WG2 – Summary

Determinations of V_{ub}, V_{cb} through semileptonic B decays

- Michele Della Morte, CP[3] Origins and IFIC
- Damir Becirevic, CNRS, Paris Sud
- Alexei Sibidanov, Sidney Univ.

We thank the speakers of the 5 sessions for the:

16 theoretical talks (Lattice, sum-rules, BSM …)
Including 3 reviews

8 experimental talks (BaBar, Belle, LHCb)
Including 2 reviews

I will try to focus on the new(er) aspects not covered in the plenaries

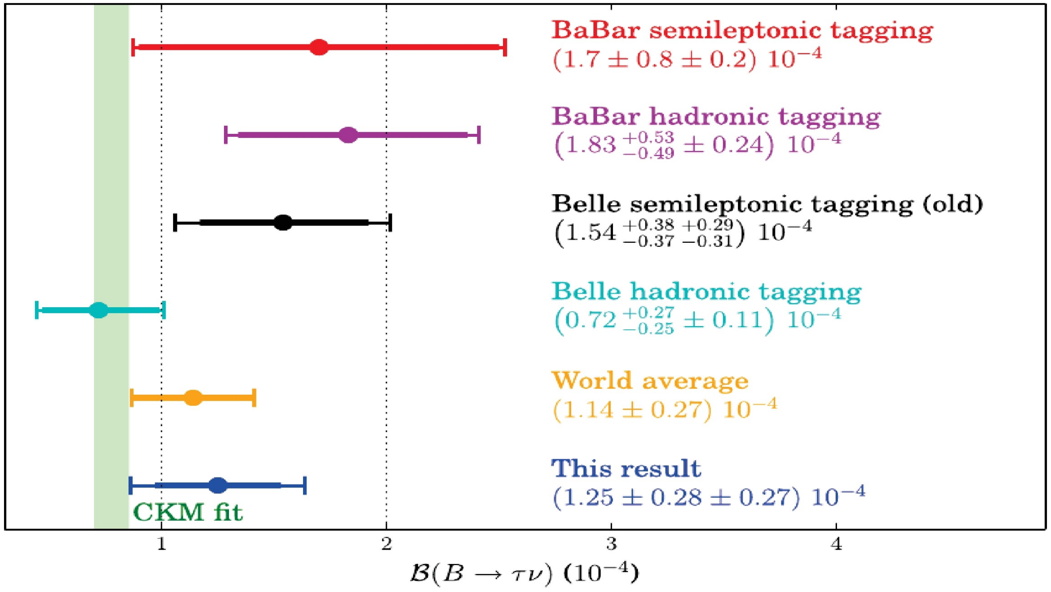
Session 1, leptonic decays (mostly)

- Experimental talk by Martin Heck, from Belle:
- Comparison of inclusive tag reconstruction in B → l nu and 'more elaborate' complete reconstruction of the tag side (Belle II ?)
- B → tau nu analysis including semileptonic tag, more tau decay channels and 20% more statistics (tension with Utfits gone)

Results

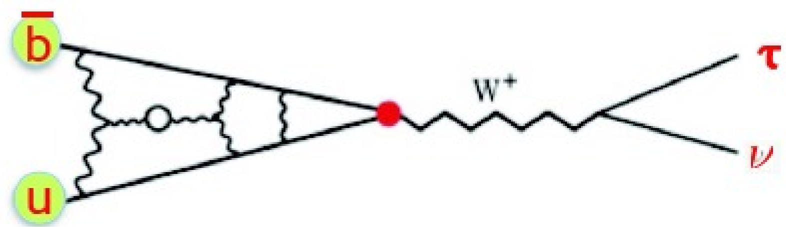
Karlsruher Institut für Technologie

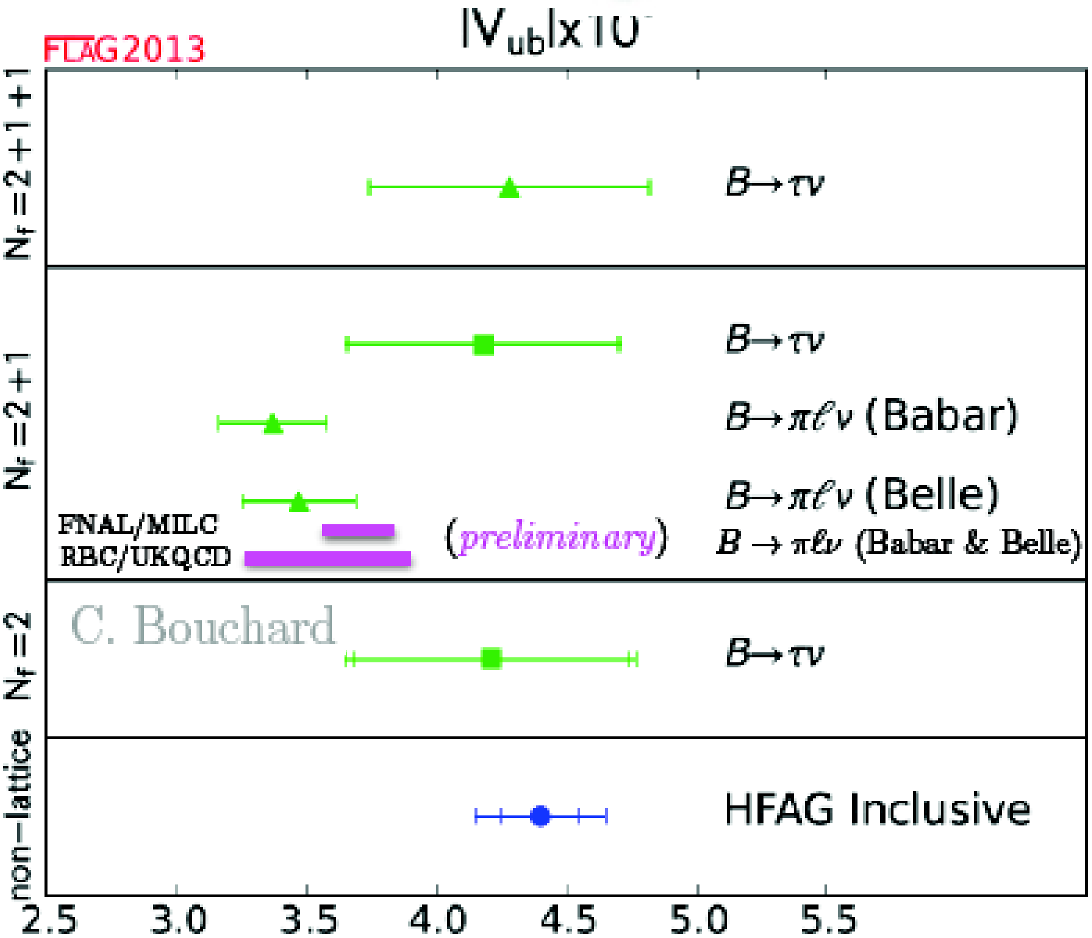
$$\mathcal{B}(B^+ \to \tau^+ \nu_\tau) = (1.25 \pm 0.28 \pm 0.27) \times 10^{-4}$$

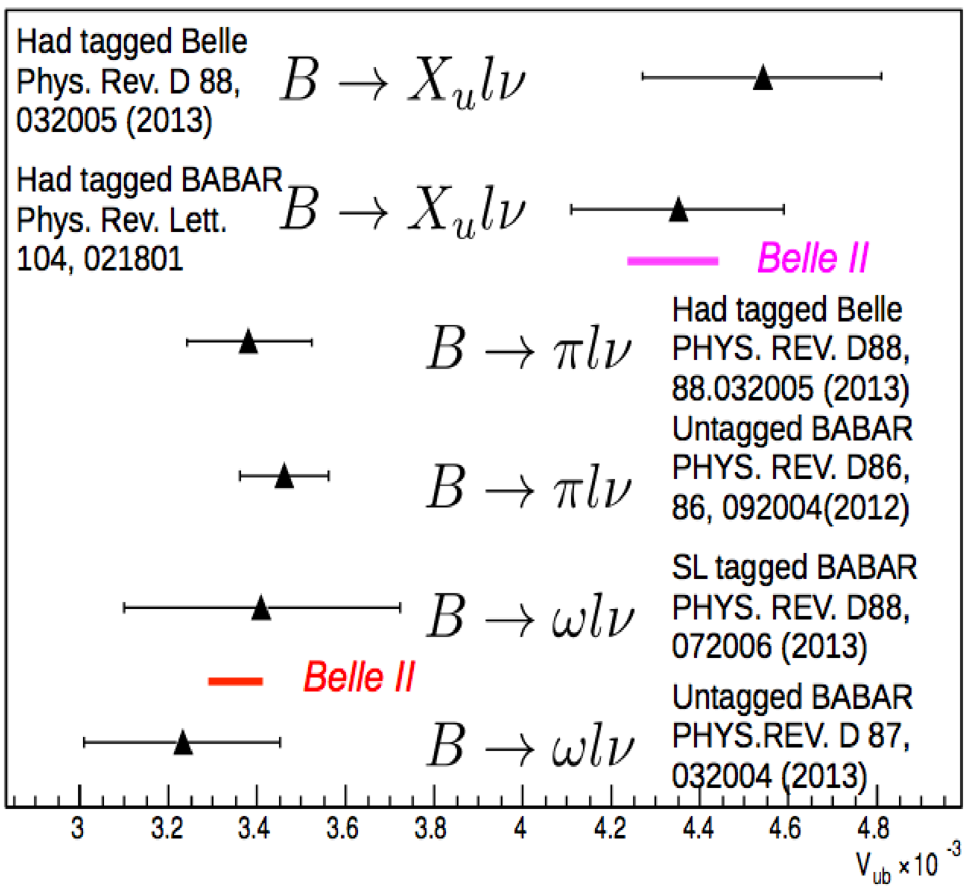


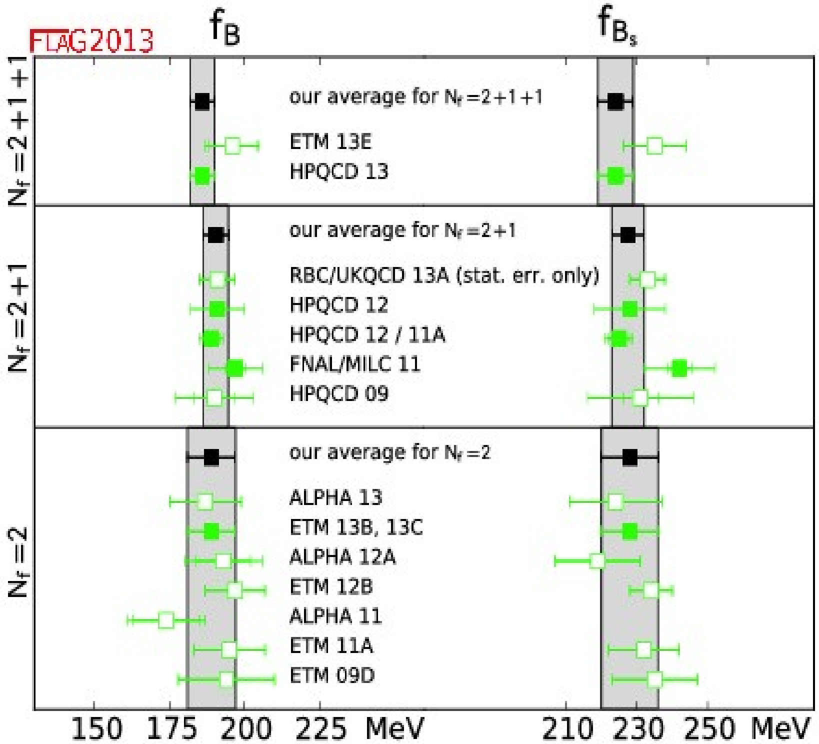
- Two lattice talks: Heechang Na: B meson decay constants from FNAL, NRQCD and HISQ

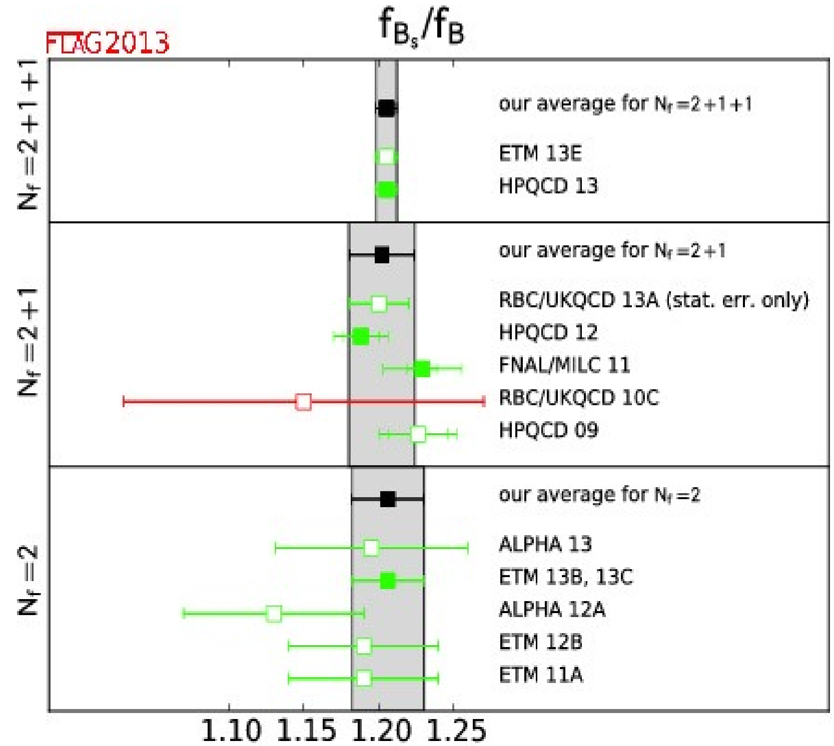
  Gregorio Herdoiza for ETMC





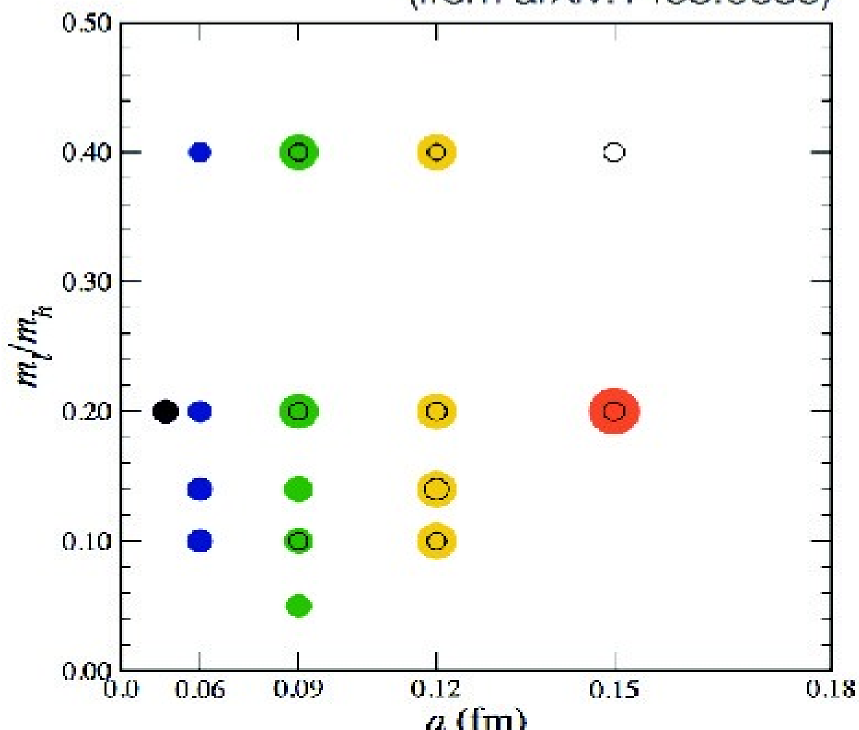






- HPQCD 2+1+(1) : f_{Bs} HISQ+f_{Bs}/f_B in NRQCD
- FNAL/MILC: Fermilab approach, extending 2+1 and 2+1+1 MILC ensembles
- ETMC: 2 and 2+1+1 with ratio method

(from arXiv:1403.0635)



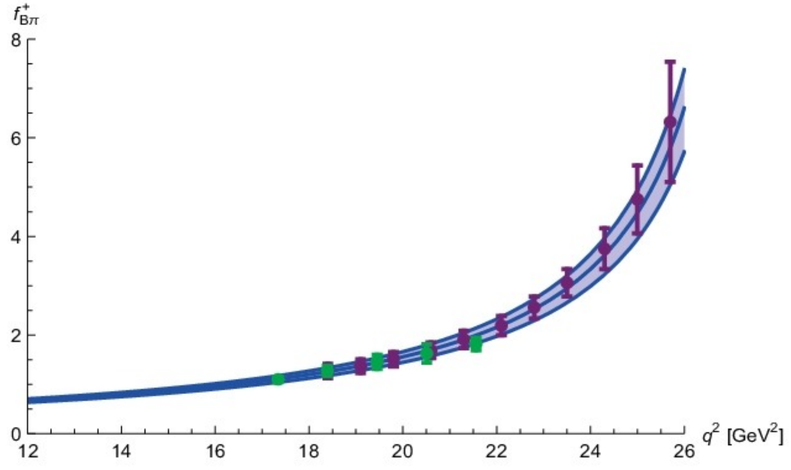
2 sum-rules talks: A. Khodjamirian (LCSR)

Results for $B \to \pi$ form factor (preliminary !):

- first attempt of statistical (Bayesian) analysis:
  updated inputs, taken as priors,
  constructing likelihood by imposing $[m_B]_{SR}$ within 1% of m_B
  [I.Imsong, AK, Th.Mannel, D.van Dyk, work in progress]
- 6 quantities obtained from LCSR:
  $f^+_{B\pi}(q^2)$ + first + second derivative
  (value, slope, curvature) at $q^2 = 0, 10$ GeV^2 ,
  output resembles gaussian distribution with large correlations
- BCL parameterization fitted to LCSR results,

$f_{B\pi}(0) = 0.31 \pm 0.02$
$b_1^+ = -1.28^{+.43}_{-0.58}$
$b_2^+ = -0.88^{+0.43}_{-0.53}$

68% probability intervals



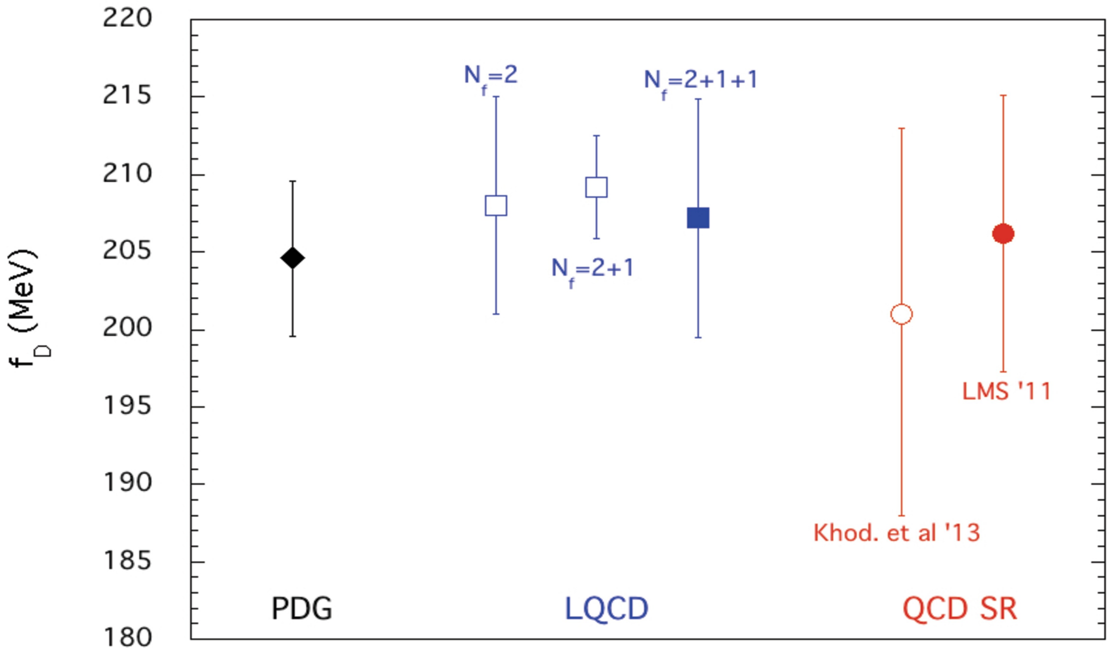
• -HPQCD , • -Fermilab-MILC

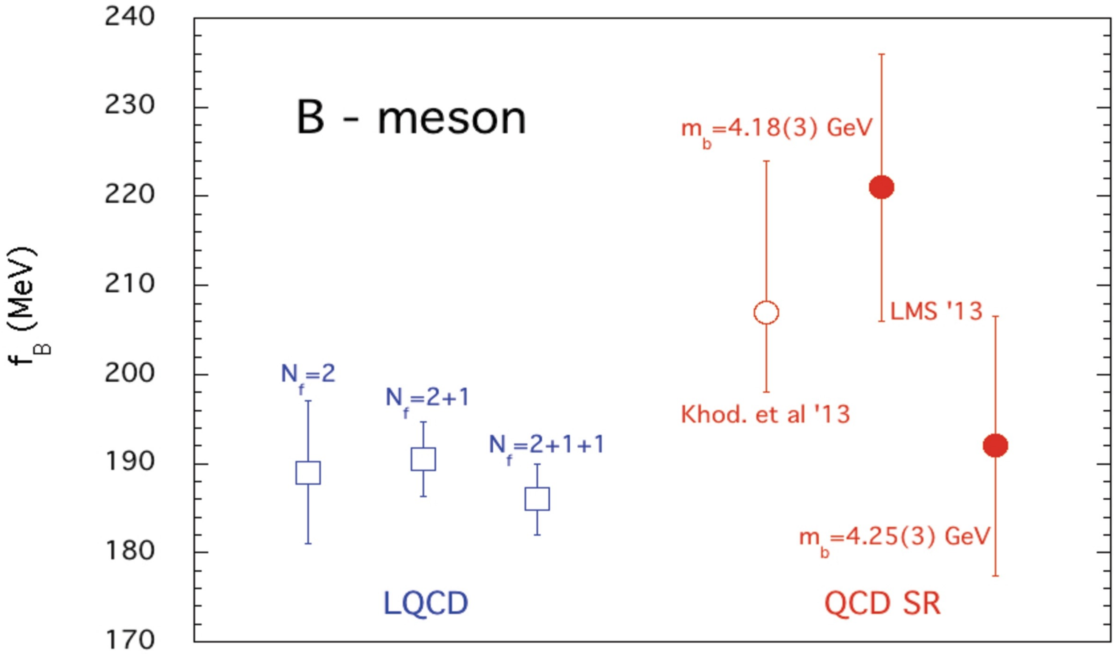
- extrapolating
  beyond the LCSR region
  good agreement with lattice results

With prospects for B → pi pi l nu

Borel sum rules vs lattice (S. Simula)

Slight tension in the B sector. Also results for B* and D*





Session 2: V_{cb}

Experimental review by R. Glattauer (Belle)

Inclusive-Exclusive discrepancy: up to 3σ

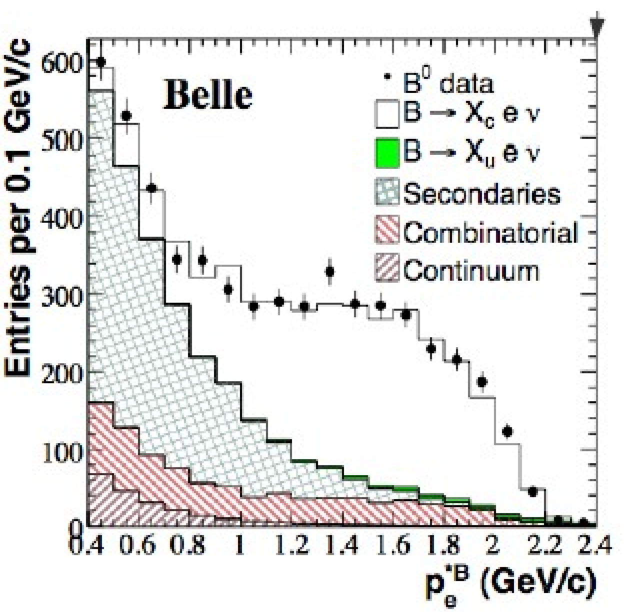
Exclusive $B \to D^* \ell \nu$ $F(1)\lvert V_{cb}\rvert = (35.90 \pm 0.11_{stat} \pm 0.44_{syst}) \times 10^{-3}$	**F(1)**	**$\lvert V_{cb}\rvert$ (10^{-3})**
Lattice QCD [PoS LATTICE2010, 311 (2010)]	0.908 ± 0.017	$39.54 \pm 0.50_{exp} \pm 0.74_{th}$
Lattice QCD [arXiv:1403.0635]	0.920 ± 0.013	$39.04 \pm 0.49_{exp} \pm 0.56_{th}$
Sum rules [PRD 81: 113002 (2010)]	0.866 ± 0.020	$41.47 \pm 0.52_{exp} \pm 0.96_{th}$

Exclusive $B \to D \ell \nu$ $G(1)\lvert V_{cb}\rvert = (42.64 \pm 0.72_{stat} \pm 1.35_{syst}) \times 10^{-3}$	**G(1)**	**$\lvert V_{cb}\rvert$ (10^{-3})**
Lattice QCD [NPPS 140, 461-463 (2005)]	1.081 ± 0.024	$39.44 \pm 1.42_{exp} \pm 0.88_{th}$
Sum rules [PLB585, 253-262 (2004)]	1.047 ± 0.020	$40.73 \pm 1.46_{exp} \pm 0.78_{th}$

Inclusive	**$\lvert V_{cb}\rvert$ (10^{-3})**
[PRD 89:014022 (2014)]	42.42 ± 0.86

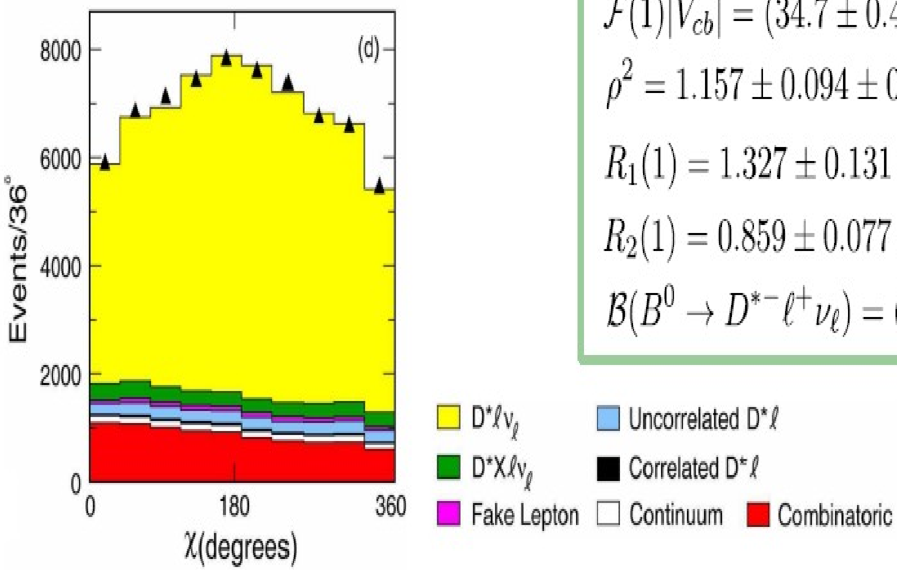
Inclusive $B \to X_c \ell \nu$

Measure moments of lepton energy and hadronic mass



$B \to D^* \ell \nu$ BaBar

[PRD 77:032002, 2008]

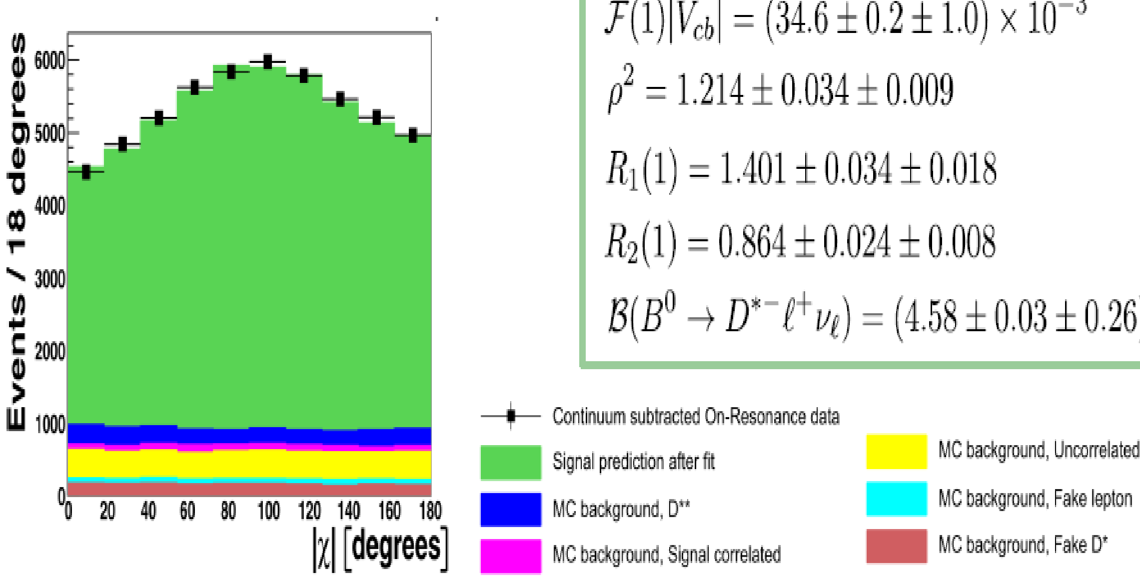


$$\mathcal{F}(1)|V_{cb}| = (34.7 \pm 0.4 \pm 1.0) \times 10^{-3}$$
$$\rho^2 = 1.157 \pm 0.094 \pm 0.027$$
$$R_1(1) = 1.327 \pm 0.131 \pm 0.043$$
$$R_2(1) = 0.859 \pm 0.077 \pm 0.021$$
$$\mathcal{B}(B^0 \to D^{*-}\ell^+\nu_\ell) = (4.72 \pm 0.05 \pm 0.34)\%$$

$79 fb^{-1}$

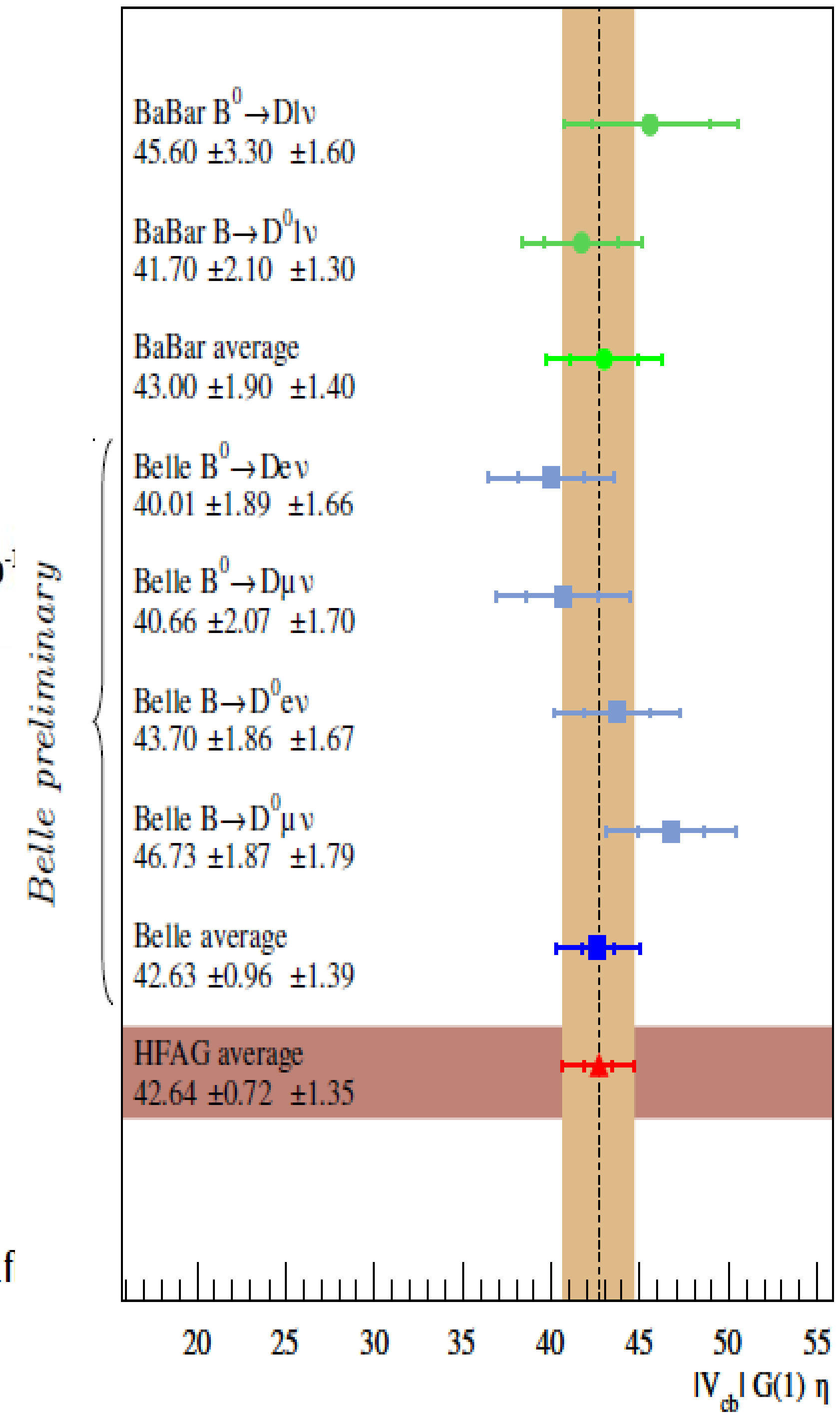
$B \to D^* \ell \nu$ Belle

[PRD 82:112007, 2010]

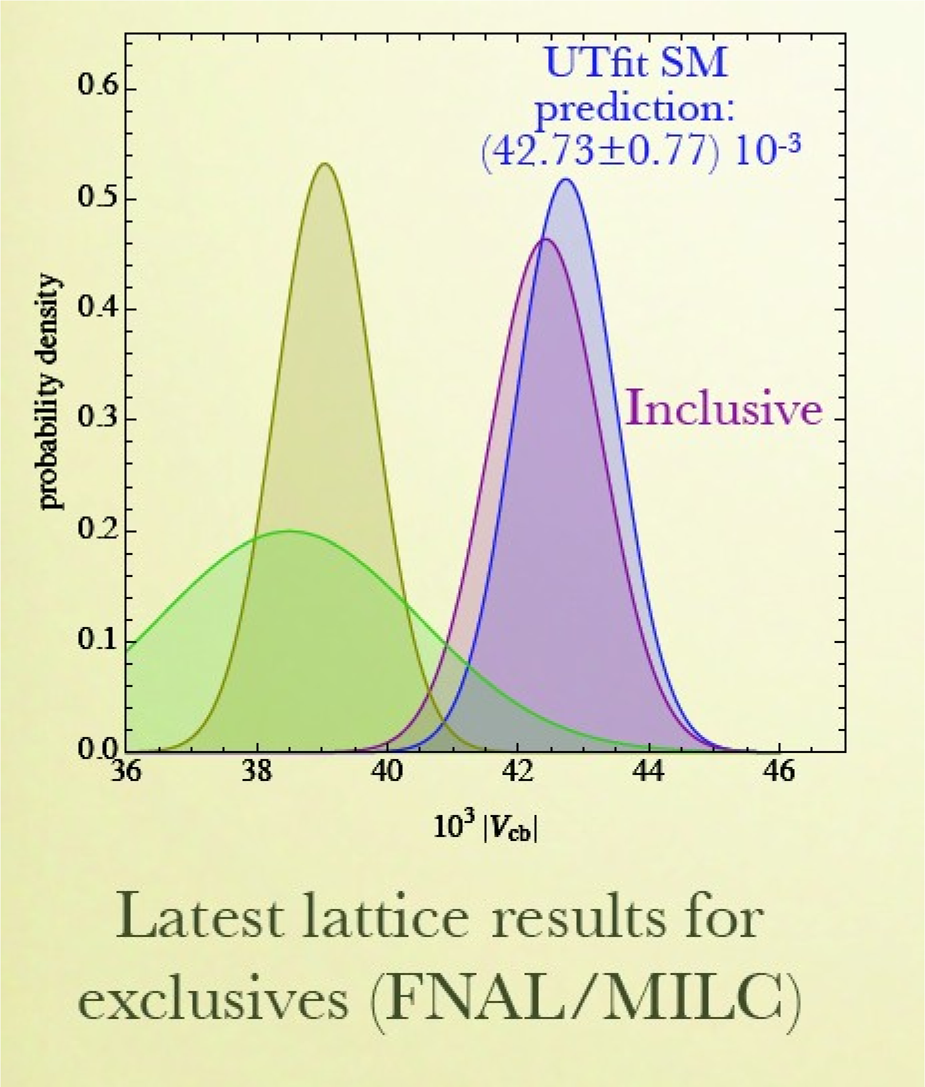


$$\mathcal{F}(1)|V_{cb}| = (34.6 \pm 0.2 \pm 1.0) \times 10^{-3}$$
$$\rho^2 = 1.214 \pm 0.034 \pm 0.009$$
$$R_1(1) = 1.401 \pm 0.034 \pm 0.018$$
$$R_2(1) = 0.864 \pm 0.024 \pm 0.008$$
$$\mathcal{B}(B^0 \to D^{*-}\ell^+\nu_\ell) = (4.58 \pm 0.03 \pm 0.26)\%$$

711f



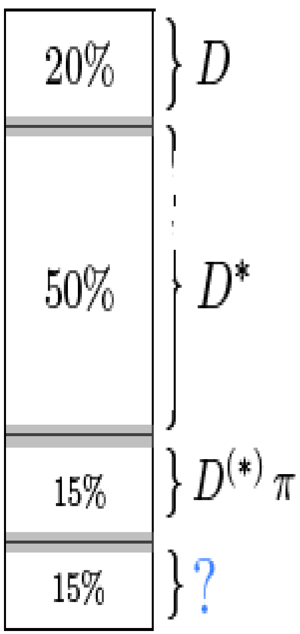
Vcb inclusive theory: P. Gambino



- Effects up to $1/m_h^{4,5}$ (using LLSA) and $O(\alpha_s \Lambda^2/m_b^2)$ included in the OPE.
- 3 σ (8%) discrepancy remains large and mysterious.
- All pert. corr.= 5%, power corr.=4%. Maybe Belle-II will clarify.

F. Bernlochner (BABAR): Measurement of $B \to D^{(*)} \pi^+ \pi^- \ell \bar{\nu}_\ell$

- Background for B → D(*) tau nu
- Maybe relevant for inclusive determination (LLSA)
- Event reconstruction: tag & recoil approach. Fully reconstruct a B through 2968 possible hadronic modes

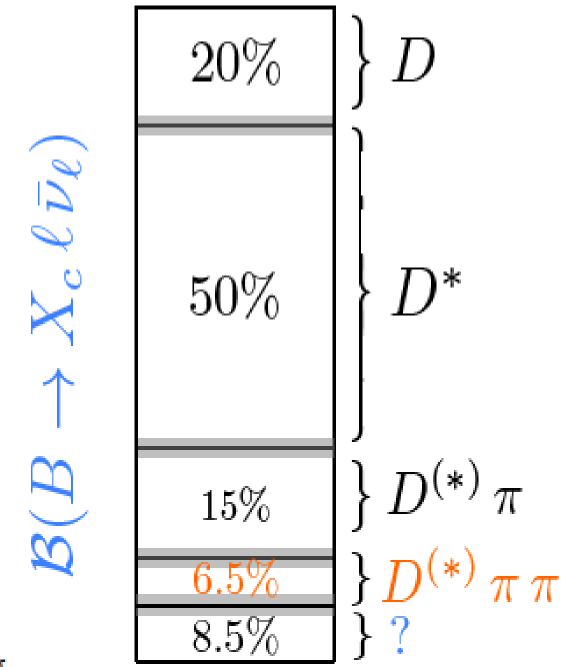


BABAR preliminary

signal	norm.	R [%]	$\mathcal{B}$ [%]
$D^0\pi^+$	D^+	$18.89 \pm 1.73 \pm 1.13$	$0.412 \pm 0.038 \pm 0.025 \pm 0.023$
$D^+\pi^-$	D^0	$18.02 \pm 1.31 \pm 1.32$	$0.402 \pm 0.029 \pm 0.029 \pm 0.022$
$D^{*0}\pi^+$	D^{*+}	$12.80 \pm 0.87 \pm 0.84$	$0.631 \pm 0.043 \pm 0.042 \pm 0.014$
$D^{*+}\pi^-$	D^{*0}	$10.64 \pm 0.59 \pm 1.16$	$0.607 \pm 0.034 \pm 0.066 \pm 0.020$
$D^0\pi^+\pi^-$	D^0	$9.56 \pm 2.04 \pm 1.24$	$0.213 \pm 0.045 \pm 0.028 \pm 0.012$
$D^+\pi^+\pi^-$	D^+	$5.25 \pm 1.90 \pm 1.21$	$0.114 \pm 0.041 \pm 0.026 \pm 0.006$
$D^{*0}\pi^+\pi^-$	D^{*0}	$1.61 \pm 0.78 \pm 0.35$	$0.092 \pm 0.044 \pm 0.020 \pm 0.003$
$D^{*+}\pi^+\pi^-$	D^{*+}	$2.69 \pm 0.92 \pm 0.49$	$0.132 \pm 0.045 \pm 0.024 \pm 0.003$
$D\pi^\pm$	D	$18.41 \pm 1.06 \pm 0.85$	$0.421 \pm 0.024 \pm 0.019 \pm 0.016$
$D^*\pi^\pm$	D^*	$11.79 \pm 0.54 \pm 0.59$	$0.641 \pm 0.029 \pm 0.032 \pm 0.021$
$D\pi^+\pi^-$	D	$7.28 \pm 1.39 \pm 0.89$	$0.166 \pm 0.032 \pm 0.020 \pm 0.006$
$D^*\pi^+\pi^-$	D^*	$2.04 \pm 0.60 \pm 0.30$	$0.111 \pm 0.033 \pm 0.016 \pm 0.004$

given uncertainties: first: statistical; second: systematic; (third: due to normalization branching

reference branching fractions for $\mathcal{B}(B \to D^{(*)}\ell\overline{\nu})$ taken from PDG



→ Significance of gap reduces from $7\,\sigma$ to about $3\,\sigma$.

Two lattice talks: F. Sanfilippo (Nf=2, ETMC, ratio method)

$B_s \to D_s$ near zero recoil

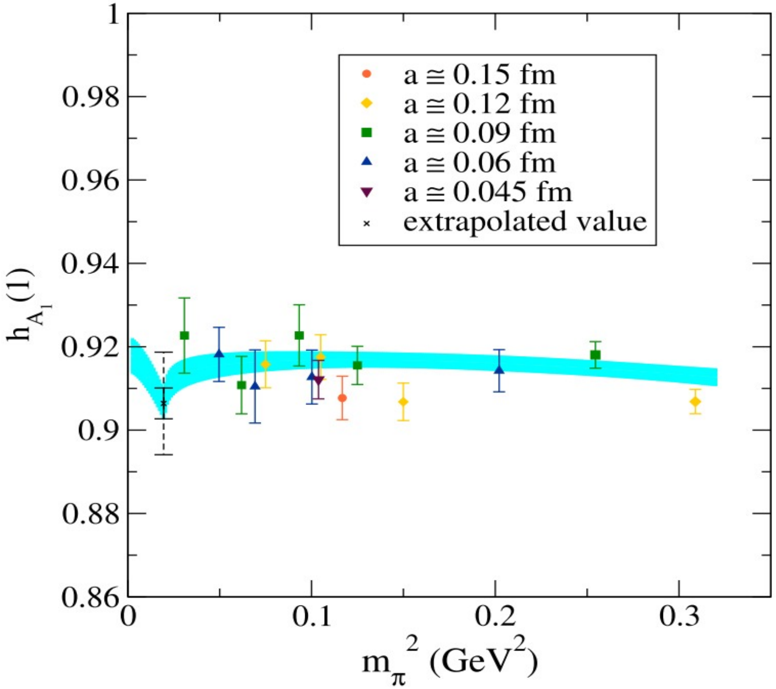
- First unquenched determination of $\mathcal{G}^{B_s \to D_s}(1) = 1.052(46)$: compatible with previous results
- Determination of f_T/f_+ and f_0/f_+ important to constraint BSM low energy couplings
- So far statistics does not allow to study $B \to D$ at the precision needed to have impact on V_{cb}

$B_s \to D_s^*$ at zero recoil

- Determination of $\mathcal{F}^{B_s \to D_s^*}(1) = 0.953(35)$
- The first computation of the ratio T_2/A_1 at zero recoil: very close to 1 (at $\mu = 2$ GeV)
  - important to constraint new physics models from $B_s \to D_s^* \ell\nu$

D. Du (FNAL/MILC and HPQCD)

- FNAL/MILC: (double) ratio method, 2+1 MILC, b+c Fermilab
- B->D l nu, new results
- Ongoing B->D l nu by HPQCD using 2+1+1 HISQ + NRQCD
- Also fits with with exp data



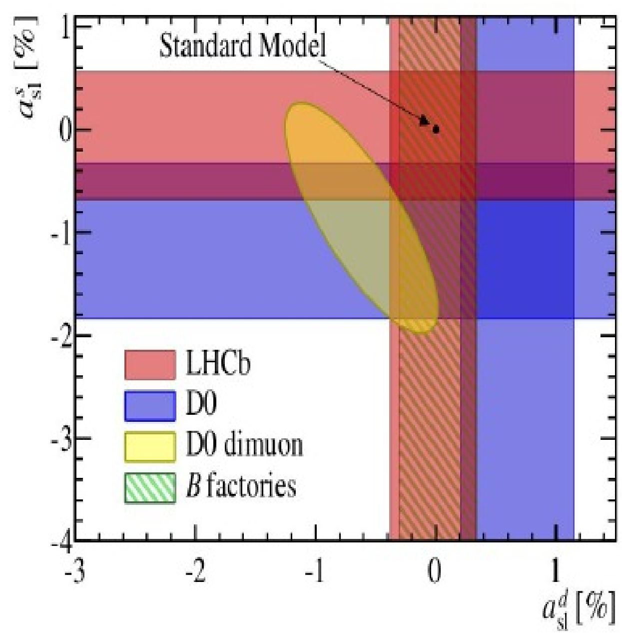
Session 3: V_{ub} semileptonic (mostly)

Semileptonic program at LHCb, B. Khanji

- Flavor tagging, $\Delta m_{s,d}$ (benchmark)

$$\Delta m_\mathrm{d} = (0.503 \pm 0.011(\mathrm{stat}) \pm 0.013(\mathrm{syst}))\,\mathrm{ps}^{-1}$$
$$\Delta m_\mathrm{s} = (17.93 \pm 0.22(\mathrm{stat}) \pm 0.15(\mathrm{syst}))\,\mathrm{ps}^{-1}$$

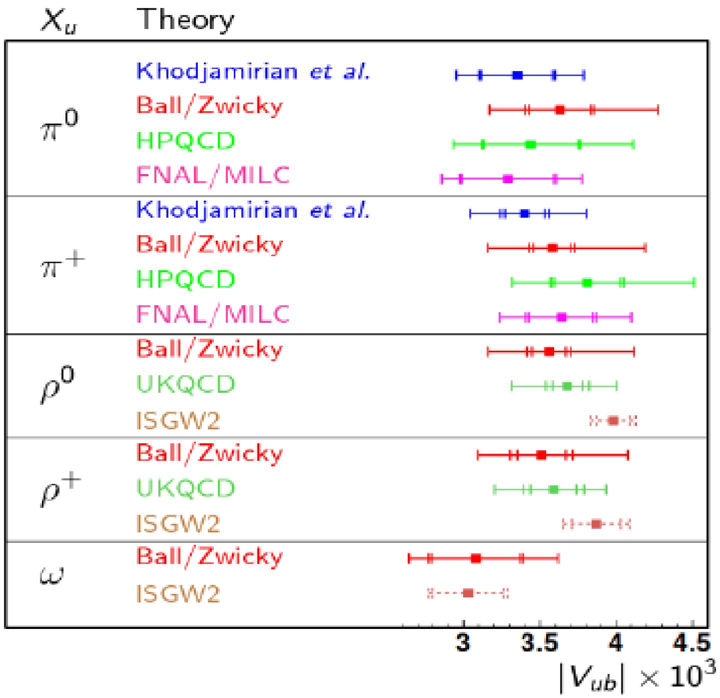
- $a_\mathrm{sl}^\mathrm{s} = (+0.06 \pm 0.5(\mathrm{stat.}) \pm 0.36(\mathrm{syst.}))\%$ with $1\,\mathrm{fb}^{-1}$
- $a_\mathrm{sl}^\mathrm{d} = (-0.04 \pm 0.19(\mathrm{stat.}) \pm 0.30(\mathrm{syst.}))\%$ with $3\,\mathrm{fb}^{-1}$ (Preliminary!)
  - https://indico.cern.ch/event/253826/session/7/contribution/80
- Good agreement with SM
- Both measurements are most precise to date
- Results from LHCb + B-factories + D0:



Measurements of V_{ub}/V_{cb}, $\mathcal{R}(D^{*-})$ & Λ_b form factors

EXCLUSIVE Hadronically tagged $B \to (\pi, \rho, \omega)\ l\ \nu$

[Phys. Rev. D 88, 032005 (2013)]



Khodjamirian *et al.*
PRD **83**, 094031 (2011)

Ball/Zwicky
PRD **71**, 014015 (2005)
PRD **71**, 014029 (2005)

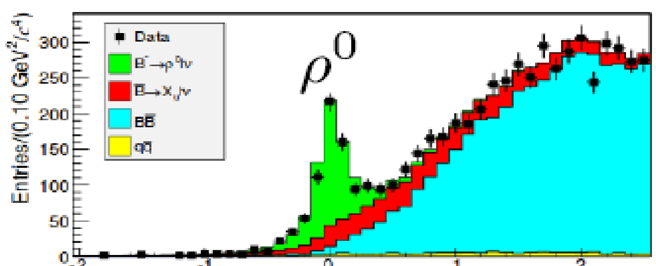
HPQCD
PRD **73**, 074502 (2006)

FNAL/MILC
PRD **79**, 054507 (2009)

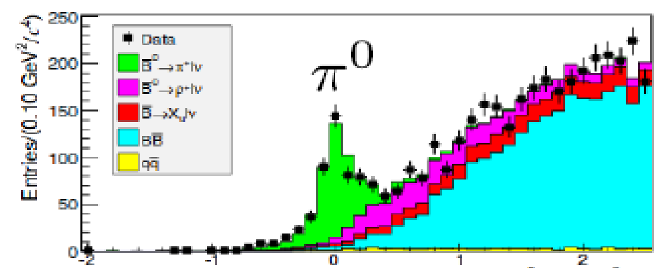
UKQCD
PLB **416**, 392 (1998)

ISGW2
PRD **52**, 2783 (1995)
Theory error is not available.

- First published hadronically tagged, exclusive charmless measurement at Belle
- Multivariate algorithm for tagging
- Loose cuts on lepton momenta
- Signal extracted in extended, binned likelihood fit in M^2_{miss}

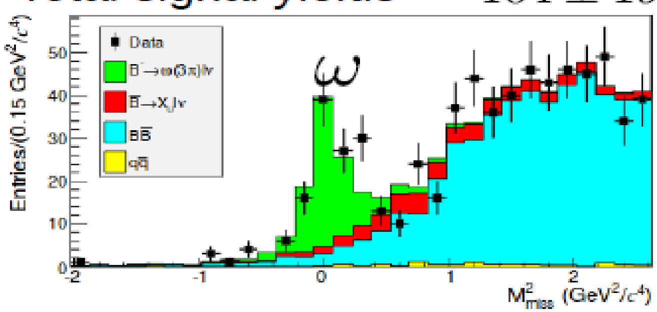


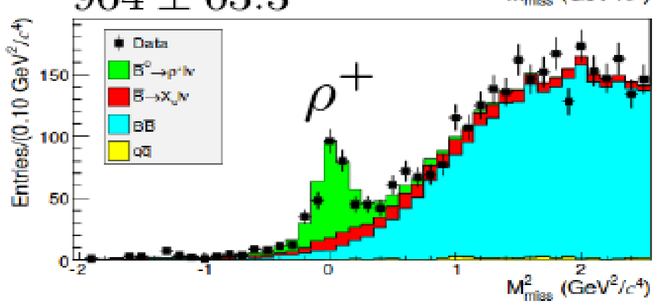
964 ± 63.3

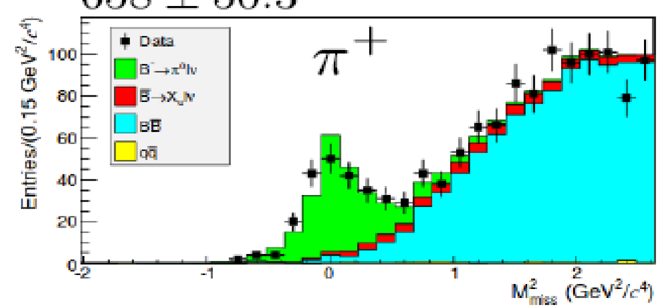


658 ± 50.3

Total signal yields $\to$ 104 ± 19

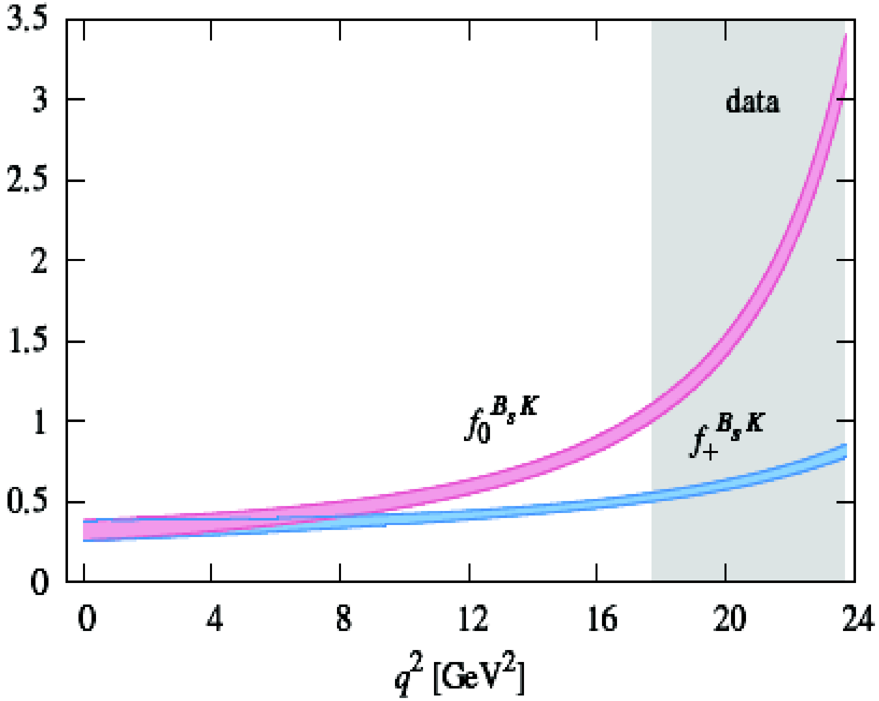


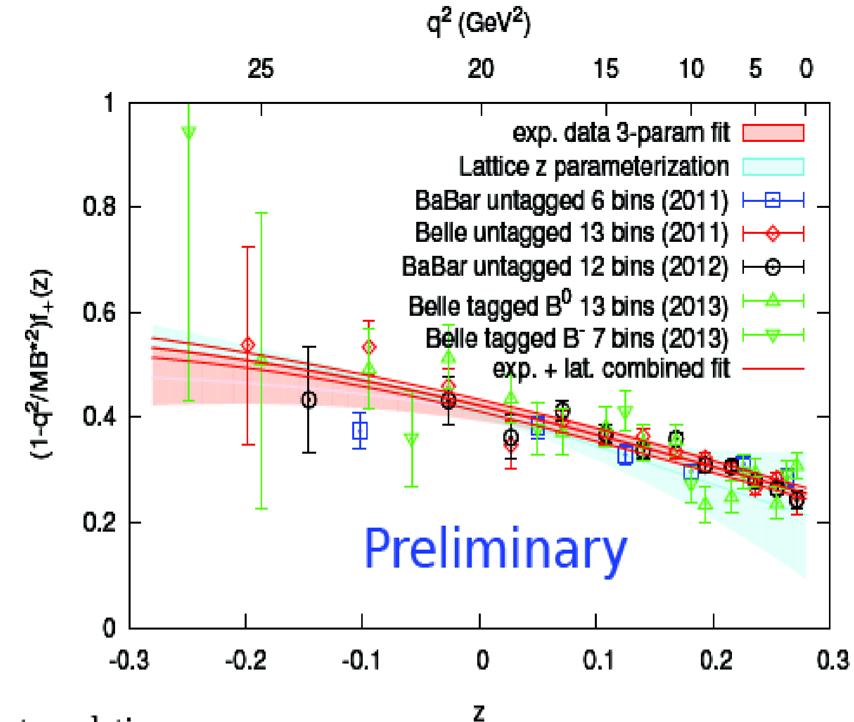




- Enhancement seen at mass of $f_2(1270)$, 3 times the MC predictions (ISGW2 & Pythia 6.2)

B_s->K l nu, B->pi l nu, lattice (HPQCD, FNAL/MILC) C. Bouchard





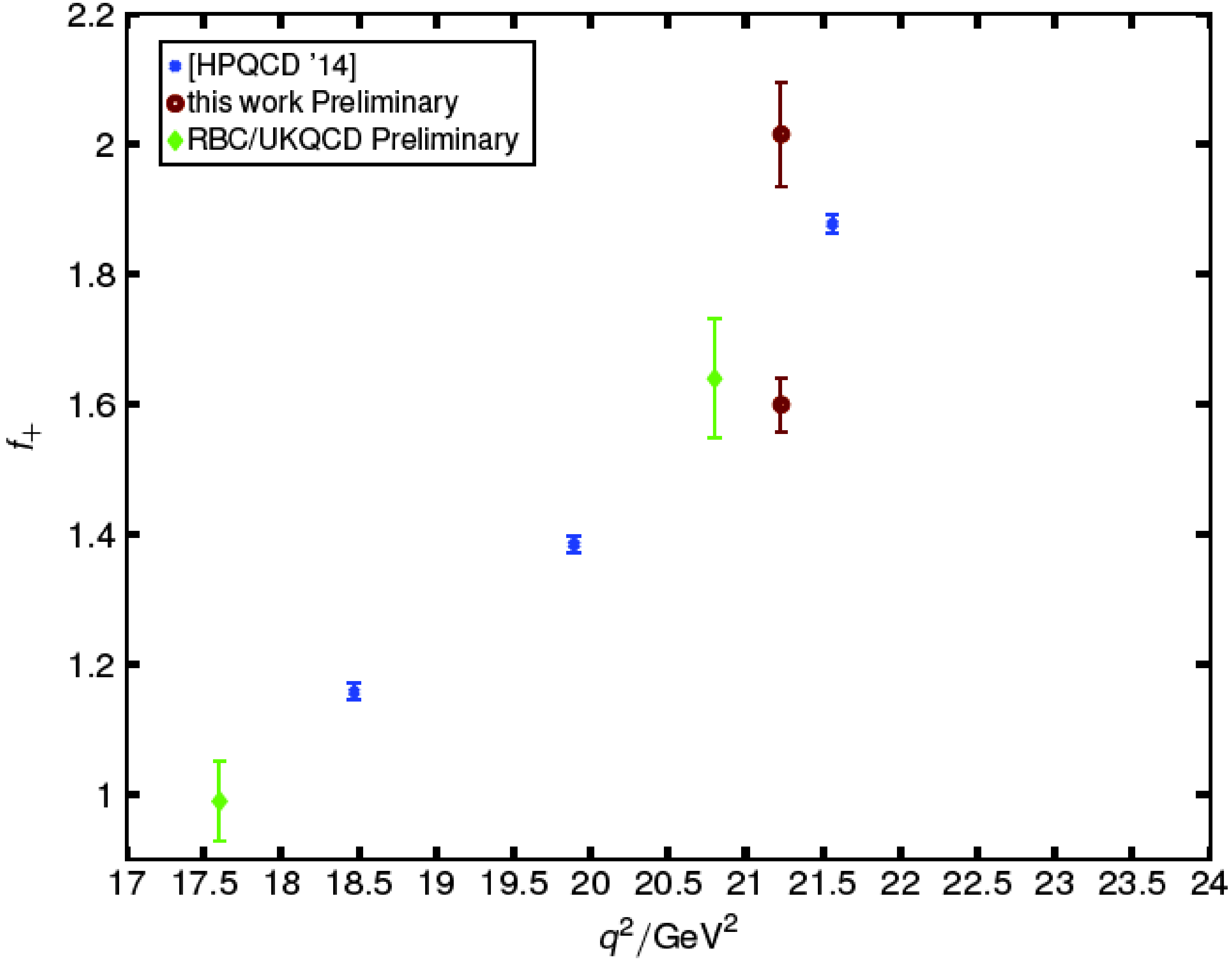
- the first lattice calculation
  - simultaneous chiral, continuum, and kinema
  - BCL z expansion through $\mathcal{O}(z^3)$
- pushing to lower q^2 would be beneficial

- Two-step extrapolation
  - Hard Pion ChPT with discretization terms
  - functional least-squares z expansion: BCL through $\mathcal{O}(z^3)$
- $|V_{ub}| = (3.70 \pm 0.14) \times 10^{-3}$ (*most precise determination to date*)
  - blinded analysis, $\chi^2/\text{dof} = 77/55$, p-value=0.022
  - roughly equal lattice and experimental errors
  - dominant lattice errors: statistical, chiral, HQ discretization

- Results also from RBC/UKQCD, tension in B_s->K l nu.
- Discussion on best parametrization (q^2 vs z) in comparing to exp. and different lattice approaches

B_s->K l nu in lattice HQET, F. Bahr (ALPHA)

- Static order, 2 flavors, twisting for s



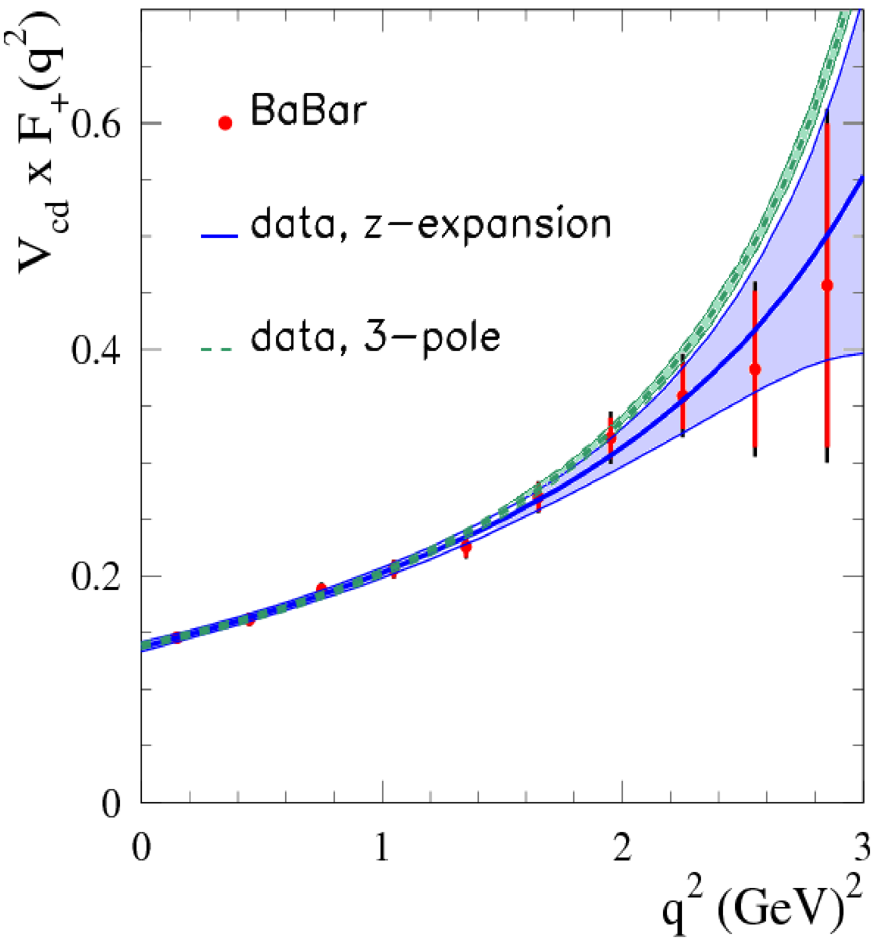
- blue: [HPQCD '14] , $a = 0.09$ fm, $m_\pi = 320$ MeV Pert. renormalisation
- brown: this work, continuum, static, $m_\pi = 340$ MeV, NP renormalisation [Della Morte et al. '07] . Preliminary.
- green: RBC/UKQCD Preliminary, chiral, continuum. Pert. Renormalisation

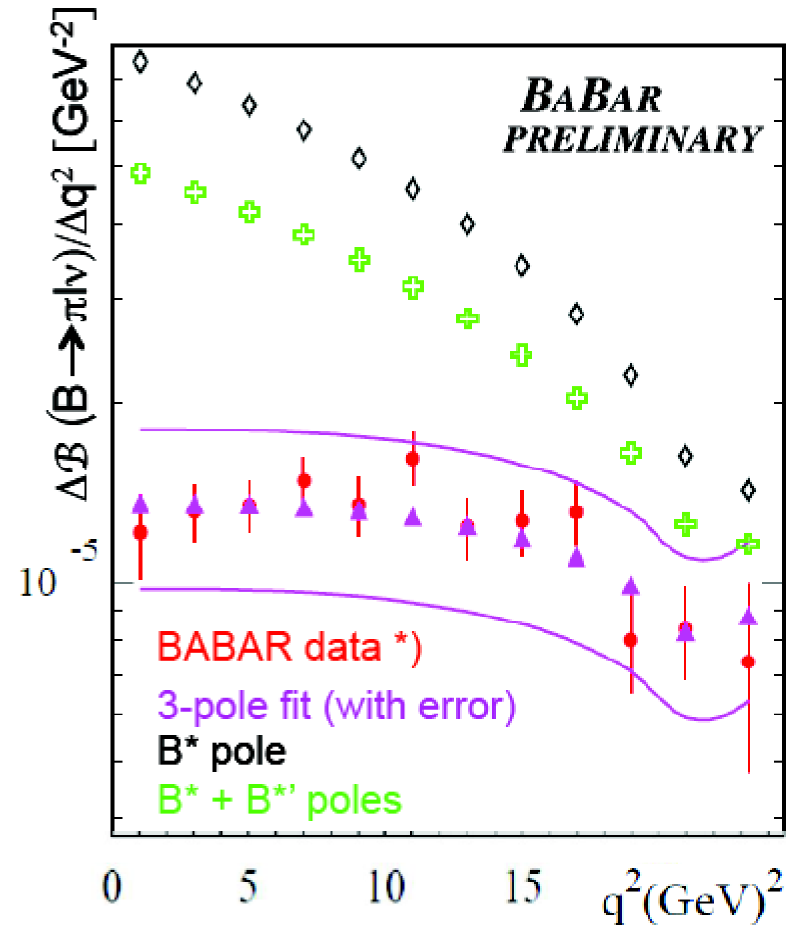
- B. Blossier discussed the perspective to approach the 1/2 vs 3/2 puzzle on the lattice (-> F. Bernlochner talk)

$$[\Gamma(B \to D_{1/2} l\nu) \simeq \Gamma(B \to D_{3/2} l\nu)]^{\rm exp} \text{ while } [\Gamma(B \to D_{1/2} l\nu) \ll \Gamma(B \to D_{3/2} l\nu)]^{\rm th}$$

Session 4: New Physics (mostly)

V. Luth, Measurement of D-->pi e nu at BaBar



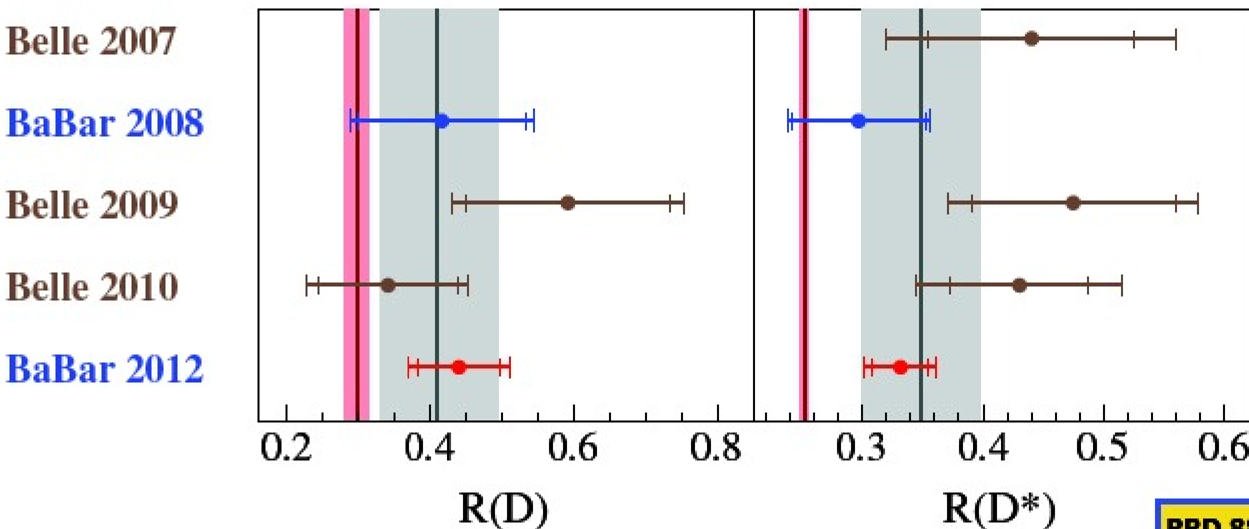


- Two approaches to relate D and B Form factors have been pursued
  - 3-pole ansatz for B decays (with B*, B*', B_{eff} poles) with same kind of constraints as for D mesons
  - Extrapolation of the $D \to \pi^- e^+ \nu$ 3-pole fit relying LQCD calculation for constant FF ratio

Both methods result in value of $|V_{ub}|$, but uncertainties are dominated by current theoretical uncertainties in decay constants, hadronic couplings, and form factor ratios.

Current Status of $B \to D^{(*)} \tau \nu_\tau$ measurements

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965



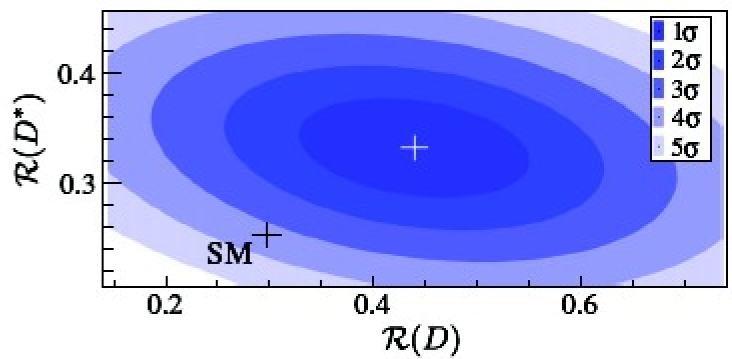
$$\mathcal{R}(D) \equiv \frac{\mathcal{B}(B \to D\tau^- \bar{\nu}_\tau)}{\mathcal{B}(B \to D l^- \bar{\nu}_l)}$$

$$\mathcal{R}(D^*) \equiv \frac{\mathcal{B}(B \to D^*\tau^- \bar{\nu}_\tau)}{\mathcal{B}(B \to D^* l^- \bar{\nu}_l)}$$

$$\mathcal{R}(D^0) = \mathcal{R}(D^+) = \mathcal{R}(D)$$

$$\mathcal{R}(D^{*0}) = \mathcal{R}(D^{*+}) = \mathcal{R}(D^*)$$

PRD 88 072012 (2013)



Lattice QCD has R(D) = 0.316 ± 0.012 ± 0.007

Bailey et al. PRL 109 071802 (2012)

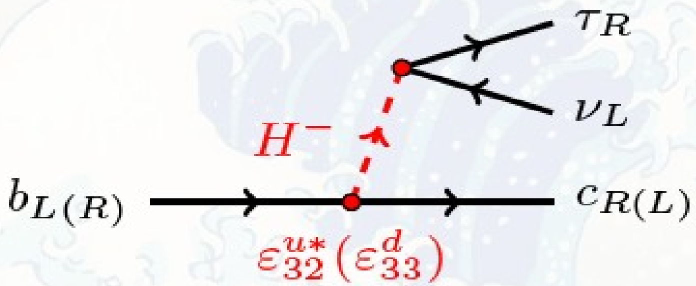
$$\mathcal{R}(D)^{SM(HQET)} = 0.305 \pm 0.012, \quad \mathcal{R}(D^*)^{SM(HQET)} = 0.252 \pm 0.004$$

PRD 87 034028 (2013)

Two talks on 2HDM and $R(D^{(*)})$ by A. Crivellin and A. Celis
Summary by A. Tayduganov (session 5)

2HDM of type III with non-minimal flavour violation

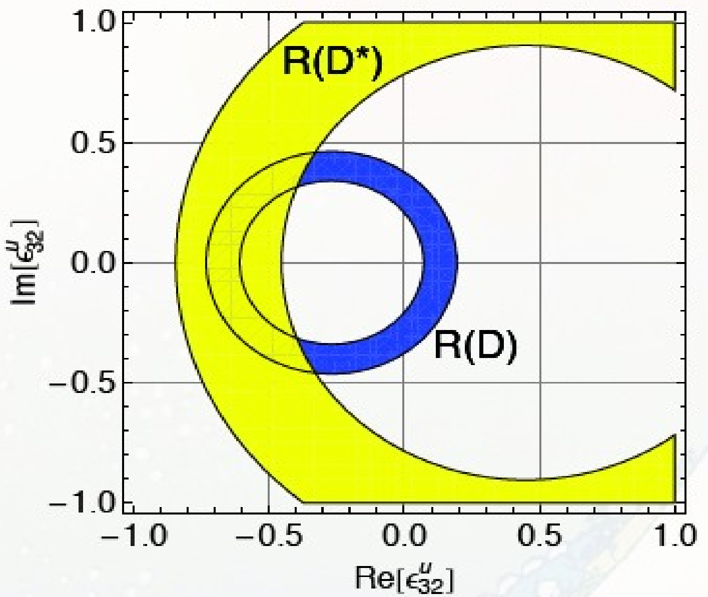
$$\mathcal{L}_Y = \overline{Q}^a_{fL}[Y^d_{fi}\epsilon_{ab}H^{b*}_d - \varepsilon^d_{fi}H^a_u]d_{iR} - \overline{Q}^a_{fL}[Y^u_{fi}\epsilon_{ab}H^{b*}_u + \varepsilon^u_{fi}H^a_u]u_{iR} + \text{h.c.}$$



$$C_{S_1} \simeq \frac{1}{2\sqrt{2}G_F}\frac{m_\tau}{v}\varepsilon^d_{33}\frac{\sin\beta\tan^2\beta}{M^2_{H^\pm}}$$

-disfavoured by *BABAR*!

$$C_{S_2} \simeq \frac{1}{2\sqrt{2}G_F V_{cb}}\frac{m_\tau}{v}\varepsilon^{u*}_{32}\frac{\sin\beta\tan\beta}{M^2_{H^\pm}}$$



Allowed 1σ regions for $\tan\beta = 50$ and $M_H = 500$ GeV

[Crivellin at al.('12), arXiv:1206.2634]

2HDM-III can explain $R(D)$ and $R(D^*)$ simultaneously using a single free parameter ε^u_{32}.

[see the talk of A. Crivellin]

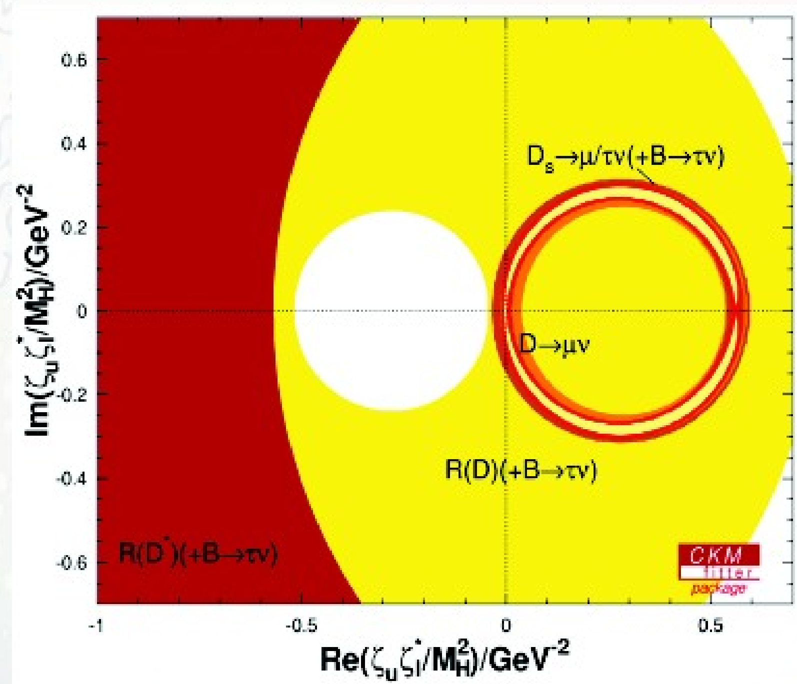
Aligned 2HDM

$$\mathcal{L}_Y^{H^\pm} = -\frac{\sqrt{2}}{v}\left[\overline{u}\varsigma_d V_{\text{CKM}} M_d P_R d - \overline{u}\varsigma_u M_u V_{\text{CKM}} P_L d + \varsigma_\ell \overline{\nu} M_\ell P_R \ell\right] H^+ + \text{h.c.}$$

$$C_{S_1} = -\varsigma_d \varsigma_\ell^* \frac{m_b m_\tau}{M_{H^\pm}^2}$$

$$\boxed{C_{S_2} = \varsigma_u \varsigma_\ell^* \frac{m_c m_\tau}{M_{H^\pm}^2}}$$

-tension between $D_{(s)}$ leptonic decays and $R(D^*)$ and $B \to \tau\overline{\nu}$.



[Celis at al.('13), arXiv:1210.8443]

A2HDM can explain $R(D^{(*)})$ and $B \to \tau\overline{\nu}$ simultaneously. However, the resulting parameter ranges are in conflict with the constraints from leptonic charm decays.

[see the talk of A. Celis]

Leptoquark models

$\mathcal{L}_{\rm eff}$ with generic dimensionless $SU(3)\times SU(2)\times U(1)$ invariant *non-diagonal* couplings of scalar and vector LQs (6 models)

$$\mathcal{L}^{\rm LQ}_{F=0} = \left(h^{ij}_{1L}\,\overline{Q}_{iL}\gamma^\mu L_{jL} + h^{ij}_{1R}\,\overline{d}_{iR}\gamma^\mu \ell_{jR}\right) U_{1\mu} + h^{ij}_{3L}\,\overline{Q}_{iL}\boldsymbol{\sigma}\gamma^\mu L_{jL}\boldsymbol{U}_{3\mu}$$
$$+ \left(h^{ij}_{2L}\,\overline{u}_{iR}L_{jL} + h^{ij}_{2R}\,\overline{Q}_{iL}i\sigma_2\ell_{jR}\right) R_2$$
$$\mathcal{L}^{\rm LQ}_{F=-2} = \left(g^{ij}_{1L}\,\overline{Q}^c_{iL}i\sigma_2 L_{jL} + g^{ij}_{1R}\,\overline{u}^c_{iR}\ell_{jR}\right) S_1 + g^{ij}_{3L}\,\overline{Q}^c_{iL}i\sigma_2\boldsymbol{\sigma}L_{jL}\boldsymbol{S}_3$$
$$+ \left(g^{ij}_{2L}\,\overline{d}^c_{iR}\gamma^\mu L_{jL} + g^{ij}_{2R}\,\overline{Q}^c_{iL}\gamma^\mu\ell_{jR}\right) V_{2\mu}$$

[Buchmüller et al.('87), Phys.Lett.B191]

- $h^{23}_{1L}h^{33*}_{1L}$ (U_1) remain unconstrained from $\mathcal{B}(B\to X_s\nu\overline{\nu})$ and the magnitude of $\mathcal{O}(1)$ can be sufficient to explain the data.
- For $M_{S_1,R_2}\sim 1$ TeV, one can have $g^{33}_{1L}g^{23*}_{1R}$, $h^{23}_{2L}h^{33*}_{2R}\sim\mathcal{O}(1)$.

- MSSM with $\not{R}PV$ is inconsistent with both $B\to D^{(*)}\tau\overline{\nu}$ and $B\to X_s\nu\overline{\nu}$ at the same time.

The full angular analysis of $B\to D^*\tau\overline{\nu}$ has been recently done in [Duraisamy,Datta('13), arXiv:1302.7031], [Duraisamy et al.('14), arXiv:1405.3719].

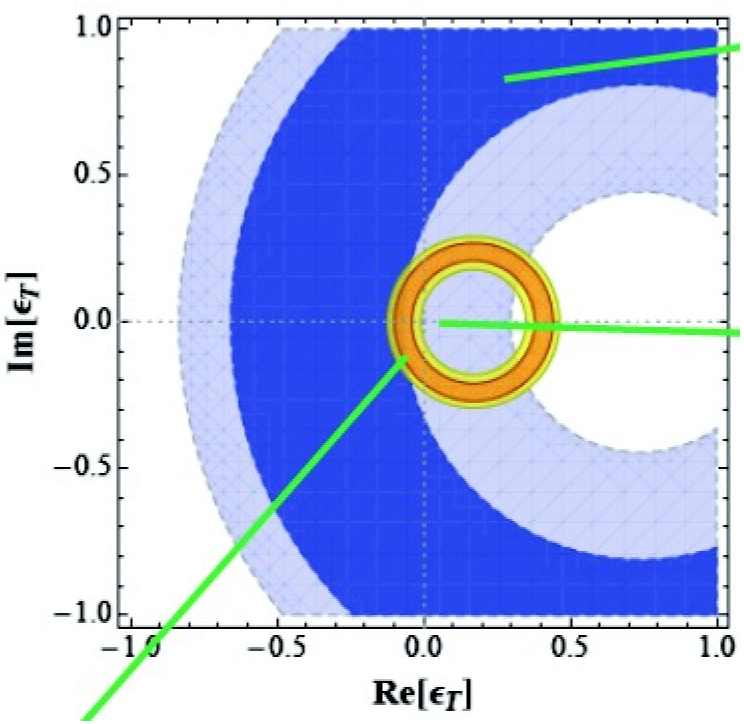
- Azimuthal asymmetries, integrated over q^2, have different sensitivities to different NP structures hence becoming powerful probes of the nature of NP.
- In particular, these observables turn out to be very efficient in discriminating between the two LQ models.

F. De Fazio. EFT, model independent approach

A different strategy:

- consider a NP scenario that enhances semileptonic modes but not leptonic ones
- predict similar effects in other analogous modes

$$H_{eff} = H_{eff}^{SM} + H_{eff}^{NP} = \frac{G_F}{\sqrt{2}} V_{cb} \left[\bar{c}\gamma_\mu(1-\gamma_5)b\,\bar{\ell}\gamma^\mu(1-\gamma_5)\bar{\nu}_\ell + \epsilon_T^\ell\,\bar{c}\sigma_{\mu\nu}(1-\gamma_5)b\,\bar{\ell}\sigma^{\mu\nu}(1-\gamma_5)\bar{\nu}_\ell\right]$$

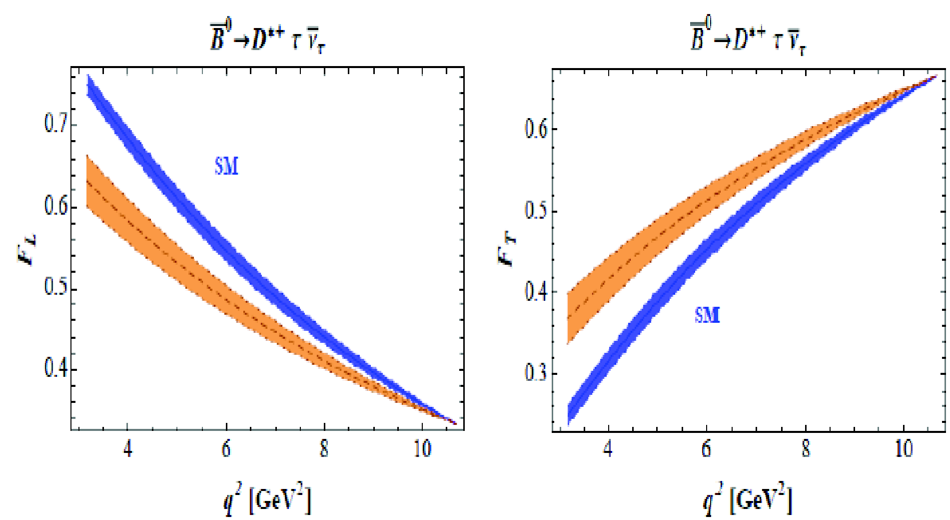


D* polarization fractions

L=longitudinal

T=transverse

$$F_{L,T}(q^2) = \frac{d\Gamma_{L,T}(B \to D^* \tau \bar{\nu}_\tau)}{dq^2} \times \left(\frac{d\Gamma(B \to D^* \tau \bar{\nu}_\tau)}{dq^2}\right)^{-1}$$

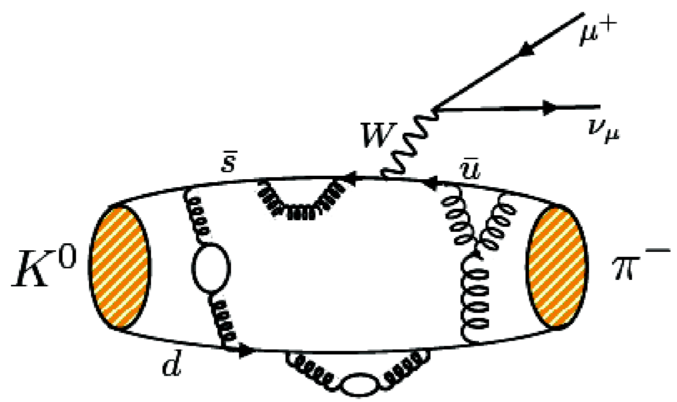


\+ forward-backward (lepton) asymmetries, difficult to measure, as emerged in the discussion.

N. Tantalo: review of lattice approaches to heavy quarks

- Prototype quantity: b-quark mass
- Touched quickly on the need and perspective of including QED effects non-perturbatively. This is a long programme in a partly un-explored territory, it is going to take time before gets well-tuned.
- In the meanwhile (A.X. El-Khadra's talk):

example: $K^0 \to \pi^- \ell^+ \nu_\ell$



Here is a request from us lattice theorists, for such EM corrections to be computed in some EFT of mesons/hadrons.

$$\Gamma_{K\ell 3} = (\text{known}) \times \begin{pmatrix} \text{phase} \\ \text{space} \end{pmatrix} \times (1 + \delta^{K\ell}_{\text{EM}} + \delta^{K\pi}_{\text{SU(2)}}) \times |V_{us}|^2 \times |f_+^{K^0\pi^-}(0)|^2$$

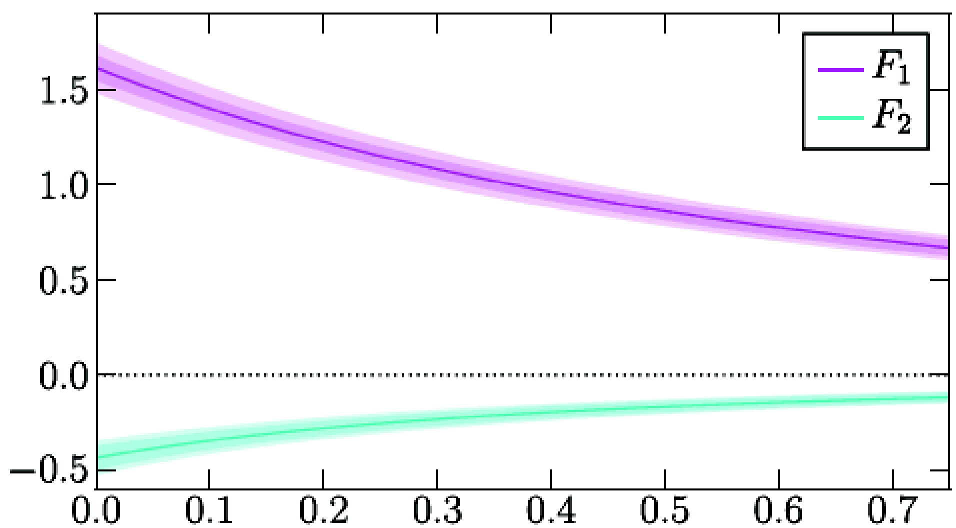
Needed to relate "pure QCD" form factor to experiment. Currently estimated phenomenologically.

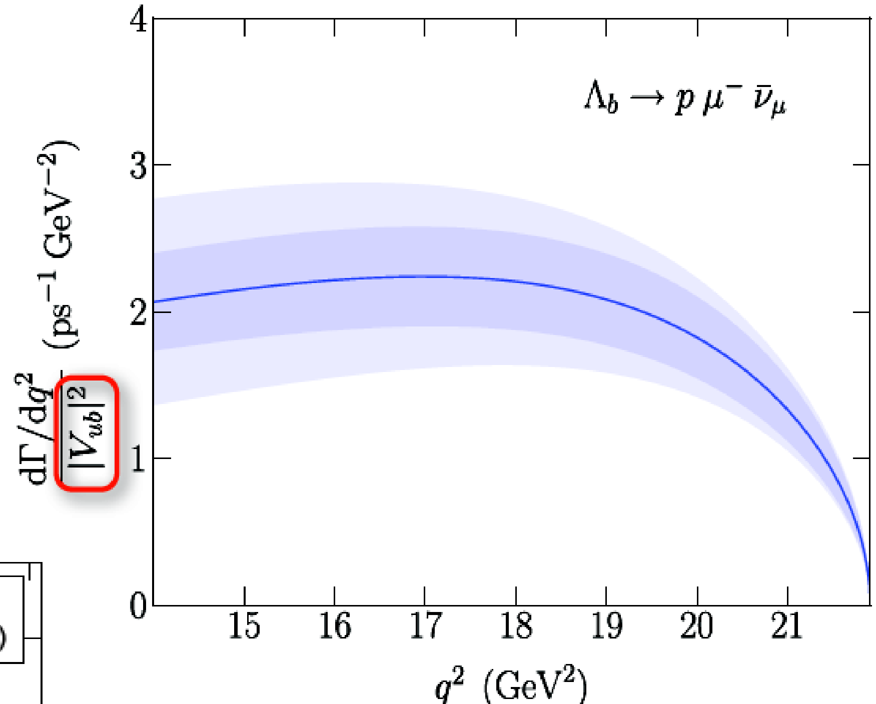
M. Wingate for S. Meinel

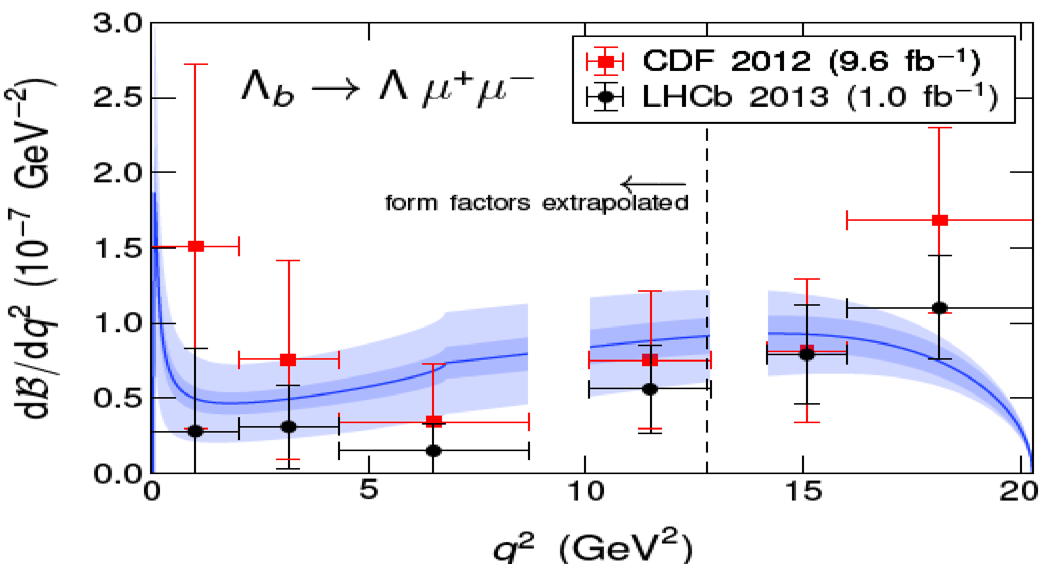
- $\Lambda_b \to p$ form factor calculation done in parallel with those for the rare $b \to s$ decay $\Lambda_b \to \Lambda\, l^+ l^-$ RBC/UKQCD lattices (2+1 domain wall)

In the $m_b \to \infty$ limit

$$\langle p(k',s')|\bar{u}\Gamma Q|\Lambda_Q(v,s)\rangle = \bar{u}_p(k',s')\left[F_1(k'\cdot v) + \not{v} F_2(k'\cdot v)\right]\Gamma u_{\Lambda_b}(v,s)$$



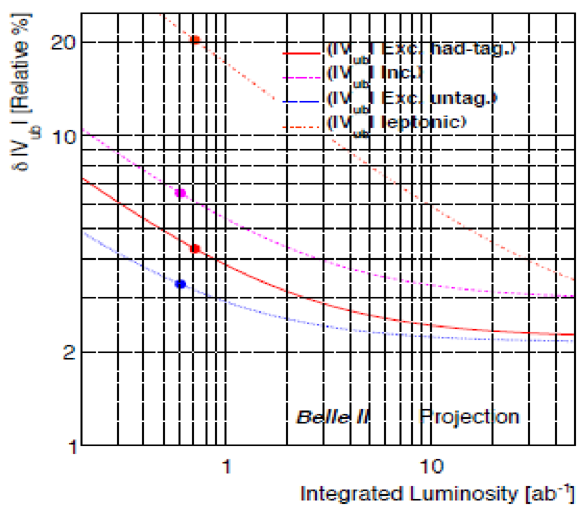




P. Urquijo for G. De Nardo. Prospects of Belle II in B semileptonic decays

- Outine of different experimental techniques, tagged vs untagged.

|Vub| extrapolation for Belle II (2)



	Statistical	Systematic (reducible, irreducible)	Total Exp	Theory	Total
$\lvert V_{ub}\rvert$ exclusive (had. tagged)					
711 fb^{-1}	3.0	(2.3, 1.0)	3.8	8.7 (2.0)	9.5 (4.3)
5 ab^{-1}	1.1	(0.9, 1.0)	1.7	4.0 (2.0)	4.4 (2.6)
50 ab^{-1}	0.4	(0.3, 1.0)	1.1	2.0	2.3
$\lvert V_{ub}\rvert$ exclusive (untagged)					
605 fb^{-1}	1.4	(2.1, 0.8)	2.9	8.7 (2.0)	9.1 (4.0)
5 ab^{-1}	0.5	(0.8, 0.8)	1.2	4.0 (2.0)	4.2 (2.4)
50 ab^{-1}	0.2	(0.3, 0.8)	0.9	2.0	2.2
$\lvert V_{ub}\rvert$ inclusive					
605 fb^{-1} (old B tag)	4.5	(3.7, 1.6)	6.0	2.5−4.5	6.5−7.5
5 ab^{-1}	1.1	(1.3, 1.6)	2.3	2.5−4.5	3.4−5.1
50 ab^{-1}	0.4	(0.4, 1.6)	1.7	2.5−4.5	3.0−4.8

Assumption is theory error down to 2% for exclusive and 2-4 % for inclusive modes

	Statistical	Systematic (reducible, irreducible)	Total Exp	Theory	Total
$\lvert V_{cb}\rvert$ exclusive : F(1)					
711 fb^{-1}	0.6	(2.8, 1.1)	3.1	1.8	3.6
5 ab^{-1}	0.2	(1.1, 1.1)	1.5	1.0	1.8
50 ab^{-1}	0.1	(0.3, 1.1)	1.2	0.8*	1.4
$\lvert V_{cb}\rvert$ exclusive : G(1)					
423 fb^{-1}	4.5	(3.1, 1.2)	5.6	2.2	3.6
5 ab^{-1}	1.3	(0.9, 1.2)	2.0	1.5*	2.7
50 ab^{-1}	0.6	(0.4, 1.2)	1.4	1.0*	1.7

Conclusions

Many interesting talks with lively discussions in a relaxed atmosphere.

If the keywords are precise and rare, we are getting there both on theory and experiments.

Still, tensions in V_{ub} and V_{cb} do not want to disappear.

We have to wait for Belle-II. However, techniques to obtain purer samples are being tested at present experiments. So it looks like we will not be un-prepared.

Flavor continues providing stringent constraints to New Physics Model, e.g. $R(D^{(*)})$.