Heavy Flavor Averaging Group (HFAG)

PDG Collaboration/Advisory Meeting
LBNL
November 19-20, 2010

Co-leaders (from 2007): ***Alan Schwartz,*** *University of Cincinnati*
GianLuca Cavoto, *INFN, Roma*

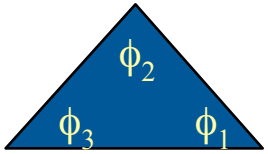
◀ (slides prepared by)

2005-2007: *Soeren Prell, Simon Eidelman*
2002-2005: *David Kirkby, Yoshihide Sakai*

Goal: ***provide up-to-date world averages for measurements of B, D, and τ meson related quantities. Results can be freely quoted by conference speakers, theorists, etc.***

Policy: ***We use the latest conference results in averages; however, if a result is not submitted for publication within 12 months of presentation (or if there are no plans to publish a result), we withdraw it from world averages.***

For averages, we do not inflate errors.



Organization

7 semi-independent subgroups:

- B Lifetimes and Mixing
- Semileptonic B Decays
- Unitarity Triangle
- Rare B Decays
- B to c Decays
- Charm Physics
- Tau Physics

Web pages: subgroups update their websites typically 2-3 times/year, e.g., after Moriond, after ICHEP/LP, sometimes after FPCP/CKM, etc.

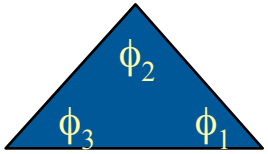
(http://www.slac.stanford.edu/xorg/hfag/)

These provide world averages for conference speakers, theorists, etc.

Preprint: every 1-2 years, all results are collected together in one paper and posted to arXiv (hep-ex). The most recent posting is:

D. Asner et al., "Averages of b-hadron, c-hadron, and τ-lepton Properties," arXiv:1010.1589

Provide averages for the PDG (next slide)



HFAG and the PDG

HFAG now provides averages to the PDG (contact: Weiming Yao)

The averages provided include:

A. Lifetimes and Oscillations:

- b lifetimes
- B mixing parameters
- b production fractions

B. UT Triangle:

- Sin2β (B^0 to ccbar K^0)
- $|\lambda|$ (B^0 to ccbar K^0)

C. Charm:

- mixing parameters x, y
- strong phases $\delta_{K\pi}$, $\delta_{K\pi\pi}$
- CPV parameters $|q/p|$, ϕ

D. Semileptonic decays:

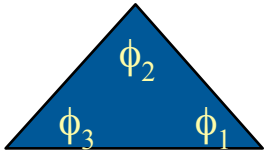
- $|V_{cb}|$ x F(1) for B^0 to D*- l+ ν with ρ^2 and correlation
- $|V_{cb}|$ x F(1) for B^0 to D- l+ ν with ρ^2 and correlation

- Exlcusive B(B^0 to D- l+ ν)
- Exclusive B(B^0 to D*- l+ ν)
- Exclusive B(B^+ to D0 l ν)
- Exclusive B(B^+ to D*0 l ν)

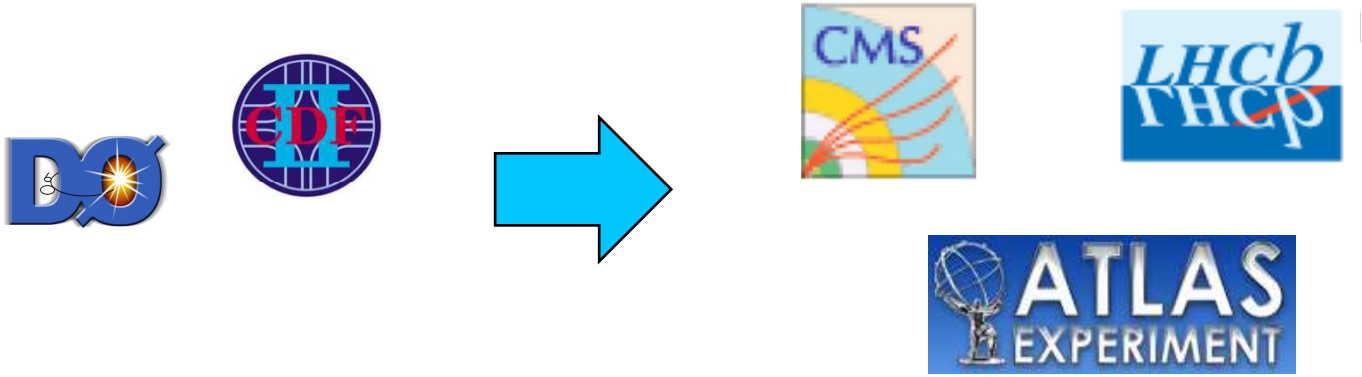
- Exclusive B(B^+ to D- π+ l ν)
- Exclusive B(B^+ to D*- π+ l ν)
- Exclusive B(B^0 to D0 π+ l ν)
- Exclusive B(B^0 to D*0 π+ l ν)

- Inclusive B(B^0/B^+ to l+ ν X)

- V_{ub} for inclusive and exclusive b to u l ν decays
- Exclusive B(B^0 to π- l+ ν)
- Exclusive B(B^0 to ρ- l+ ν)



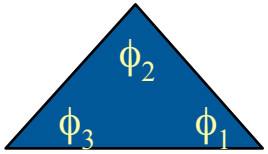
HFAG Transition to the LHC Era



HFAG began as a collaboration between Belle and BaBar, with some input from CLEO and LEP

Over the past few years, CDF and D0 have played larger roles. For B_s physics, they are now playing leading roles.
[some HFAG members: Diego Tonelli (CDF), Rick Tesarek (CDF), Rick Van Kooten (D0), Rob Harr (CDF)...]

A number of HFAG members collaborate on LHC experiments, so there is already some LHCb, ATLAS, CMS representation. However, official reps are appointed by the experiments' spokesmen; we will request this in the near-term future.



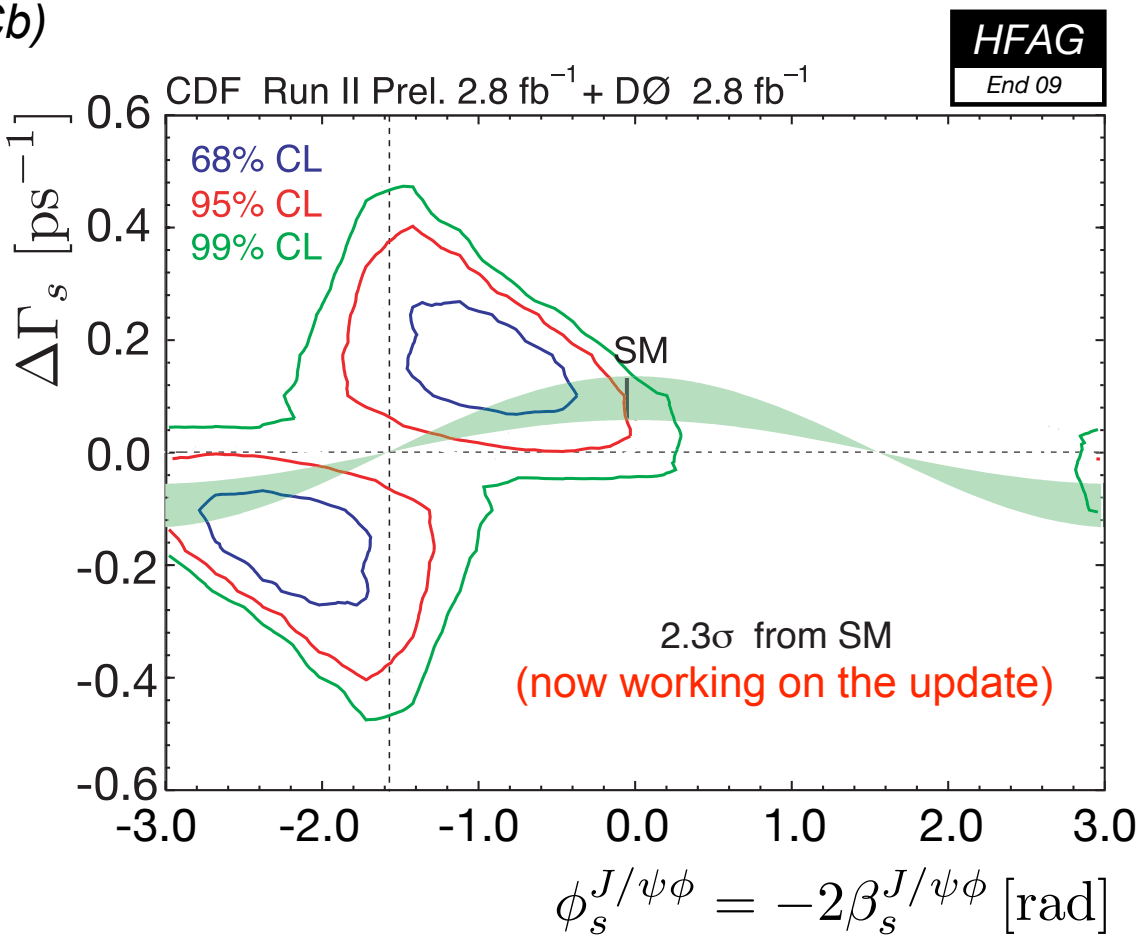
HFAG: Lifetimes and Mixing subgroup

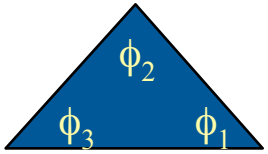
Members:

Romulus Godang (BABAR)
Guillelmo Gomez-Ceballos (CDF)
Rick van Kooten (DØ)
Olivier Schneider (BELLE/LHCb)
Rick Tesarek (CDF)

Tasks:

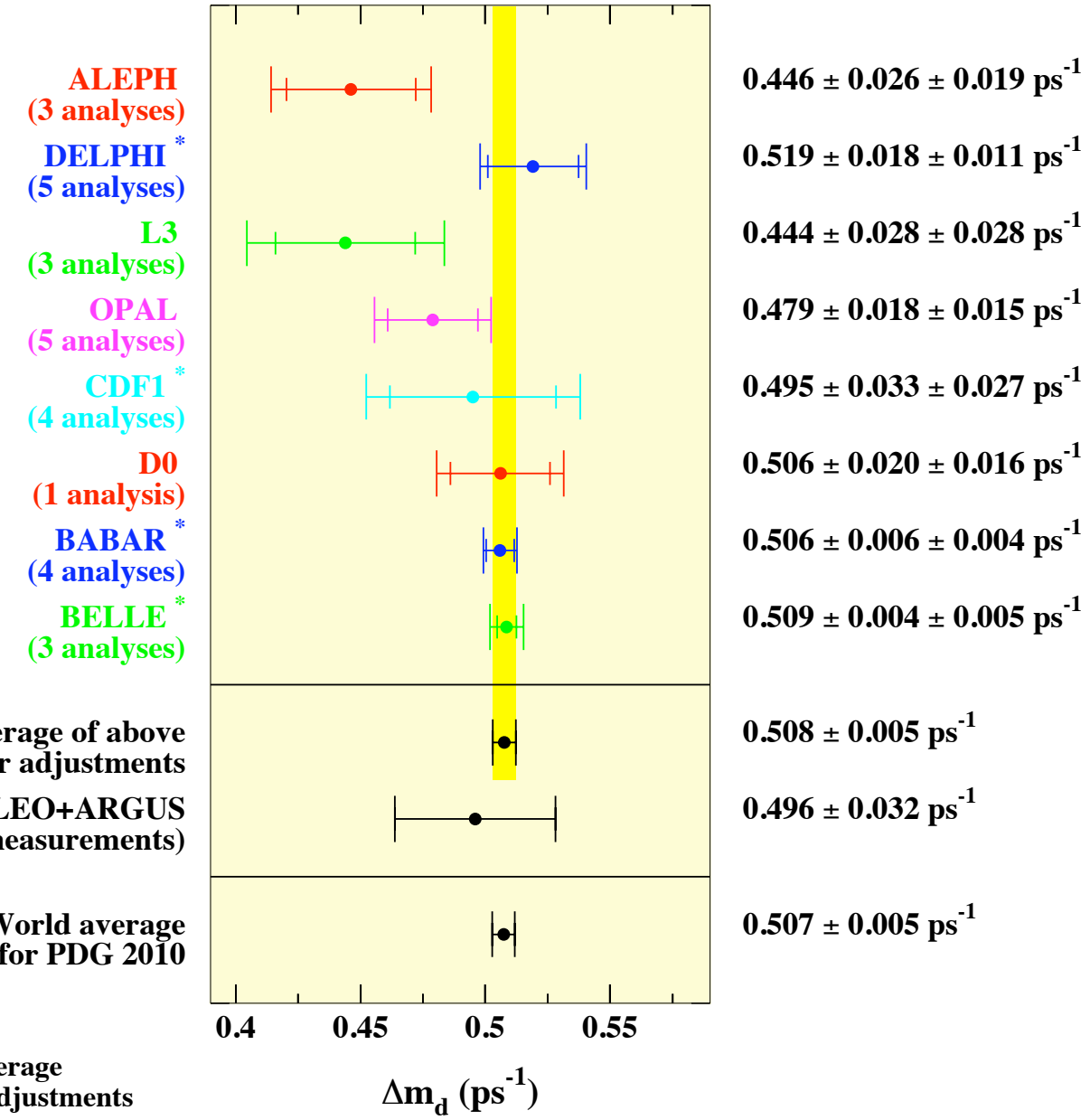
b-hadron lifetimes
b-hadron fractions
B_d mixing, CPV
($\Delta\Gamma$, Δm, $|q/p|$)
B_s mixing, CPV
($\Delta\Gamma_s$, Δm_s, $|q/p|$, β_s)



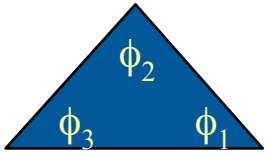


HFAG: Lifetimes and Mixing (cont'd)

Calculated for the PDG 2010:



* HFAG average without adjustments



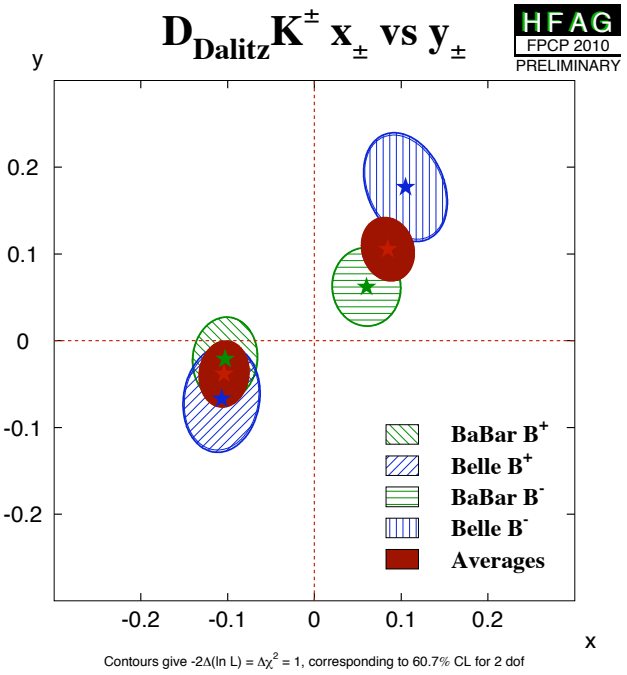
HFAG: UT Triangle subgroup

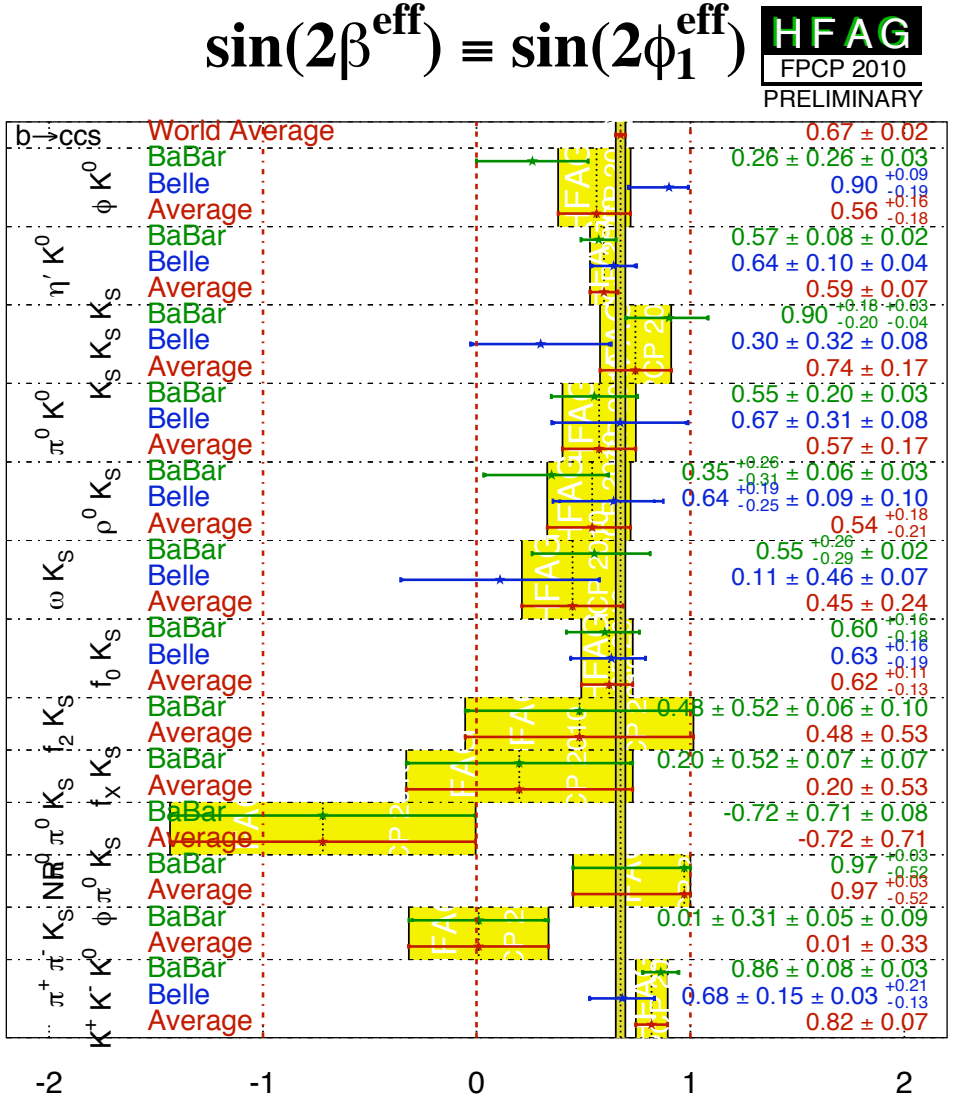
Members:

Gianluca Cavoto (BABAR)
Tim Gershon (BABAR/LHCb)
Diego Tonelli (CDF)
Karim Trabelsi (BELLE)

Tasks:

ϕ_1 (α)
ϕ_2 (β)
ϕ_3 (γ)





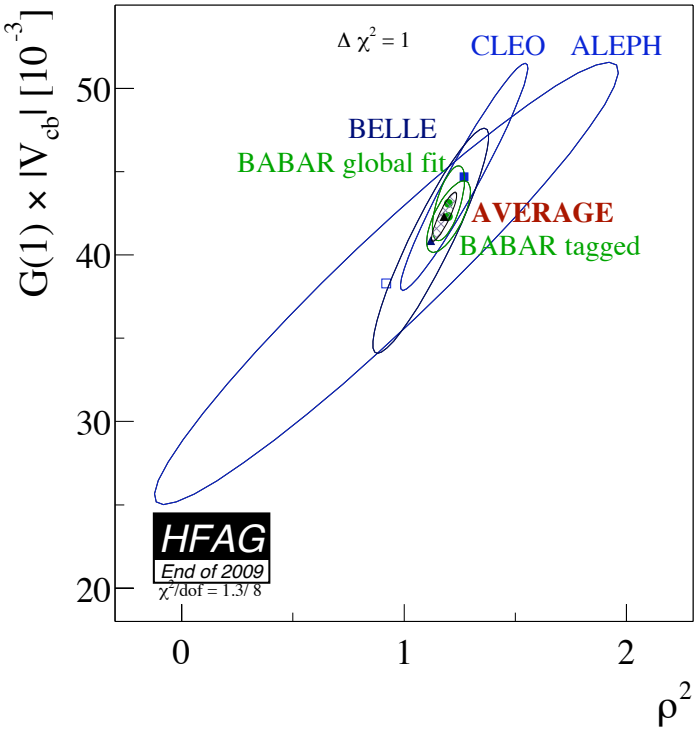
HFAG: Semileptonic subgroup

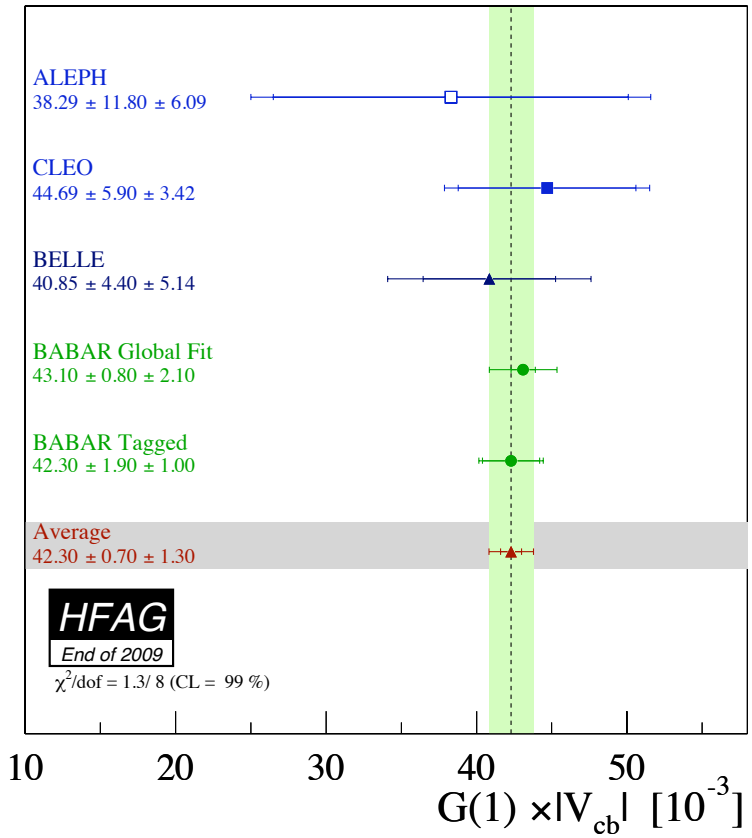
Members:

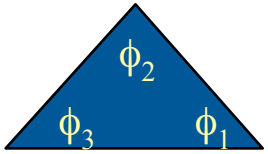
Elisabetta Barberio (BELLE)
Concezio Bozzi (BABAR)
Matthew Jones (CDF)
Vera Lüth (BABAR)
David Lopes Pegna (BABAR)
Christoph Schwanda (BELLE)
Phillip Urquijo (BELLE)

Tasks:

Branching fractions inclusive
Branching fractions exclusive
$|V_{cb}|$
$|V_{ub}|$
Moments







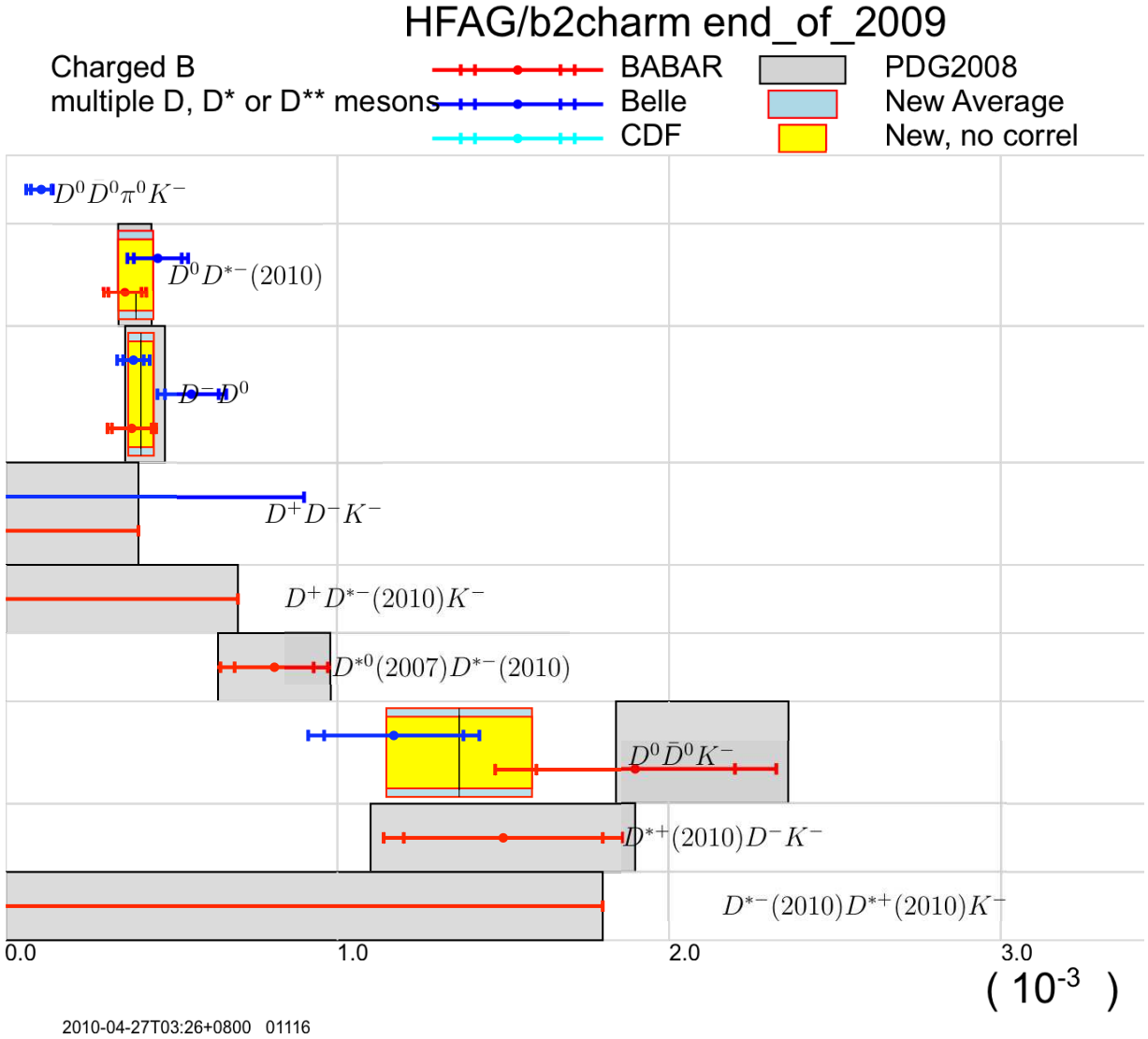
HFAG: b to charm subgroup

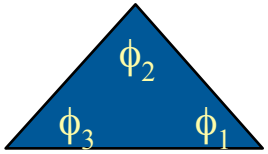
Members:

Simon Blyth (BELLE)
Andrzej Bozek (BELLE)
Cheng-Ju Lin (CDF)
Andrei Nomerotski (D∅)
Gianluigi Cibinetto (IBABAR)
Matteo Rama (BABAR)

Tasks:

Branching fractions (w/averages)





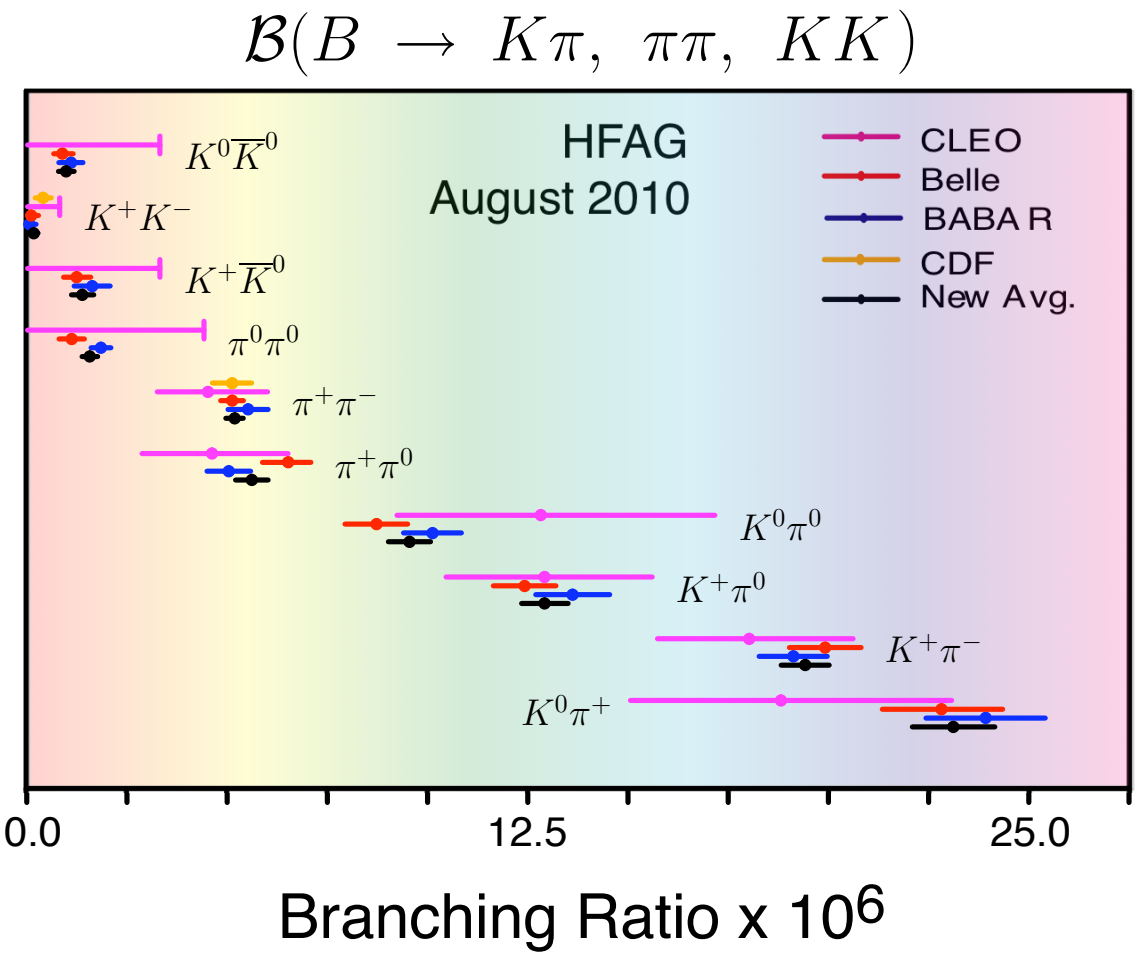
HFAG: Rare subgroup

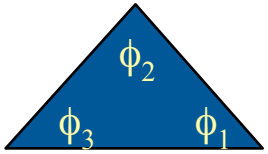
Members:

Ralf Bernhard (DØ)
Shohei Nishida (BELLE)
Rob Harr (CDF)
Jim Smith (BABAR)

Tasks:

Charmless mesonic decays
Radiative decays
Leptonic decays
Baryonic decays
A_{CP}
Vector-vector polarization
B_s decays





HFAG: Rare subgroup (cont'd)

Heavy Flavor Averaging Group
August 2010

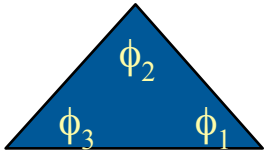
Compilation of B_s Rare Branching Fractions

All branching fractions are in units of 10^{-6}

In PDG2010 New since PDG2010 (preliminary) New since PDG2010 (published)

RPP#	Mode	PDG2010 Avg.	Belle	CDF	D0	New Avg.
15	$\pi^+\pi^-$	< 1.2	< 12	< 1.2†		< 1.2†
21	$\phi\phi$	14 ± 8		$24.0 \pm 2.1 \pm 8.6$ †		24.0 ± 8.9
22	π^+K^-	4.9 ± 1.0	< 26	$5.0 \pm 0.7 \pm 0.8$†		5.0 ± 1.1
23	K^+K^-	33 ± 9	$38^{+10}_{-9} \pm 7$	$24.4 \pm 1.4 \pm 4.6$†		26.5 ± 4.4
–	$K^0\overline{K}^0$	New	< 66			< 66
28	$\gamma\gamma$	< 8.7	< 8.7			< 8.7
29	$\phi\gamma$	57^{+18+12}_{-15-11}	57^{+18+12}_{-15-11}			57^{+21}_{-18}
30	$\mu^+\mu^-$	< 0.047		< 0.036†	< 0.032	< 0.032
31	e^+e^-	< 0.28		< 0.28†		< 0.28†
32	$e^\pm\mu^\mp$	< 0.20		< 0.20†		< 0.20†
33	$\phi\mu^+\mu^-$	< 3.2		$1.44 \pm 0.33 \pm 0.46$†	< 3.2 †	1.44 ± 0.57

†Relative BF converted to absolute BF



HFAG: Charm subgroup

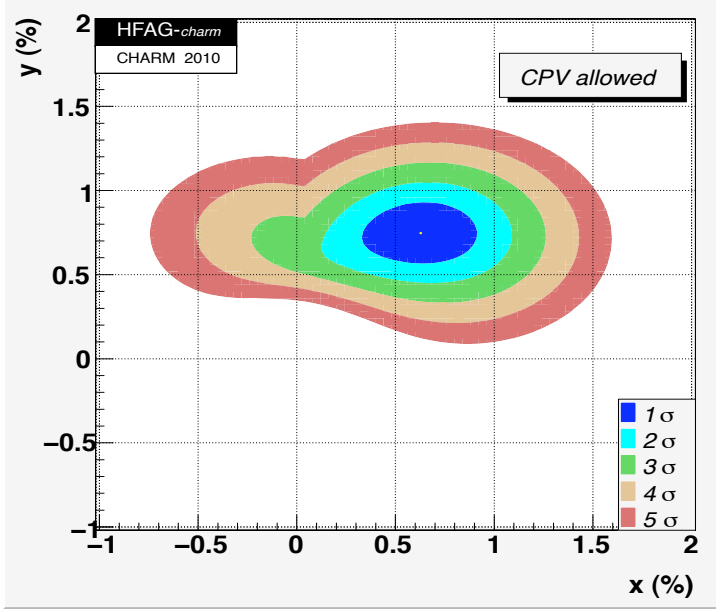
Members:

David Asner (CLEOc)
David Cassel (CLEOc)
Jonathon Coleman (BABAR)
Lawrence Gibbons (CLEO-c)
Bostjan Golob (BELLE)
Brian Meadows (BABAR)
Daniele Pedrini (FOCUS)
Milind Purohit (BABAR)
Alan Schwartz (BELLE)

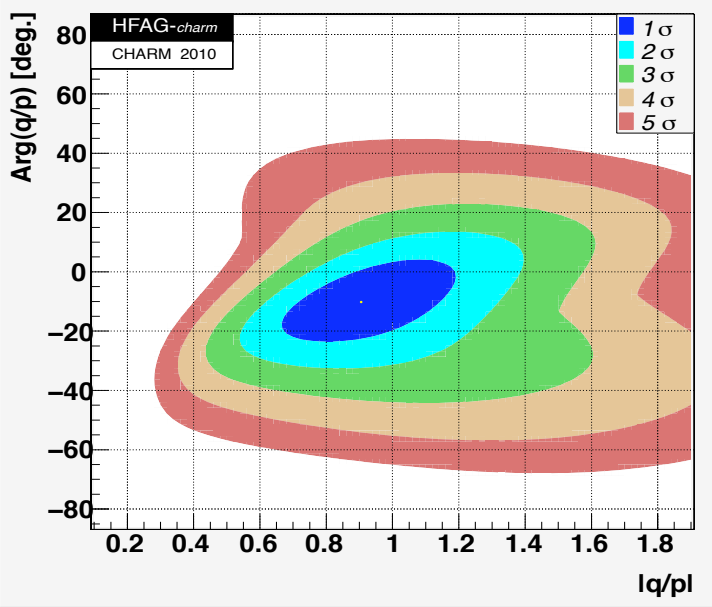
Tasks:

Mixing
CPV in mixing/interference
Direct CPV
Semileptonic (form factors)
Decay constants
Excited D's (D**, D_{sJ})
Rare decays
Charm baryons

Global fit results:



no mixing excluded at 10.2σ

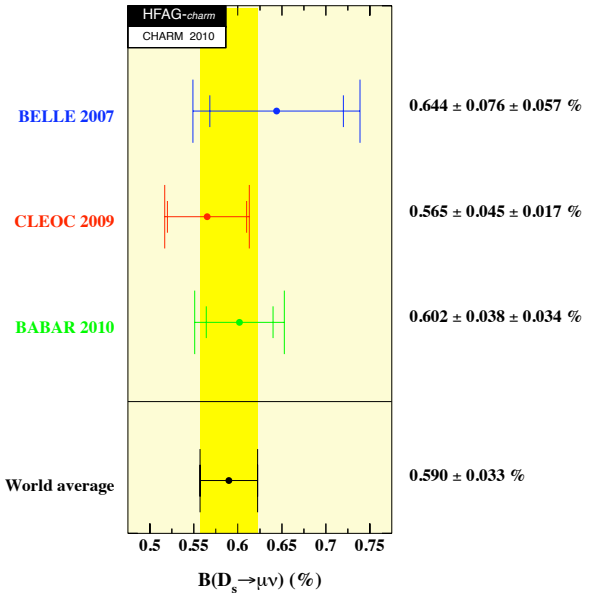


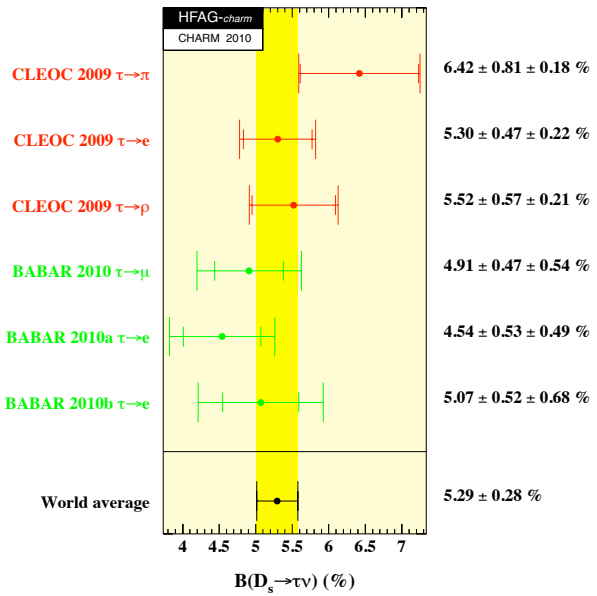
consistent with no CPV

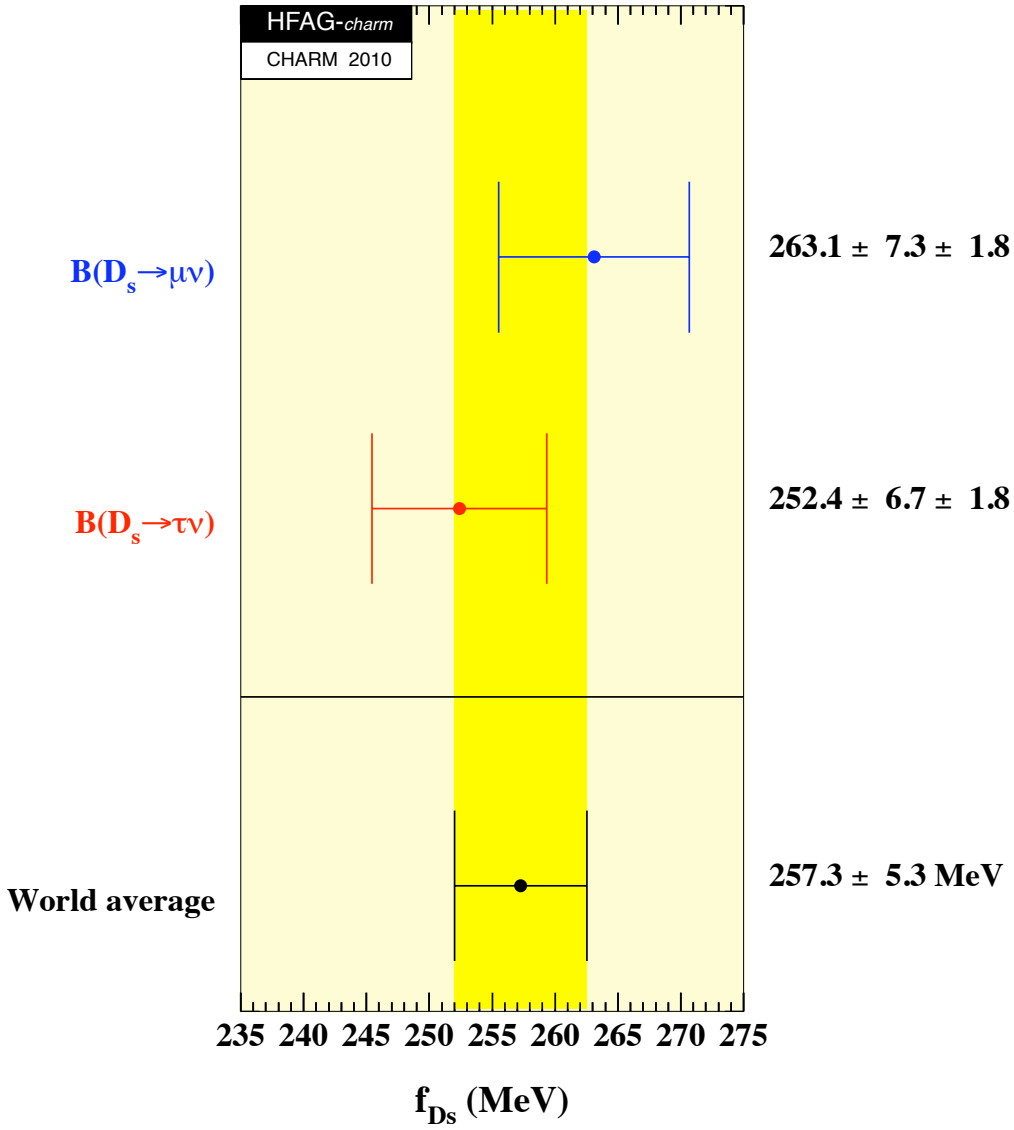
HFAG: Charm subgroup (cont'd)

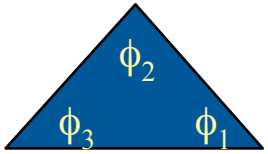
Ds decay constant:

[currently NOT in the PDG, as Stone/ Rosner present their own average (which HFAG believes less accurate)]









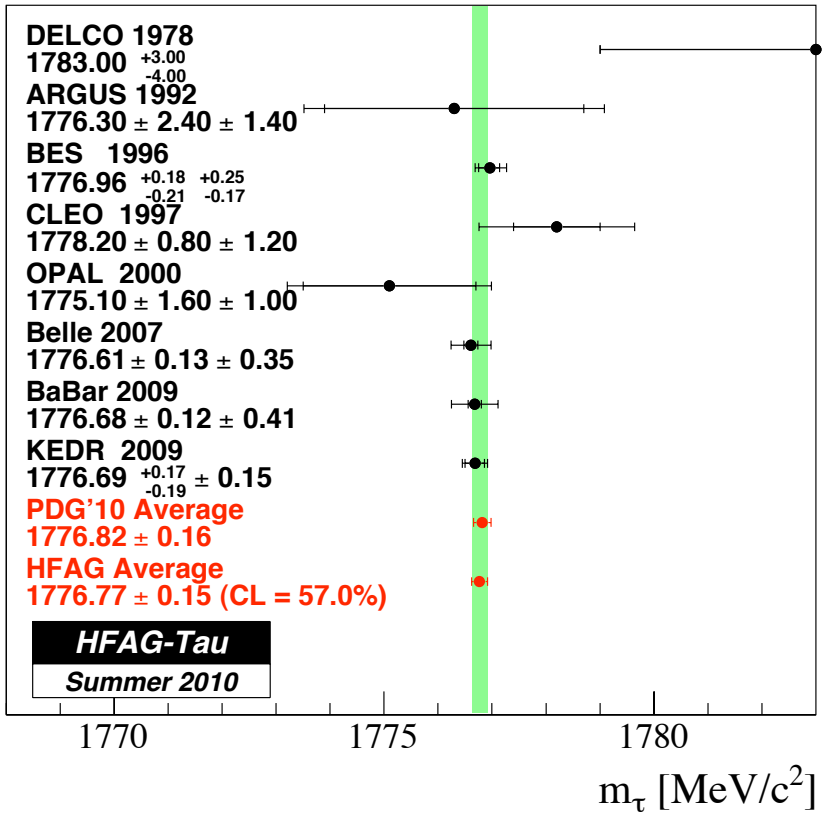
HFAG: Tau subgroup

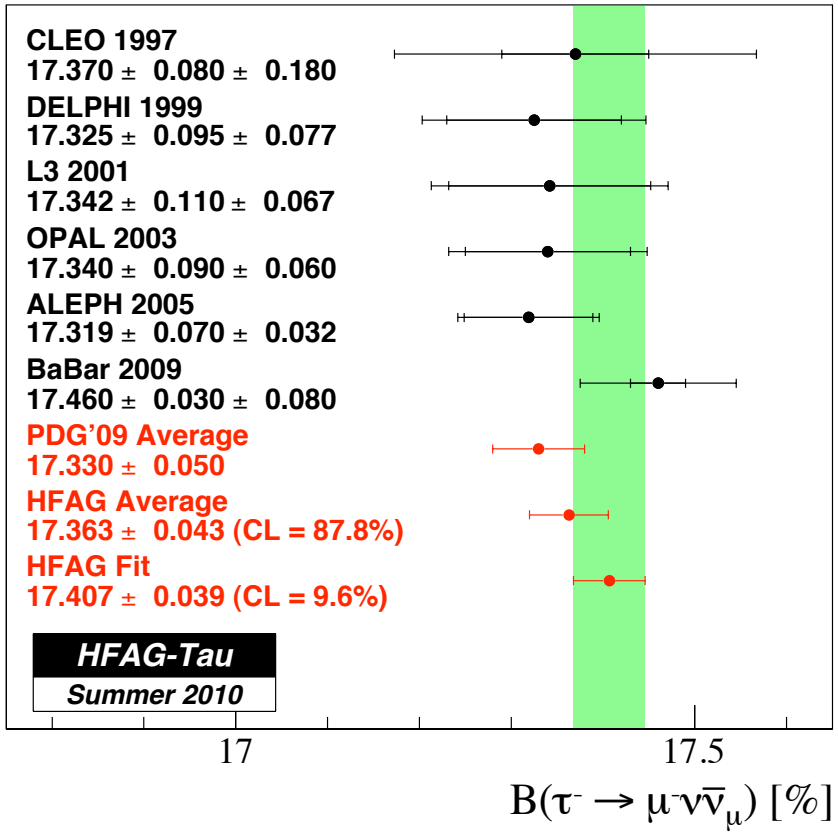
Members:

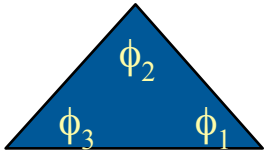
Kiyoshi Hayasaka (BELLE)
Boris Shwartz (BELLE)
Hisaki Hayashii (BELLE)
Swagato Banerjee (BABAR)
Alberto Lusiani (BABAR)
Mike Roney (BABAR)

Tasks:

Tau Mass
Branching Fractions
Extraction of |Vus|
Lepton Flavour Violating Limits







Summary of activities

- *Some new B, D, τ results still coming from full Babar data set*
- *New B, D, τ results coming from full Belle data set [Υ(4S) and Υ(5S)]*
- *New B_s results coming from larger CDF/D0 data sets*
- *New D^0-D^0 mixing and ϕ_3 (γ) results are calculated with input from CLEOc*
- *New D^0-D^0 mixing results expected from BESIII (input to global fit)*
- *Many new B_d, B^+, B_s measurements expected from LHCb*

HFAG should be busy for several years to come

- *Interaction with PDG seems very productive*