B's, CP Violation, CKM elements, HFAG

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Introduction

Overseers: A. Cerri (Sussex), W. Yao (LBNL)

Encoders:

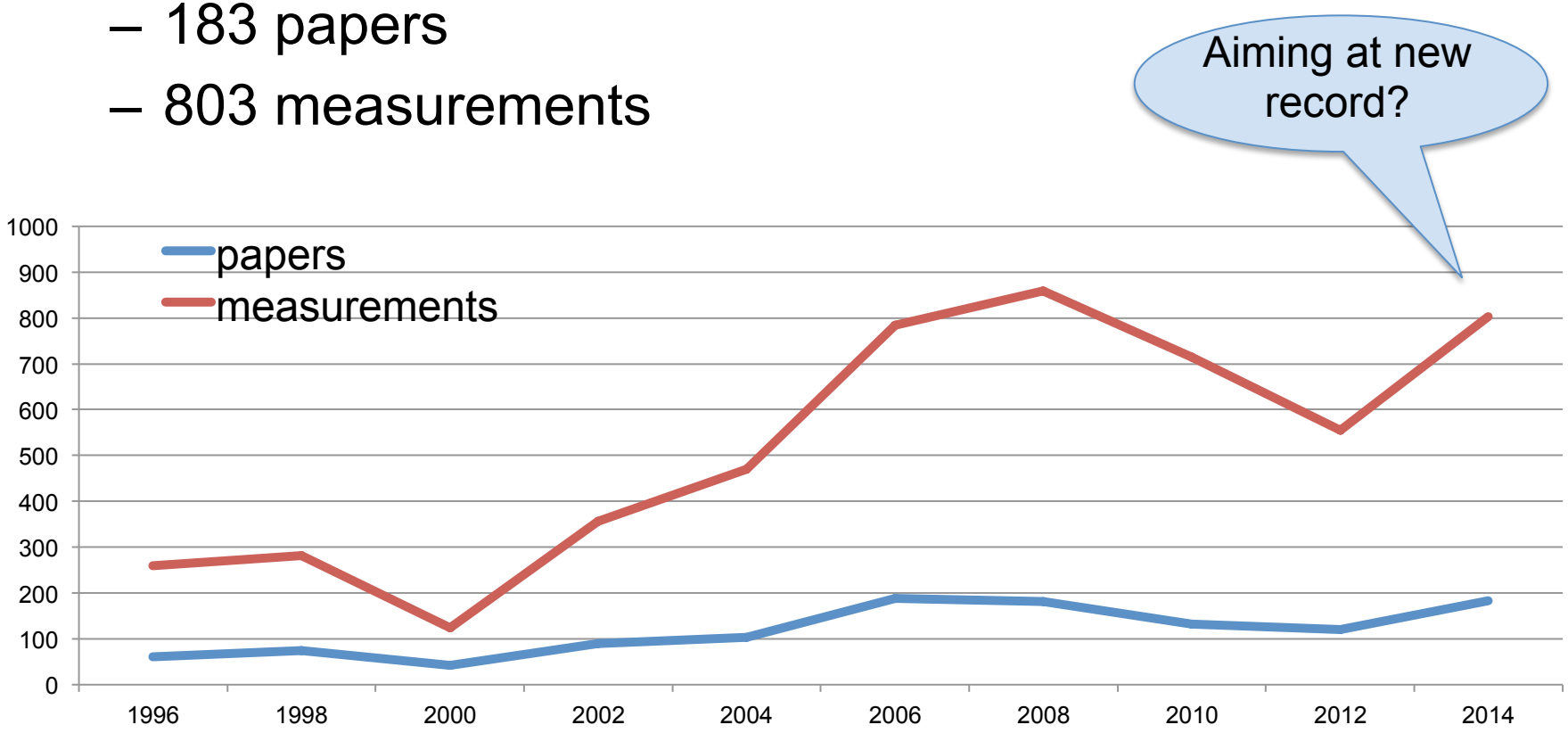
- Y. Kwon (Yonsei, Korea)
- M. Kreps (Warwick)
- J. Smith (retired) → P. Eerola (Helsinki)

Outline:

- New in RPP 2014/expected in next round
- Mini-reviews
- Prospects for 2016 edition

What's New

- B physics still one of the most productive RPP contributors:
  - 183 papers
  - 803 measurements

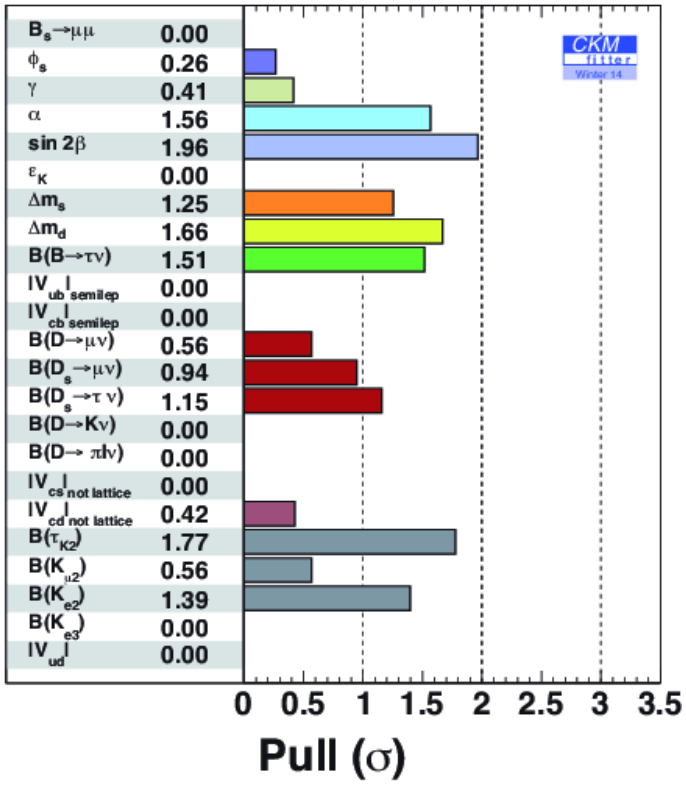


Mini-Reviews

- B production and decays (Updated Mar 2014)
  - Y. Kwon, M. Kreps
- B-Bbar mixing (Updated Apr 2014)
  - Schneider
- V_{cb} & V_{ub} determinations (Updated Feb 2014)
  - R. Kowalewski and T. Mannel
- B Polarization (Updated Dec 2013)
  - A.V. Gritsan and J.G. Smith

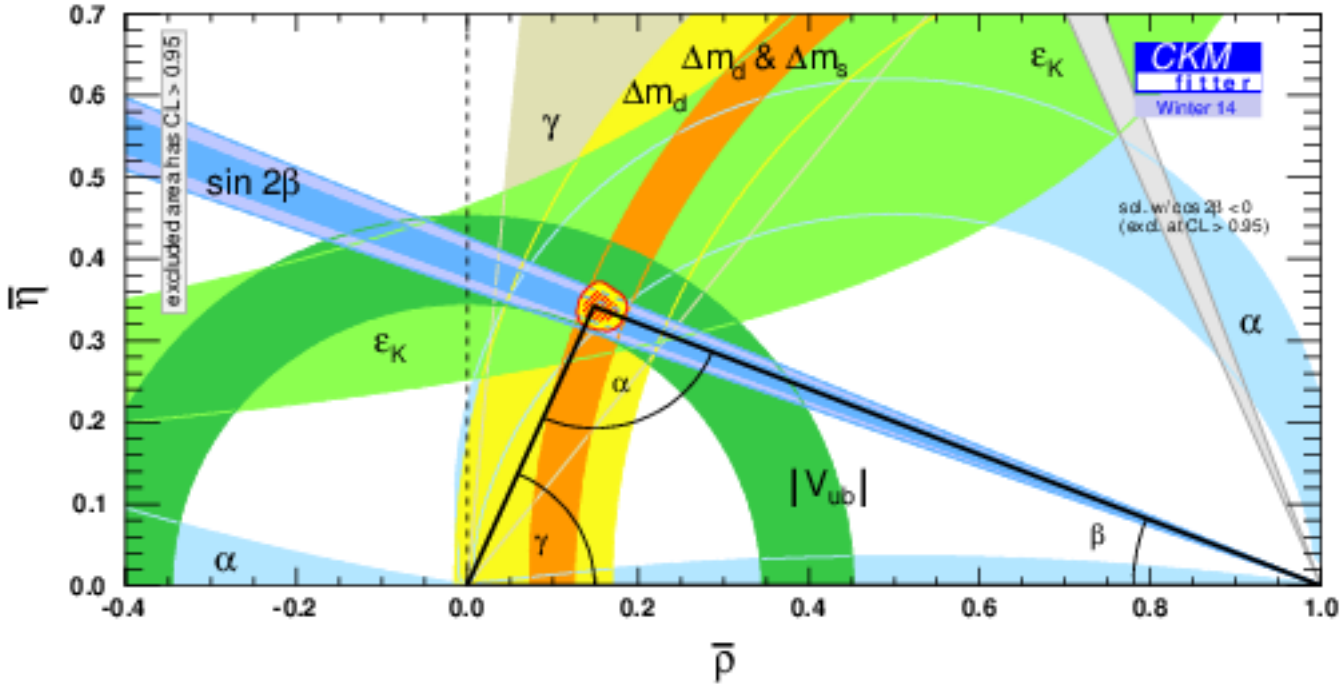
Highlights

- Included first observation of $B_s \rightarrow \mu\mu$ from LHCb & CMS
- Increased precision (e.g. on ϕ_s) and less anomalies
- Overall agreement with SM predictions



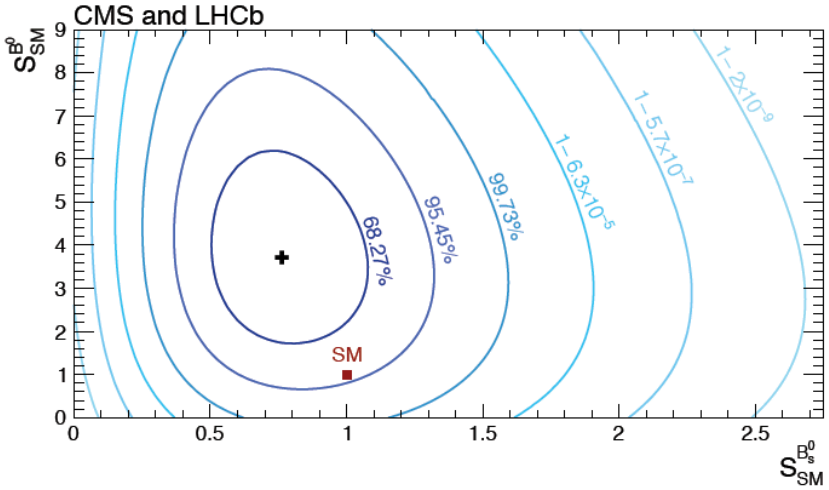
Overall CKM Determination

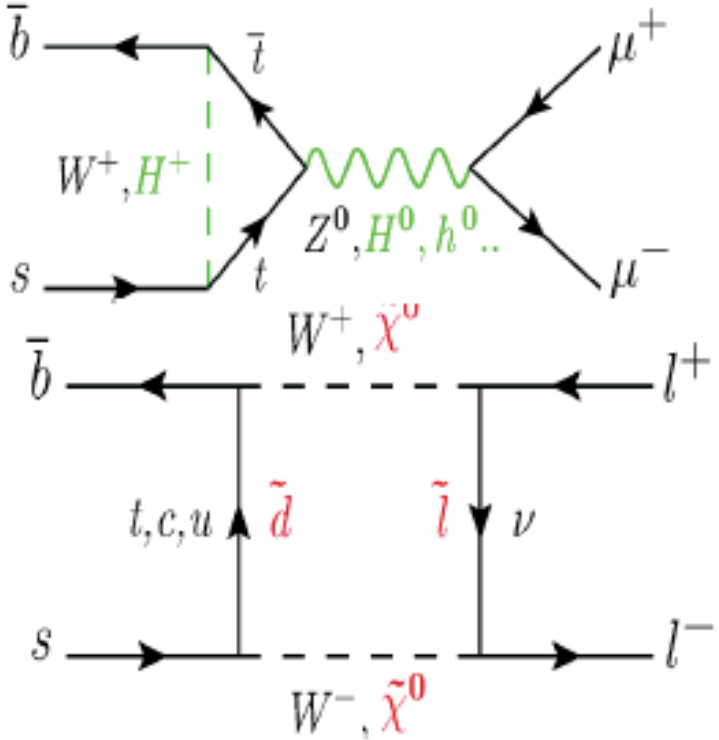
- CKM coefficients discussed in mini-reviews and CKM review
- Ingredients: BR, decays asymmetries and assumptions
- B section provides $\Delta m_{s,d}$, α, β, γ, V_{ub}, V_{cb}, V_{ts}/V_{td}



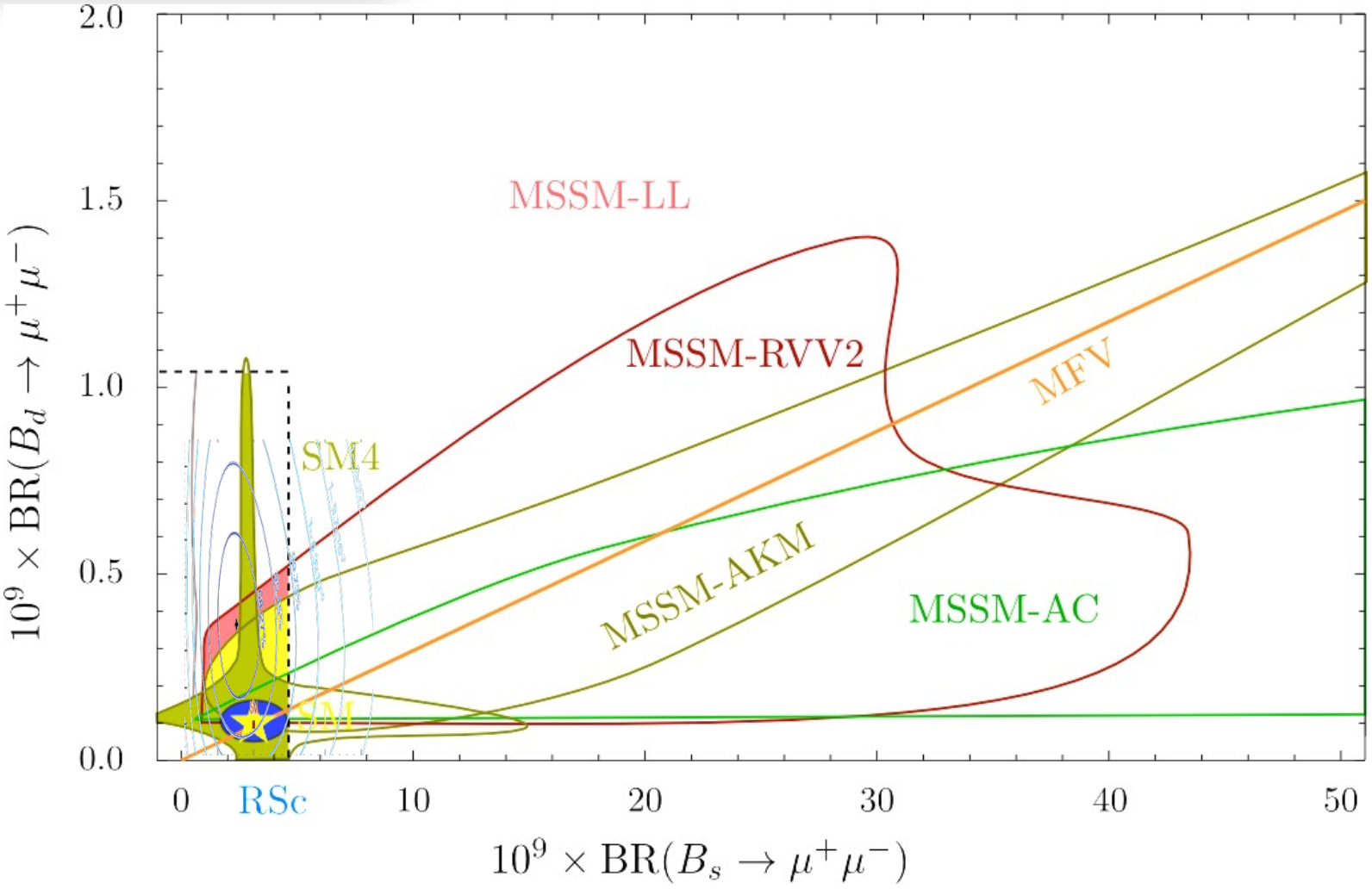
$B_{s/d} \to \mu\mu$

- Sensitive to NP
  - Theo [PRL 112 (2014) 101801]:
    - B_s: $(3.66 \pm 0.23) \times 10^{-9}$
    - B_d: $(0.106 \pm 0.009) \times 10^{-9}$
- Measured by LHCb+CMS:
  - B_s: $(2.8^{+0.7}_{-0.6}) \times 10^{-9}$ 6.2σ
  - B_d: $(0.39^{+1.6}_{-1.4}) \times 10^{-9}$ 3.2σ

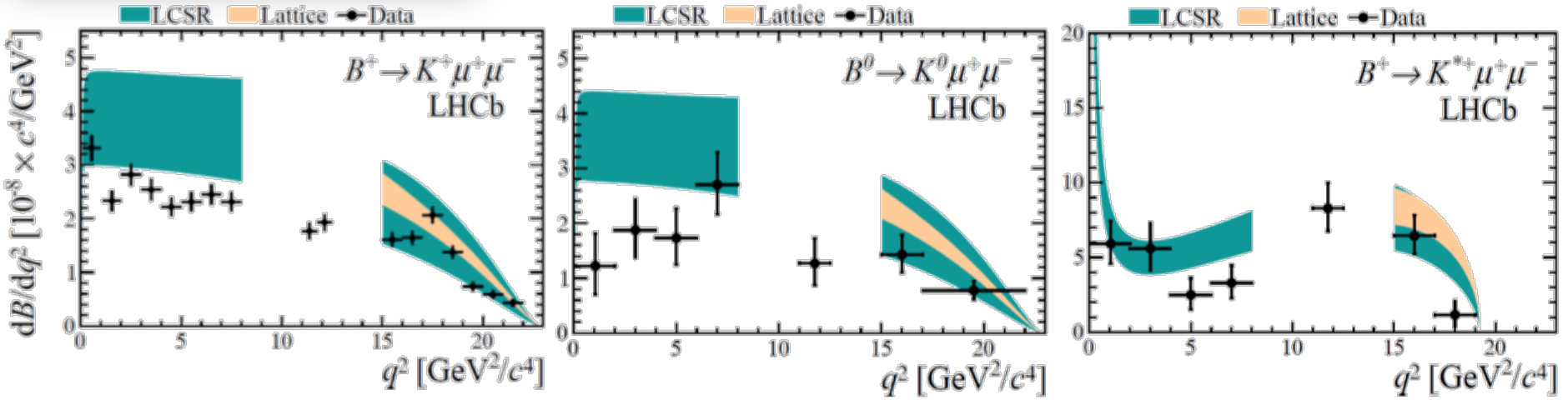




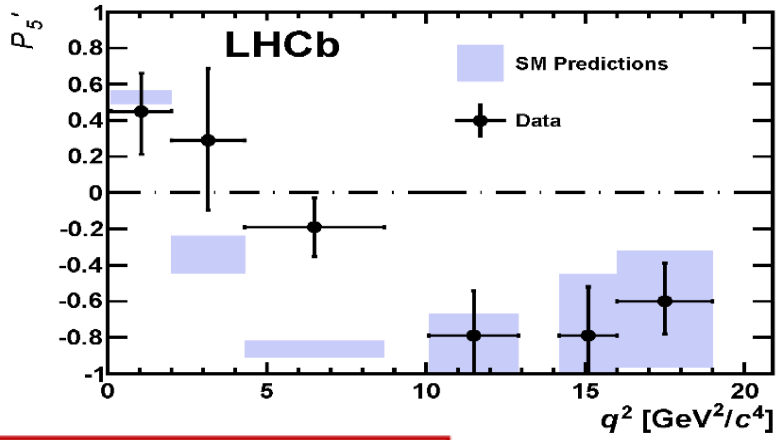
$B_{s/d} \rightarrow \mu\mu$



B→K$^{(*)}$ll



- Measurements all agree with SM
  - "But on the low side"
- "P_5' anomaly" close to ccbar resonance: theo systematics are hard
- But… lepton universality (arxiv: 1406.6482) in R_K=B(B→Kμμ)/B(B→Kee) looks interesting (2.6σ from SM):



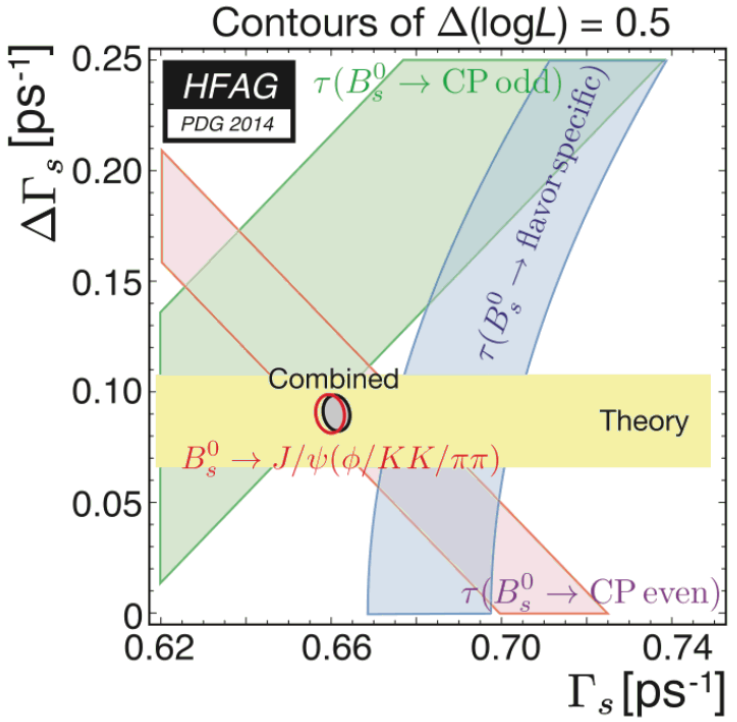
$$R_K = 0.745^{+0.090}_{-0.074}\,(\mathrm{stat}) \pm 0.036\,(\mathrm{syst})$$

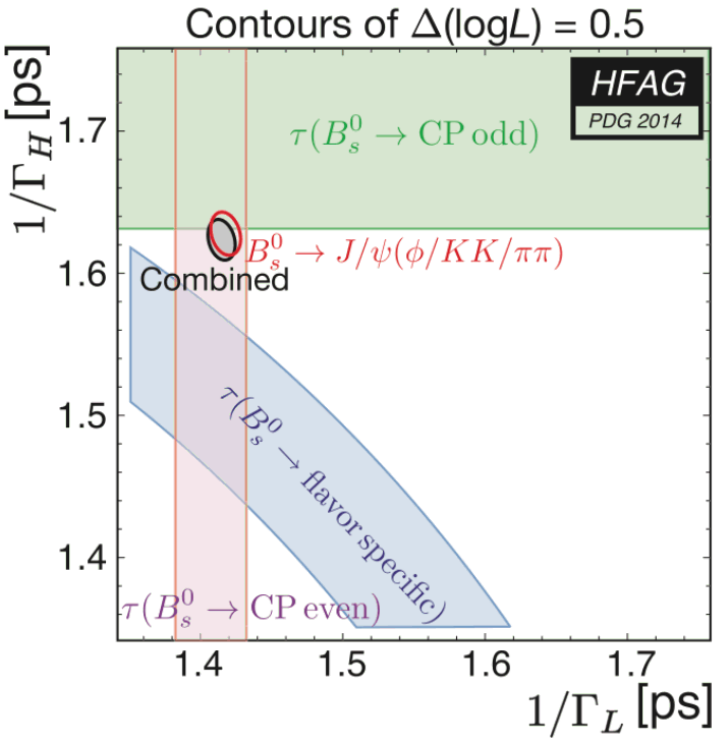
B Lifetimes & Differences

CP-odd final state	effective lifetime from single exponential fits
$B_s \to J/\psi\, f_0,\ J/\psi\, \pi\pi$	1.656 ± 0.033 ps
$B_s \to J/\psi\, K^0_S$	1.75 ± 0.14 ps
Average of above	1.661 ± 0.032 ps

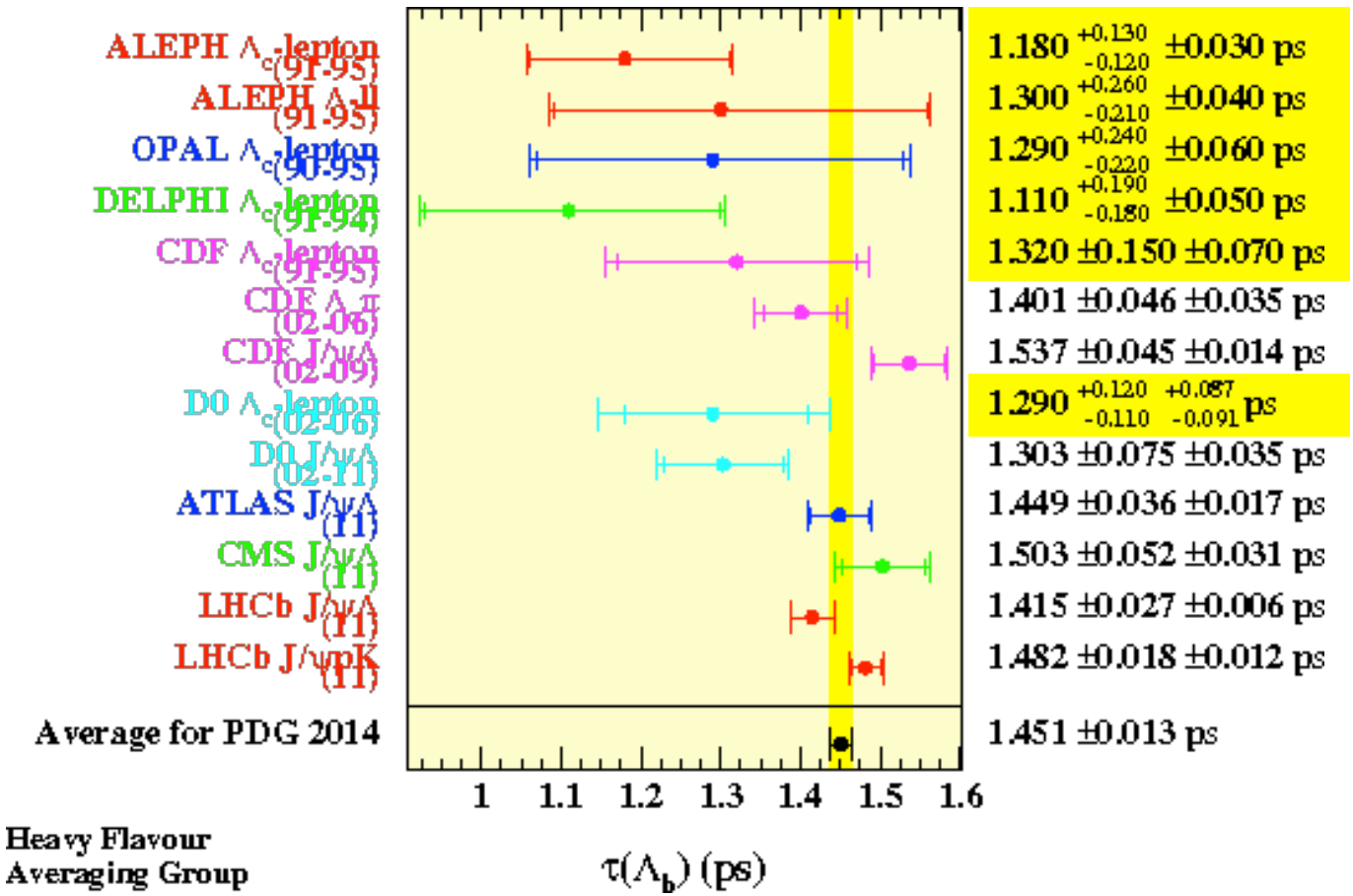
CP-even final state	effective lifetime from single exponential fits
$B_s \to K^+K^-$	1.452 ± 0.042 ps
$B_s \to D^+_s D^-_s$	1.379 ± 0.031 ps
Average of above	1.405 ± 0.025 ps

mixture of the two B_s mass eigenstates	effective lifetime from single exponential fits
$B_s \to$ flavour specific	1.465 ± 0.031 ps
$B_s \to D_s X$	1.469 ± 0.031 ps
$B_s \to J/\psi\, \phi$	1.479 ± 0.012 ps



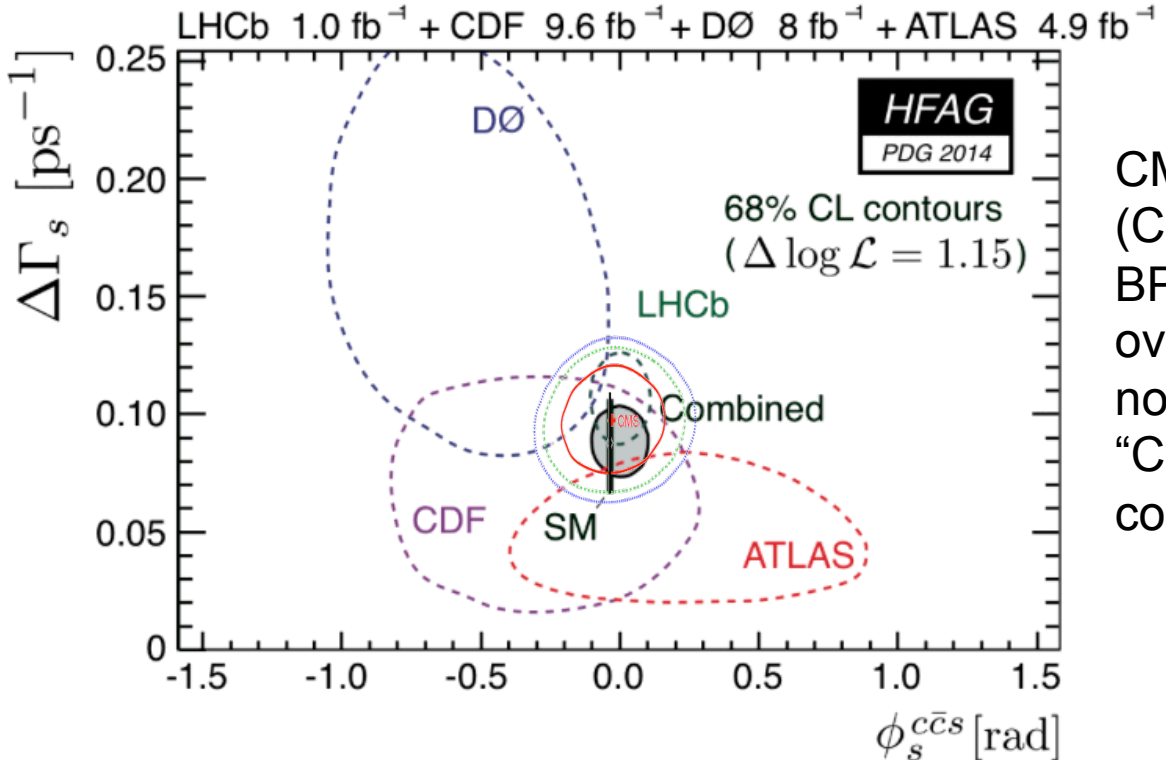


Λ_b Lifetime



- Long-standing tension seems resolved by higher precision
  - Latest results much higher precision but based on exclusive decays
  - Semi-leptonic decays seem to be systematically lower
  - It will be interesting to see future rounds of semileptonic measurements!

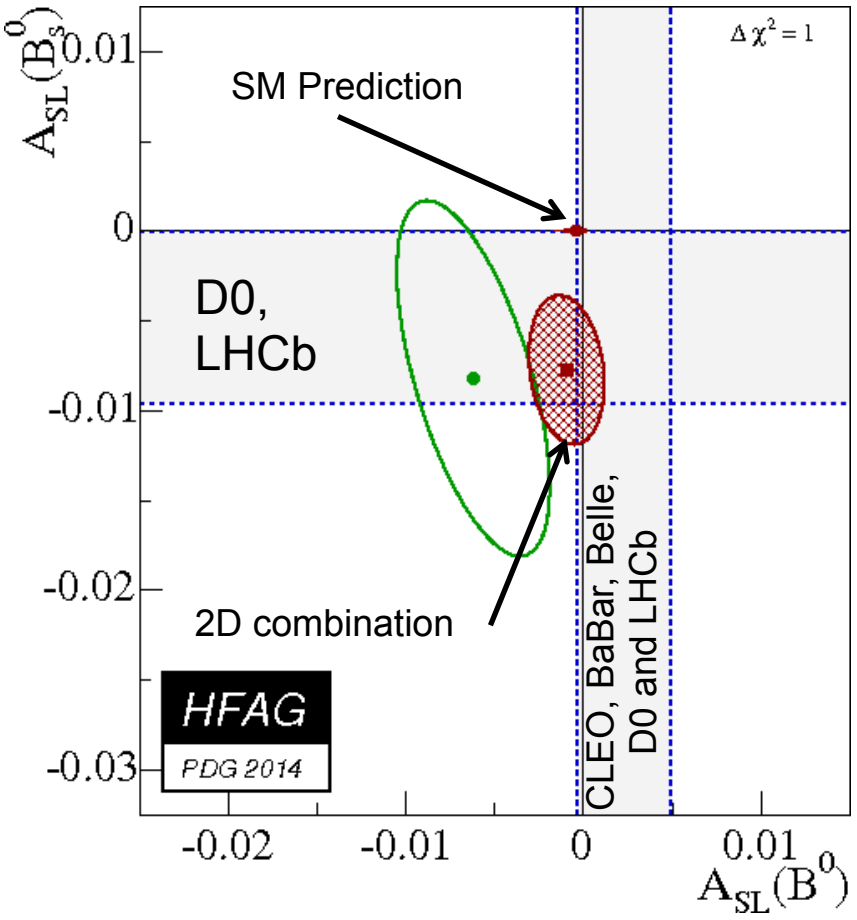
ϕ_s From $B_s \to J/\psi\phi$



CMS result (CMS-PAS-BPH-13-012) overlaid by hand, not included in "Combined" contour

- Perfect agreement with SM so far
- Still not the full set of results from Run I/LHC
- More to come in the next months!

CP Violation

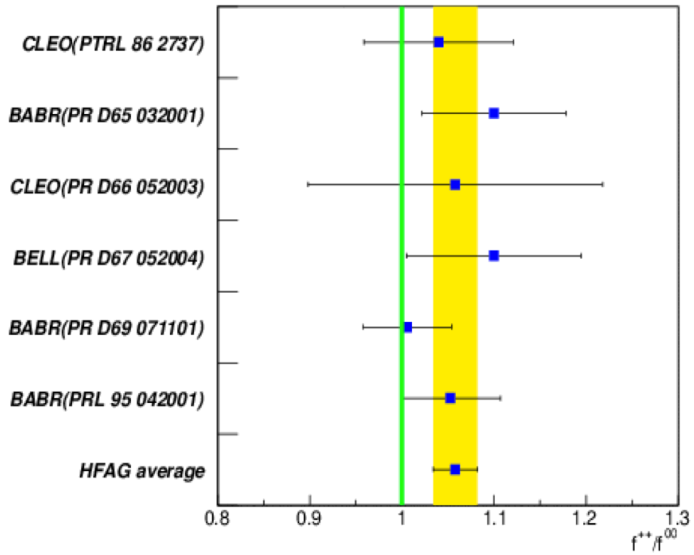


- dilepton asymmetry (green): only result in significant tension with SM prediction

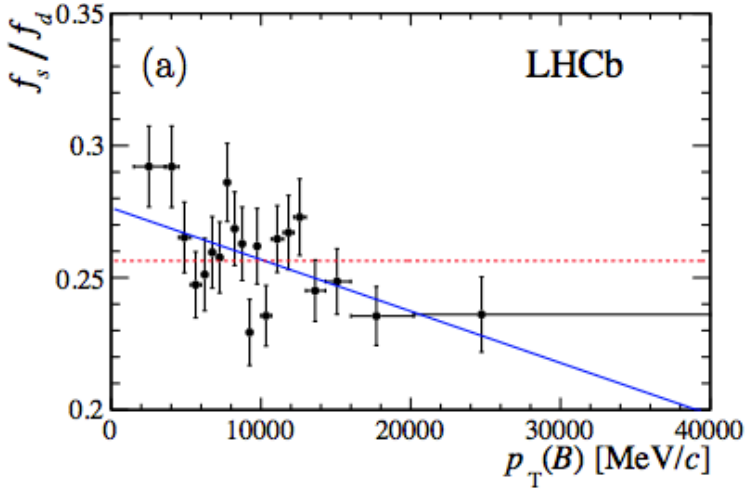
CP violation parameter in B^0 mixing	
$\lvert q/p\rvert = 0.9999 \pm 0.0016$ $A_{SL} = +0.0002 \pm 0.0032$ $\mathrm{Re}(\varepsilon_B)/(1+\lvert\varepsilon_B\rvert^2) = +0.0001 \pm 0.0008$	from measurements at the $\Upsilon(4S)$
$\lvert q/p\rvert = 1.0005 \pm 0.0011$ **A_{SL} −0.0009 ± 0.0021** **$\mathrm{Re}(\varepsilon_B)/(1+\lvert\varepsilon_B\rvert^2) = -0.0002 \pm 0.0005$**	world average

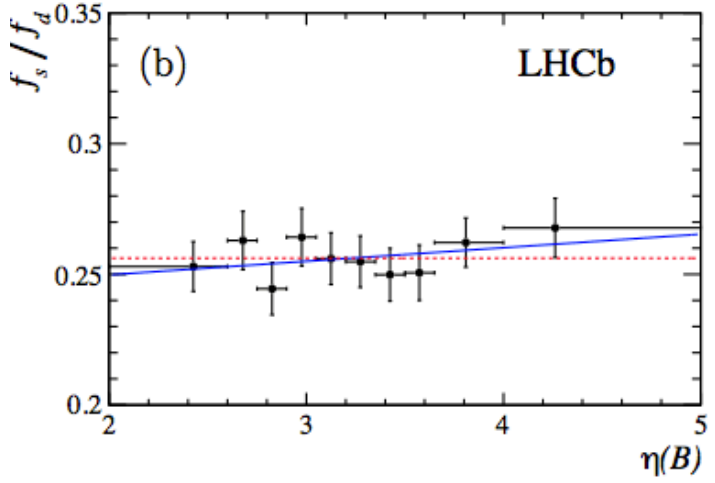
CP violation parameter in B_s mixing	
$\lvert q/p\rvert = 1.0039 \pm 0.0021$ **$A_{SL} = -0.0077 \pm 0.0042$**	world average

B Production Fractions



- fs, fd, f+ enter in many of our results
- Are they really constant fractions?
  - Several universality assumptions (Pt, eta, production mechanism…)





LHCb CERN-PH-EP-2013-006
arXiv 1301.5286

Prospects: 2016

- HFAG averages as expert input:
  - PDG averaging does not account for correlations (e.g. theo/exp systematics)
  - See details on HFAG presentation
- Reviews: update and complement
- Some tension with SM, but marginal
  - Hopefully NP will show up!