Bs and Bd mixing

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- Introduction
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- B_s mixing and physics beyond the SM

Introduction

Best channel: $B_s^o \rightarrow D_s^{\pm}\pi^{\pm}, \quad D_s^{\pm} \rightarrow \phi\pi^{\pm}, \quad \Phi \rightarrow KK$

The flavor of the B_S at production is determined by different Tagging methods (opposite side or same side tagging)

The $D_s^{\pm}$ is used to tag the flavor of the B_S at decay time.

Good proper time resolution needed!

Summary table

	Event Yield	$\delta\Delta m_s$ [ps^{-1}]	Δm_s reach	Δm_d
SM			>14.6 <31.2(4)	
World ave.			>14.9('01)(4)	(0.486+/-0.015) (3)
Babar				0.507+/-0.015+/-0.022(3)
Belle				0.456+/-0.008+/-0.030(3)
CDF/D0	20k (CDF)		60/22	
BteV /yr	 103 k	 0.10	Up to 55* 48(6)	
Atlas 30fb^{-1} /yr	 3.5 k	0.05-0.16 (1)** 0.11(20ps^{-1})(6)	38.5(1) 30(6)	
CMS /yr	4.5 k		26(6)	
LHCb /yr	 86 k	 0.011(6)	Up to 60(2)* 48(6)	

*assuming Bs lifetime = 1.464 ps **for Δm_s =20 and 38.5 ps^{-1}, respectively

Bs mixing and non-SM Physics

Model dependence in terms of single parameter f

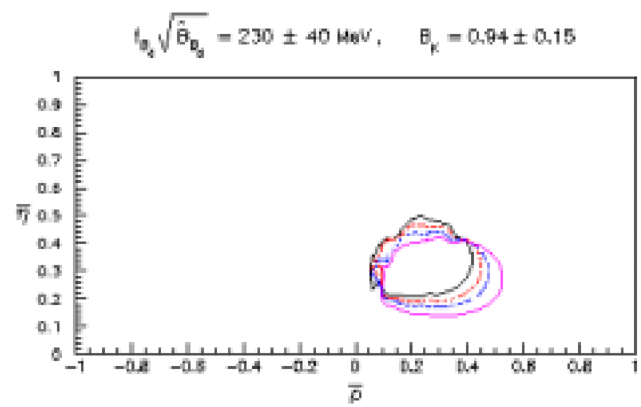
$$\Delta M_s = \Delta M_s(SM)[1+f]$$

$f = 0$ (SM) : $14.6 <= \Delta M_s <= 31.2$,

$f = 0.2$(mSUGRA) : $14.6 <= \Delta M_s <= 35.5$,

$f = 0.4$(non-mSUGRA) : $14.9 <= \Delta M_s <= 39.4$,

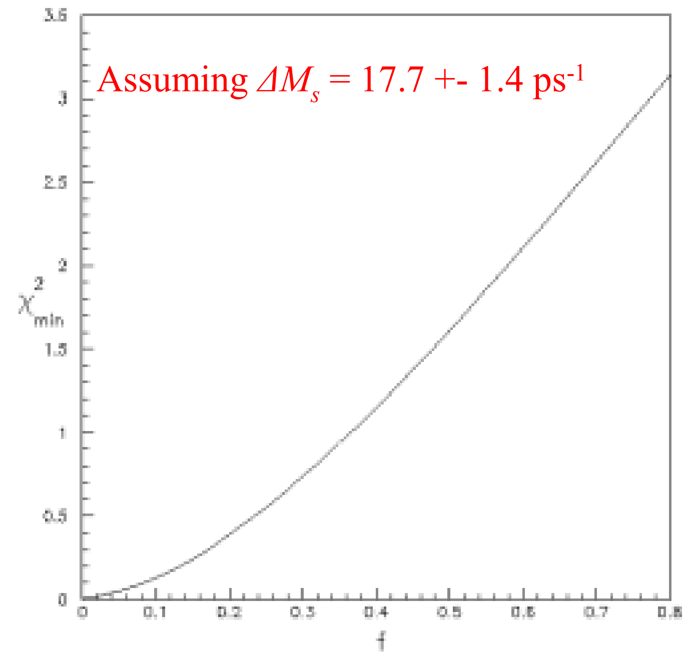
$f = 0.75$(non_SUGRA) : $15.1 <= \Delta M_s <= 48.6$.



- Upper limit sensitive to specific models
- Ranges don't tell the whole story: chi-sq minima might be quite different for the various models
- ΔM_s does not seem to be a sure candidate in ruling out/ establishing SUSY. One needs to get lucky

Fits to f

2 degrees of freedom (ρ and η):
$\rightarrow \chi^2_{min} > 2$ are disfavored
$\rightarrow$ Models with f > 0 .6
disfavored in current data
Seems like a powerful way to
distinguish between models,
but quite optimistic



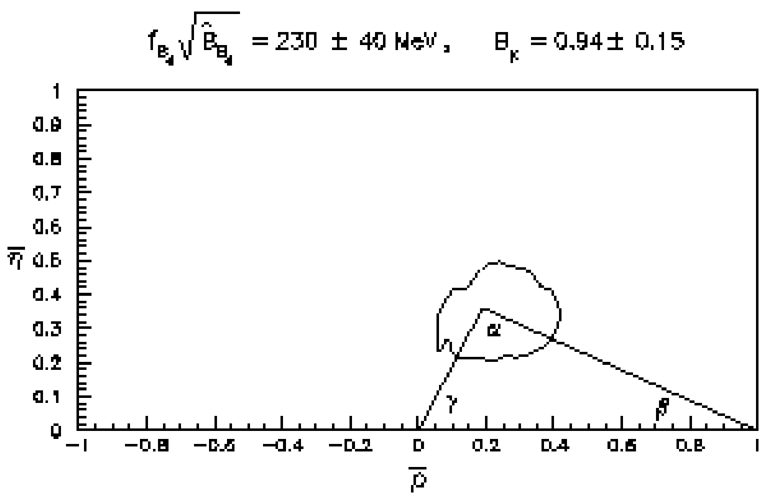
	ATLAS	CMS	LHCb
Measurable values of up to:	30 ps^{-1}	26 ps^{-1}	48 ps^{-1}
95% CL excl. of ΔM_s values up to:	-	29 ps^{-1}	58 ps^{-1}
$\sigma(\Delta M_s)$ for ΔM_s = 20 ps^{-1}	0.11	-	0.011

Other factors

The chi-sq fits to f depend on η and ρ and hence the angles of the unitarity triangle.(Specifically $\sin 2\beta$)

By making precise measurements of the angles one can reduce the Allowed regions for f.
→Might be able to rule out specific models.

Hard to make more quantitative statements at this point.



Limiting factors for ΔM_s

Theoretical limitations:

Hadronic matrix elements calculated in lattice QCD to ~10% (leptonic decay constants f_{Bs} and B parameters $\hat{B}_{Bs}$)

$$\Delta M_S = \frac{G_F^2 M_W^2}{6\pi^2} \eta_B S_0(x_t) M_{Bs} \hat{B}_{Bs} f_{Bs}^2 \left|V_{ts}\right|^2$$

Theory errors are reduced in the ratio $\Delta M_s / \Delta M_d$.

Limiting factors for ΔM_s

Experimental limitations:
Proper time resolution

	ATLAS	CMS	LHCb	BTeV
Proper time resolution	50 fs (60.5%) 93 fs (39.5%)	65 fs	43 fs	43 fs

For a proper time resolution reduced by 25 %, Atlas could achieve a ΔM_s of 50 ps^{-1} instead of 38.5 ps^{-1}! (1)

Other factors: Mistag rates. (Atlas assumes 0.22 for the muon mistag rate by which the wrong charge sign is assigned).

Backgrounds (B_d decays, combinatorical backgrounds).

Conclusions

ΔM_s will be measured at the Tevatron,
and the LHC

Better values of the angles of the CKM matrix result in smaller variance of ΔM_s for different models

→ In an optimistic scenario the measurement of ΔM_s can serve to rule out theoretical models

Future Experiments need to have very good proper time resolution to have an impact on ΔM_s.

References

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2) LHCb technical proposal: http://lhcb-tp.web.cern.ch/lhcb-tp/

3) Duccio Abbaneo: "Review of Experimental Results on Neutral B Meson Oscillations", Talk given at HQ2K, Rio de Janeiro, Brazil, Oct 2000, hep-ex/0012010

4) A. Ali and D. London, Eur. Phys. J. C 18, 665-672 (2001)

5) BTev: http://www-btev.fnal.gov/public_documents/btev_proposal/index.html

6) B Decays at the LHC, CERN-TH/2000-101 hep-ph/0003238 (1 YEAR of running)

7) A. Buras et al., hep-ph/0107048

8) "Present and Future CP Measurements", in: UK Phenomenology Workshop on Heavy Flavour and CP Violation, Durham, 17-22 Sept. 2000, hep-ph/0102159