Exclusive Ds analysis

by C-J. Lin
SLD COLLABORATION MEETING

B_s MIXING USING FULLY RECONSTRUCTED D_s

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• D_s Selection ($\phi\pi \& K^*K$)
• B Decay length resolution $R_{15}$ vs. $R_{16}$
• Boost reconstruction
• More MC vs. data cross checks
• Amplitude fits.
MC74BB97-98R16B VS. REC97-98R16A DS→φπ MODE

CRID VETO

Phi mass (GeV) CRID Veto

Ds mass (GeV) CRID Veto

REC: \( \langle x \rangle = 1.966 \pm 0.007 \) GeV
\( \sigma = 0.038 \pm 0.013 \) GeV

MC: \( \langle x \rangle = 1.968 \pm 0.002 \) GeV
\( \sigma = 0.026 \pm 0.002 \) GeV

REC: \( \langle x \rangle = 1.966 \pm 0.002 \)
\( \sigma = 0.018 \pm 0.003 \)

REC: \( \langle x \rangle = 1.969 \pm 0.007 \)
\( \sigma = 0.015 \pm 0.007 \)
MC74BB97-98R16B VS. REC97-98R16A DS→K* K MODE

W/ ONLY 1 TAGGED KAON

W/ 2 KAONS

\[ \chi^2 = 1.964 \pm 0.004 \text{ GeV} \]
\[ \sigma = 0.028 \pm 0.005 \]

\[ \chi^2 = 1.968 \pm 0.001 \text{ GeV} \]
\[ \sigma = 0.022 \pm 0.001 \]
Helicity angles:

\[ \Theta \equiv \phi \text{ or } K^+ \text{ opening angle w.r.t. } D_s \text{ boost in } D_s \text{ c.m. frame.} \]

Signal \( \Rightarrow \cos \Theta \text{ isotropic} \)

Bkg. \( \Rightarrow \cos \Theta \text{ peaks at } \pm 1 \)

\[ \Phi \equiv K^+ \text{ opening angle w.r.t. } K^+ \text{ or } \phi \text{ boost in } \phi \text{ or } K^+ \text{ c.m. frame.} \]

Signal \( \Rightarrow \cos(\Phi) \propto \cos^2 \)

Bkg. \( \Rightarrow \cos(\Phi) \text{ is flat.} \)
R15 vs. R16 DECAY LENGTH RESIDUAL

R16B  \( \sigma_{\text{CORE}} = 46 \, \mu\text{m} \)  \( (60\%) \)
  \( \sigma_{\text{TAIL}} = 158 \, \mu\text{m} \)  \( (40\%) \)

R15  \( \sigma_{\text{CORE}} = 66 \, \mu\text{m} \)
  \( \sigma_{\text{TAIL}} = 183 \, \mu\text{m} \)

Bs Signal Events

Bs Decay Length Residual (cm)  Bs Signal Events  (\( \phi \pi \) MODE)
**B BOOST RECONSTRUCTION**

- Historically, mixing group relies on the BTBOOST routine to find the B energy. BTBOOST uses HAC to estimate the neutral energy of the B.

- D. Dong has developed a kinematic technique to estimate the neutral energy.

\[
\text{True missing mass is bounded between: } \\
0 \leq M^2 \leq M^2_{\text{max}} \\
\text{where, } \\
M^2_{\text{max}} = M^2_B - 2m_B (m^2_{ch} + p^2_{\mu}) + m^2_{ch}
\]

![Figure 2: Correlation between the maximum missing mass (see text) and the true missing mass in Monte Carlo simulated } B^0 \text{ and } B^0 \rightarrow J/\psi \rightarrow \mu^+ \mu^- \text{ decays.}

- To get the optimal resolution, we calculate the weighted average:

\[
(\Delta \beta \delta)^{\text{weighted}} = \frac{\sum \frac{1}{\sigma^2} (\Delta \beta \delta)^2}{\sum \frac{1}{\sigma^2}}, \quad \text{where } \sum \frac{1}{\sigma^2} \approx \text{BTBOOST}
\]
PARAMETERIZE THE ERROR OF M_{\text{MOMAX}} ALGORITHM
IN TERMS OF MAXIMUM MISSING MASS

MC96-98bb Boost Resolution Parameterization

Rel Boost Resid (M0MAX2 bin0)

Rel Boost Resid (M0MAX2 bin1)

Rel Boost Resid (M0MAX2 bin2)

Rel Boost Resid (M0MAX2 bin3)

\[ \psi = 0.12 \pm 0.0187 \times (M_{\text{MOMAX}}^2) \]
PARAMETERIZE THE ERROR OF BTBOOST ALGORITHM IN TERMS OF VISIBLE (CHARGED) ENERGY

Boost Residual in E(charged) Bins (BTBOOST Algorithm)

E(charged) < 15 GeV

15 < E(CHARGED) < 20

20 < E(CHARGED) < 25

Single gaussian fits

25 < E(CHARGED) < 30

E(charged) < 30 GeV

\[ O_{\beta\gamma} = 0.1414 + 0.015 \times (E_{\text{ch} \beta}) + 0.00016 \times (E_{\text{ch} \beta})^2 \]
**MCBB97-98R16B BOOST RECONSTRUCTION**

- **BTBOOST+M0MAX**
  - $\sigma_{\beta_Y \text{ CORE}} = 10.5\%$
  - $\sigma_{\beta_Y \text{ TAIL}} = 21.4\%$

- **BTBOOST ONLY**
  - $\sigma_{\beta_Y \text{ CORE}} = 10.0\%$
  - $\sigma_{\beta_Y \text{ TAIL}} = 31.0\%$

**Relative Boost Residual (Bs Events)**

428
MC74BB97-98R16B VS. REC97-98V16A Rec. B Proper Time Distribution

Proper time (psec) Phi Pi mode

Proper time (psec) K* K mode

Combined

Proper time (psec) Combined

429
MC74BB97-98R16B VS. REC97-98V16A Bs Plots

B Boost

B Decay Length Error (cm)

Number of B tracks (include Ds tracks)
MC74BB97-98R16B VS. REC97-98V16A Rec. B Vtx Charge Distribution

B Vertex Charge (phi pi)

B Vertex Charge (K* K)

B Vertex Charge (combined)

Neutral B
Charged B

ID: 120
Entries: 239
Mean: 0.1339
RMS: 1.210
M.C. AMPLITUDE FIT TESTS

MC74bb97-98R16B AMPLITUDE FITS (φπ + K⁺ K⁻ MODES)

Delta Ms (psec⁻¹)

- ΔMs = 8 psec⁻¹

- ΔMs = 10 psec⁻¹

432
RECON-98R16A Data (Φπ + K⁺K⁻ Mode)

45 events

102 events

RECON-98R16A Reconstructed Events (Φπ⁺K⁺K⁻) FULL NORM

<table>
<thead>
<tr>
<th>ID</th>
<th>25</th>
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<tbody>
<tr>
<td>Entries</td>
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<tr>
<td>Mean</td>
<td>9.995</td>
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<tr>
<td>RMS</td>
<td>5.918</td>
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Sensitivity @ 95% C.L. = 0.5 psec⁻¹

Excluded region @ 95% C.L.:

~ 1.5 psec⁻¹ < ΔM₅ < 4.0 psec⁻¹
TO DO LIST:

FOR THE SUMMER CONFERENCES

- Estimate the systematic errors.
- Improve the stability of the amplitude fit.
- More MC/Data cross checks.

FUTURE IMPROVEMENTS

- Optimize D_s selection cuts for R_{K}\ell.
- Improve B tagging efficiency.
- Study additional D_s decay modes
  \[ D_s^+ \rightarrow \phi \pi^+ \pi^- \pi^+ \]
  \[ \rightarrow K^0 K^{*+} \]
  \[ \rightarrow \phi \ell^+ \nu_\ell \]
  etc...
- Likelihood parameterizations
  - \( Q_\ell \) decay by decay
  - mdsc background