Excellence Cluster Universe

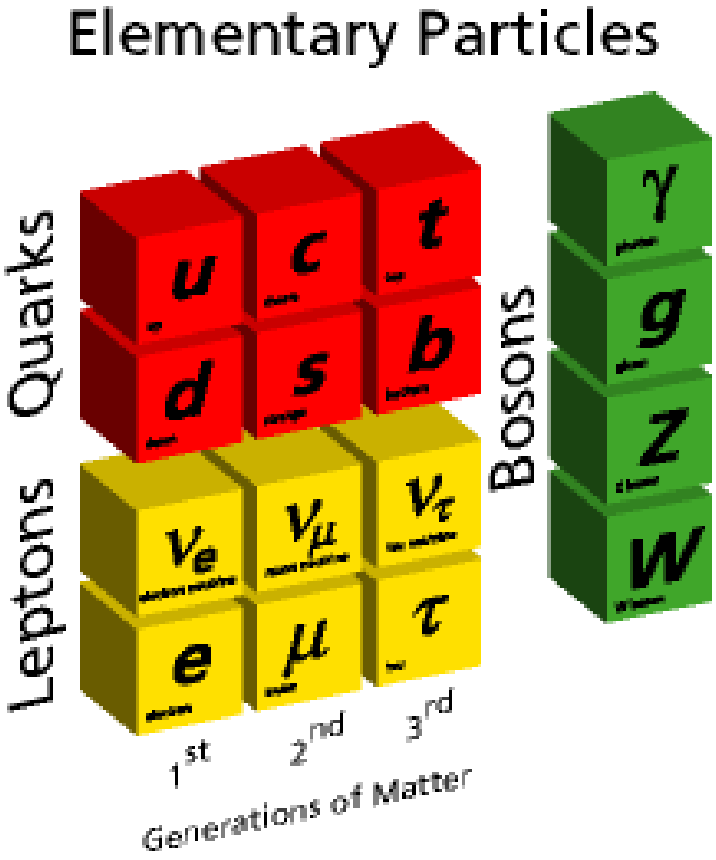
Arnold Sommerfeld Center for Theoretical Physics

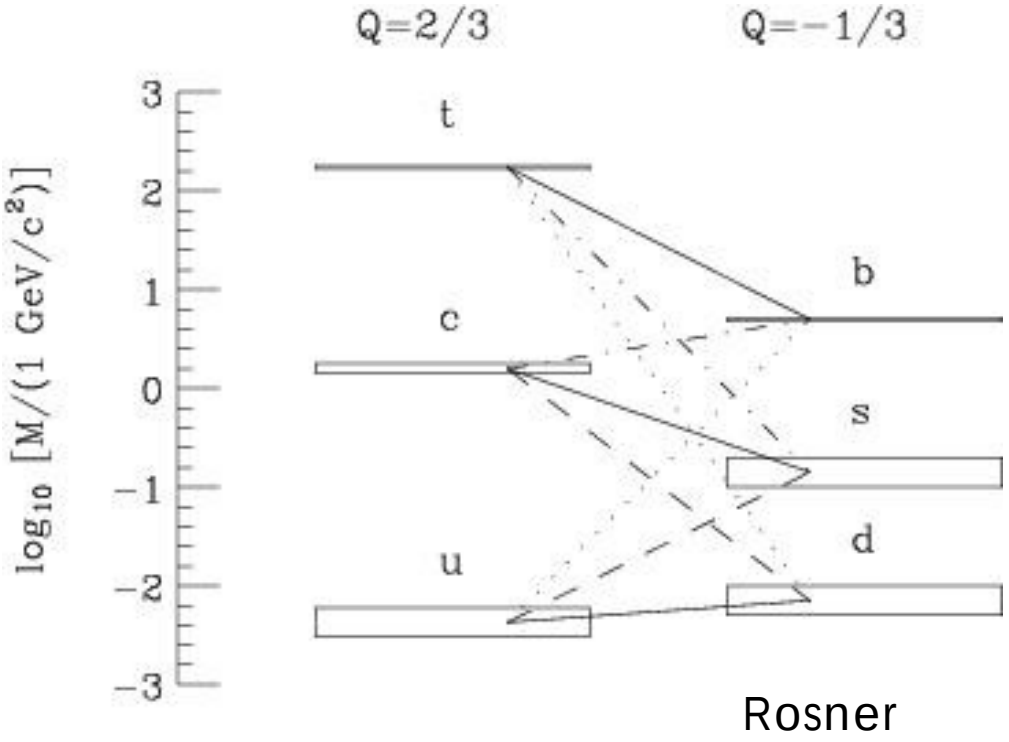
MLL

B Decays and QCD

G. Buchalla Science Week December 2007

Quark Flavour Physics

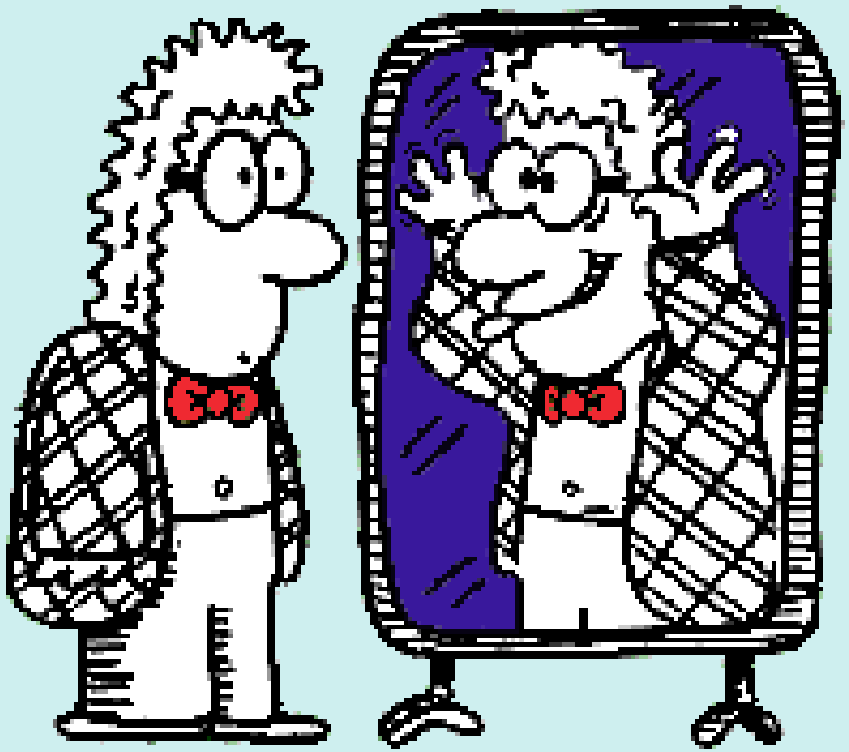




Rosner

Flavour Mixing V_{CKM}
Rare Processes
CP Violation

THE MIRROR DID **NOT** SEEM TO BE OPERATING PROPERLY.



B Physics Experiments

e^+e^- SLAC KEK $p\bar{p}$ Fermilab

pp CERN

e^+e^-

Quark
Flavour
Dynamics

CKM
New Physics

Quark
Colour
Dynamics

QCD

B Decays

3rd Generation Large Mass Long Lifetime

$$B \to \pi\pi, \quad \pi K, \quad \rho\rho, \quad K^* \mu^+ \mu^-, \quad K^* \gamma, \quad \rho\gamma, \ldots$$

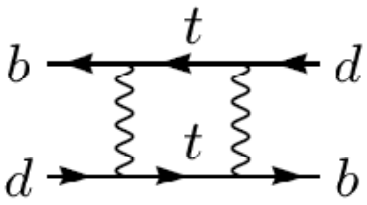
CP Violation in $B \to \pi^+\pi^-,\ \rho^+\rho^-$

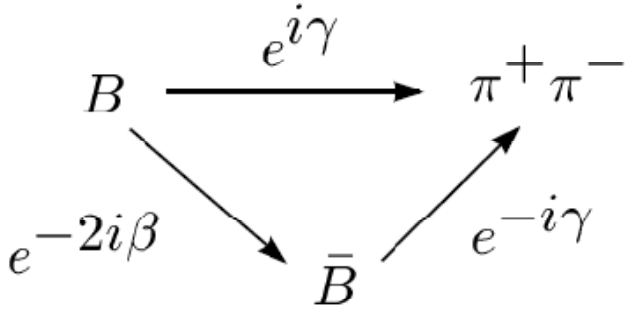
$$a_{CP}(t) = \frac{\Gamma(B(t) \to \pi^+\pi^-) - \Gamma(\overline{B}(t) \to \pi^+\pi^-)}{+} = -S\,\sin(\Delta M\ t) + C\,\cos(\Delta M\ t)$$

$$A(B \to \pi^+\pi^-) = V_{ub}^*\, V_{ud}\,(\bar{b} \to \bar{d}u\bar{u}) + V_{cb}^*\, V_{cd}\,(\bar{b} \to \bar{d}c\bar{c} \to \bar{d}u\bar{u})$$

	S	C
$\pi^+\pi^-$	-0.61 ± 0.08	$-0.38 \pm 0.07^*$
$\rho^+\rho^-$	-0.05 ± 0.17	-0.06 ± 0.13

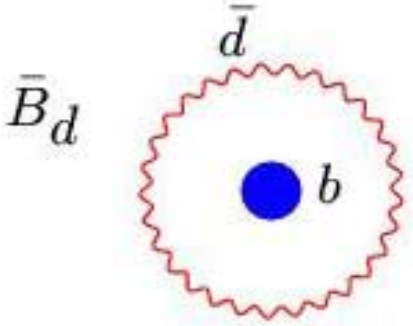
BaBar/Belle/HFAG

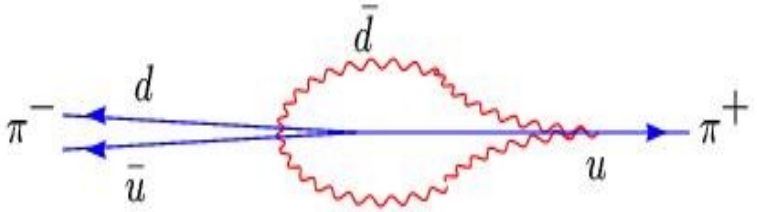




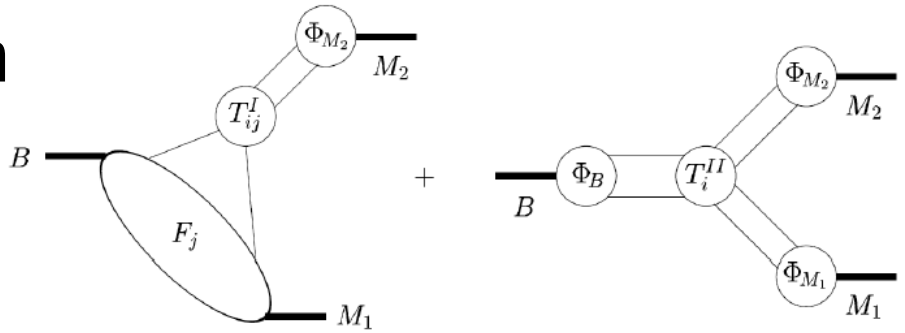
QCD Factorization

Exclusive B decays:





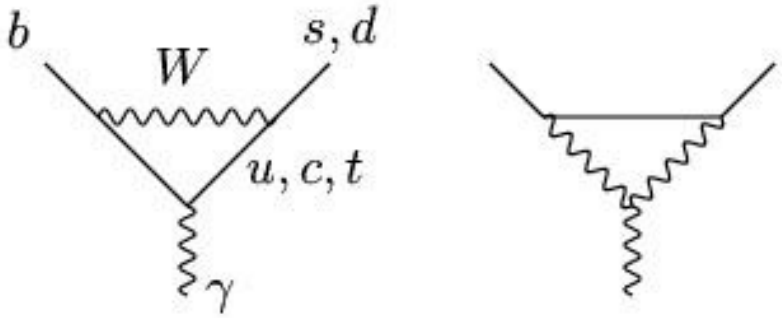
- systematic approach
- many applications



Beneke, G.B., Neubert, Sachrajda

SCET Bauer, Fleming, Pirjol, Stewart

Radiative B Decays



$B \to K^* \gamma$

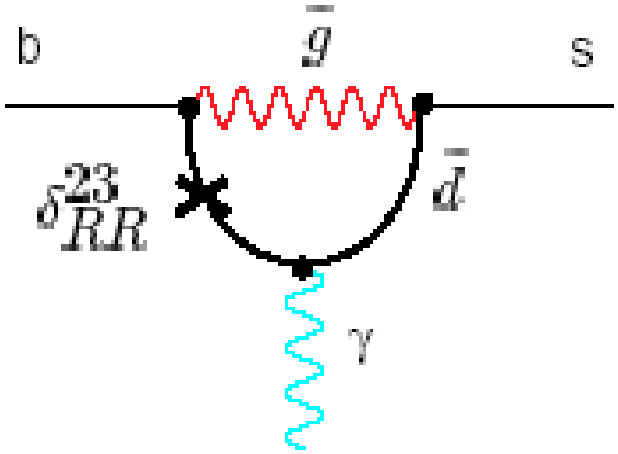
$B \to \rho \gamma$

$BR = (4.0 \pm 0.2) \cdot 10^{-5}$

$BR \approx 10^{-6}$

$\xrightarrow{theory}$ $\left| V_{td} / V_{ts} \right|$

more exotic possibility:



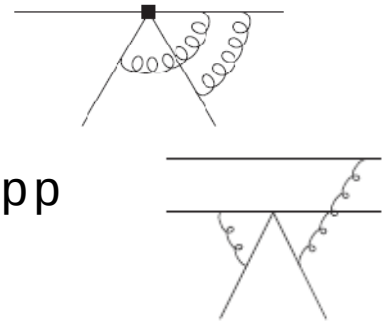
Current Projects and Recent Results

M Albrecht M Bartsch G Bell G. B. C Kraus V Pilipp

- Higher-Order QCD Corrections for $B \to \pi\pi$ *NNLO*

  2-loop vertex corrections (G. Bell

  $O(\alpha_s^2)$ spectator interaction (V. Pilipp



- $B \to \rho\gamma$ $|V_{td}|$ New Physics
- $B \to VV$ $(V = \rho, K^*, ...)$
- B_c decays
- charm-loop effects $B \to K^* l^+ l^- \quad \leftrightarrow \quad B \to \pi^+ \pi^-$

Workshop 2005/2007
Flavour in the Era of the LHC

Working Groups
1 Collider Aspects of Flavour Physics at High Q^2
2 B D and K Decays
3 Flavour in the Lepton Sector

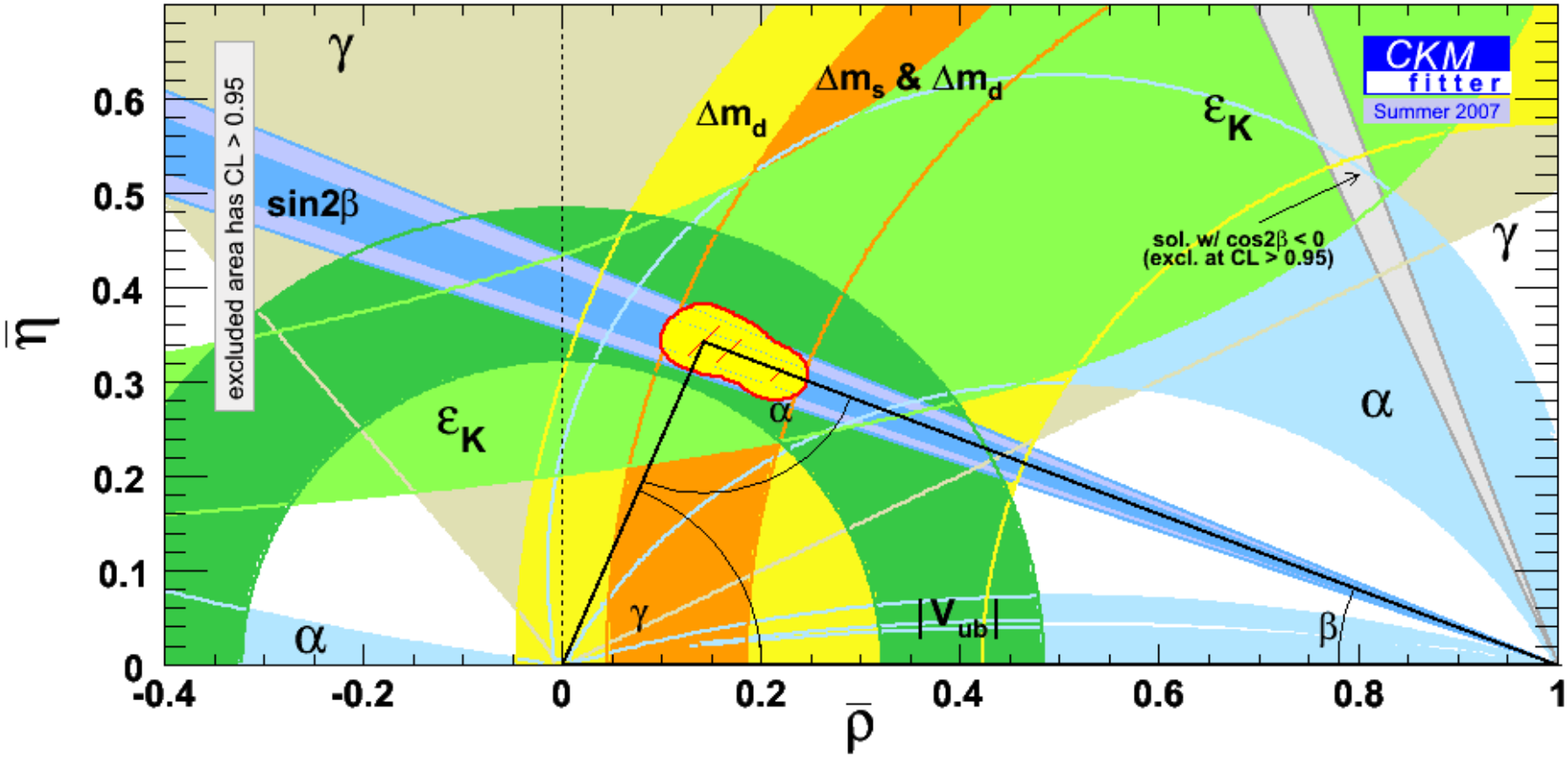
WG 2 B D and K Decays

G.B. Komatsubara Muheim Silvestrini

WG 2 Report

1. New Physics Scenarios
2. Weak Decays and QCD
3. Benchmark Channels
4. Future Facilities
5. Assessments

Coming Soon


CKM
fitter
Summer 2007
excluded area has CL > 0.95
sin2β
γ
Δm_d
Δm_s & Δm_d
ε_K
sol. w/ cos2β < 0
(excl. at CL > 0.95)
α
β
|V_ub|
η̄
ρ̄
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.4
-0.2
0.2
0.4
0.6
0.8
1