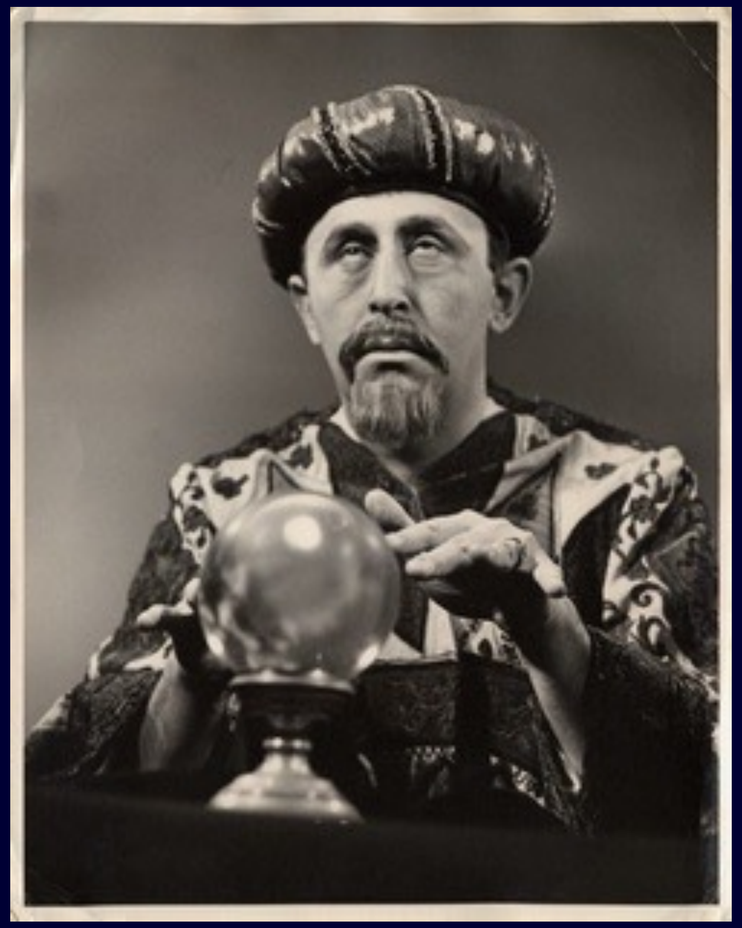


Future of Flavour

ALEXANDER LENZ, IPPP DURHAM, 12TH JUNE 2020

Sorry for all of us not being in A Toxa

Wishful thinking #1: There will be a future conference in A Toxa

Outline of the non-summary talk:

- Flavour physics within Fundamental Physics
- Motivation for Flavour Physics
- Future of Flavour Physics

- Selected lessons I learnt from Quark Flavour Physics = QFP
- Conclusion

- **4 predictions from looking into my crystal ball with serious impact on flavour physics**

Status of (Quark) Flavour

Many, many excellent talks

I will not repeat that...

March 2020 update of 1903.09578

	All			LFUV		
2D Hyp.	Best fit	Pull_{SM}	p-value	Best fit	Pull_{SM}	p-value
$(\mathcal{C}_{9\mu}^{\text{NP}}, \mathcal{C}_{10\mu}^{\text{NP}})$	(-0.98,+0.19)	6.2	39.8 %	(-0.31,+0.44)	3.2	70.0 %
$(\mathcal{C}_{9\mu}^{\text{NP}}, \mathcal{C}_{7'})$	(-1.04,+0.01)	6.0	36.5 %	(-0.92,-0.04)	3.0	57.4 %
$(\mathcal{C}_{9\mu}^{\text{NP}}, \mathcal{C}_{9'\mu})$	(-1.14,+0.55)	6.5	47.4 %	(-1.86,+1.20)	3.5	81.2 %
$(\mathcal{C}_{9\mu}^{\text{NP}}, \mathcal{C}_{10'\mu})$	(-1.17,-0.33)	6.6	50.3 %	(-1.87,-0.59)	3.7	89.6 %
$(\mathcal{C}_{9\mu}^{\text{NP}}, \mathcal{C}_{9e}^{\text{NP}})$	(-1.09,-0.25)	6.0	36.5 %	(-0.72,+0.19)	2.9	54.5 %
Hyp. 1	(-1.10,+0.28)	6.5	48.9 %	(-1.69,+0.29)	3.5	82.4 %
Hyp. 2	(-1.01,+0.07)	5.9	33.7 %	(-1.95,+0.22)	3.1	64.3 %
Hyp. 3	(-0.51,+0.10)	5.4	24.0 %	(-0.39,-0.04)	3.2	69.9 %
Hyp. 4	(-0.52,+0.11)	5.6	26.4 %	(-0.46,+0.15)	3.4	77.9 %
Hyp. 5	(-1.17,+0.23)	6.6	51.1 %	(-2.05,+0.50)	3.8	91.9 %

APS physics | Journals | Physics Magazine | PhysicsCentral | APS News

Physics ABOUT BROWSE PRESS COLLECTIONS

NEWS FEATURE

The Era of Anomalies

May 14, 2020 • *Physics* 13, 79

Particle physicists are faced with a growing list of "anomalies"—experimental results that conflict with the standard model but fail to overturn it for lack of sufficient evidence.

Brookhaven National Laboratory

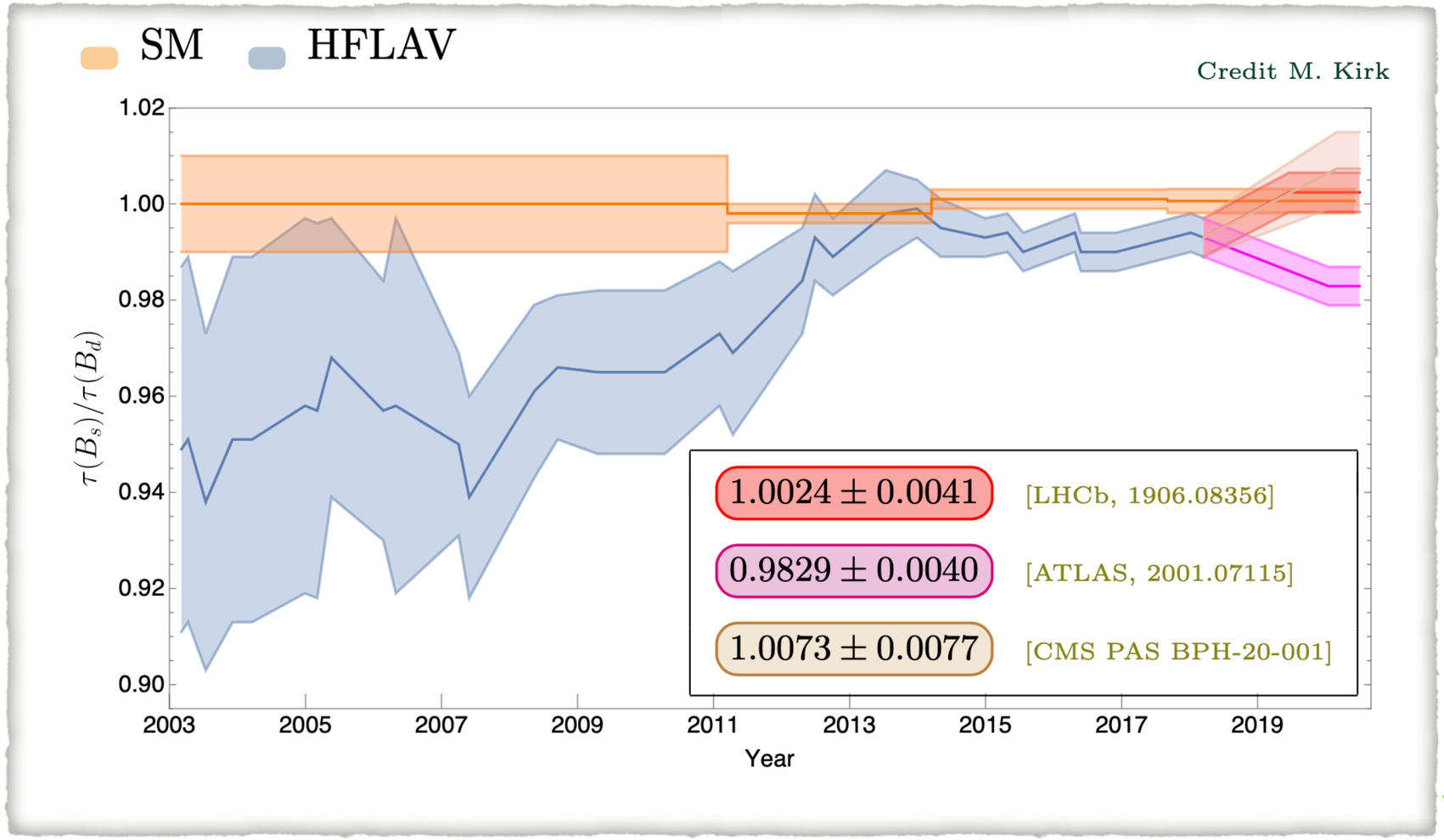
For their study of the muon anomaly, the Muon g-2 Collaboration transported a 50-foot-wide magnet halfway across the US in the summer of 2013.

Anomalies will of course always have a dominant role...

Dan Garisto

Status of (Quark) Flavour

A less well known 4 sigma anomaly...



Anomalies will of course always have a dominant role...

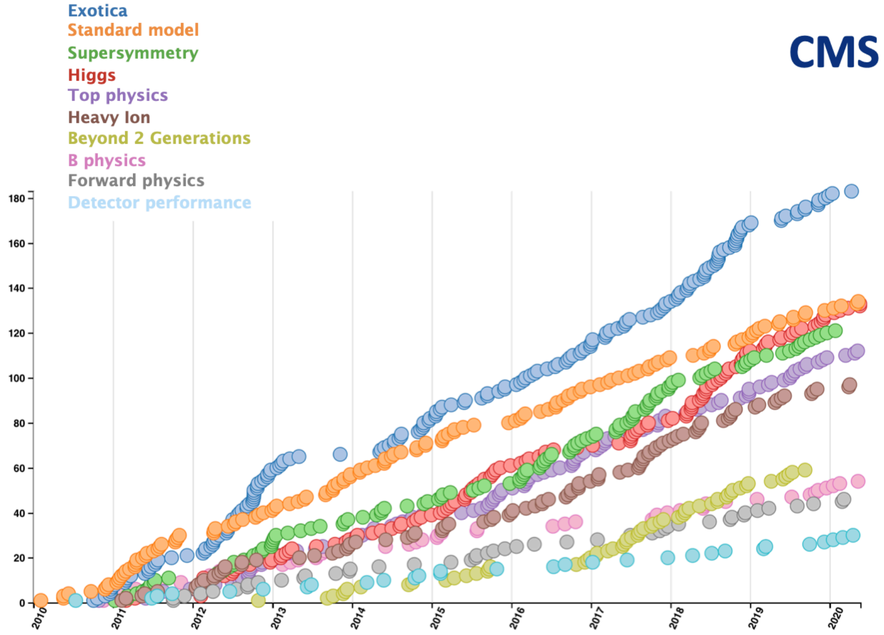
Status of Quark Flavour within Collider

To date, more than 2700 peer-reviewed physics papers have been published by the seven running LHC experiments (ALICE, ATLAS, CMS, LHCb, LHCf, MoEDAL and TOTEM). Approximately 10% of these are related to the Higgs boson, and 30% to searches for BSM phenomena. The remaining 1600 or so report measurements of SM particles and interactions, enriching our knowledge of the proton structure and of the dynamics of strong interactions, of electroweak (EW) interactions, of flavour properties, and

Michelangelo Mangano
LHC at 10 - CERN Courier
2003.05976
10% Higgs = 270 paper

No number for quark flavour

ATLAS and CMS are joining in



CMS publications

969 papers on collider data published or submitted to a journal.

994 papers overall

We have now had several CMS papers accepted in Machine Learning journals

http://cms-results.web.cern.ch/cms-results/public-results/publications-vs-time/

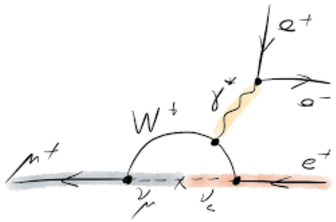
LHCb @ Inspire

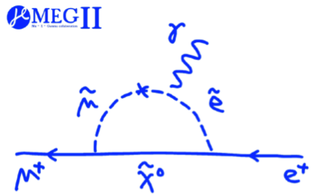
	Citeable	Published
Papers	1,926	620
Citations	44,761	39,127
h-index	102	96
Citations/paper (avg)	23.2	63.1

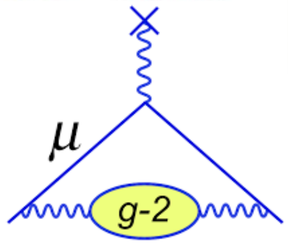
May be, we have to work harder on our reputation! (Ask Sven for help)

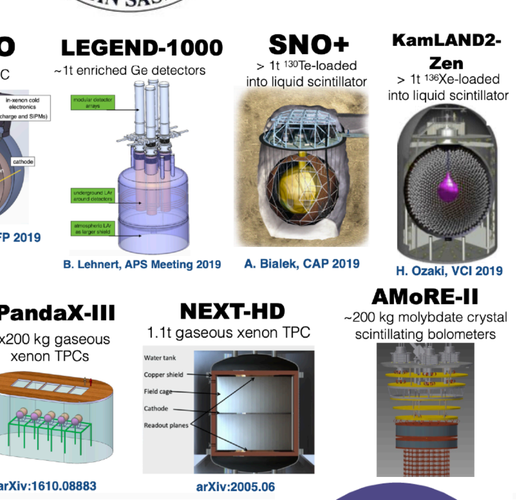
Status of Flavour

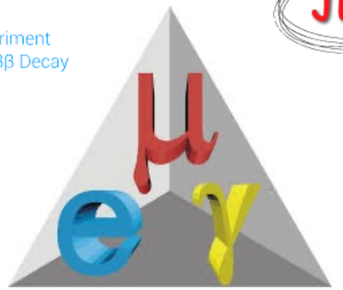
Besides the LHC experiments we have e.g.











Wishful thinking #2: Flavour Physics will even be more important in the future

Status of Flavour Physics within fundamental physics

Currently there is a huge interest from students and funding agencies in e.g.

- Gravitational Waves
- Quantum Computing
- Machine Learning
- Quantum Sensors
- Atoms Interferometry
- …

see. e.g. RECONNECT 2020

May be, we have to top up our game!

Motivation for Flavour Physics

	Kaons	Charm	Beauty	Spectrosopy	Neutrino	Charged Leptons g-2, tau,
Determine SM Parameter	✓	✓	✓	✓	✓	✓
Search for CPV	✓	✓	✓	—	✓	✓
Indirect BSM Searches	✓	✓	✓	✓	✓	✓
Solve Flavour Problem	✓	✓	✓	—	✓	✓
Understand QCD	Rare - mixing ✓ ✓	✓	✓	✓	✓	✓

Top, Higgs, nEDM…

Sorry for not covering all aspects

	Kaons	Charm	Beauty	Spectrosopy	Neutrino	Charged Leptons g-2, tau,
Determine SM Parameter	✓	✓	✓	✓	✓	✓
Search for CPV	✓	✓	✓	—	✓	✓
Indirect BSM Searches	✓	✓	✓	✓	✓	✓
Solve Flavour Problem	✓	✓	✓	—	✓	✓
Understand QCD	Rare - mixing ✓ ✓	✓	✓	✓	✓	✓

Top, Higgs, nEDM…

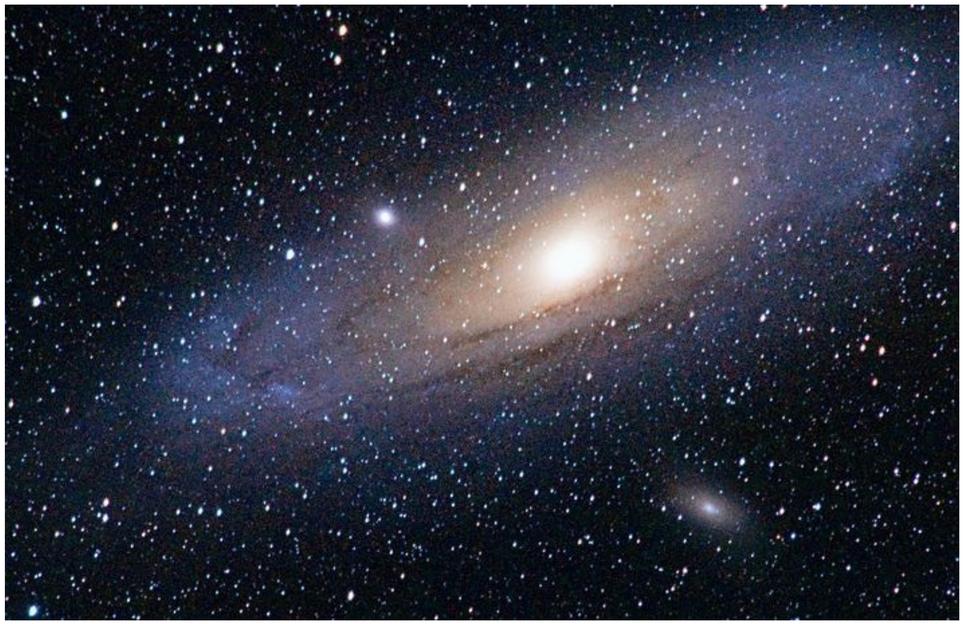
Motivation for Flavour Physics

	Kaons	Charm	Beauty	Spectrosopy	Neutrino	Charged Leptons g-2, tau,
Determine SM Parameter	✓	✓	✓	✓	✓	✓
Search for CPV	✓	✓	✓	—	✓	✓
Indirect BSM Searches	✓	✓	✓	✓	✓	✓
Solve Flavour Problem	✓	✓	✓	—	✓	✓
Understand QCD	Rare - mixing ✓ ✓	✓	✓	✓	✓	✓

Top, Higgs, nEDM…

Motivation for Flavour Physics

Astrophysics to top up our game



Quark flavour experiments as DM detectors

Summary

Baryogenesis and Dark Matter from B-mesons:

- Which actually relates the CP violation in the B^0 system to Baryogenesis
- Baryon number is conserved and hence Dark Matter is anti-Baryonic

Distinctive experimental signatures:

- Positive semileptonic asymmetry in B^0 meson decays $A_{\ell\ell}^{d\,s} > 10^{-5}$
- Neutral and charged B mesons decay into a baryon and missing energy

$$\mathrm{Br}(B \to \psi + \mathrm{Baryon} + X) > 2 \times 10^{-3}$$

Ongoing search for B → Baryon + ME at BaBar&Belle-II!

B-factories should test this scenario given the constraints on other missing energy channels:

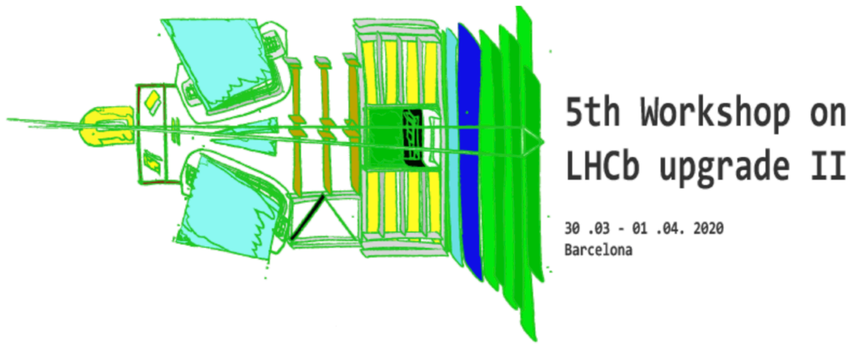
$$\mathrm{Br}(B^+ \to K^+ \bar{\nu}\nu) < 10^{-5}$$

Sharpening experimental signatures in 2006.XXXXX

with: Gonzalo Alonso-Álvarez, Gilly Elor & David McKeen

Neutrino experiments as telescopes

Future of Flavour

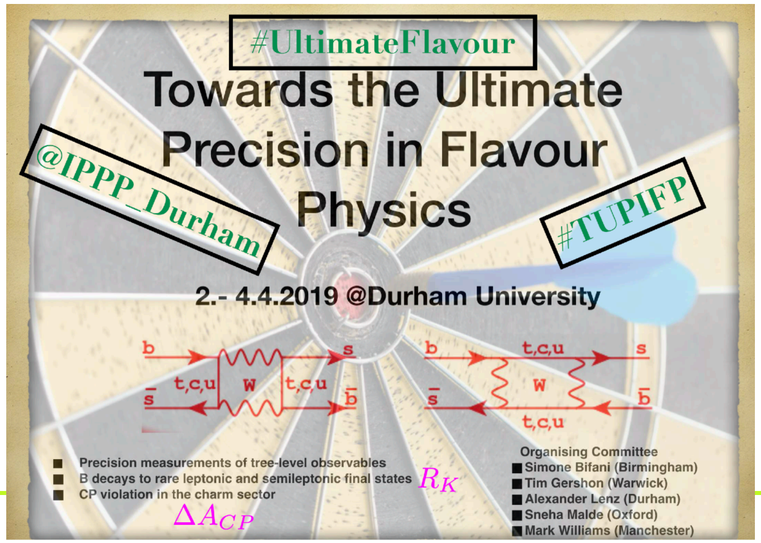


5th Workshop on LHCb upgrade II

CERN-LPCC-2018-06
February 25, 2019

Opportunities in Flavour Physics at the HL-LHC and HE-LHC

Report from Working Group 4 on the Physics of the HL-LHC, and Perspectives at the HE-LHC



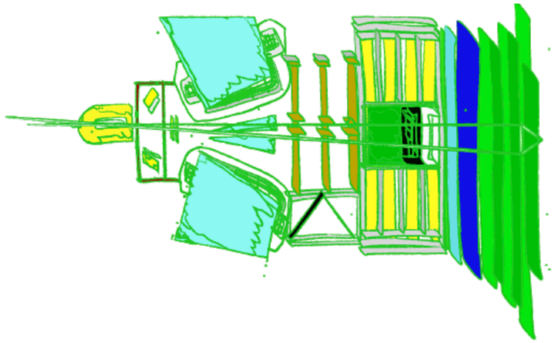
Instead of predicting the future - try to identify some lessons that might be useful to shape the future

Future of Flavour

Poll done among theorists, concerning

The most interesting future topics in

CPV in b- and c-decays



5th Workshop on LHCb upgrade II

5th Workshop on
LHCb upgrade II

30 .03 - 01 .04. 2020
Barcelona

We have to get more control over theory

14 Replies from: Andrzej Buras, Sebastian Jäger, Yuval Grosman, Uli Nierste, Marco Ciuchini, Jure Zupan, Gudrun Hiller, Thorsten Feldmann, Zoltan Ligeti, Thomas Mannel, Danny van Dyk, Svjetlana Fajfer, Gino Isidori, Luca Silvestrini

- Mixing induced CPV in charm IIIII II
- B -> K(*) mu mu and friends: IIII
- Gamma below 1% IIII
- A_CP (D_0-> K+K-), A_CP (D_0-> pi +pi-) IIII
- Sort out penguin pollution for beta, beta_s II
- B-> 3 bodies II
- epsilon'/epsilon -> relation to charm due to SU(2)_L II
- A_CP (D_0-> K_S K_S), A_CP (D_0-> K* K_S) II
- A_CP in rare charm decays D-> pi (pi) mu mu…. II
- b-> c \bar{c} s -> non-leptonic (lifetimes)
- A_CP in c-> u gamma, Lambda_c -> p gamma
- S_f in b->s qq transitions
- A_SL

8

Serious prediction #1: If CPV in charm mixing us measured, there will be paper claiming SM and BSM

Instead of predicting the future - try to identify some lessons that might be useful to shape the future

Lesson a) learnt in QFP

Anomalies are great and should be fully exploited, but do not forget…

$$\frac{\tau(B_s)}{\tau(B_d)}^{\text{HQE 1986}} \approx 1\,, \quad \frac{\tau(B^+)}{\tau(B_d)}^{\text{HQE 1986}} \approx 1.1\,, \quad \frac{\tau(\Lambda_b)}{\tau(B_d)}^{\text{HQE 1986}} \approx 0.96$$

Hierarchy of Lifetimes of Charmed and Beautiful Hadrons
Mikhail A. Shifman, M.B. Voloshin (Moscow, ITEP). 1986. 30 pp.
Published in **Sov.Phys.JETP 64 (1986) 698, Zh.Eksp.Teor.Fiz. 91 (1986) 1180-1193**
ITEP-86-83
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 281 records 250+

See also:
History of epsilon'/epsilon

Experimental numbers for $\tau(\Lambda_b)$

2003	HFAG	average	1.212 ± 0.052	0.798 ± 0.034
1998	OPAL	$\Lambda_c l$	1.29 ± 0.25	$0.85 \pm 0.16*$
1998	ALEPH	$\Lambda_c l$	1.21 ± 0.11	$0.80 \pm 0.07*$
1995	ALEPH	$\Lambda_c l$	1.02 ± 0.24	$0.67 \pm 0.16*$
1992	ALEPH	$\Lambda_c l$	1.12 ± 0.37	$0.74 \pm 0.24*$

Lesson a) learnt in QFP

Anomalies are great and should be fully exploited, but be careful….

See also:
History of
epsilon'/epsilon

Status in 2019

$$\frac{\tau(\Lambda_b)}{\tau(B_d)}^{\text{HQE 2014}} = 0.935 \pm 0.054$$

AL 2014
Uraltsev Memorial Book

Λ_b	**1.471 ± 0.009 ps**	$\Lambda_b/B^0 = 0.969 \pm 0.006$

4.9 sigma above 2003 average!!!

HFLAV 2019

keep this in mind when discussing experimental anomalies

Platitude #1: Experimental numbers can change and we need control experiments

Lesson b) learnt in QFP

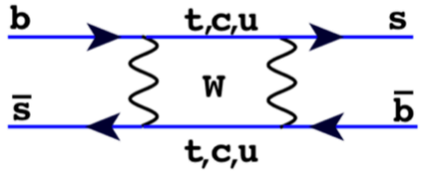
See also: History of epsilon'/epsilon

Theory predictions for extremely precisely measured B mixing

Experiment.: HFLAV 2019

$\Delta m_s = 17.757 \pm 0.021\ \mathrm{ps}^{-1}$ $\Delta m_d = 0.5064 \pm 0.0019\ \mathrm{ps}^{-1}$

Theory



$$M_{12}^s = \frac{G_F^2}{12\pi^2} \lambda_t^2 M_W^2 S_0(x_t) B f_{B_s}^2 M_{B_s} \hat{\eta}_B$$

CKM

Inami-Lim

Buras Jamin Weisz

In the SM one operator:

$$Q = \bar{s}^\alpha \gamma_\mu (1-\gamma_5) b^\alpha \times \bar{s}^\beta \gamma^\mu (1-\gamma_5) b^\beta$$

$$\langle Q \rangle \equiv \langle B_s^0 | Q | \bar{B}_s^0 \rangle = \frac{8}{3} M_{B_s}^2 f_{B_s}^2 B(\mu)$$

Non-perturbative theory input:

1) **Lattice:** ETM, FNAL-MILC, RBC-UKQCD, HPQCD
2) **Sum rules:** Siegen, Durham

B-mixing:

- Macroscopic Quantum Effect
- Pure loop effect => sensitive to BSM
- Very precisely measured
- Sensitive to badly know CKM elements V_tx
- Theory precision dominated by non-perturbative input

Lesson b) learnt in QFP

See also:
History of
epsilon'/epsilon

Theory predictions for extremely precisely measured B mixing

State-of the-art values for f_Bs^2 B from FNAL-MILC 1602.03560 (dominated the FLAG average) gives:

$$\Delta M_s^{\mathrm{SM,\,2017}} = (20.01 \pm 1.25)\ \mathrm{ps}^{-1}\ .$$

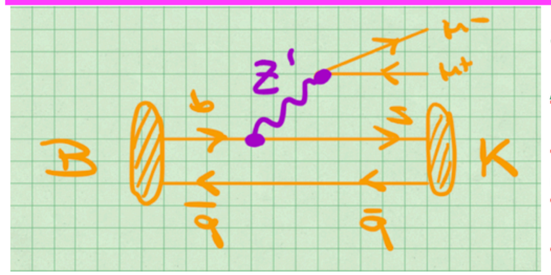
Which is around 2 standard deviations (another anomaly :-)) larger than experiment:

$$\Delta M_s^{\mathrm{Exp}} = (17.757 \pm 0.021)\ \mathrm{ps}^{-1}$$

This can have severe consequences for BSM models explaining the flavour anomalies

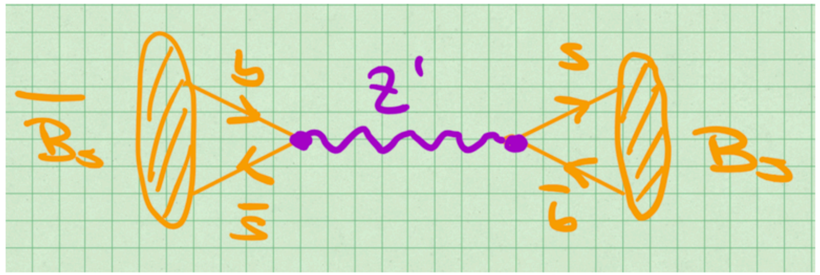
Lesson b) learnt in QFP

Flavour anomalies could e.g. be explained by Z' models



See e.g. Allanach, Davighi, Gripaios, Lohitsiri, Madigan, Meville, You,..

Such a models also modifies the mass difference of neutral mesons



arXiv:1712.06572v1 (hep-ph)

[Submitted on 18 Dec 2017 (this version), latest version 15 May 2018 (v2)]

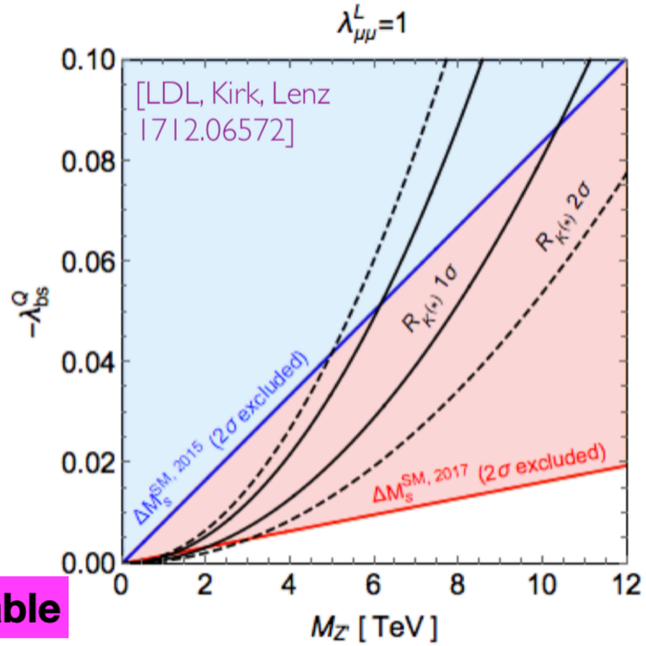
One constraint to kill them all?

Luca Di Luzio, Matthew Kirk, Alexander Lenz

Many times the BSM contribution to ΔM_q is positive

Using the large FNAL-MILC value:

One constraint to kill them all! Di Luzio, Kirk, AL



Drastic consequences of FNAL result!

Independent determination of Bs mixing inputs desirable

See also: History of epsilon'/epsilon

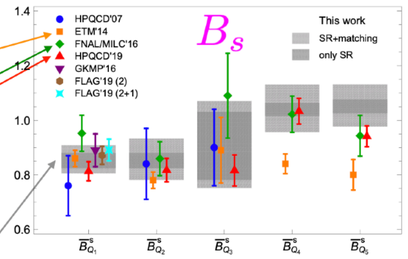
Lesson b) learnt in QFP

See also:
History of
epsilon'/epsilon

Independent determinations of non-perturbative B mixing parameter:

B_s-mixing

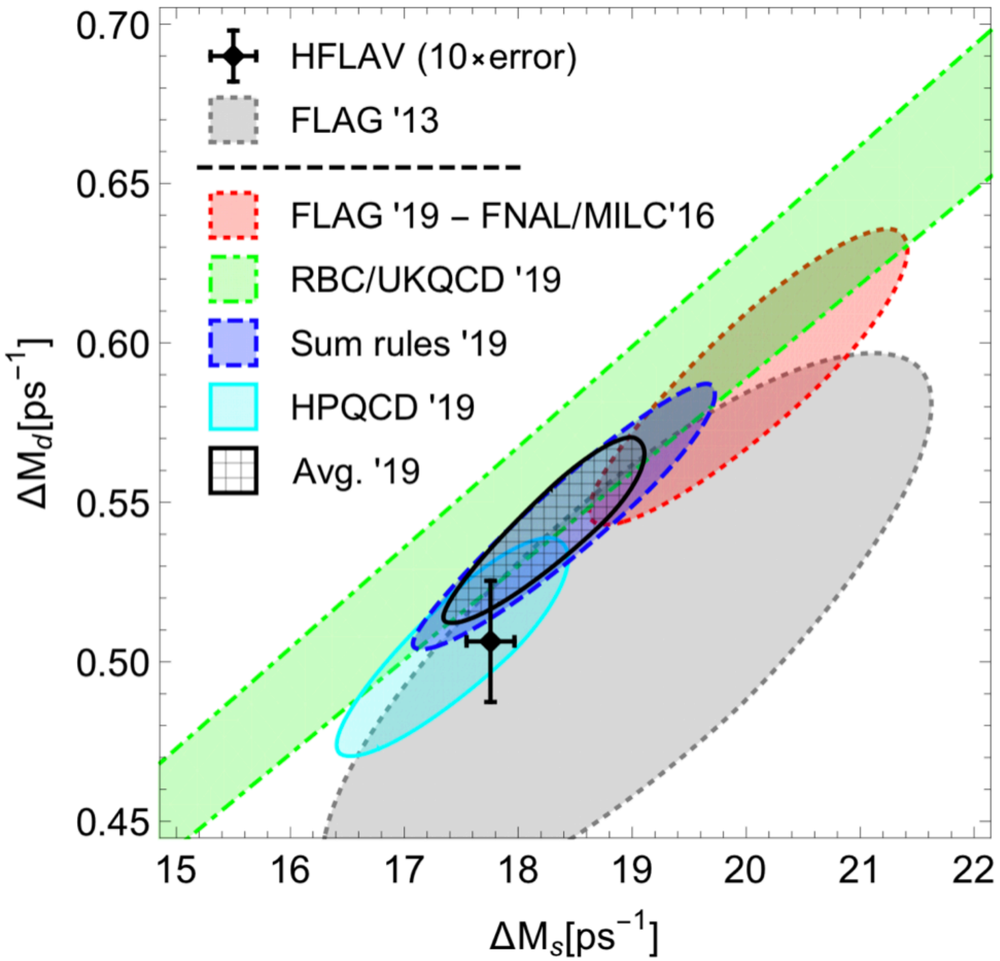
1. **Lattice**
   * ETM 1308.1851
   * FNAL-MILC 1602.03560
   * HPQCD 1907.01025



2. **HQET-sum rules: 3-loop + NLO matching:**
   *Durham: King, AL, Rauh (Bern) 1904.00940

$$r^{(0)}_{\tilde{Q}_1} = 8 - \frac{a_2}{2} - \frac{8\pi^2}{3}$$

$$r^{(2)}_{\tilde{Q}_1} = \frac{1}{1+x^2}\left[\frac{(1-x)^2 a_2}{4} + \frac{2\pi^2(1-4x+x^2)}{3} + 2x\psi(x)\left(2+\frac{1+x}{1-x}\ln(x)\right)\right.$$
$$\left. + \begin{cases} -\frac{2(6+6x-x^2+2x^3)}{3} + 2(2-4x+x^2)\ln(x) - 4(1-x^2)\mathrm{Li}_2(1-1/x), & x \le 1, \\ -\frac{2(2-x+6x^2+6x^3)}{3x} - 2(1-4x+2x^2)\ln(x) + 4(1-x^2)\mathrm{Li}_2(1-x), & x > 1, \end{cases}\right]$$



Very active field:
- **Flag 19: mostly FNAL-MILC (2/16)**
- **RBC-UK: 12-18**
- **Sum rules: Durham 4/19 (based on Siegen 16-18, Durham 17)**
- **HPQCD: 07/19**

New averages of lattice and sum rules
Di Luzio, Kirk, AL, Rauh
1909.11087 JHEP

Platitude #2: Theory numbers can change and we need independent calculations for a check

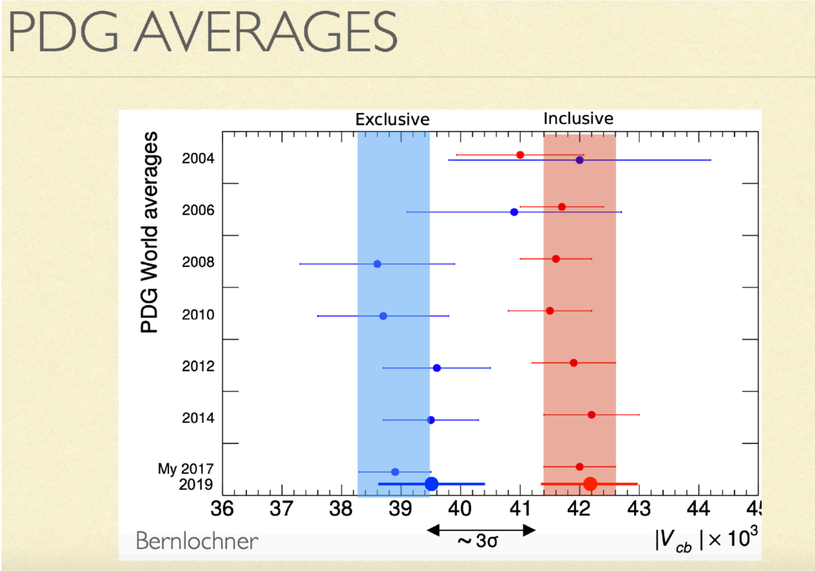
Lesson c) learnt in QFP

Bread and butter physics: determination of SM parameter

B -> D* l nu $|V_{cb}| = (38.76 \pm 0.42_{\rm exp} \pm 0.55_{\rm th}) \times 10^{-3}$,

B -> D l nu $|V_{cb}| = (39.58 \pm 0.94_{\rm exp} \pm 0.37_{\rm th}) \times 10^{-3}$

B -> X_c l nu $|V_{cb}| = (42.19 \pm 0.78) \times 10^{-3}$



gamma_CKM $\gamma = (72.1^{+4.1}_{-4.5})^\circ$

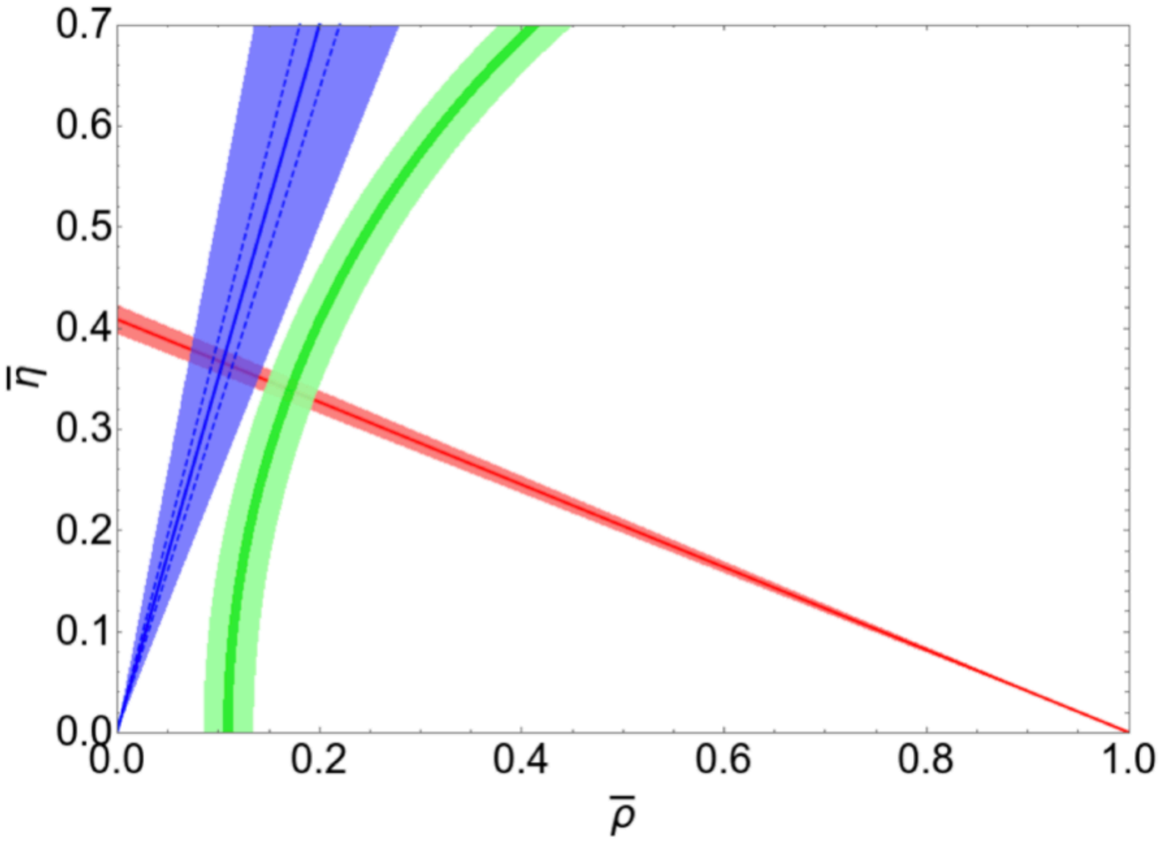
The Review of Particle Physics (2020)

Numbers from HFLAV, similar problem for V_ub

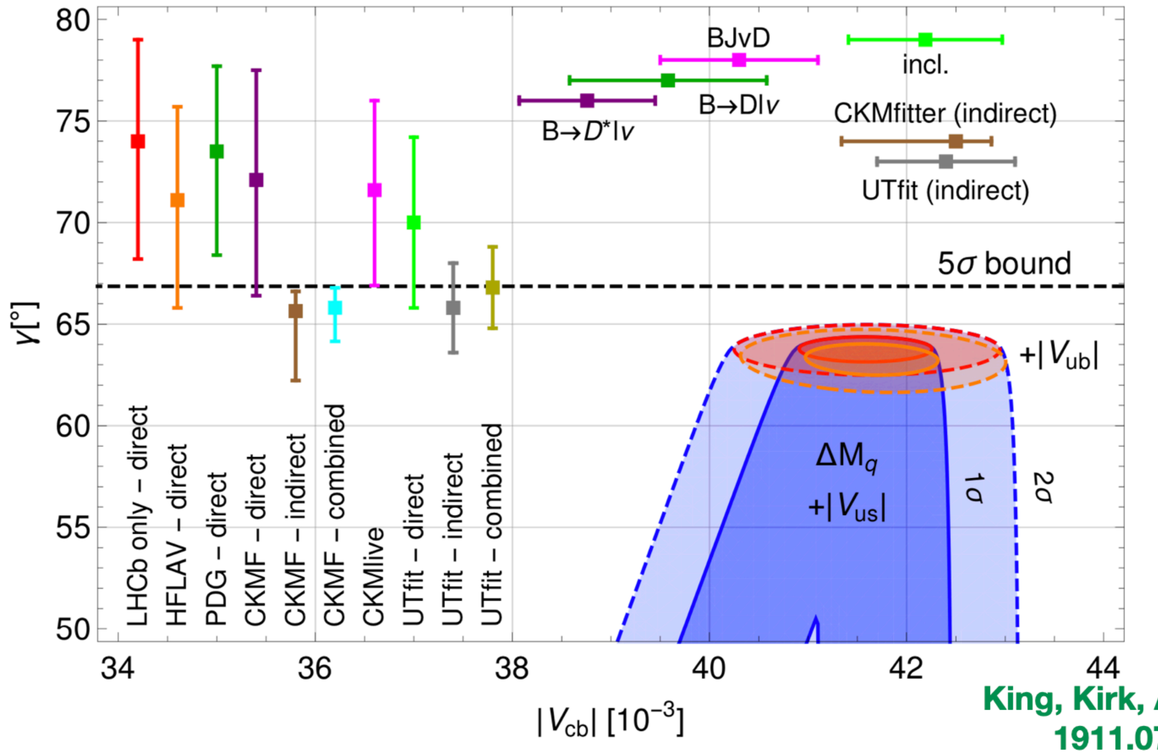
Lesson c) learnt in QFP

Due to the improved precision, B-mixing can be used to determine V_tx precisely

Within the SM this can be transformed into bounds on V_cb, V_ub and gamma



Within the SM we get $\gamma = (63.4 \pm 0.9)^\circ$ $|V_{cb}| = (41.6 \pm 0.7) \cdot 10^{-3}$



King, Kirk, AL, Rauh
1911.07856

Competitive precision for Vcb - favours inclusive value, upper limit on gamma

Lesson c) learnt in QFP

Paolo

V_{cb} plays an important role in UT

$$\varepsilon_K \approx x|V_{cb}|^4 + \ldots$$

and in the prediction of FCNC:

$$\propto |V_{tb}V_{ts}|^2 \simeq |V_{cb}|^2\left[1 + O(\lambda^2)\right]$$

PROCEEDINGS OF SCIENCE

arXiv:1912.03024 (hep-lat)

2019 Update on ε_K with lattice QCD inputs

LANL-SWME Collaboration

We present updated results for ε_K determined directly from the standard model (SM) with lattice QCD inputs such as $\hat{B}_K$, $|V_{cb}|$, $|V_{us}|$, ξ_0, ξ_2, $\xi_{\rm LD}$, f_K, and m_c. We find that the standard model with exclusive $|V_{cb}|$ and other lattice QCD inputs describes only 65% of the experimental value of $|\varepsilon_K|$ and does not explain its remaining 35%, which leads to a strong tension in $|\varepsilon_K|$ at the $4.6\sigma \sim 4.2\sigma$ level between the SM theory and experiment. We also find that this tension disappears when we use the inclusive value of $|V_{cb}|$ obtained using the heavy quark expansion based on QCD sum rules.

V_cb inclusive is wrong: NP in B-mixing

NP in K-mixing

V_cb exclusive is wrong: NP in exclusive decays?

Platitude #3: Bread and butter physics is crucial and can be a smoking gun for BSM!

Lesson d) learnt in QFP

prejudice

/ˈprɛdʒʊdɪs/

noun

plural noun: **prejudices**

1. preconceived opinion that is not based on reason or actual experience.
   "English **prejudice against** foreigners"

Lesson d) learnt in QFP

prejudice

/ˈprɛdʒʊdɪs/

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1. preconceived opinion that is not based on reason or actual experience.
   "English **prejudice against** foreigners"

- The "B-physics anomalies" provide a concrete demonstration of the high discovery potential of flavor physics. Even if they will go away, they have been very beneficial in shaking some prejudices in model building and in (re-)opening new interesting directions.

Gino

Lesson d) learnt in QFP

Scientific prejudices partly based on reason and experience - probably ok, as long as we are aware of it:

d1) Modelbuilding: for a long time SUSY was almost the only game in town and things like lepto-quarks were unacceptable/disgusting ——— now it seems that lepto-quarks and Z'-bosons are the only game in town and SUSY is unacceptable/disgusting…

G. Isidori – bsll decays: what we learned & what we still hope to learn

I am aware that Sven, Dominik,… will not agree with the statement about SUSY!

III. *The return of the Leptoquark*

Leptoquarks suffered of an (*undeserved*) "bad reputation" for two main reasons:

d2) No new physics is present in hadronic tree-level decays

d3) Darwin term is unimportant for hadron lifetimes

d4) gamma extractions from B_d, B^+ and B_s have to be the same? Any ideas?

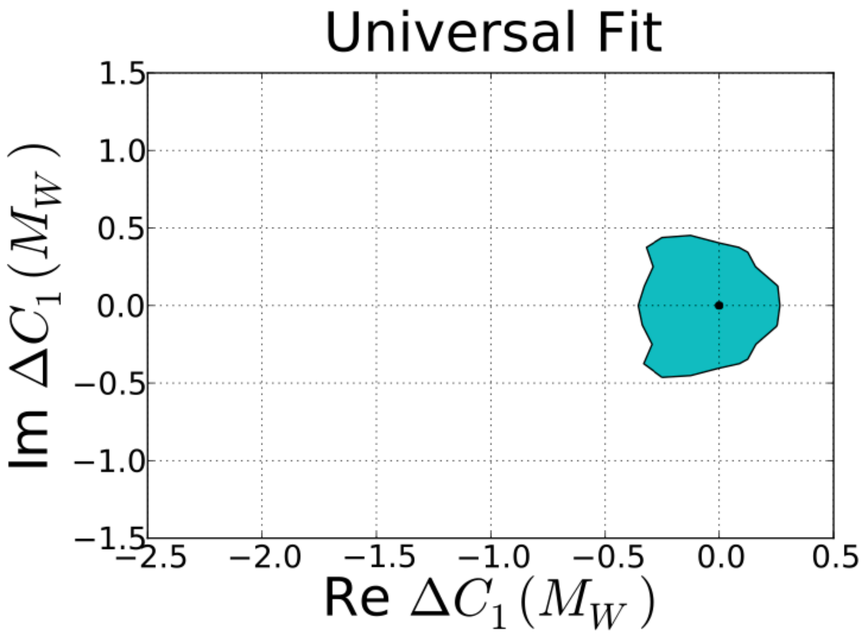
d5)… **probably endless list**

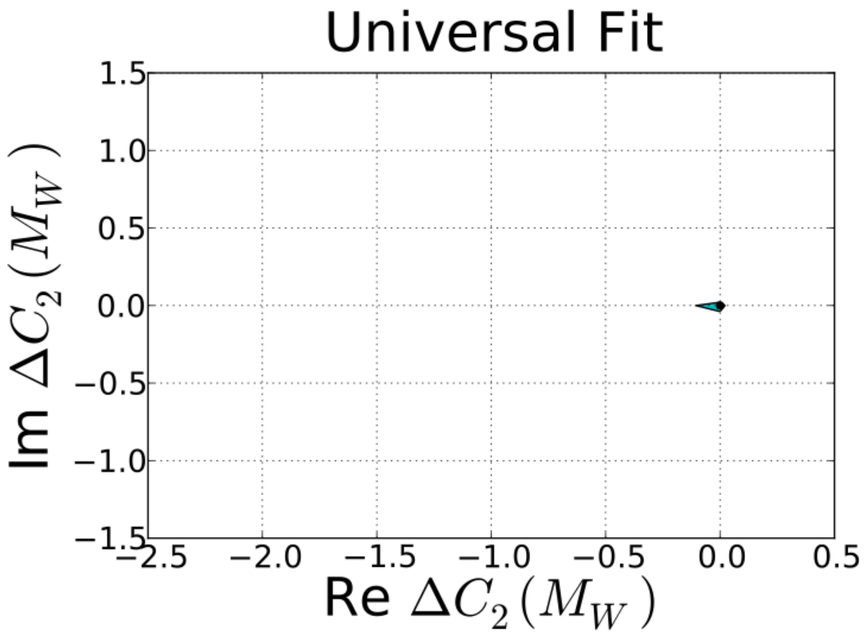
Lesson d2) learnt in QFP

d2) do a systematic study of potential BSM effects in hadronic tree-level decays

$$C_1(M_W) := C_1^{\rm SM}(M_W) + \Delta C_1(M_W),$$
$$C_2(M_W) := C_2^{\rm SM}(M_W) + \Delta C_2(M_W),$$

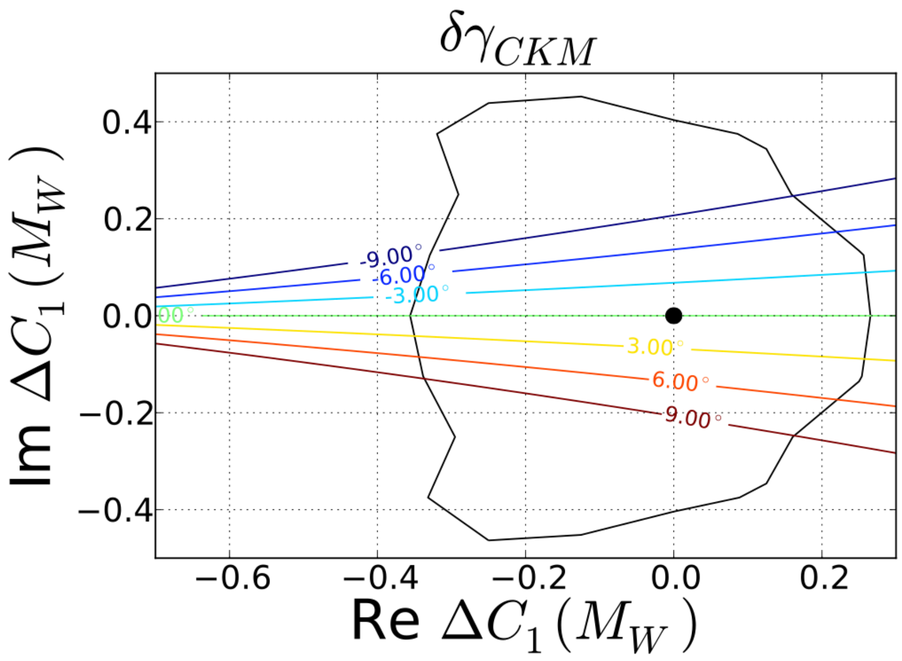
Allowed size of BSM effects in tree-level decays





Lesson d2) learnt in QFP

d2) Consequences of BSM effects in hadronic tree-level decays



A deviation of the direct determination of gamma from B-mixing results could points towards:

A) BSM effects in B-mixing

B) BSM effects in tree-level decays

For a better quantitative understanding hadronic matrix elements needed

BSM effects in non-leptonic decays are not excluded by experiment

Their potential size could have dramatic effects

Lesson d3) learnt in QFP

d3) Darwin term is unimportant for Hadron lifetimes

Textbook knowledge

$$\Gamma(B) = \Gamma_0 + \Gamma_2 \frac{\langle \mathcal{O}_5 \rangle}{m_b^2} + \Gamma_3 \frac{\langle \mathcal{O}_6 \rangle}{m_b^3} + \ldots + 16\pi^2 \left[\tilde{\Gamma}_3 \frac{\langle \tilde{\mathcal{O}}_6 \rangle}{m_b^3} + \tilde{\Gamma}_4 \frac{\langle \tilde{\mathcal{O}}_7 \rangle}{m_b^4} + \ldots \right]$$

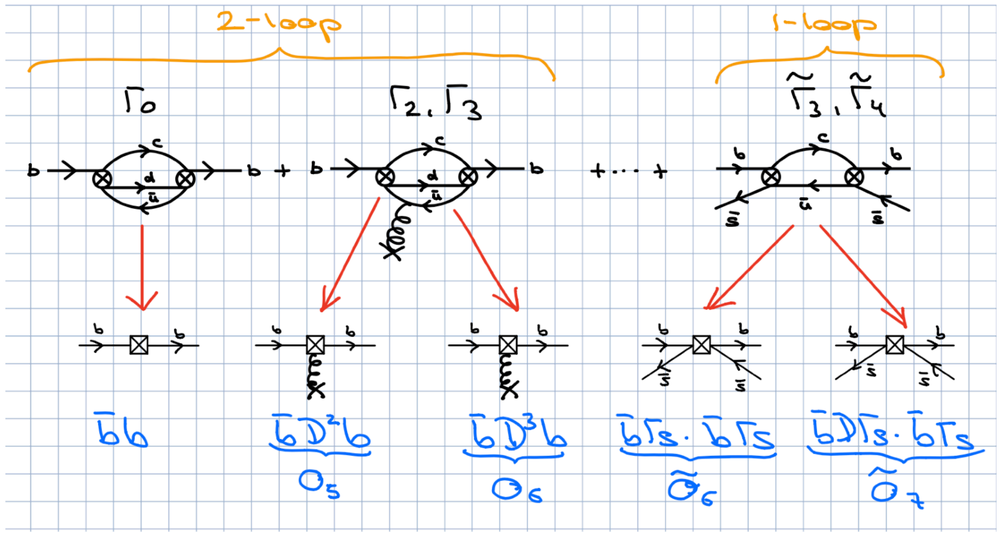
Spectator effects in inclusive decays of beauty hadrons #12

M. Neubert (CERN), Christopher T. Sachrajda (CERN) (Mar 4, 1996)

Published in: *Nucl.Phys.B* 483 (1997) 339-370 • e-Print: hep-ph/9603202 [hep-ph]

pdf DOI cite 332 citations

seem safe to neglect them altogether. However, as a result of the difference in the phase-space for $2 \to 2$-body reactions as compared to $1 \to 3$-body decays, these effects are enhanced by a factor of order $16\pi^2$. It is conceivable that they could be larger than the terms of order $(\Lambda_{\rm QCD}/m_b)^2$ included in (2). Moreover, spectator



AL: "It is not worth calculating the Darwin term" - Aleksey Rusov: "Why not, it is important in sl decays"

Lesson d3) learnt in QFP

d3) Darwin term is unimportant for Hadron lifetimes?

Calculation of Darwin term (independently obtained by two groups) yields,

however,

$$\Gamma_{\rm NL}(B) = \Gamma_0 \left[1 - \underbrace{0.0112}_{\mu_\pi^2} - \underbrace{0.0071}_{\mu_G^2} - \underbrace{0.0415}_{\rho_D^3} - \underbrace{0.0029}_{\tau_i^{(q)}} \underbrace{\begin{matrix} -0.1033\,(B^+) \\ +0.0148\,(B_d) \end{matrix}}_{\mathcal{B}_i^{(q)}} \right],$$

To determine effect on lifetime ratios, the matrix elements of the Darwin operator for different mesons have to be determined!

Determination could maybe be done on a 5s run at Belle

Lesson e) learnt in QFP

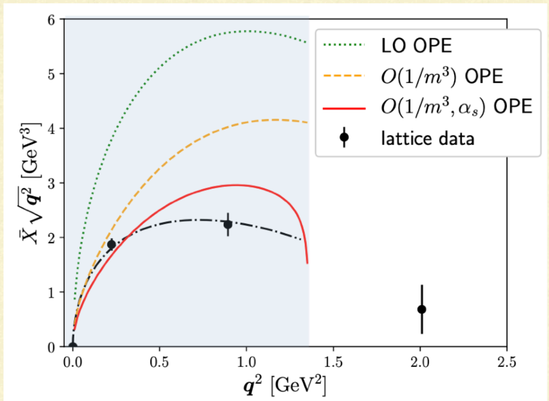
Synergies in flavour physics

- Kaon physics: Chiral perturbation theory - Lattice

Best strategy: χ**PT (amplitudes) + Lattice (LECs)**

A. Pich K Decays & CP violation 27

- Semi-leptonic decays: inclusive approach on the lattice



$\Gamma/|V_{cb}|^2 = 4.88(57) \times 10^{-13}$ GeV Lattice

$\Gamma/|V_{cb}|^2 = 5.41(82) \times 10^{-13}$ GeV OPE

including all known corrections

- HQE vs. Spectroscopy - treatment of Darwin term...

- ....

Future of Flavour

- Future can be bright (many experiments), but we have quite some competition
  Provide input for future studies, e.g. SNOWMASS 21,…
- Selected lessons learnt:
  - Experimental numbers can change - experimental cross checks needed: Belle II, B@CMS, B@ATLAS? - Neutrino experiments….
  - Theory numbers can change - independent cross-checks needed - a “second” higher order or lattice calculation has to be also highly rated!
  - Bread and butter physics can contain some surprises
  - Prejudices offer a chance to write some interesting papers
  - ….
- Control over QCD will be crucial for our future
- Synergies: looking over the fences surrounding our subfields might be very helpful

Future of Flavour

Messages from the machine room to the top deck

Disclaimer: the sun deck is important as well, but I think it needs less advertisement

Serious prediction #2: QCD will be even more important

Taken from Thomas Mannel

Looking

into my

crystal ball

Future of Flavour

Further things that will happen for sure:

1. There will be a future flavour group where lattice and sum rules will happily work together (names are available offline)

Future of Flavour

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A Short History of CP Violation

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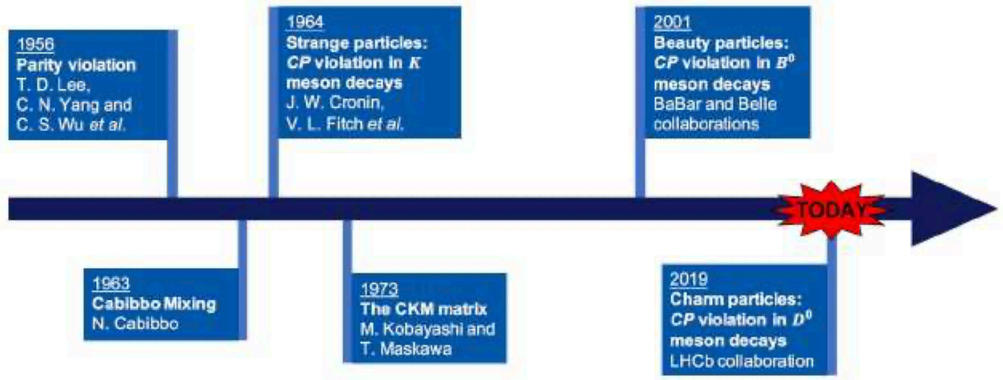
- It is hard to argue that the LHCb result requires BSM
- Yet, BSM can still be present



This is just the beginning for charm

Future of Flavour

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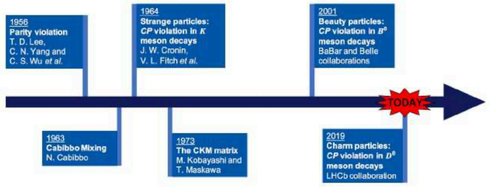

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3. Andrzej Buras will find BSM in Kaon physics

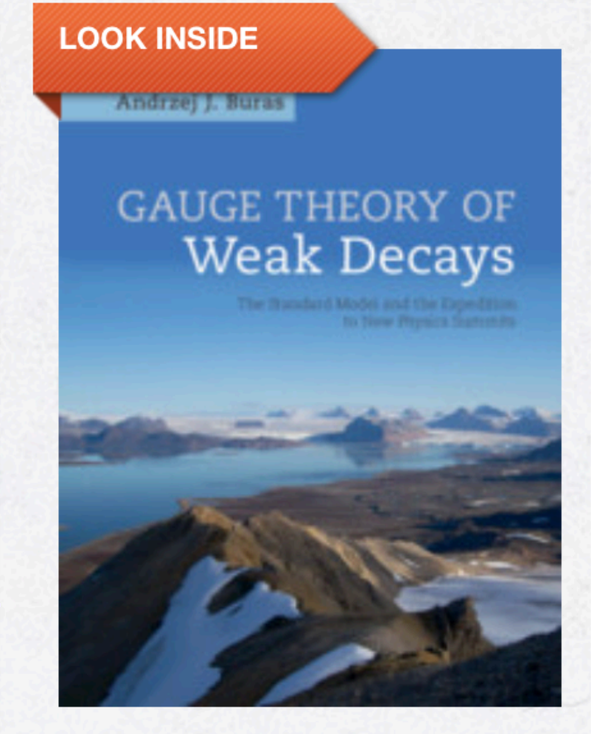
[1] arXiv:2006.01138 [pdf, other]

Another SMEFT Story: Z' Facing New Results on ε'/ε, ΔM_K and $K \to \pi\nu\bar{\nu}$

Jason Aebischer, Andrzej J. Buras, Jacky Kumar

Comments: 35 pages, 12 figures

Subjects: **High Energy Physics – Phenomenology (hep-ph)**; High Energy Physics –



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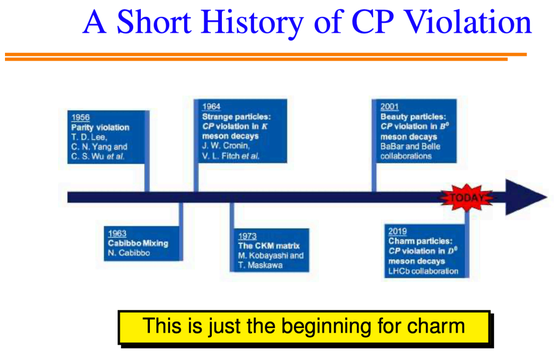

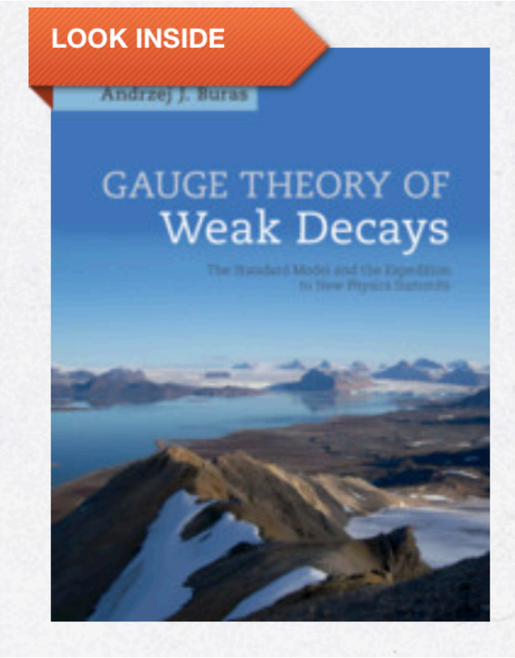

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4. Prejudice will not die out in our field - see e.g. the last slide of the last talk of FPCP2020

Thanks a lot

to the organisers of

FPCP 2020

for a great job

Future of (Flavour) Conferences

Sorry for all of us not being in A Toxa

Wishful thinking #1: There will be a future conference in A Toxa

How many live/virtual conferences do we really need?

Attendance level: virtual vs. real?

How many real new results are presented at a typical conference?

When do we need the next edition in a conference series?