

Possibilities for Measuring Δm_s Using Semileptonic Decay $B_s \rightarrow \phi l X \nu$ in Dilepton Trigger Data

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2nd B Mixing Workshop

12 July, 2004

Introduction

Best limit on B_s mixing in CDF Run I came from a sample of B_s semileptonic decays collected using Run I dilepton triggers.

Ting Miao CDF Note #4485.

- Analysis used partially reconstructed decay of $B_s \rightarrow \phi l X \nu$ and an opposite side soft lepton relative to the ϕl pair as a flavor tag.
- Found 1068 ± 70 candidates with a B_s purity of 61%.
- Obtained a lower limit of $\Delta m_s > 5.8 ps^{-1}$

How well would this method work in Run II data?

Features of the Analysis

Fully reconstructed B_s hadronic decay events provide the best precision in the measurement of Δm_s . However, poor small hadronic branching ratios make it difficult to obtain a large enough sample size.

- Semileptonics

- Large branching ratios \rightarrow large sample size.
- Less accurate because decays are partially reconstructed.

- Inclusive Search

- More modes \rightarrow larger sample size.
- Actual decay products are not fully specified; large background

- $B_s \rightarrow \phi l X \nu$ in Dilepton Data

- The mode is self-tagged
- The dimuon sample is not prescaled

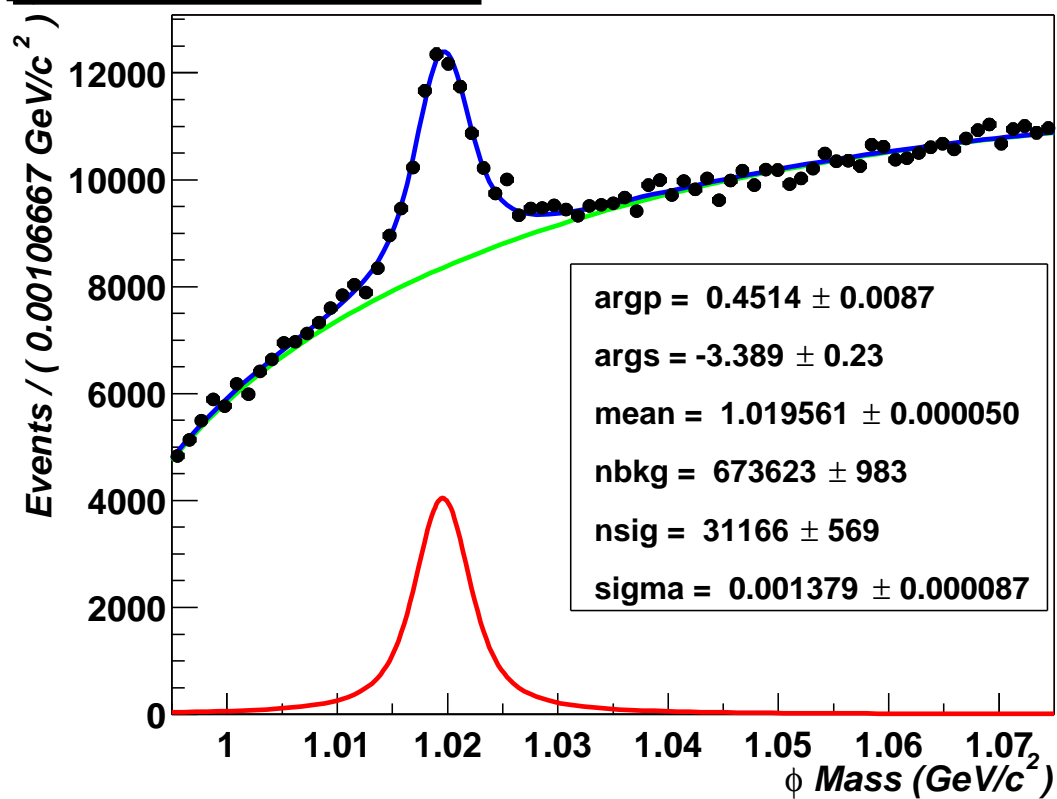
Our Sample of $B_s \rightarrow \phi\mu X\nu$ w/ opposite side μ

Use 5.3.1 version of [UniversalFinder](#) (available in [Sin2BetaMods](#) package) to strip a sample from 5.1.1f dimuon data ([xrar0c](#)).

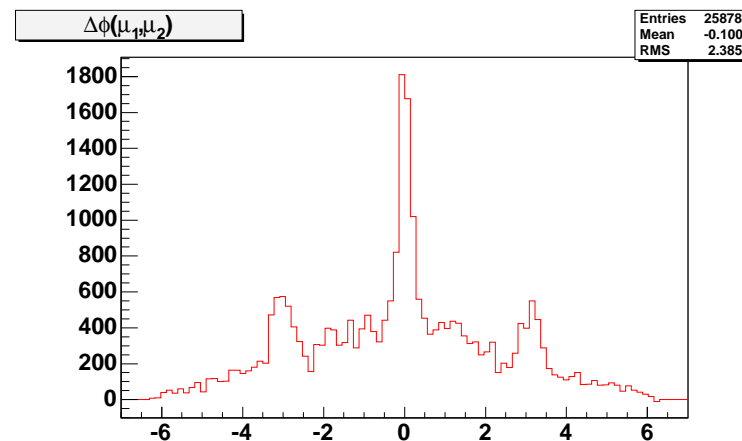
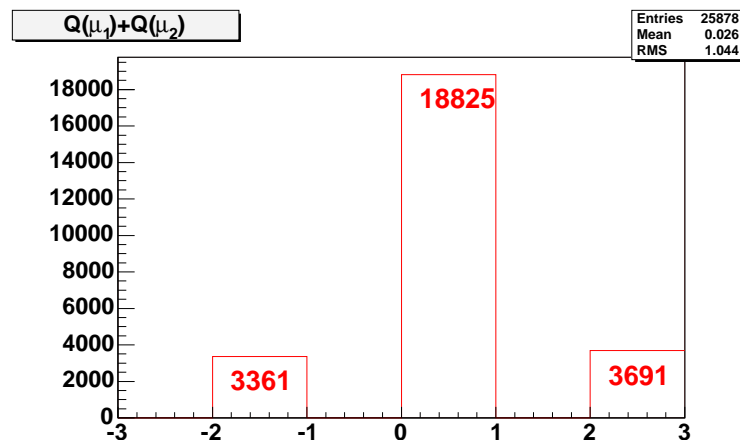
Particle	Run I	This Analysis
μ	$p_T > 2 \text{ GeV}$	$p_T > 1.3 \text{ GeV}$
K	$p_T > 1 \text{ GeV}$ $\Delta R(K, l) < 1$ $dE/dx: L(K_1, K_2) > 0.25$	$p_T > 1.3 \text{ GeV}$ not yet implemented not yet implemented
ϕ	$p_T > 2.7 \text{ GeV}$	$p_T > 2.7 \text{ GeV}$
$\phi\mu$	$2.0 < m_{\phi l} < 5.0$ $p_T(\phi l) > 5.0 \text{ GeV}$ $p_T^{rel} > 1.0 \text{ GeV}$	$2.0 < m_{\phi l} < 5.0$ $p_T(\phi l) > 5.0 \text{ GeV}$ not yet implemented
ϕh	$\Delta R(h, \phi l) < 1$ $1.0 < m_{\phi h} < 2.0$ $\text{Prob}(\chi^2) > 0.01$	not yet implemented not yet implemented not yet implemented
$\phi h \mu$	$m_{\phi h \mu} < 6 \text{ GeV}$ $\text{Prob}(\chi^2) > 0.01$	not yet implemented not yet implemented
$\mu\mu$	$\Delta R(l_{tag}, l) > 2$	$\Delta\phi(l_{tag}, \phi l) > 1.8$

Our ϕ Yield

$\phi \rightarrow K^+ K^-$ Mass



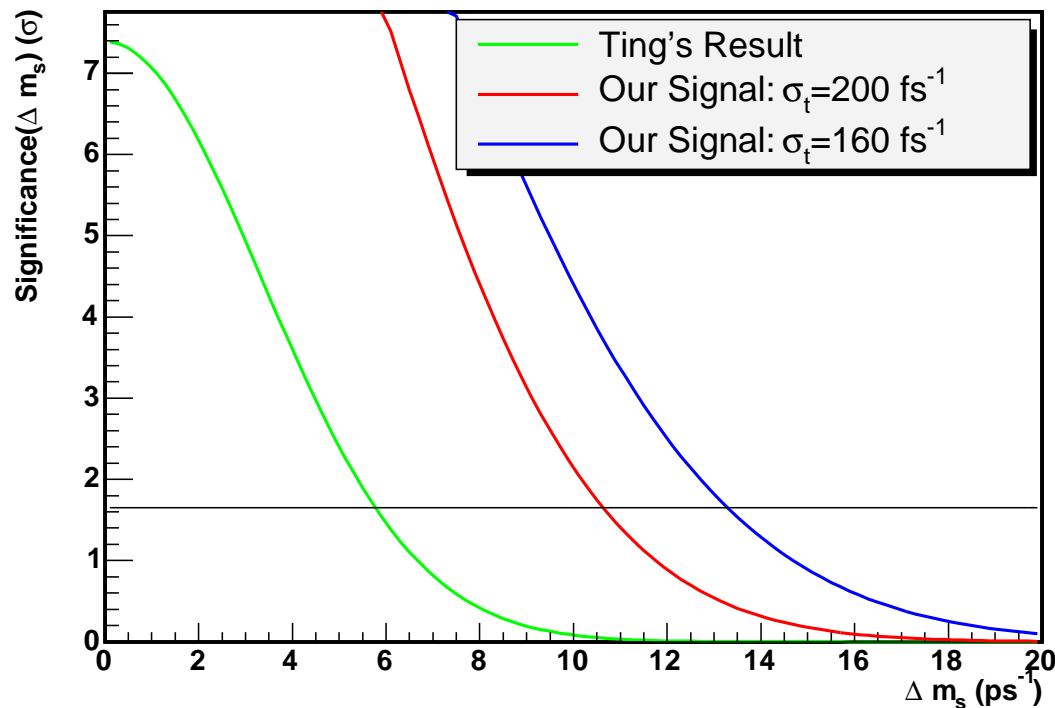
Signal Region: 1.014-1.026 GeV
 Low Sideband: 0.999-1.011 GeV
 High Sideband: 1.029-1.041 GeV
Yield: 26850 ϕ from B_s , B^0 , and B^+ .
 $S/B: \sim 25\%$



Possible Δm_s Sensitivity

	Ting	Us	Notes
ϵ	1	1	Thanks to the dimuon trigger.
D	0.52	0.52	Taken from Ting's Run I note (4485)
σ_t	300 fs^{-1}	$160, 200 \text{ fs}^{-1}$	Assumed an error for Ting's analysis. Our values were taken from Nuno's note (6811).
S	1068	16379	estimated with $f_{B_s} = 0.61$ from Ting's Note
B	1753	117872	Obtained from the S/B in our ϕ mass peak.

Projected Δm_s Sensitivity



Significance(Δm_s)

$$= \sqrt{\frac{S\epsilon D^2}{2}} \cdot e^{-\frac{1}{2}(\Delta m_s \sigma_t)^2} \cdot \sqrt{\frac{S}{S+B}}$$

Sensitivity to $\Delta m_s < 10 \text{ ps}^{-1}$

To Do List and Conclusions

The preliminary numbers indicate that the Run I technique may also be promising for us in Run II.

there is still much to do...

- Determine the missing parameters in our sensitivity estimate:
 ϵ , D , σ_t
- Improve our S/B. Big gains expected in dE/dx for example
- Use 5.3.3 with L00 and Primary Vertex
- Implement hadron track adding for D_s vertex.
- Sample composition study. The Run II sample composition will very likely be much different from Run I
- Generic semileptonic MC for K factor estimation.
- Use Ting's existing Run I fitter for Δm_s fit.