

Toward a 10^{36} B Factory at SLAC?

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B physics in 2003:

The Standard Model can explain the magnitude of CP violation seen in the K and B systems.

B physics in 2013:

Will physics **beyond** the Standard Model **also** show up in the B system?
If so, how will B physics results **impact and complement LHC results**?

Cosmology suggests SM CP violation is not the whole story,
Also terrestrial hints, e.g. $B \rightarrow \phi K_s$
Many, but not all, beyond-SM models produce observable effects in B physics.

Mantra of B/LHC Complementarity

LHC will find new physics, and determine its mass scale.
If it's SUSY, it will determine flavor-**diagonal** squark mass terms.

B physics experiments will measure the flavor violation in new physics.
If it's SUSY, will determine flavor-**off-diagonal** squark mass terms.

Interpretation of B physics deviations within new physics models definitely requires knowing the mass scale (LHC):

deviations = $f(\text{new angles}, \text{new } \delta M^2, \text{new mass scale})$.

10^{36} workshop to study complementarity more quantitatively by October.
Also to address reach of 2×10^{35} vs. 10^{36} vs. LHCb/BTeV

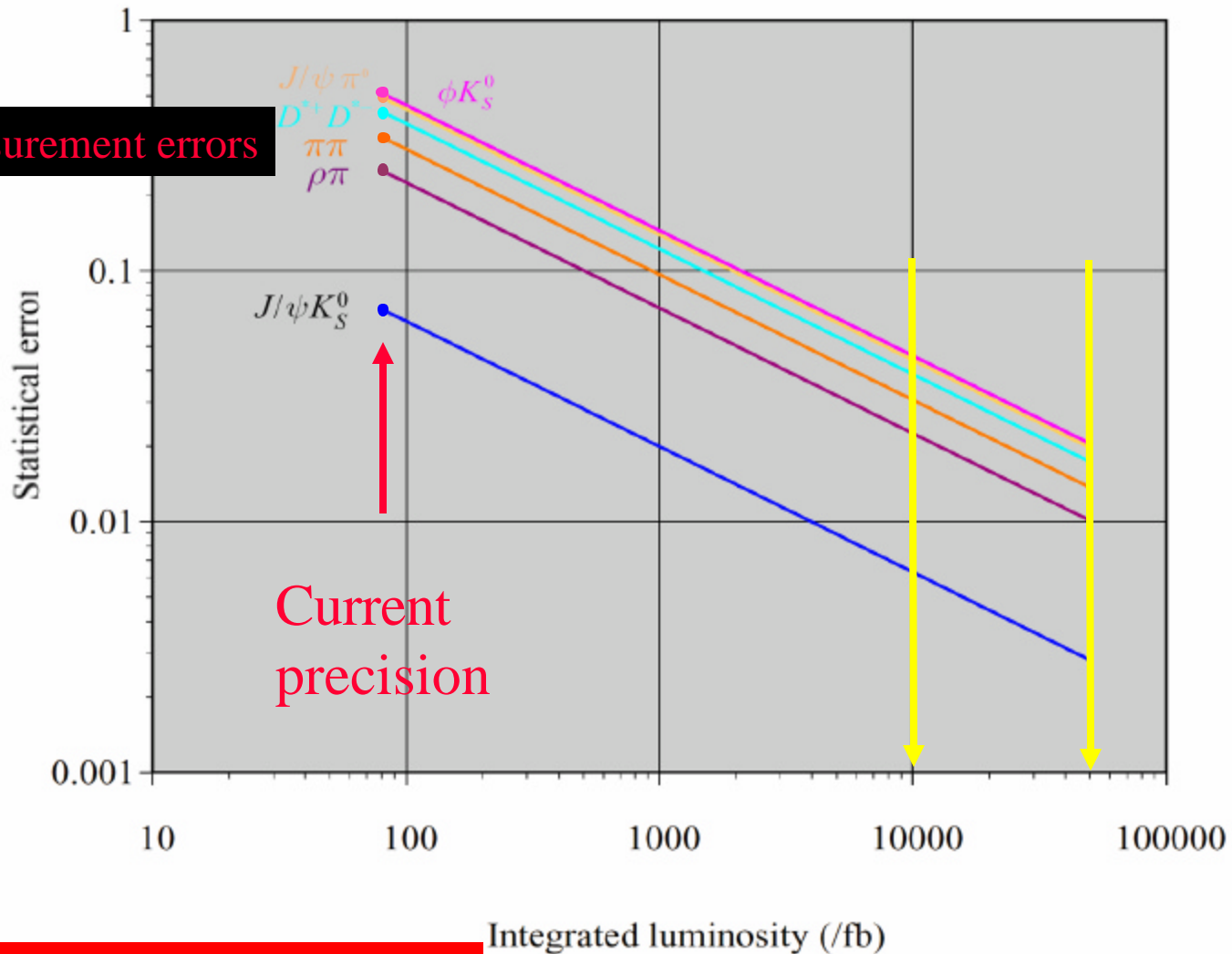
Comparison with BTeV/LHCb

e^+e^- does relatively better if more: ν_s , π^0 s, tagging, or inclusive

Feature	Quantity	Mode	2×10^{35}	10^{36}	LHCb/BTeV
Side	V_{ub}	$B \rightarrow (\pi, \rho, X_u) l\nu$	★★	★★	-----
Angles	β (vs.ref.)	$B \rightarrow \phi K_S$	★★	★★★★	★★
	α_{eff}	$B \rightarrow \pi^+ \pi^-$	★	★★	★
	α	$B^0 \rightarrow \pi^0 \pi^0$	★	★★	-----
	α	$B^0 \rightarrow \rho \pi$	★	★★	★★★★
	~ 0	$B_S \rightarrow (J/\psi) \eta^{(\prime)}$	-----	-----	★★★★
	γ	$B_{(S)} \rightarrow D_{(S)} K$	★★	★★★★	★★
Rare Decays	$C_{7,8,9,10}$	$B \rightarrow K^* l^+ l^-$	★	★★★★	★★★★
	$\text{sign}(C_7)$	$A_{FB}(B \rightarrow K^* l^+ l^-)$	-----	★★	★★
	$\text{Im}(C_7 C_i^*)$	$A_{CP}(B \rightarrow K^* \gamma)$	★★	★★★★	★★

from D. Hitlin's March 20 B day talk

Extrapolated statistical errors on CP asymmetries



BABAR measurement errors

Current precision

10 to 50 ab^{-1} are required for a meaningful comparison

Detector Upgrades

- Both Babar and Belle have started to look at upgrade paths to make the detectors 10^{36} -capable
 - 10^{36} is quite different from 10^{35} : current detectors could be stretched to work at 10^{35} with relatively minor changes. 10^{36} requires *a lot* of changes.
 - Main concerns are:
 - Machine-related backgrounds
 - synchrotron radiation
 - particle backgrounds, due primarily to continuous injection
 - Radiation dose
 - Physics backgrounds – hadronic split-offs,

Conclusions

10^{36} has huge physics opportunities if there is new flavor physics.
 10^{36} needed to compete head-to-head with LHCb/BTeV on most angle CP asymmetries.

However, $10^{36} = L_{\text{now}} \times 100$ is a big step for both machine and detector.
(Previous factor of 1000 came largely from one source (1000 bunches).)

“Adiabatic approach” aiming at 2×10^{35} could allow one to see how anomalies play out. Less \$ up front (\$0.2B vs. \$0.5B??).
This may be important if there is a linear collider in the US.

Timeliness with respect to LHC, LHCb and BTeV also important.

Of the large projects we have looked at, the Y(4S) machines seem closest to having a complete design.

Little synergy with LC technology though.