Ab with vertex-charge

by G. Crawford
**Analysis Summary:**

- Require one vertex with $M_1 > M_{tag} \in [1.6, 2.5]$ 

**new**
- **Require:** There is a 2nd vtx such that $Q_{2} > 0$, $M_2 > M_{opp}$ 

- Sign thrust axis from $Q_{v_1} - Q_{v_2}$
  
  [If $\text{sign}(Q_{v_1}) = \text{sign}(Q_{v_2})$, weight = 0]

**new**
- Overall scale of $\langle AP \rangle$ from "binary calibration";
  
  for given $[M_{tag}, M_{opp}]$ count:

  $$- + \} \ vs. \ \{ + + \ \Rightarrow \ \langle AP \rangle_{\text{new}}$$

  magnitude of $(Q_{1}, Q_{2})$ doesn't matter...only sign.

**new**
- Shape of $Pcorr(M)$ from MC truth

**NO:**

- Dependence
- Light flavor correl
- Explicit correlations (?)
Matching parts

Mark highlighted fit to assemblies using self-collimated

- require \( \frac{\alpha}{\gamma} \leq 5 \times 10^{-6} \) to tag separately

- re-tuned track selection for the electromagnetic (en)

- standard knock-out and selection (eseel)

- standard quality track cuts (exx) etc.

- use "default" Ris track eff. carvings

  \[ (\quad)^{\text{nobsd}} \]

  \[ \text{mc: 97-8 K16 66 (out full set)} \]

  \[ \text{data: 97-8 K16 (Pass 1), less 1/20 (cranes)} \]

[Data + Event Selection]
Correct Sign Prob. vs. (Mass, $\cos\Theta$)

$97 \pm 66 \text{ MC}$

$P_{\text{corr}}(\text{BM})$ vs. $P_{\text{corr}}(\text{BM})$

$V_{\text{tx Mass}} (\text{GeV/c}^2)$

$V_{\text{tx Mass}} (\text{GeV/c}^2)$

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$\tilde{\nu}_6$ MC vs. DATA

$\nu \bar{\nu} \Rightarrow \text{correlation}$

**Top Panel:**
- DATA
- $\pi$ MC
- Tag Vtx

**Bottom Panel:**
- Opp Vtx

MC Qual Trks in Tag Vtx

MC Qual Trks in Opp Vtx

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Eff. Corr’ngs (from R15) - close to "right."  
...could use a bit more.

Will use corrected MC as "default."  
... but...
MC Mass of Tag Vtx

MC Mass of Opp Vtx

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Self-Calibration vs. Mass

$\mathbf{P_{\text{Self,1 vtx}}}$

Chg Mass (GeV/c$^2$)

$\mathbf{P_{\text{Self,2 vtx}}}$

Tag Mass (GeV/c$^2$)

$0 \pm \sqrt{-1} \times x$

$\pm 2 \times \sqrt{x}$
R15 vs. R16

- R16 has better vertexing efficiency, mainly at low DL
- Some evidence for lower charge purity at short DL ($\leq 1$ mm; at long DL ($\geq 5$ mm), R16 slightly better on average, $<P_{corr}>$ same for R15/R16
- Can we do better? — revisit track attachment.

- Yes, but not much. $<P_{corr}> \uparrow 1\%$ (absolute)

- Cuts for "improved" track attachment:
  - iff track is in 2nd ZVTOP sec. vtx: $B3NORM \geq 4$
  - all others: $L > 800\ \mu\text{m}$
    - $L/\sigma_{L} > 0.3$
    - OR
    - $L/\sigma_{L} > 15 + [-15 + (L/\sigma_{L}/0.3)]$ and $B3NORM \geq 3$

- Other prospects?
  - Improved Chg. Dipole
  - Ghost Track

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2 cm #16 $b\bar{b}$ MC
w/new trk. attachment

$\rho_c$ $0.8$
$T_d$ $0.78$
$8$
$0.76$
$B$ $\beta$ $0.74$
$8$
$0.72$
$0.7$
$c$ $0.9$
$P_{corr,b}(M)dM$

$0.8$
$0.78$
$0.76$
$0.74$
$0.72$
$0.7$
$0.65$
$0.6$
$0.55$
$0.5$
$0.45$
$0.5$
$0.75$
$0$
$0.1$
$0.2$
$0.3$
$0.4$
$0.5$
$0.6$
$0.7$

$\cos\Theta$

$0.95$
$0.85$
$0.75$
$0.65$
$0.55$
$0.45$
$0.35$
$0.25$
$0.15$
$0.05$
$0.05$
$0.1$
$0.15$
$0.2$
$0.25$
$0.3$
$0.35$
$0.4$
$0.45$
$0.5$

Vertex Decay Length (cm)

$<P_{corr}> vs. \text{Decay Length}: \langle \eta \rangle$

<table>
<thead>
<tr>
<th></th>
<th>all DL</th>
<th>DL$&gt;1$ mm</th>
<th>DL$&gt;5$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>This fit</td>
<td>74.5±0.3</td>
<td>75.1±0.3</td>
<td>75.8±0.6</td>
</tr>
<tr>
<td>&quot;standard&quot; R16</td>
<td>73.4±0.3</td>
<td>73.9±0.3</td>
<td>74.5±0.6</td>
</tr>
<tr>
<td>R15</td>
<td>73.6±0.2</td>
<td>73.7±0.2</td>
<td>73.8±0.4</td>
</tr>
</tbody>
</table>

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Self-Cal. vs. Mass (large range)

Chg Mass (GeV/c^2)

Tag Mass (GeV/c^2)
Chg Mass (GeV/c²) vs Tag Mass (GeV/c²)
R16 97-98 DATA selfcal

SM prediction

Vtx Chg Asym $A_b$ vs. mass cut

$p_{\text{correct}}$ vs. mass cut

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$A_b$ vs. mass cut

Vtx Chg Asym $A_b$ vs. mass cut

$\langle p_{\text{correct}} \rangle$ vs. mass cut

97-98 MC bb true

SM prediction

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R16 97–98 MC bb self-cal

SM prediction

Vtx Chg Asym $A_b$ vs. mass cut

$\langle p_{\text{correct}} \rangle$ vs. mass cut

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R16 97–98 DATA selfcal

SM prediction

Vtx Chg Asym $A_b$ vs. mass cut

$\langle p_{\text{correct}} \rangle$ vs. mass cut

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Vtx Chg $P_{\text{correct}}$, R16 97/98 Data/MC

Data / corr pc Orr self

bb MC pc Orr true

Data / bb MC true ratio
Vtx Raw Asym, R16 97/98 Data/R15 MC

\[ A_{\text{raw}}^{\text{L2Fe}} = 0.418 \pm 0.015 \]

\[ A_{\text{raw}} = 0.609 \pm 0.009 \]

\( (P_e = 100\%) \)
<table>
<thead>
<tr>
<th></th>
<th>MC66 true</th>
<th>MC66 self</th>
<th>MC allflav true</th>
<th>MC allflav self</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pcorr (0±)</td>
<td>72±72.9±0.3</td>
<td>73.1±0.6</td>
<td>—</td>
<td>73.6±1.1</td>
<td>75.4±1.1</td>
</tr>
<tr>
<td>Pcorr (±5)</td>
<td>84.8±0.3</td>
<td>84.3±0.9</td>
<td>—</td>
<td>84.8±1.5</td>
<td>86.9±1.3</td>
</tr>
</tbody>
</table>

| LRFB (uncorrected) | 0.464±0.009 | 0.439±0.015 | 0.461±0.020 |
| A_{b, raw} (fit)   | 0.926±0.012  | 0.930±0.012 | 0.913±0.022   | 0.901±0.022   | 0.873±0.030 |

includes

- light-flavor corr'ns
- QCD corr'ns (as per Victor)
-  & corr'ns (for MC)

does not include

- cosθ corr'n (assumed flat)
- gluon splitting corr'n (α + 0.004)
<table>
<thead>
<tr>
<th>Source</th>
<th>Variation</th>
<th>$\delta A_{12}/A_{10}$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Cal State</td>
<td>$\pm 10$</td>
<td>$+3.7 \pm 3.4$ **</td>
</tr>
<tr>
<td>$\cos\theta$ shape</td>
<td>MC vs. flat</td>
<td>$\pm 0.6$</td>
</tr>
<tr>
<td>Light flavor corr'n</td>
<td>$\pm 50%$ of corr'n</td>
<td>$&lt; 0.1$</td>
</tr>
<tr>
<td>Tag purity</td>
<td>$\alpha \pm \delta \alpha$</td>
<td>$\pm 0.1$</td>
</tr>
<tr>
<td>Detector effects:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP $\pi$ smear</td>
<td>ON/OFF</td>
<td>$\pm 0.1$</td>
</tr>
<tr>
<td>track corr'n</td>
<td>$\pm 50%$ of corr'n</td>
<td>$\pm 0.5$</td>
</tr>
<tr>
<td>Beam Pol.</td>
<td>$\delta P_e / P_e$</td>
<td>$\pm 0.5$</td>
</tr>
<tr>
<td>QCD</td>
<td>$\pm 50%$ of corr'n</td>
<td>$\pm 0.4$</td>
</tr>
<tr>
<td>Gluon splitting</td>
<td>as per Victor</td>
<td>$\pm 0.2$</td>
</tr>
<tr>
<td>BNV Asymmetry</td>
<td>$A_c = 0.67 \pm 0.05$</td>
<td>$\pm 0.1$</td>
</tr>
<tr>
<td>Mass dependence of Pcorr</td>
<td>$[M_{tag} \pm 0.5]$</td>
<td>$\pm 2.1$</td>
</tr>
</tbody>
</table>

Net: $+4.3 \pm 4.2$
Vtx-Chg. Summary

- 1st pass analysis vcomplete
  - MC bb, udscb give "right" answer (no bias)
  - MC self-cal matches MC truth (≤ 1%)

- Some evidence for mass-dependence in DATA
  - does not appear to be due to DATA/MC mismatch
  - fluctuations?
  - mass correlated w/ something else?
  - will take largish systematic error for now

- Result (~90% R16): \( A_b = 0.873 \pm 0.030 \pm 0.038 \pm 0.034 \)

To Do:

- a few more x-checks of data
- jet-change correlations
- write?
  - ... ready by July 2nd week.