Measurement of $A_{FB}^{b\bar{b}}$ using $K^{\pm}$ for $b/\bar{b}$ separation

Delphi

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STATUS REPORT

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Introduction

- Aim: Measuring $A_{FB}^{b\bar{b}}$ using charged kaons

For $b\bar{b}$ events:

$$N_K^-(\vartheta) = c_b^-(\vartheta)\, N_b(\vartheta) + w_b^-(\vartheta)\, N_{\bar{b}}(\vartheta)$$

$$N_K^+(\vartheta) = w_b^+(\vartheta)\, N_b(\vartheta) + c_b^+(\vartheta)\, N_{\bar{b}}(\vartheta)$$

$c_b^\pm (w_b^\pm)$ (Efficiencies for getting kaons with correct(wrong) charge from b quarks) include:

- probability for correct(wrong) charge sign - together with mixing
- detection efficiency
- charge (material) asymmetry

Measured asymmetry:

$$A_K(\vartheta) = \frac{N_{K^-}(\vartheta) - N_{K^+}(\vartheta)}{N_{K^-}(\vartheta) + N_{K^+}(\vartheta)}$$

is then connected to the forward-backward asymmetry as:

$$\boxed{A_K(\vartheta) \approx \frac{c_b - w_b}{c_b + w_b} \frac{8}{3} A_{FB}^{b\bar{b}} \frac{\cos\vartheta}{1+\cos^2\vartheta} - \frac{\delta}{2}\,,}$$

where coefficients are:

$$\frac{c_b - w_b}{c_b + w_b} = \frac{[c^-(\vartheta) + c^+(\vartheta)] - [w^-(\vartheta) + w^+(\vartheta)]}{[c^-(\vartheta) + c^+(\vartheta)] + [w^-(\vartheta) + w^+(\vartheta)]}$$

$$\frac{\delta}{2} = \frac{[c^+(\vartheta) + w^+(\vartheta)] - [c^-(\vartheta) + w^-(\vartheta)]}{[c^+(\vartheta) + w^+(\vartheta)] + [c^-(\vartheta) + w^-(\vartheta)]}\,.$$

Double tag

- Aim: Measuring coefficient $\frac{c_{\rm b}-w_{\rm b}}{c_{\rm b}+w_{\rm b}}$ from real data using double tag For $\rm b\overline{b}$ events:

$$N^{++}(\vartheta) = c_{\rm b}^{+}(\vartheta+\pi)w_{\rm b}^{+}(\vartheta)\,N_{\rm b}(\vartheta) + w_{\rm b}^{+}(\vartheta+\pi)c_{\overline{\rm b}}^{+}(\vartheta)\,N_{\overline{\rm b}}(\vartheta)$$
$$N^{--}(\vartheta) = w_{\rm b}^{-}(\vartheta+\pi)c_{\rm b}^{-}(\vartheta)\,N_{\rm b}(\vartheta) + c_{\rm b}^{-}(\vartheta+\pi)w_{\overline{\rm b}}^{-}(\vartheta)\,N_{\overline{\rm b}}(\vartheta)$$
$$N^{-+}(\vartheta) = w_{\rm b}^{-}(\vartheta+\pi)w_{\rm b}^{+}(\vartheta)\,N_{\rm b}(\vartheta) + c_{\rm b}^{-}(\vartheta+\pi)c_{\overline{\rm b}}^{+}(\vartheta)\,N_{\overline{\rm b}}(\vartheta)$$
$$N^{+-}(\vartheta) = c_{\rm b}^{+}(\vartheta+\pi)c_{\rm b}^{-}(\vartheta)\,N_{\rm b}(\vartheta) + w_{\rm b}^{+}(\vartheta+\pi)w_{\overline{\rm b}}^{-}(\vartheta)\,N_{\overline{\rm b}}(\vartheta)$$

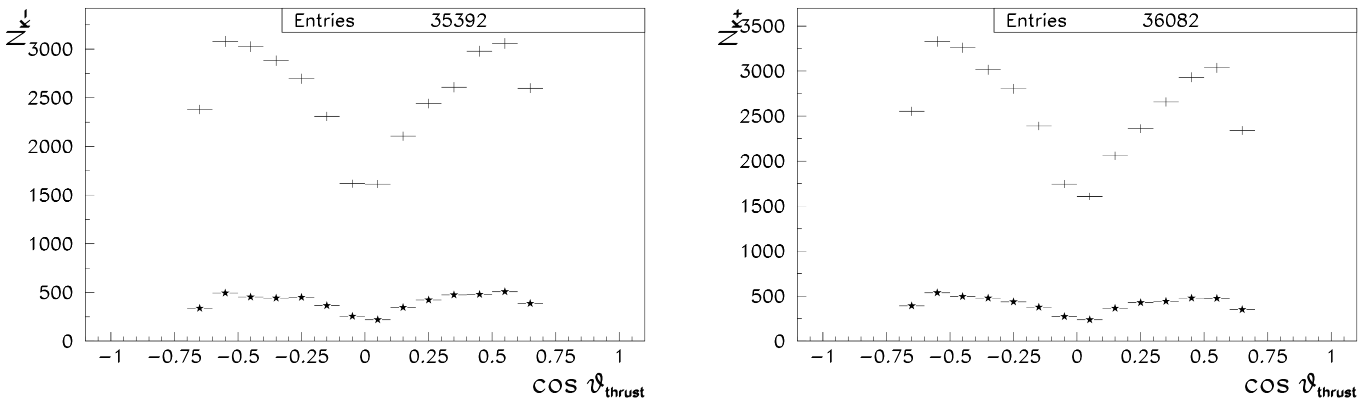
We connect coefficients $(c_{\rm b}^{+}(\vartheta+\pi)c_{\rm b}^{-}(\vartheta) = c_{\rm b}^{-}(\vartheta+\pi)c_{\rm b}^{+}(\vartheta)$, etc.) and define combinations:

$$N^{opp}(\vartheta) = N^{-+}(\vartheta) + N^{+-}(\vartheta)$$
$$N^{like}(\vartheta) = N^{--}(\vartheta) + N^{++}(\vartheta)$$

and calculate the ratio: $\boxed{\frac{N^{opp}(\vartheta)-N^{like}(\vartheta)}{N^{opp}(\vartheta)+N^{like}(\vartheta)} = \left(\frac{c_{\rm b}-w_{\rm b}}{c_{\rm b}+w_{\rm b}}\right)^2,}$ where we omitted terms of the second order in material asymmetry.

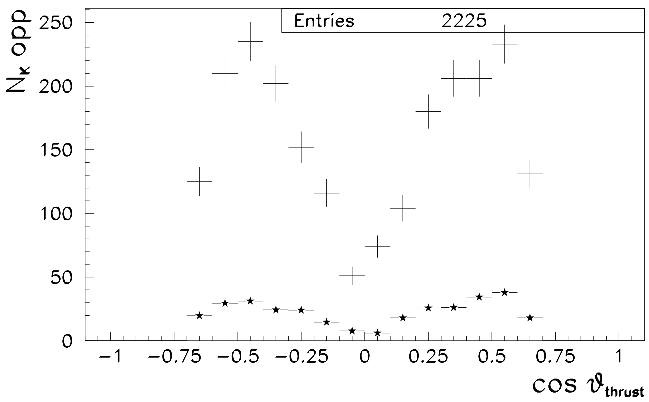
Measurement

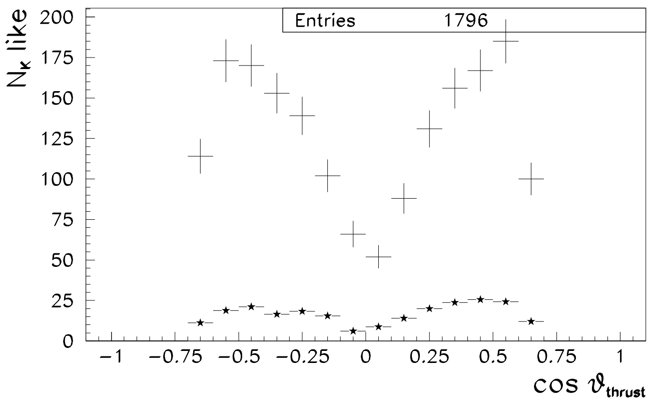
- Event selection:
  - Multihadronic Z^0 decays
  - $b\bar{b}$ events are selected with b-tagging ($(\log_{10} P_b)_{max} = -2.525$)
  - Charged kaons are identified with B-RICH (liquid and gaseous radiator)
  - $p_K > 2.5$ GeV/c
  - $K^{\pm}$ from the decays of B hadrons are selected according to the B-SAURUS neural network output - one kaon per event
  - Non-$b\bar{b}$ contribution was subtracted using MC 1994 C2($1.5 \cdot 10^6$)
- Real data: 94 multihadronics $\approx 1.5 \cdot 10^6$ events ($\sim$ half of the statistics) After all the selection criteria $\sim$72000 events remained.



- Double tag event selection:
  - Same selection criteria for events and charged kaons
  - One selected kaon per hemisphere is allowed
  - Non-$b\overline{b}$ contribution was subtracted using the same MC sample

After all the selection criteria $\sim$4000 events remained.

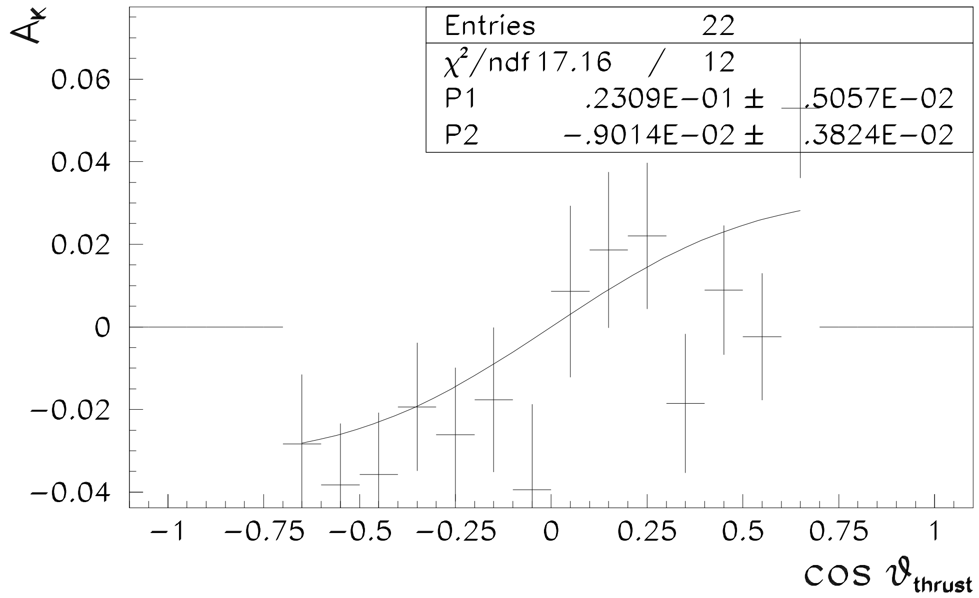




$$\frac{N^{opp}(\vartheta) - N^{like}(\vartheta)}{N^{opp}(\vartheta) + N^{like}(\vartheta)} = \left(\frac{c_{\mathrm{b}} - w_{\mathrm{b}}}{c_{\mathrm{b}} + w_{\mathrm{b}}}\right)^2 ,$$

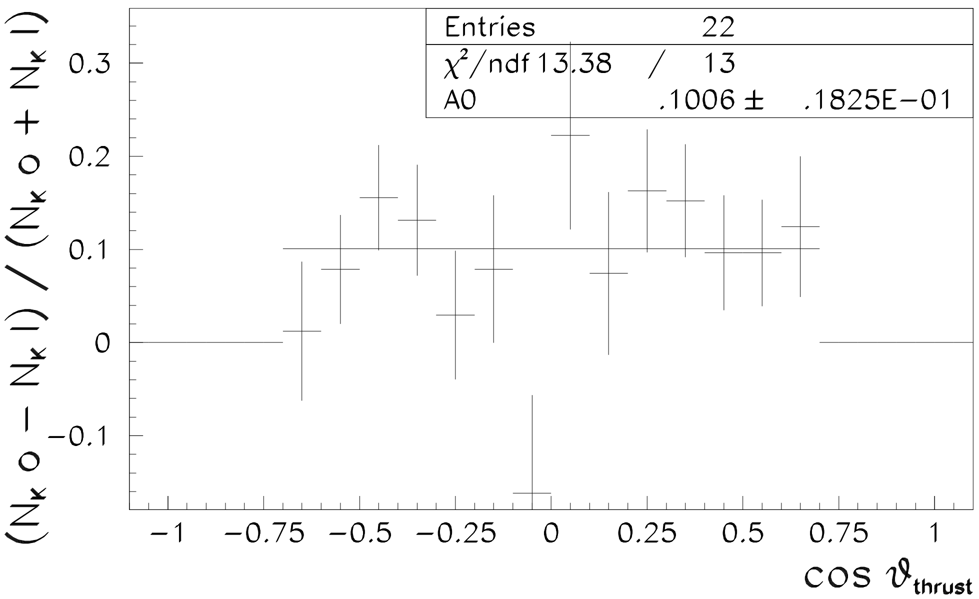
Results

- Fitted asymmetry looks like:



Material asymmetry was left as a free (constant) parameter of the fit.

- Coefficient was determined from the histogram:



$\rightarrow (c_{\mathrm{b}} - w_{\mathrm{b}})/(c_{\mathrm{b}} - w_{\mathrm{b}}) = 0.317 \pm 0.029$

- Measured value for the asymmetry is then:

$$\boxed{A_{FB}^{\mathrm{b}\bar{\mathrm{b}}} = 0.073 \pm 0.017}$$

Comments

- Previous result was obatined by evaluation of coefficients c and w from MC.
- First result of the analysis with double tag. Further analysis is in progress.
- Another method will be used for coefficient measurement (lepton-kaon tag) and result will be compared.