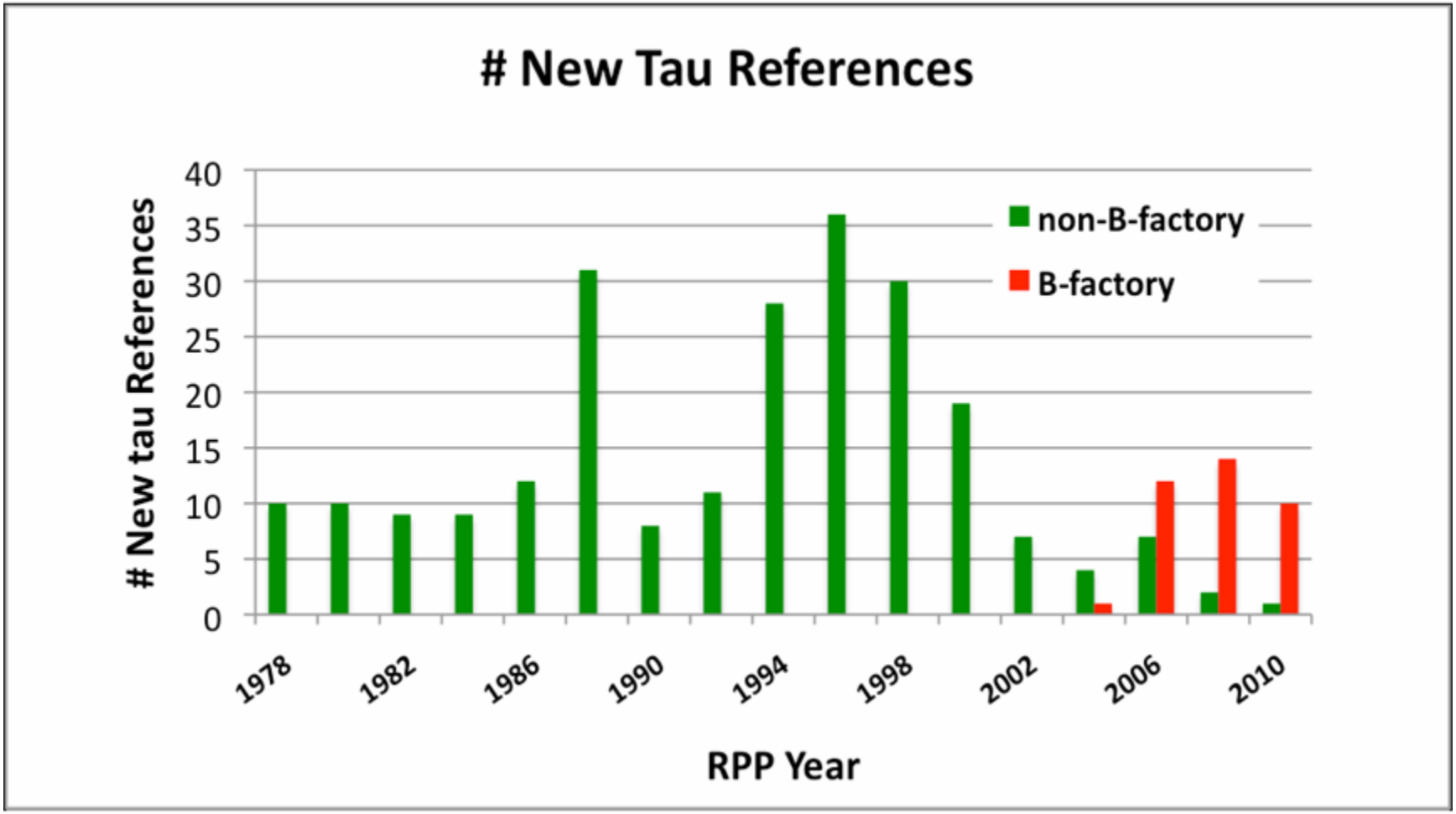
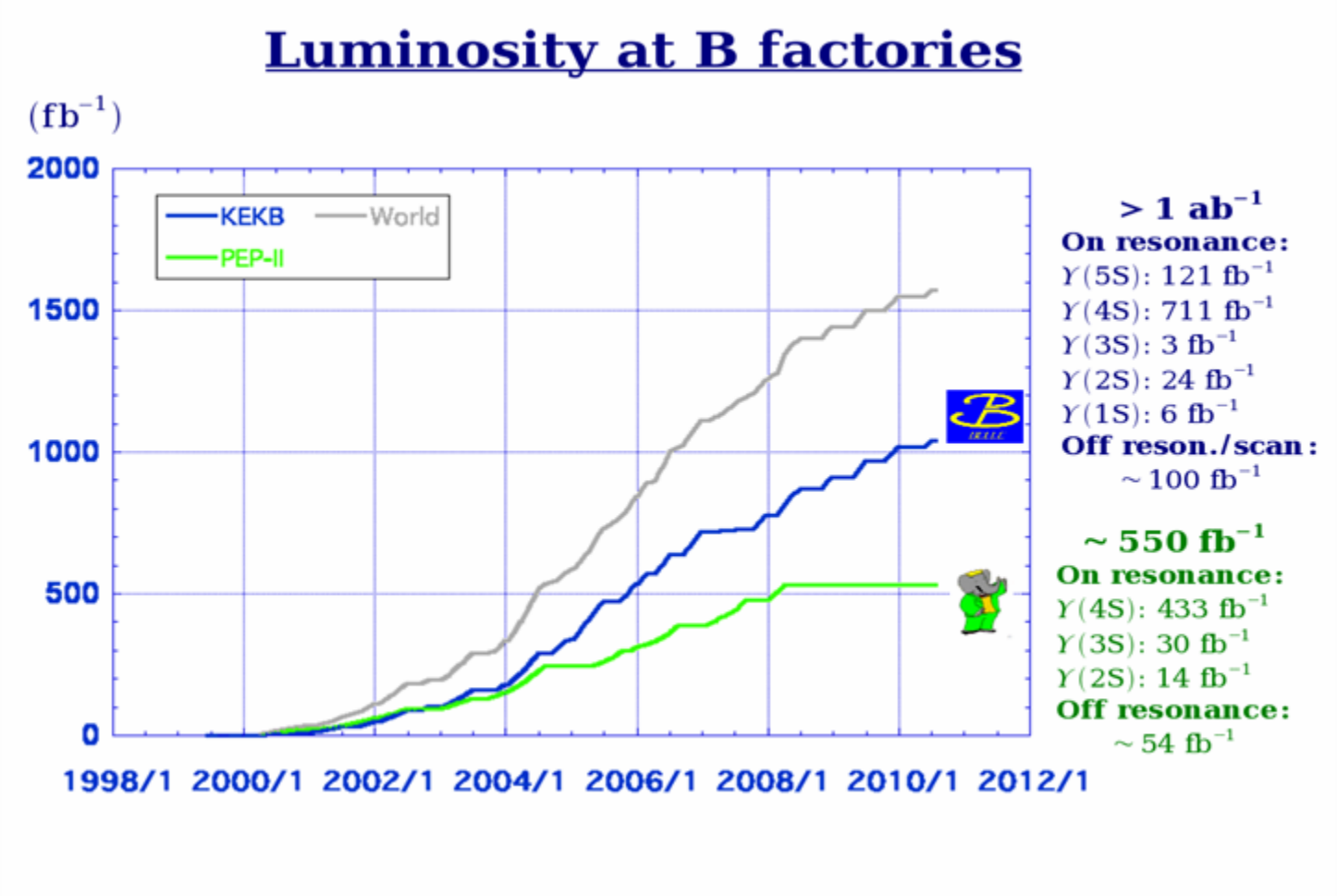
Tau Branching Fractions:

Comparison of B-factory to non-B-factory Measurements

PDG Collaboration Meeting
K. Hayes, Hillsdale College
Nov. 19, 2010


New Tau References
New tau References
40
35
30
25
20
15
10
5
0
1978
1982
1986
1990
1994
1998
2002
2006
2010
RPP Year
non-B-factory
B-factory



http://belle.kek.jp/bdocs/lumi_belle.png

#Produced τ-pairs (x10^6): Belle: 719 BaBar: 482
(largest published τ data sample):

COMPARISON: Belle, BaBar, & non-B-factory

	Belle	BaBar	non-BF
# Neutrinoless τ-decay modes:	**44**	**40**	**51**
Average B-factory improvement in limit: x89			
# Conventional τ-decay limits:	**5**	**7**	**24**
Average B-factory improvement in limit: x17			
# Measured τ Branching Fractions:	**10**	**9**	**105**
# also measured at non-B-factory:	8	7	--

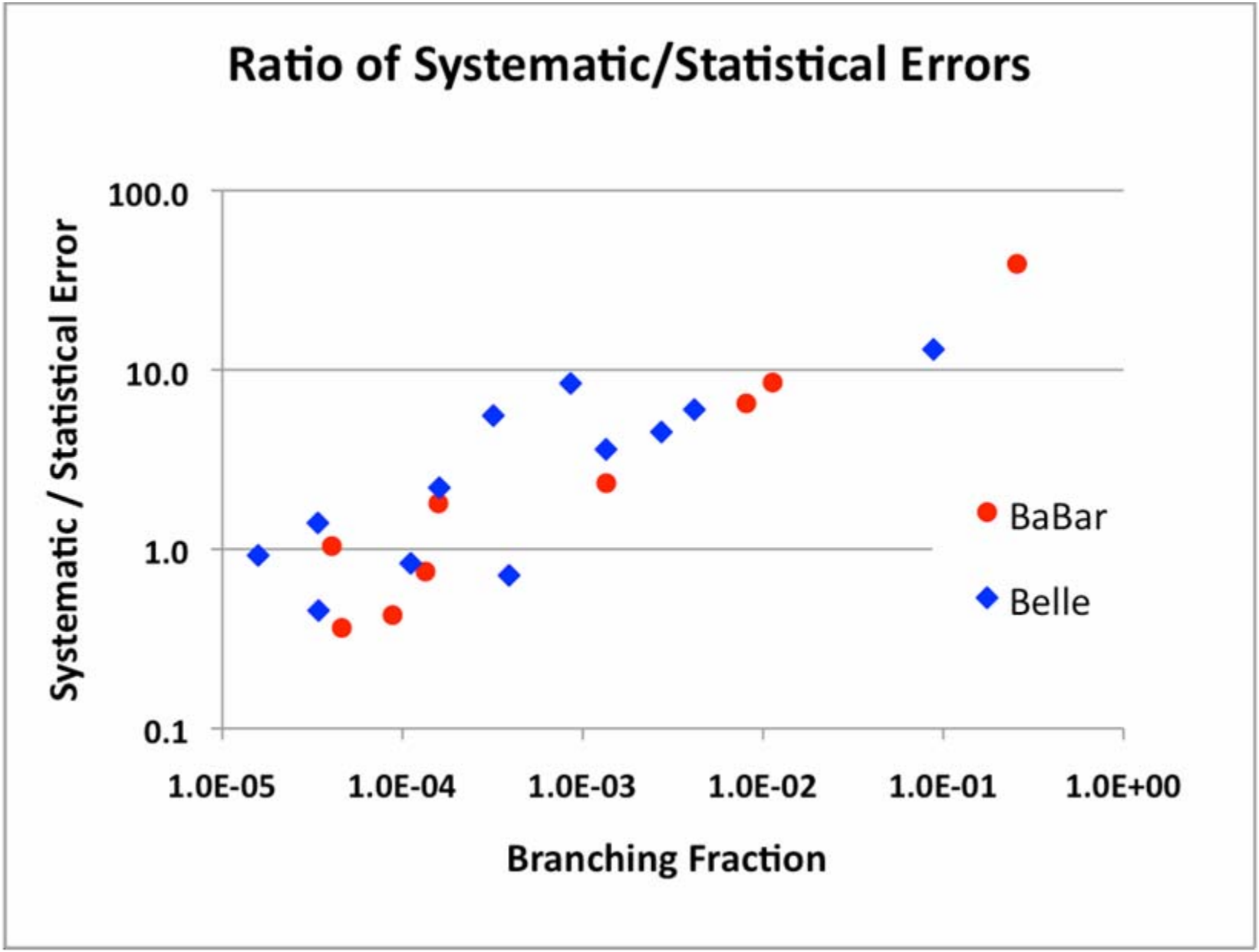
Only One Branching Fraction common to Belle & BaBar:

$\tau^- \rightarrow \phi K^- \nu_\tau$

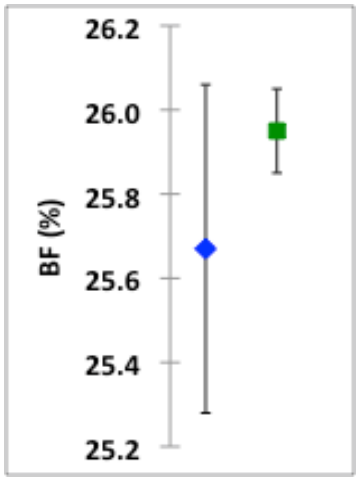
Belle: $(4.05 \pm 0.25 \pm 0.26) \times 10^{-5}$

BaBar: $(3.39 \pm 0.20 \pm 0.28) \times 10^{-5}$

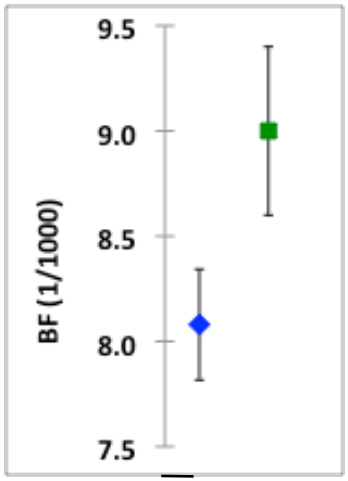
(CLEO: $< 6.7 \times 10^{-5}$ CL=90%)


Ratio of Systematic/Statistical Errors
Systematic / Statistical Error
100.0
10.0
1.0
0.1
1.0E-05
1.0E-04
1.0E-03
1.0E-02
1.0E-01
1.0E+00
Branching Fraction
BaBar
Belle

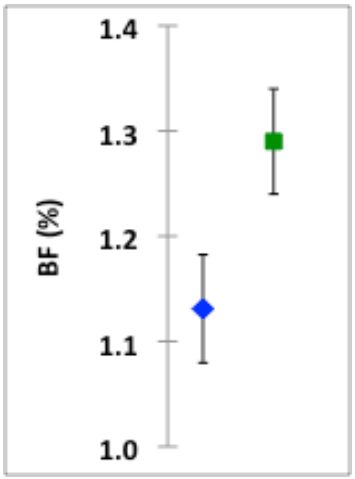
Belle & non-B-Factory RPP BF Values



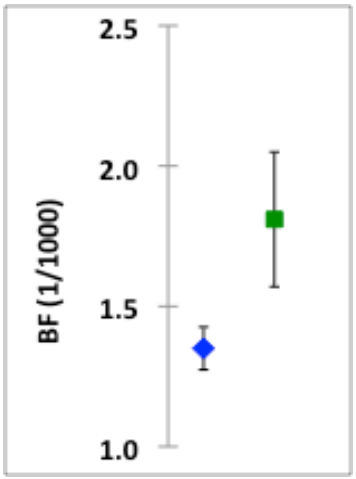
$h^- \pi^o \nu_\tau$



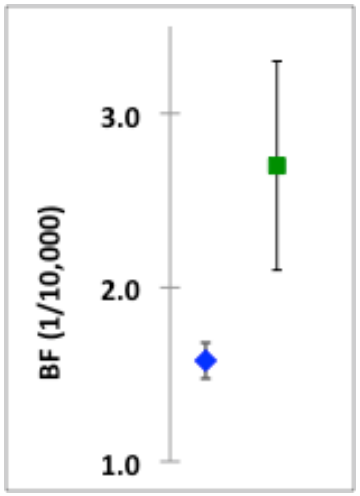
$\pi^- \overline{K}^o \nu_\tau$



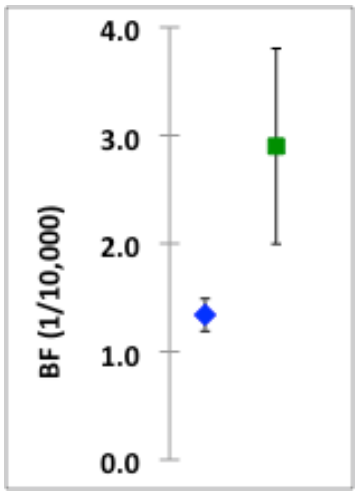
$K^*(892)^- \nu_\tau$



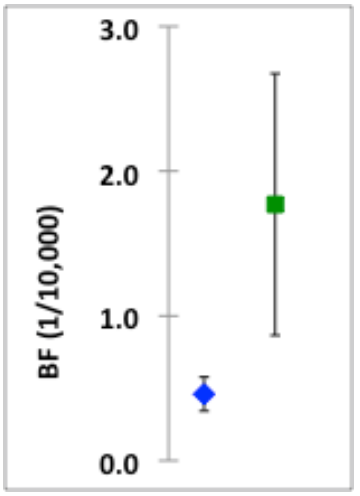
$\eta \pi^- \nu_\tau$



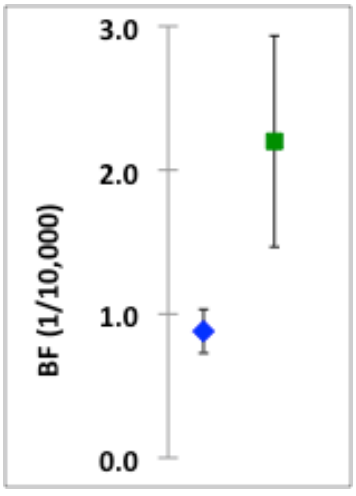
$\eta K^- \nu_\tau$



$\eta K^*(892)^- \nu_\tau$

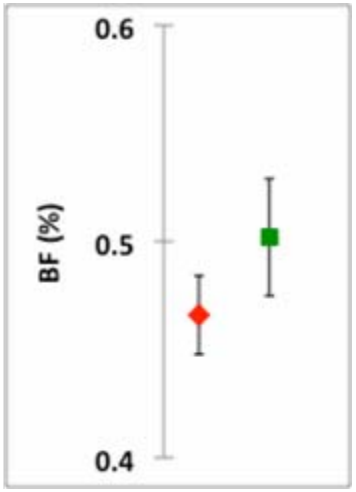


$\eta K^- \pi^o \nu_\tau$

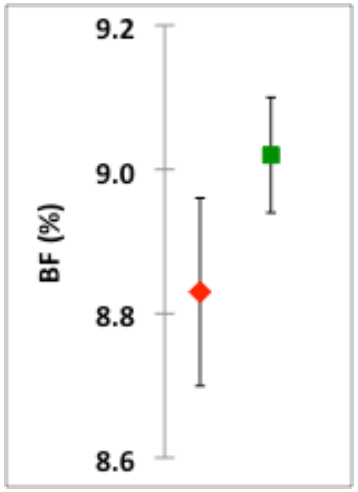


$\eta \overline{K}^o \pi^- \nu_\tau$

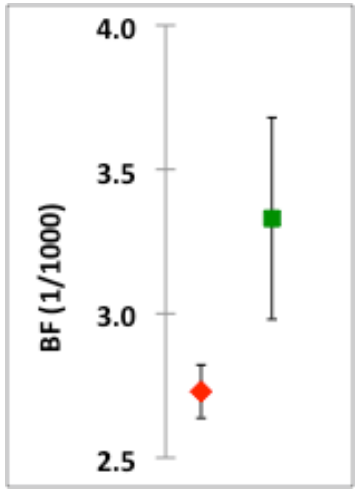
BaBar & non-B-Factory RPP BF Values



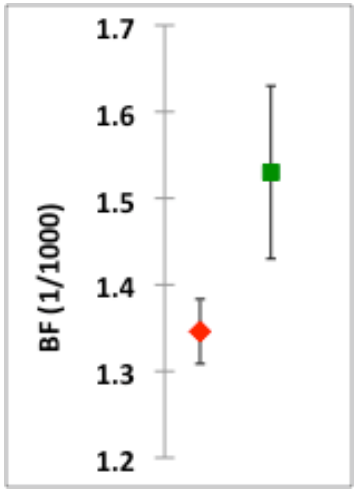
$K^- \pi^o \nu_\tau$



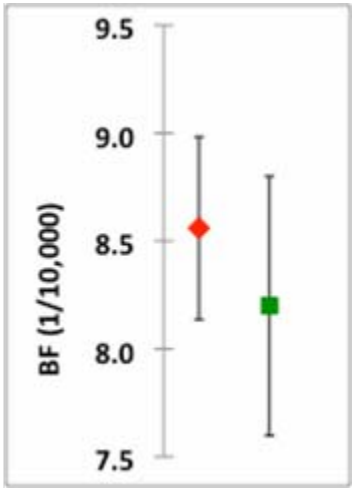
$\pi^-\pi^+\pi^- \nu_\tau$ (ex.K^o)



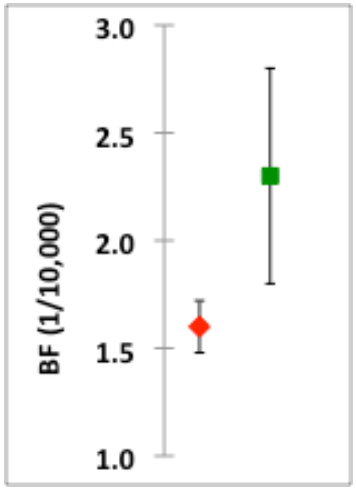
$K^-\pi^+\pi^- \nu_\tau$ (ex.K^o)



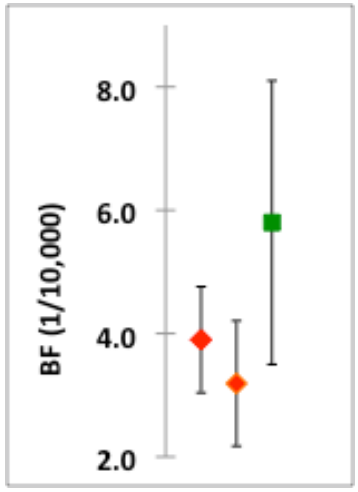
$K^-K^+K^- \nu_\tau$



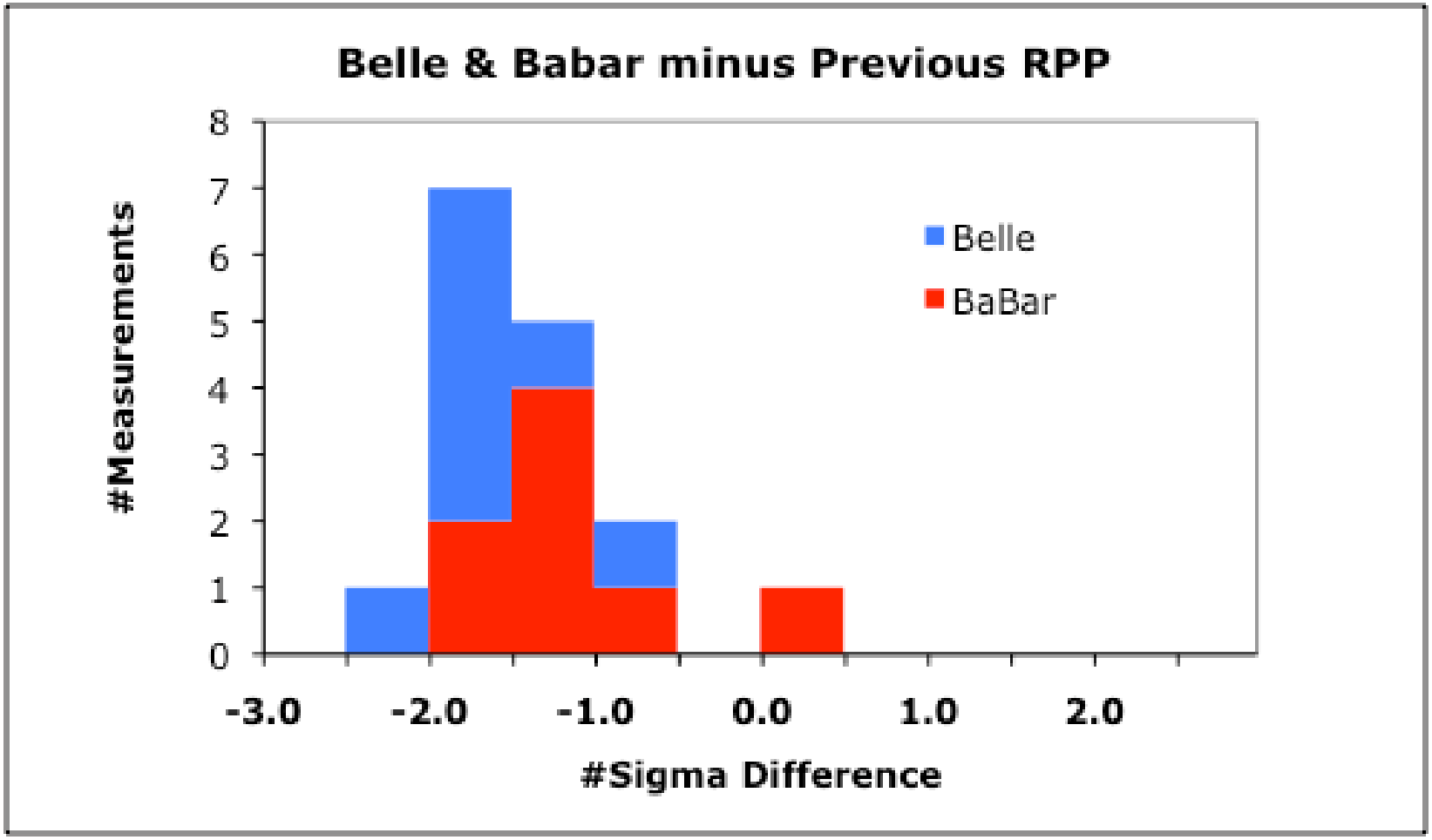
$3h^-2h^+ \nu_\tau$ (ex.K^o)



$\eta\ \pi^-\pi^+\pi^- \nu_\tau$



$f_1(1285)\pi^- \nu_\tau$



<# Sigma Difference> = -1.4

RPP 2010: “The cause of this discrepancy remains to be understood.”

Comparison: Belle & Older Results

MODE	# Belle Events	# Old Results	Most Precise Old Result	# Old Result Events	Ratio: #Events Belle/Old
$h^- \pi^o \nu_\tau$	$5.4X10^6$	4	DELPHI	$3.5X10^4$	154
$\pi^- \overline{K}^o \nu_\tau$	$5.3x10^4$	5	ALEPH	937	57
$K^*(892)^- \nu_\tau$	$4.9x10^4$	3	ALEPH	-	-
$\eta \pi^- \nu_\tau$	$6.0x10^3$	2	CLEO	125	48
$\eta K^- \nu_\tau$	$1.6x10^3$	2	CLEO	85	19
$\eta K^*(892)^- \nu_\tau$	245	1	CLEO	25	10
$\eta K^- \pi^o \nu_\tau$	270	1	CLEO	36	7.5
$\eta \overline{K}^o \pi^- \nu_\tau$	161	1	CLEO	15	11

Comparison: BaBar & Older Results

MODE	# BaBar Events	# Old Results	Most Precise Old Result	# Old Result Events	Ratio: # Events BaBar/Old
$K^- \pi^o \nu_\tau$	7.8×10^4	3	ALEPH	923	85
$\pi^-\pi^+\pi^- \nu_\tau$ (ex.K^o)	1.6×10^6	1	CLEO-3	4.3×10^4	37
$K^-\pi^+\pi^- \nu_\tau$ (ex.K^o)	7.0×10^4	4	CLEO-3	3.5×10^3	20
$K^-K^+K^- \nu_\tau$	1.8×10^4	4	CLEO-3	932	19
$3h^-2h^+ \nu_\tau$ (ex.K^o)	3.4×10^4	5	CLEO-3	295	115
$\eta \pi^-\pi^+\pi^- \nu_\tau$	1.8×10^3	1	CLEO	170	11
$f_1(1285)\pi^- \nu_\tau$ ($f_1 \to 2\pi^+2\pi^-$) ($f1 \to \eta\pi^+\pi^-$)	1.4×10^3 1.3×10^3	1	CLEO	54	26 24

Highly Correlated Branching Fractions

Belle: $B(K^*(892)^- \nu_\tau)$ & $B(\pi^- \bar{K}^o \nu_\tau)$

$B(K^*(892)^- \nu_\tau)$ determined from fit to $K_S\pi^-$ mass spectrum.

$B(K^*(892)^- \nu_\tau \to K_S\pi^-\nu_\tau)/B(K_S\pi^-\nu_\tau) = (0.933 \pm 0.027)$

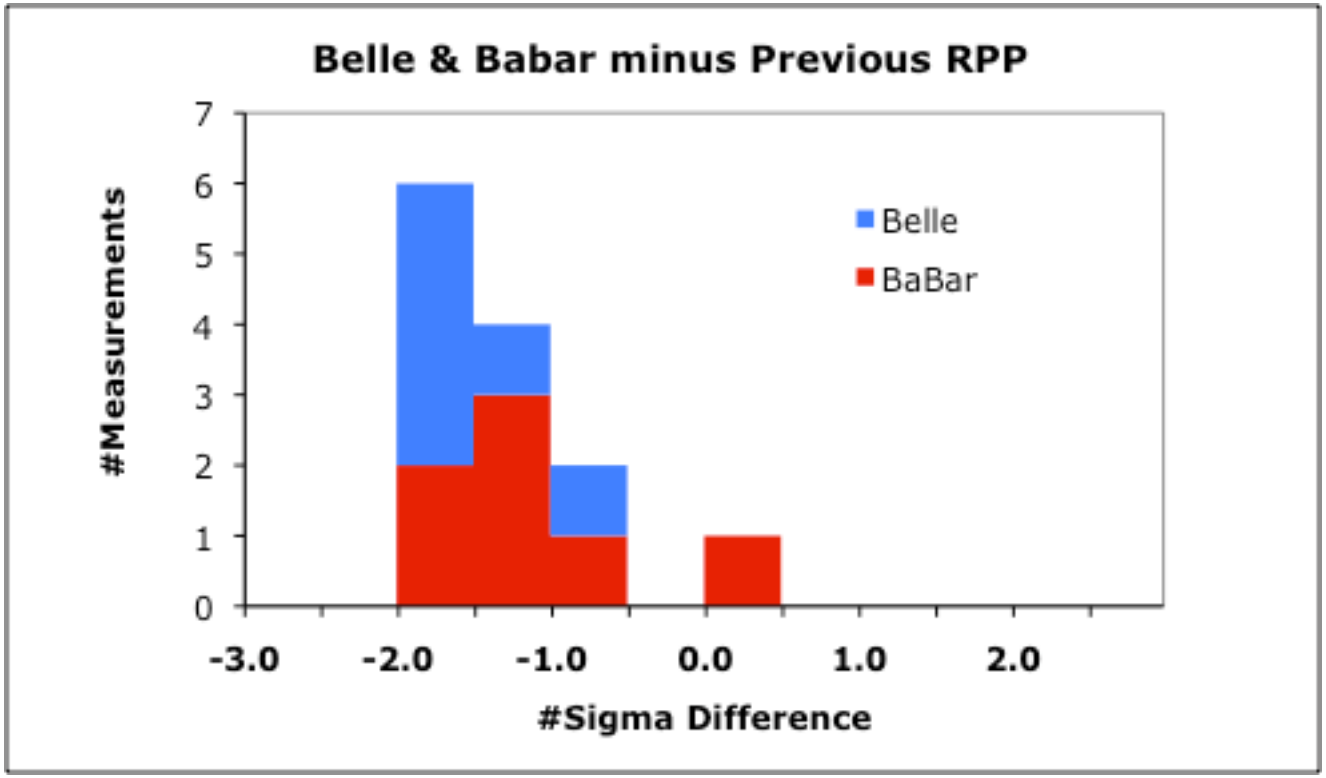
Belle: $B(\eta K^*(892)^- \nu_\tau)$ & $B(\eta K^- \pi^o \nu_\tau)$ & $B(\eta \bar{K}^o \pi^- \nu_\tau)$

$B(\eta K^*(892)^- \nu_\tau)$ determined from fits to $K\pi$ mass spectrum in events used to measure $B(\eta K^- \pi^o \nu_\tau)$ & $B(\eta K^o \pi^- \nu_\tau)$

BaBar: $B(\eta \pi^-\pi^+\pi^- \nu_\tau)$ & $B(f_1(1285)\pi^- \nu_\tau)$

One measurement of $B(f_1(1285)\pi^- \nu_\tau)$ is determined using $f_1(1285) \to \eta \pi^-\pi^+$ decays.

Remove 3 Significantly Correlated measurements



<# Sigma Difference> = -1.3

Conclusions

- Belle & BaBar event samples are one to two orders of magnitude larger than previous experiments
- Belle & BaBar measurements of large branching fractions are dominated by systematic errors
- Belle & BaBar branching fractions tend to be one to two sigma smaller than non-B-factory measurements