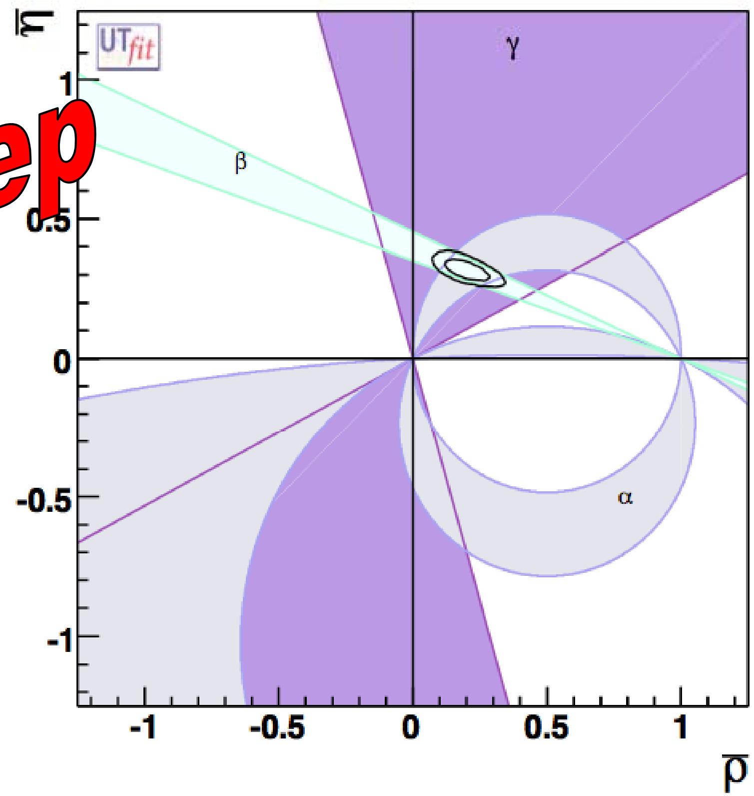
The new measurements allow the analysis WITHOUT THE LATTICE HADRONIC PARAMETERS (eventually only those



with Vub

pre-ichep

Without Vub



IMPACT of the NEW MEASUREMENTS on LATTICE HADRONIC PARAMETERS

$$f_{B_s}\hat{B}_{B_s}^{1/2} \quad \xi \quad \hat{B}_K$$

Comparison between experiments and theory

exps vs predictions

$f_{Bs}\sqrt{B_{Bs}} = 262 \pm 35$ MeV

lattic

$f_{Bs}\sqrt{B_{Bs}} = 261 \pm 6$ MeV

UTA 2% ERROR

!$\xi = 1.24 \pm 0.09$ **UTA**

$\xi = 1.23 \pm 0.06$

lattice

$B_K = 0.75 \pm 0.09$

$B_K = 0.79 \pm 0.04 \pm 0.08$

Dawson

$f_B = 187 \pm 0.13$ MeV

$f_B = 189 \pm 27$ MeV

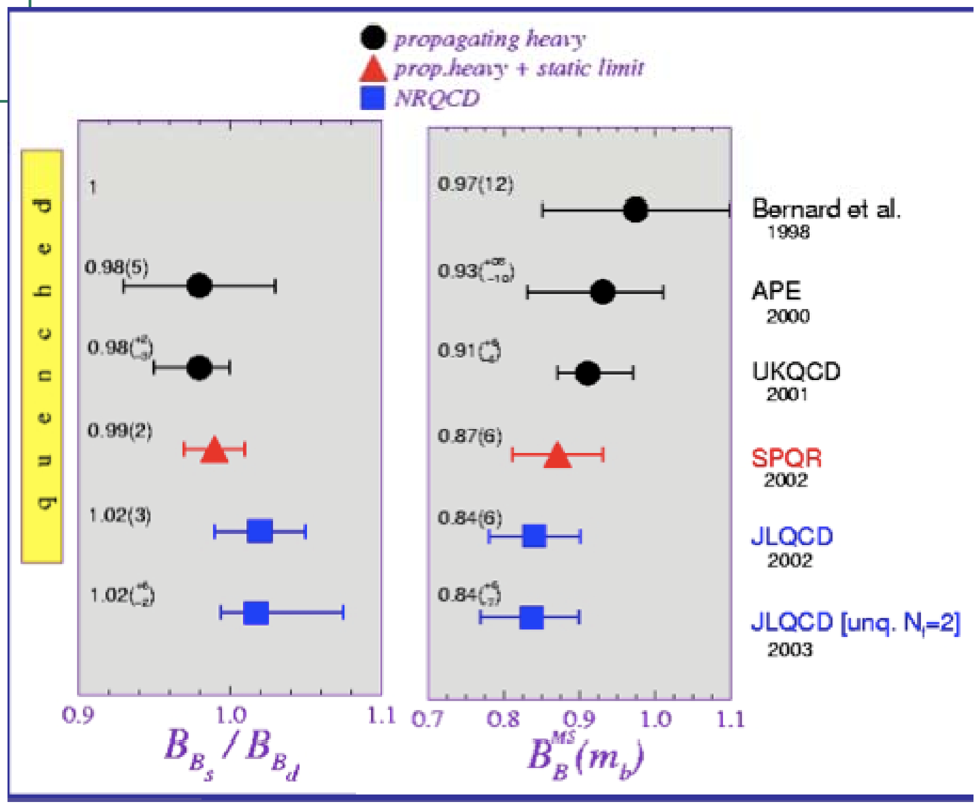
SPECTACULAR AGREEMENT (EVEN WITH QUENCHED LATTICE QCD)

exps vs predictions

Using the lattice determination of the B-parameters $B_{Bd} = B_{Bs} = 1.28 \pm 0.05 \pm 0.09$

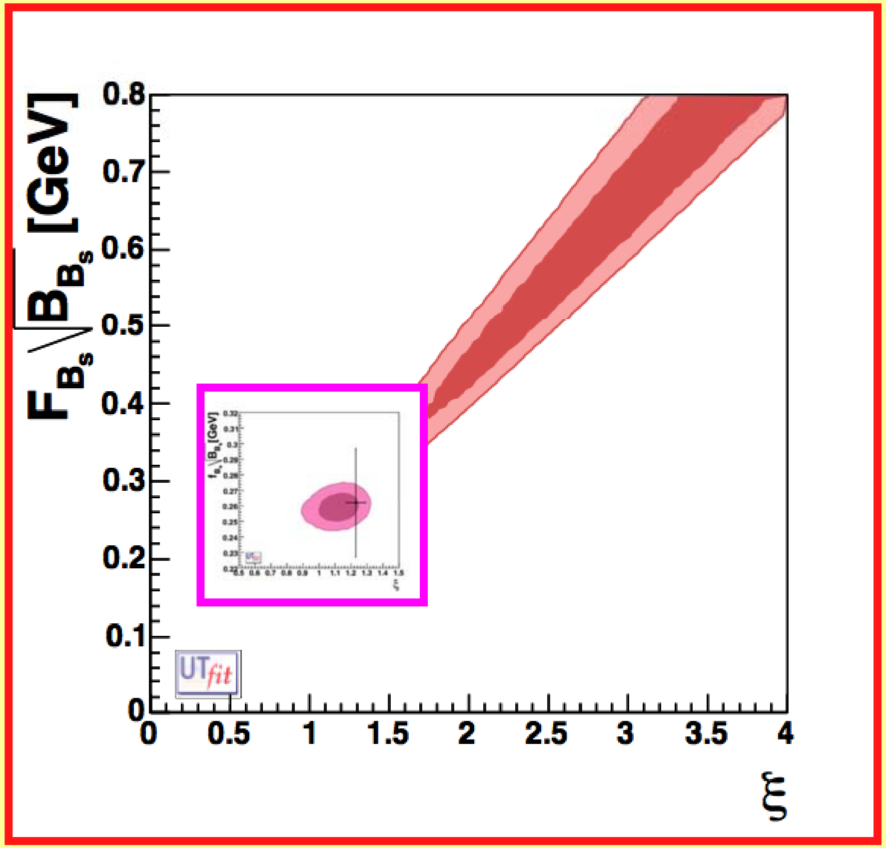
$f_B = 190 \pm 14$ MeV

$f_B = 189 \pm 27$ MeV



$f_{Bs} = 229 \pm 9$ MeV

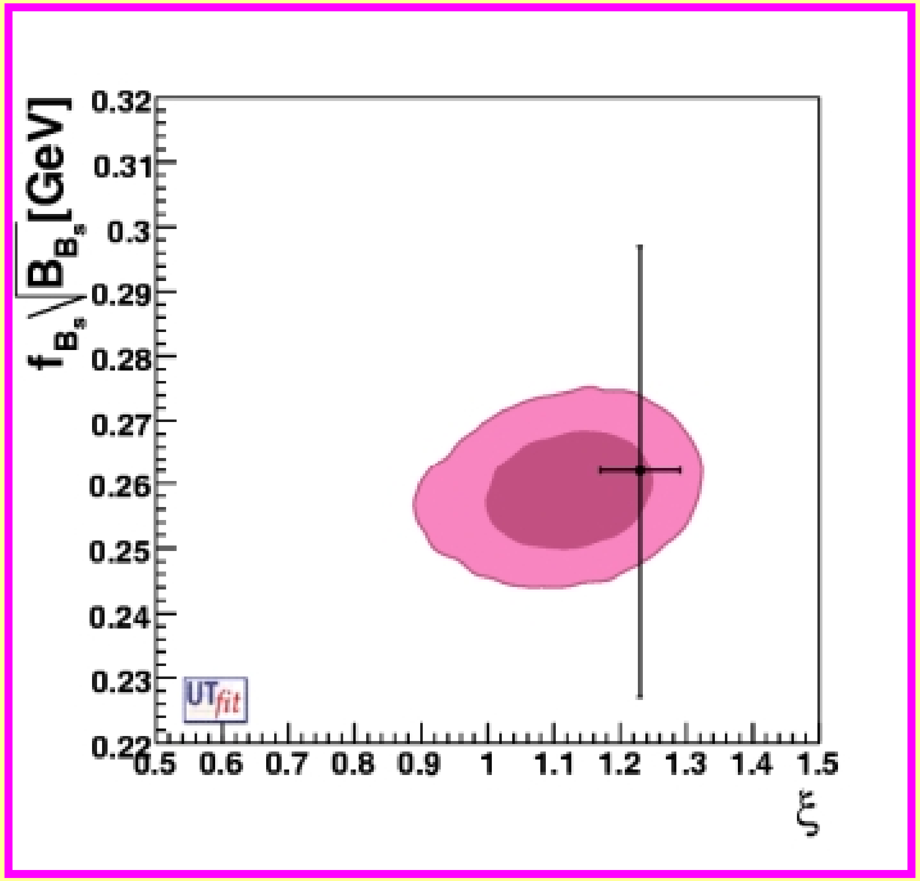
$f_{Bs} = 230 \pm 30$ MeV



F_{B_s}√B_{B_s} [GeV]
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
0 0.5 1 1.5 2 2.5 3 3.5 4
ξ

OLD

NEW



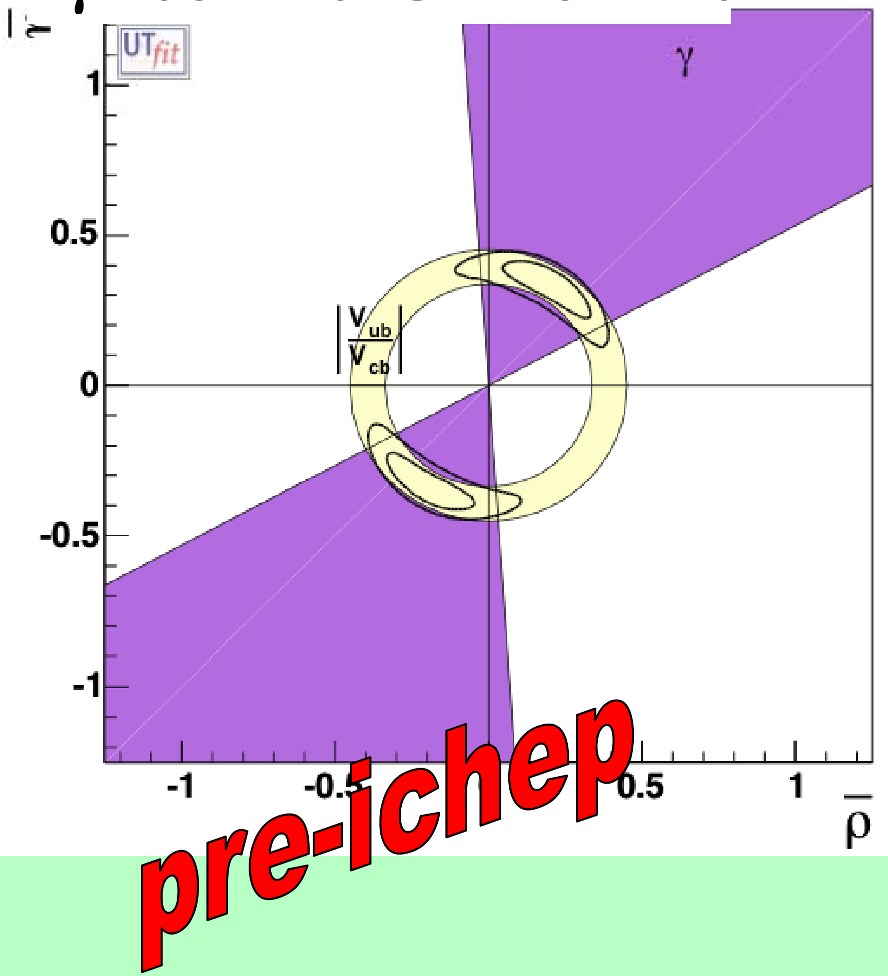
f_{B_s}√B_{B_s} [GeV]
0.22 0.23 0.24 0.25 0.26 0.27 0.28 0.29 0.3 0.31 0.32
0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5
ξ

Only tree level processes

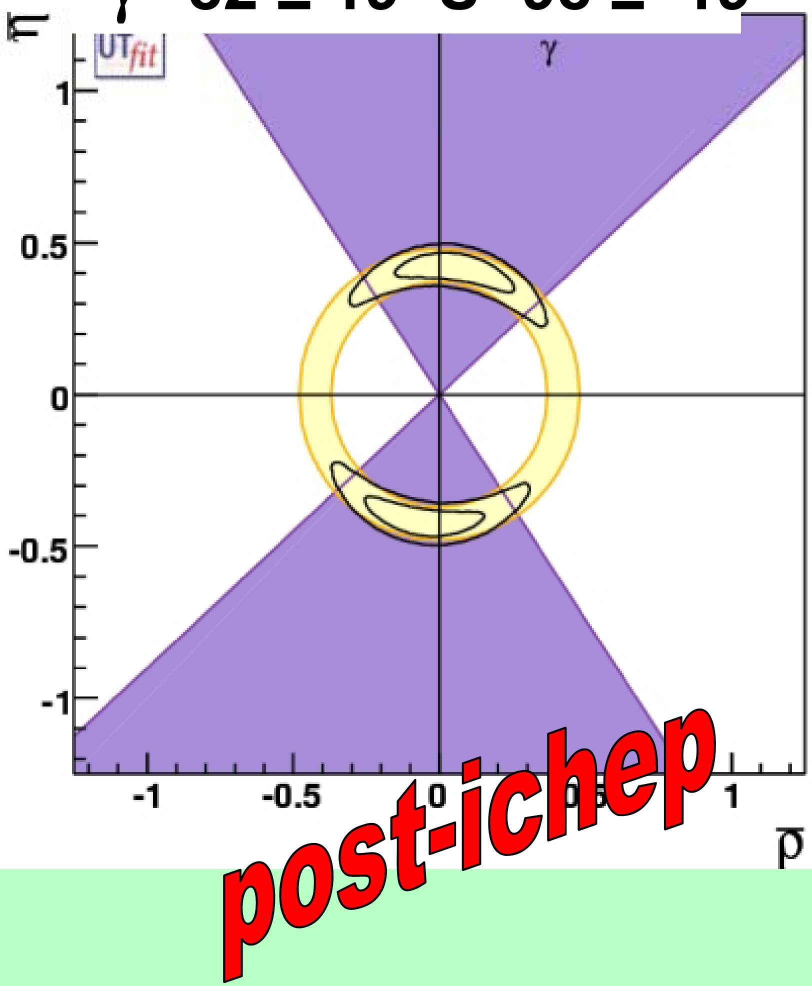
CP VIOLATION PROVEN IN THE SM !!

$B \to DK \quad B \to DK^*$

$\gamma = 65 \pm 20 \;\; U \; -115 \pm 20$



$\gamma = 82 \pm 19 \;\; U \; -98 \pm 19$

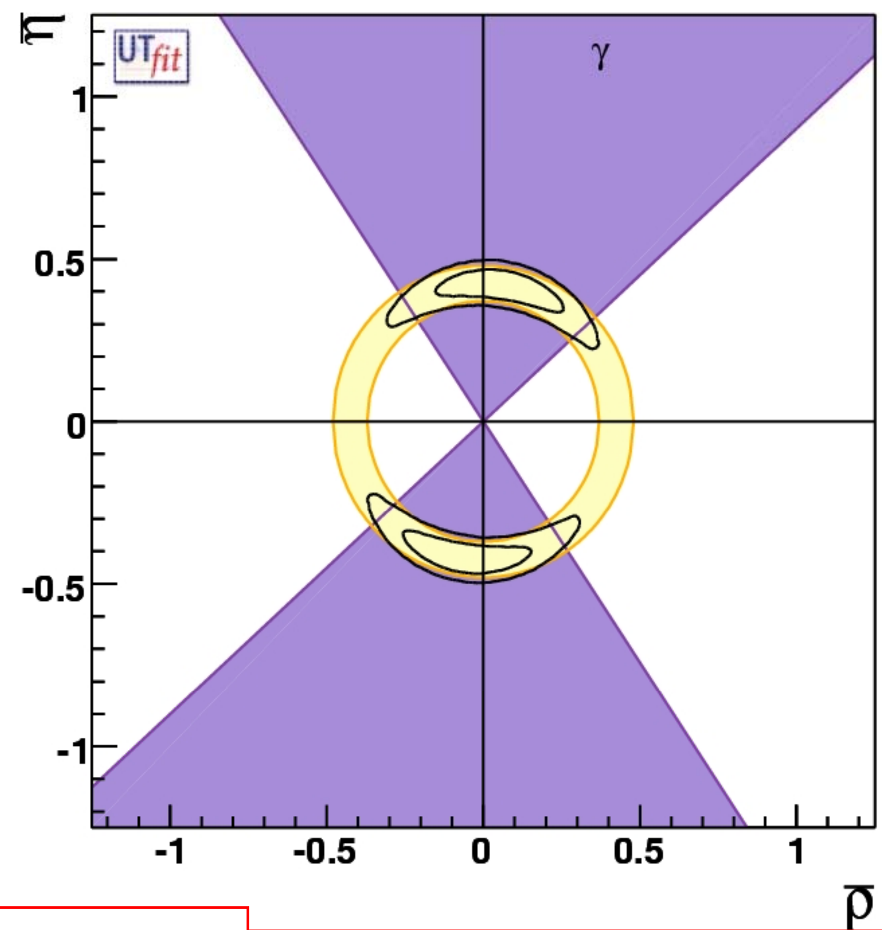


CP Violation beyond the Standard Model

Only tree level processes

very important to improve:

- V_{ub}/V_{cb} from semileptonic decays
- γ from tree level processes



CP VIOLATION PROVEN IN THE SM !!

$\bar{\eta} = \pm\, 0.40 \pm 0.06$

$\bar{\rho} = 0.00 \pm 0.23$

Even in the favourable case in which
the theory above the cutoff is weakly coupled,
such as in the Minimal Supersymmetric Standard Model (MSSM),
large contributions to FCNC and CP processes are expected
contrary to the increasigly precise experimental measurements.

FLAVOUR PUZZLE

FLAVOUR PUZZLE

Model Independent Analysis of ΔF = 2 transitions

$$C_{B_q} e^{2i\phi_{B_q}} = \frac{\langle B_q^0 | H_{eff}^{full} | \bar{B}_q^0 \rangle}{\langle B_q^0 | H_{eff}^{SM} | \bar{B}_q^0 \rangle}, \quad q = s, d$$

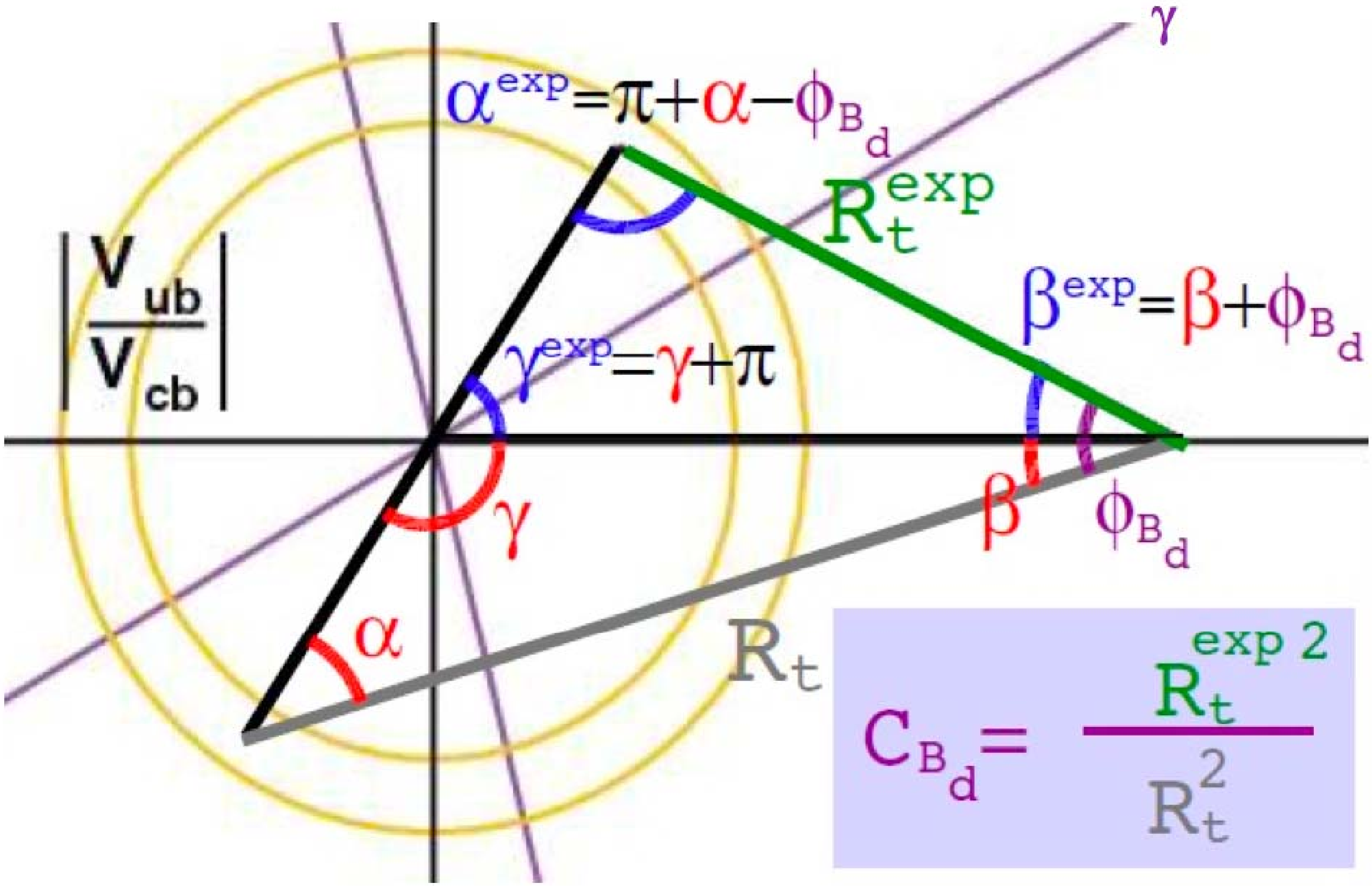
$$\Delta m_d^{exp} = C_{B_d} \Delta m_d^{SM}, \quad \sin 2\beta^{exp} = \sin(2\beta^{SM} + 2\phi_{B_d}),$$

$$\alpha^{exp} = \alpha^{SM} - \phi_{B_d}$$

$$C_{\varepsilon_K} = \frac{Im\left[\langle K^0 | H_{eff}^{full} | \bar{K}^0 \rangle\right]}{Im\left[\langle K^0 | H_{eff}^{SM} | \bar{K}^0 \rangle\right]},$$

$$\varepsilon_K^{exp} = C_{\varepsilon_K} \varepsilon_K^{SM}$$

The Unitarity Triangle in the presence of NP



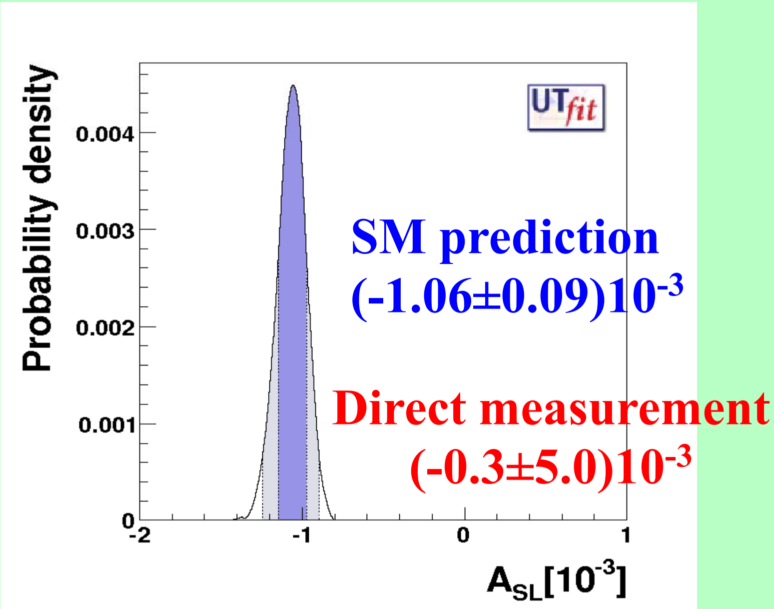
Additional contraints

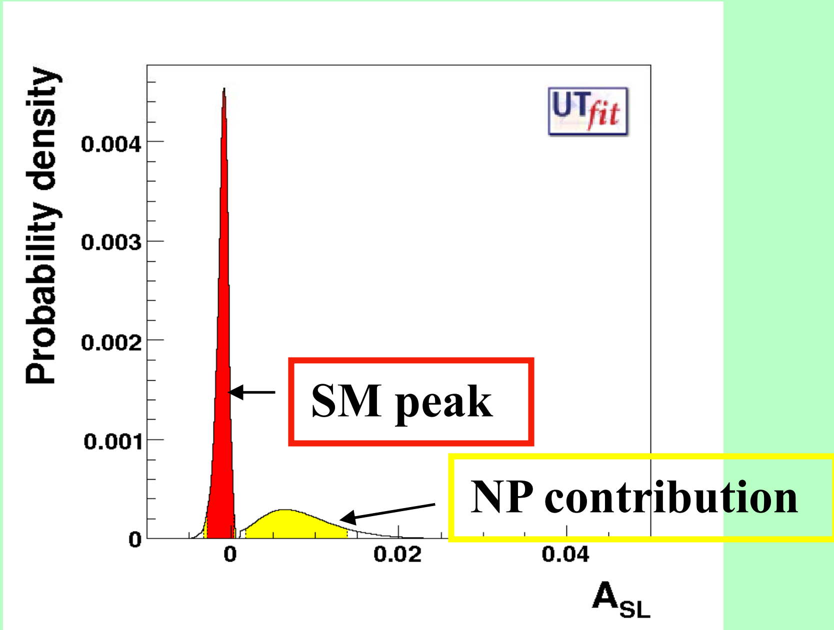
Semileptonic decay asymmetry

$$A_{\rm SL} \equiv \frac{\Gamma(\bar{B}^0 \to \ell^+ X) - \Gamma(B^0 \to \ell^- X)}{\Gamma(\bar{B}^0 \to \ell^+ X) + \Gamma(B^0 \to \ell^- X)}$$

$$= -\mathrm{Re}\left(\frac{\Gamma_{12}}{M_{12}}\right)^{\rm SM} \frac{\sin 2\phi_{B_d}}{C_{B_d}} + \mathrm{Im}\left(\frac{\Gamma_{12}}{M_{12}}\right)^{\rm SM} \frac{\cos 2\phi_{B_d}}{C_{B_d}}$$

Sensitive to both C_{Bd} and phase shift ϕ_{Bd}





Not precise enough to bound CKM in SM (experimental error too large)…

… but good for reducing NP allowed parameter space

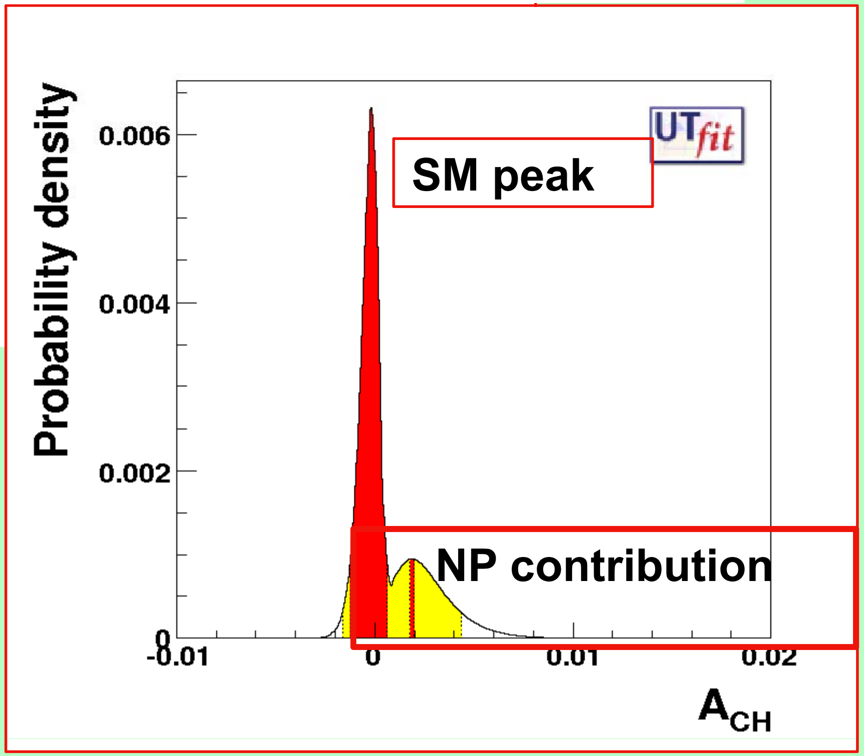
Additional contraints

CP aymmetry in dimuon evei

DØnote 5042-CONF_V1.4

$$A = \frac{N^{++} - N^{--}}{N^{++} + N^{--}}$$

$$A \propto \frac{A_B}{4} = Im\left(\frac{\Gamma_{12}}{4M_{12}}\right)$$



f_d~0.4, f_s~0.1
production fractions of B_d and B_s

Admixture of B_d and B_s
charge asymmetries

Sensitive to C_{Bd}, ϕ_{Bd}, C_{Bs}, ϕ_{Bs}!

Additional contraints

$\Delta\Gamma_s/\Gamma_s$

$$\frac{\Delta\Gamma_q}{\Delta m_q} = -2\frac{\kappa}{C_{B_q}}\Bigg\{\cos(2\phi_{B_q})\left(n_1 + \frac{n_6 B_2 + n_{11}}{B_1}\right) - \frac{\cos(\phi_q^{SM} + 2\phi_{B_q})}{R_t^q}\left(n_2 + \frac{n_7 B_2 + n_{12}}{B_1}\right) + \frac{\cos(2(\phi_q^{SM} + \phi_{B_q}))}{R_t^{q^2}}$$
$$\left(n_3 + \frac{n_8 B_2 + n_{13}}{B_1}\right) + \cos(\phi_q^{Pen} + 2\phi_{B_q})\,C_q^{Pen}\left(n_4 + n_9\frac{B_2}{B_1}\right) - \cos(\phi_q^{SM} + \phi_q^{Pen} + 2\phi_{B_q})\,\frac{C_q^{Pen}}{R_t^q}\left(n_5 + n_{10}\frac{B_2}{B_1}\right)\Bigg\}$$

	SM	SM+NP	exp
$10^3\,\Delta\Gamma_d/\Gamma_d$	2.8 ± 2.7	2.0 ± 1.8	9 ± 37
$\Delta\Gamma_s/\Gamma_s$	0.10 ± 0.06	0.00 ± 0.08	0.25 ± 0.09

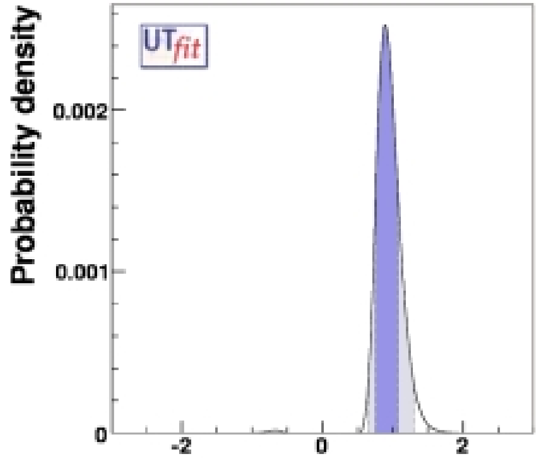
The experimental measurement of $\Delta\Gamma_s$ actually measures $\Delta\Gamma_s\cos(\beta_s+\phi_{Bs})$ (Dunietz et al., hep-ph/0012219)

→ NP can only decrease the experimental result with respect to the SM value

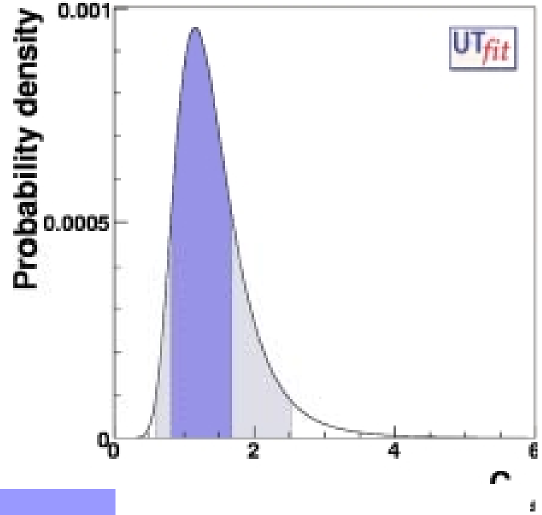
Since all the other parameters are fixed by other constraints, this gives the first available bound on NP phase in B_s mixing!

Bounds on C and ϕ parameters

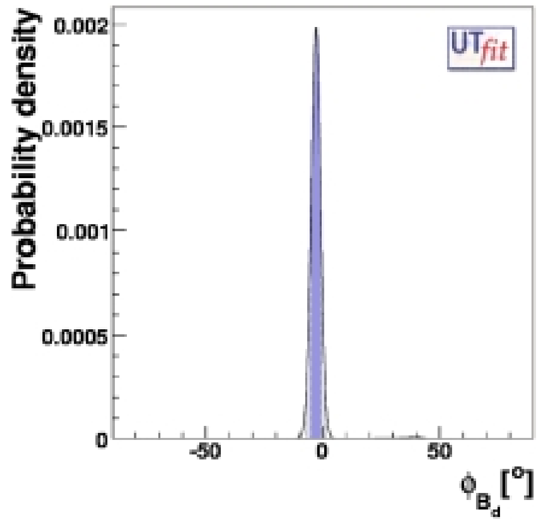
$C_{\varepsilon K} = 0.91 \pm 0.15$



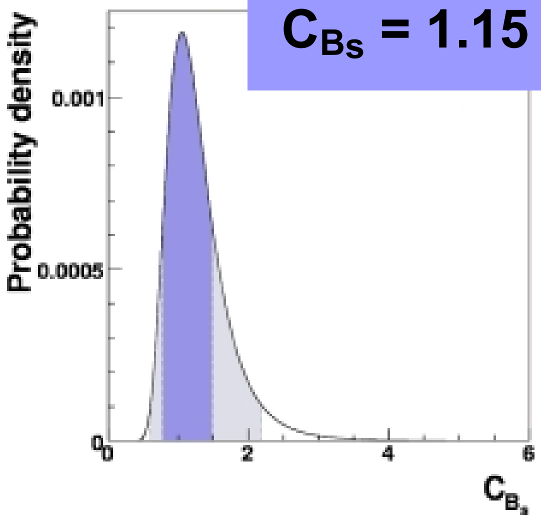
$C_{Bd} = 1.24 \pm 0.43$



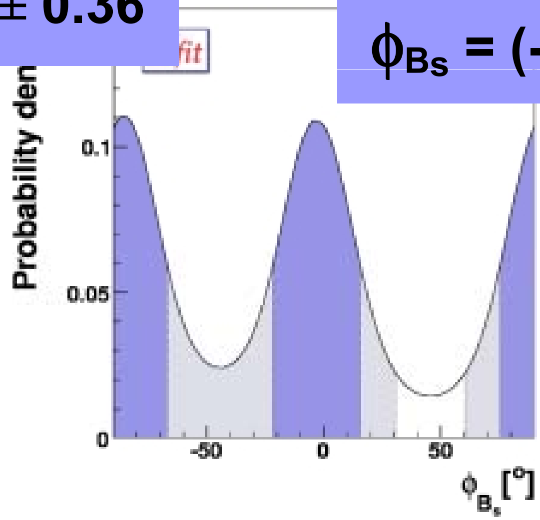
$\phi_{Bd} = -3.0 \pm 2.0$



$C_{Bs} = 1.15 \pm 0.36$



$\phi_{Bs} = (-3 \pm 19)^o \cup (94 \pm 19)^o$

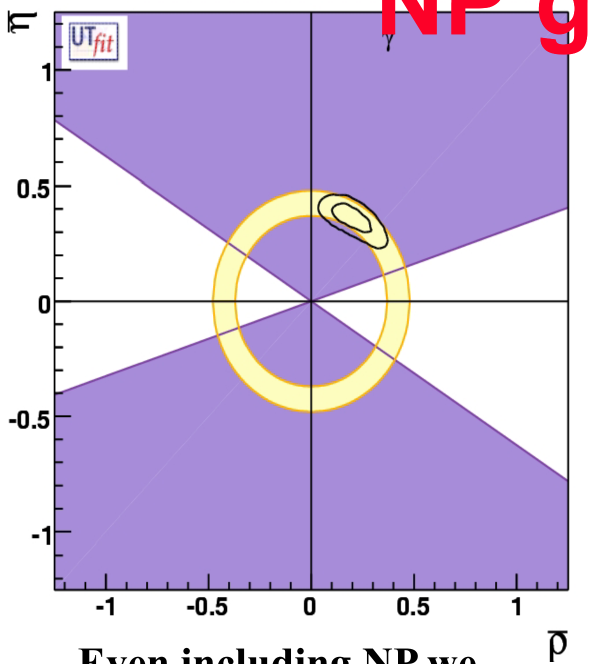


All C parameters compatible with 1 and ϕ with 0
→ SM works just fine

1.5σ shift of ϕ_{Bd} due to the V_{ub} vs sin2β bare agreement

UPGRADED

Using all available constraints in NP generalized analysis



Even including NP we are still on the SM solution

$\bar{\rho} = 0.20 \pm 0.07$
($\rho = 0.166 \pm 0.029$ in SM)

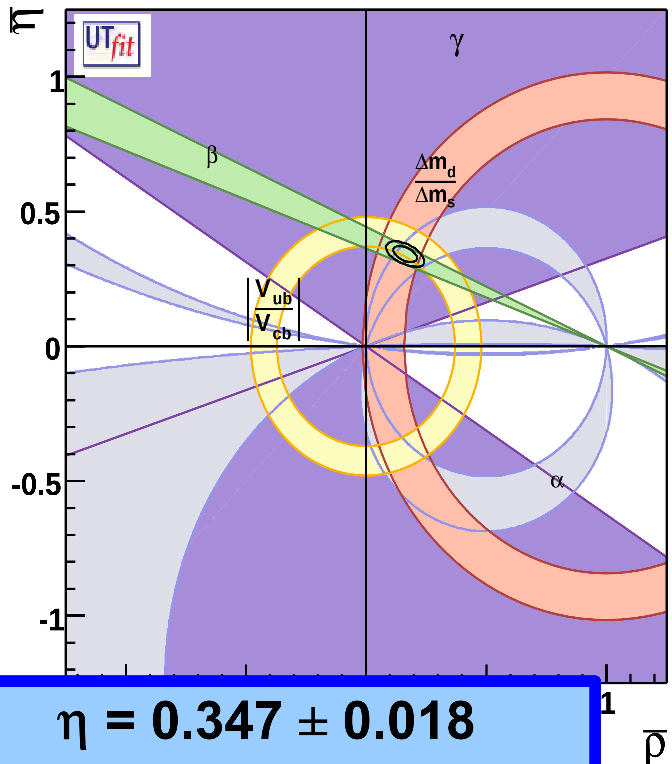
$\bar{\eta} = 0.37 \pm 0.04$
($\eta = 0.340 \pm 0.017$ in SM)

Observable	ρ, η	C_{Bd}, ϕ_{Bd}	$C_{\varepsilon K}$	C_{Bs}, ϕ_{Bs}
V_{ub}/V_{cb}	X			
γ (DK)	X			
ε_K	X		X	
$\sin 2\beta$	X	X		
Δm_d	X	X		
α ($\rho\rho$, $\rho\pi$, $\pi\pi$)	X	X		
A_{SL} B_d	X	X		
$\Delta\Gamma_d/\Gamma_d$	X	X		
Δm_s				X
A_{CH}	X	X		X
$\Delta\Gamma_s/\Gamma_s$	X			X

MFV: Universal Unitarity Triangle Fit

Just using constraints which are insensitive to NP in MFV scenarios

ρ = 0.153 ± 0.030
(ρ = 0.166 ± 0.029 in SM)



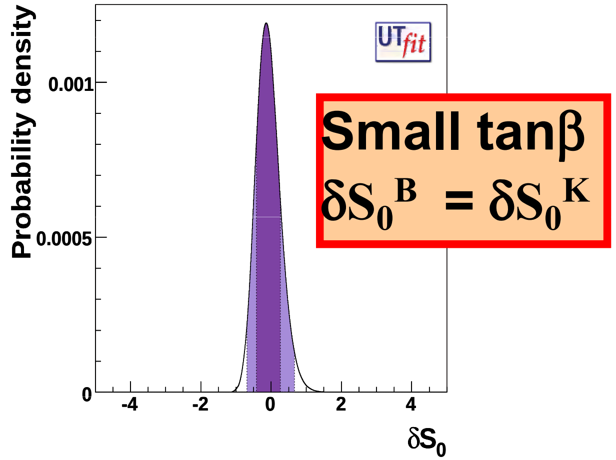
η = 0.347 ± 0.018
(η = 0.340 ± 0.017 in SM)

Output of UUT fit

Parameter	Output	Parameter	Output
$\bar{\rho}$	0.162 ± 0.033	$\bar{\eta}$	0.342 ± 0.019
$\alpha[^\circ]$	92.9 ± 5.3	$\beta[^\circ]$	22.2 ± 1.0
$\gamma[^\circ]$	64.5 ± 5.2	$\sin 2\beta$	0.698 ± 0.023
$\sin 2\beta_s$	0.037 ± 0.002	$\mathrm{Im}\lambda_t\ [10^{-5}]$	13.8 ± 0.8
$V_{ub}[10^{-3}]$	3.69 ± 0.15	$V_{cb}[10^{-2}]$	4.18 ± 0.07
$V_{td}[10^{-3}]$	8.5 ± 0.4	$\lvert V_{td}/V_{ts}\rvert$	0.208 ± 0.009
R_b	0.380 ± 0.015	R_t	0.904 ± 0.035

In MFV extensions of the SM one can determine CKM parameters independently of NP constributions, but using angles, tree level processes and mixing amplitudes ratio

MFV scenario: translating into a test of the NP scale

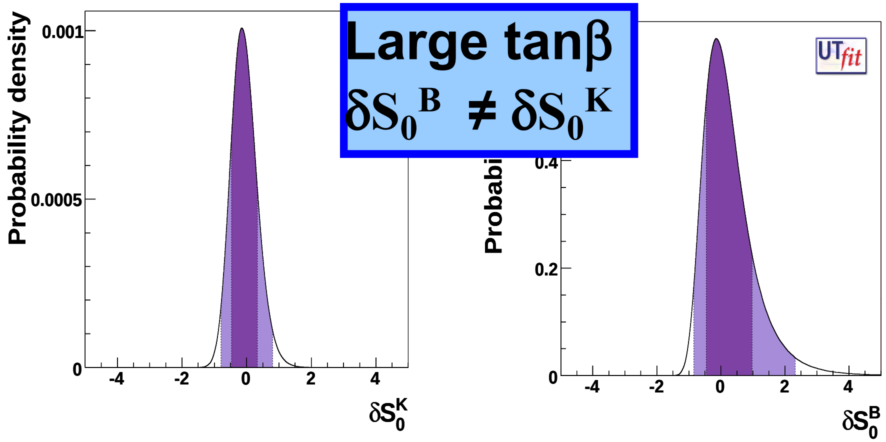


NP enters the game as additional contribution to the top box diagram

(D'Ambrosio et al. hep-ph/0207036)

$$S_0(x_t) \rightarrow S_0(x_t) + \delta S_0(x_t)$$

Common shift δS^0 to Inami-Lim fu
in B and K mixing in case of small
while two dinstict shifts for large t
(bottom Yukawa coupling importa



$$\delta S_0(x_t) = 4a\left(\frac{\Lambda_0}{\Lambda}\right)^2$$

a = 1 (as a reference)

$\Lambda_0 = 2.4$ TeV

Λ_0 is the equivalent SM scale

$\Lambda > 5.9$ TeV @ 95% for small tanβ

$\Lambda > 5.4$ TeV @ 95% for large tanβ

CONCLUSIONS

SM Predictions of Bayesian Analysis, using Lattice QCD confirmed by Experiments ($\sin 2\beta_{UTA}$ and Δm_s)

Extraordinary experimental progresses allow **the extraction of several hadronic quantities from the data**.

It is very important to **reduce the lattice errors** particularly for B_K

A special effort must be done for the semileptonic **form factors necessary to the extraction of V_{ub}**

It is crucial to reduce the error on **the direct determination of the angle γ** from B -> DK, D*K and DK* decays

PROGRESS SINCE 1988