Two fermion $b\bar{b}$ and $c\bar{c}$ production at LEP2

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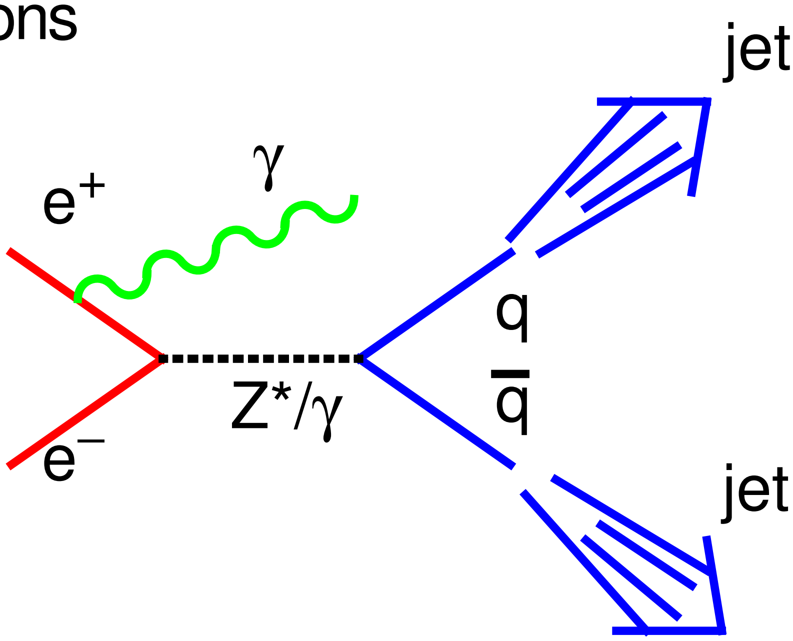
Cross-sections, $A_{FB}^{b\bar{b}}$, and $A_{FB}^{c\bar{c}}$ measurements

- Definitions and SM predictions
- Measurements
- Interpretations



Abstracts from ALEPH, DELPHI, OPAL:
#906, #439, #338, #264, #268

Definitions and SM predictions

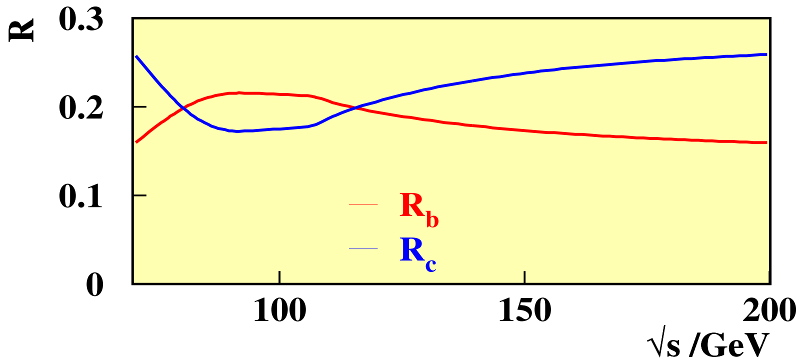
Q quark production: $R_Q = \dfrac{\sigma(Q\bar{Q})}{\sigma(had)}$ or $\sigma(Q\bar{Q})$

Angular distribution of production: $A_{FB} = \dfrac{N_F - N_B}{N_F + N_B}$

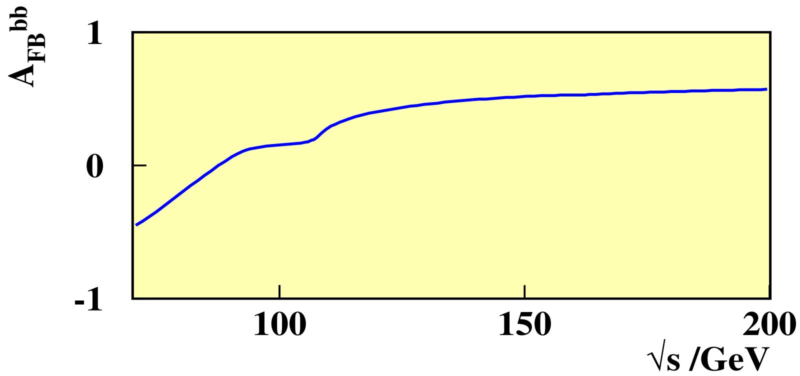
Above the Z^0

R_b down

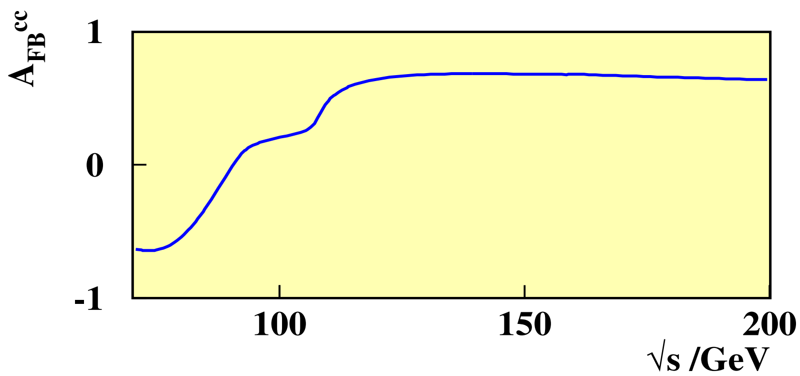
R_c up

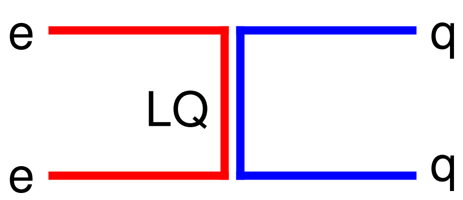


$A_{FB}^{b\bar{b}}$ up



$A_{FB}^{c\bar{c}}$ up





Possible non-SM effects

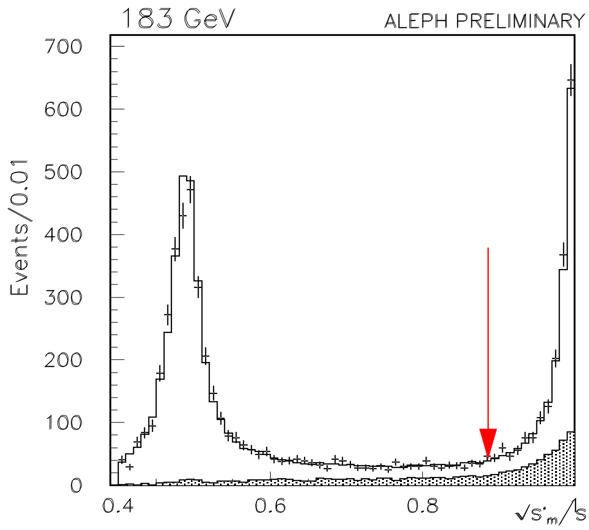
from eg. t-channel LQ / RPV $\tilde{q}$.

Non-radiative hadronic selection

The LEP2 data analysed

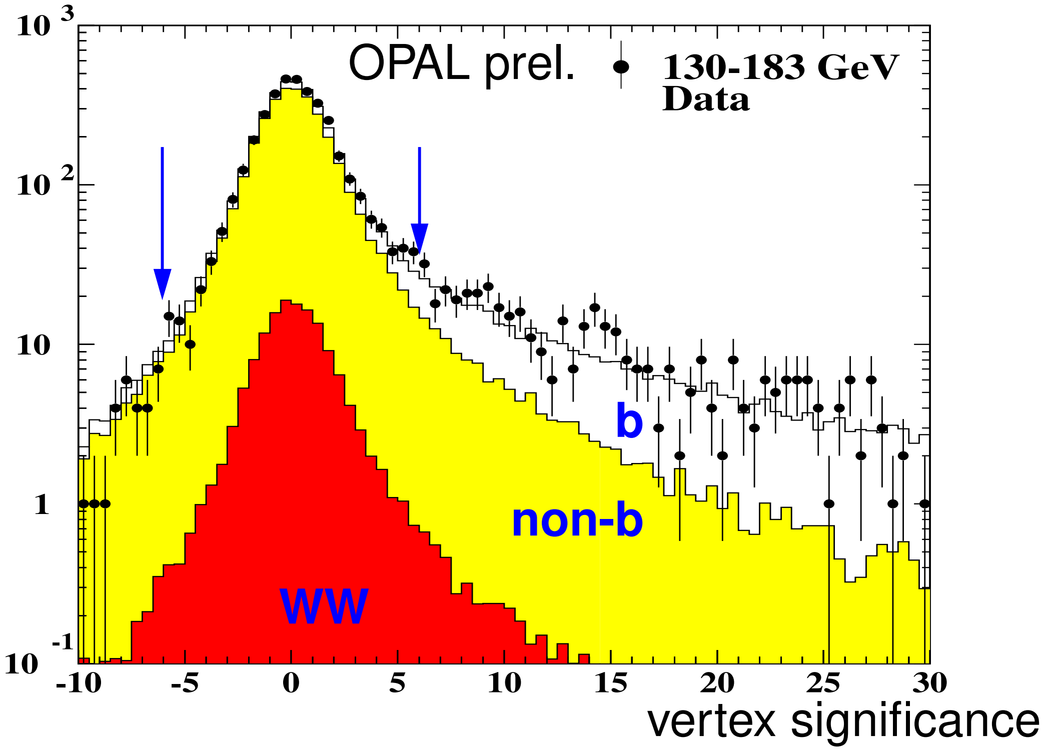
energy $\sqrt{s}$ GeV	130	136	161	172	183
$\int L dt$ pb^{-1}/expt	5	5	10	10	56

- Remove ISR events
  $\sqrt{\frac{s'}{s}}$ >0.85 (DELPHI/OPAL)
  >0.9 (ALEPH)
- Remove WW bkgd
- ε=90%, Π=90%



R_b measurements

ALEPH, DELPHI, OPAL lifetime tag b events.



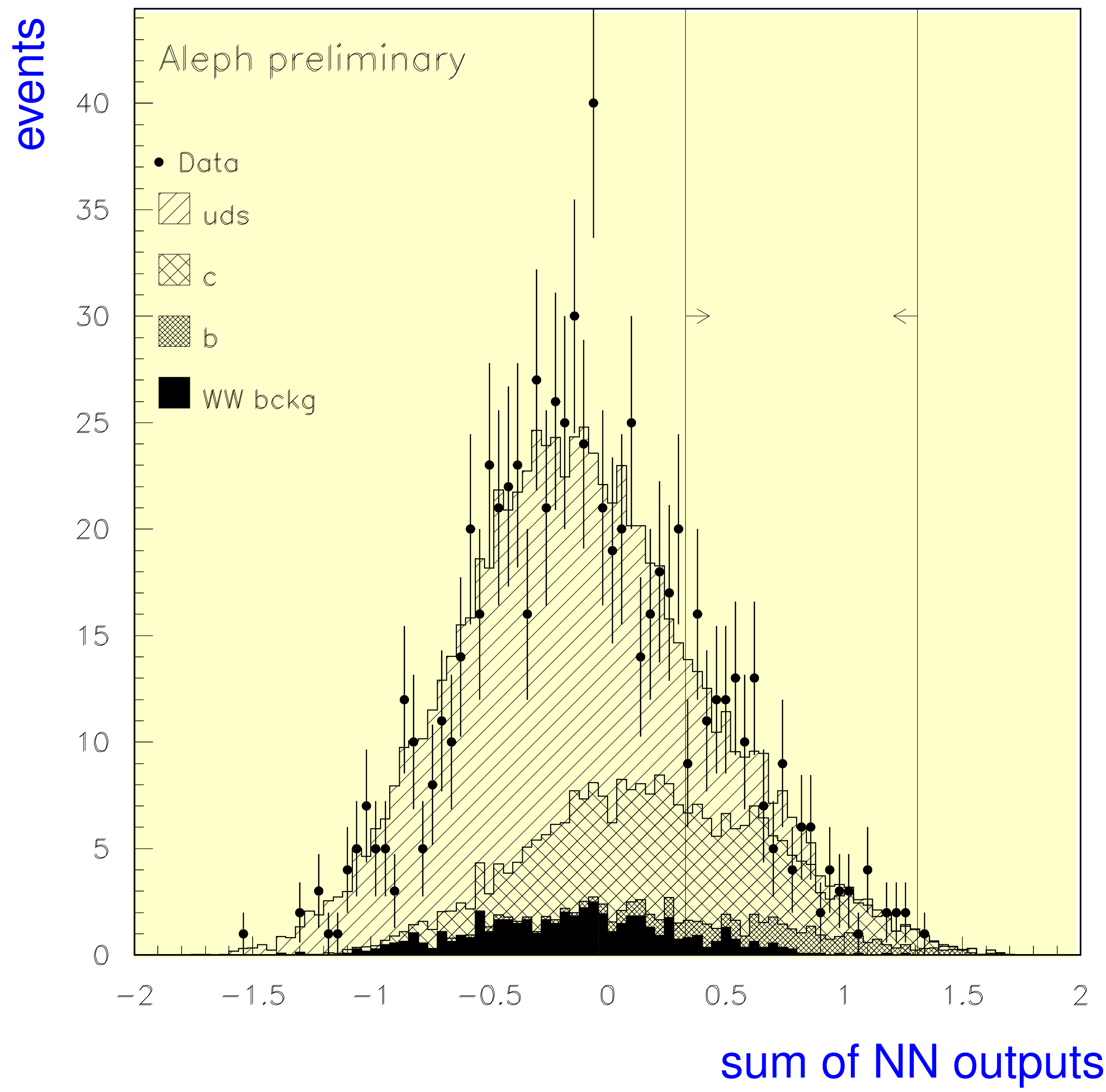
R_c measurements

Count tagged event ⇨ $\sigma(c\bar{c})$

c quark evt tagging:

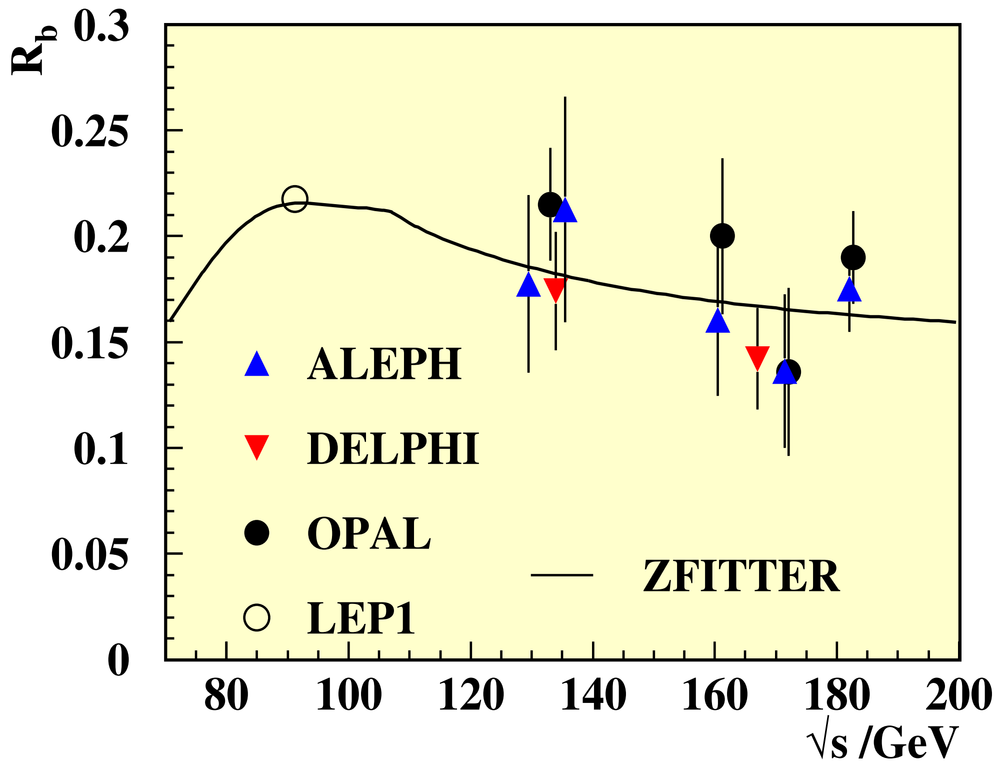
DELPHI: lifetime info. Also get light sample.
43% purity,35% efficiency

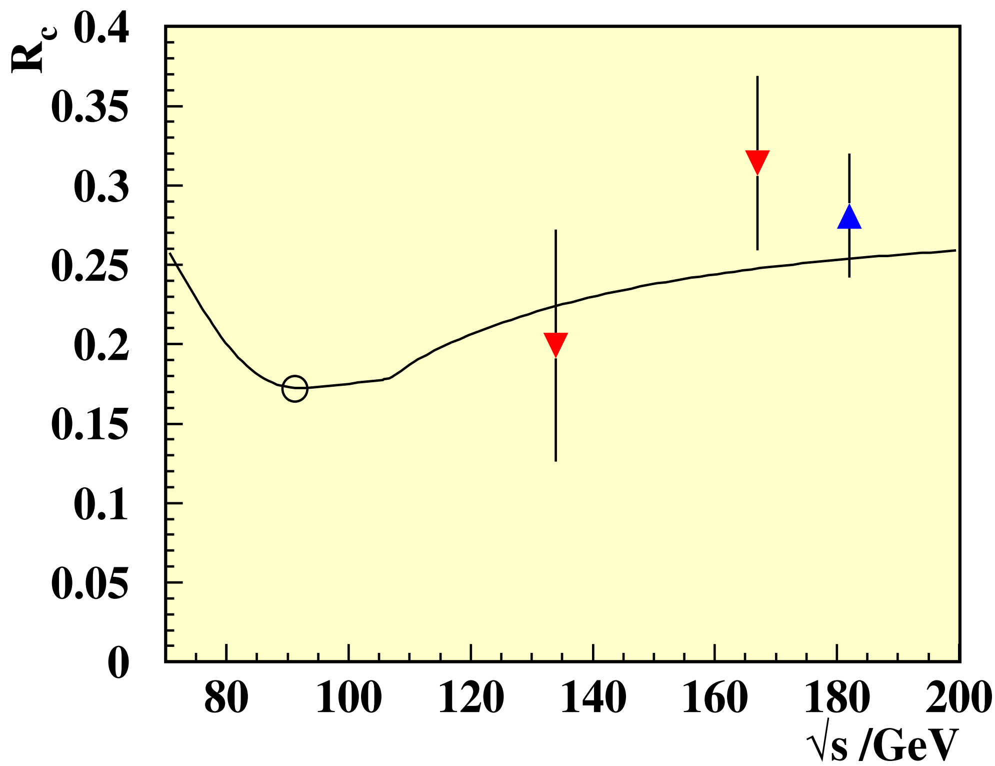
ALEPH: b veto then 12 variable ANN using
lepton, slow pion, D meson information
52% purity, 22% efficiency.



R_b and R_c results

ALEPH quote $\sigma(b\bar{b})$, $\sigma(c\bar{c})$ ➪ convert to R_b, R_c for comparison with DELPHI and OPAL.



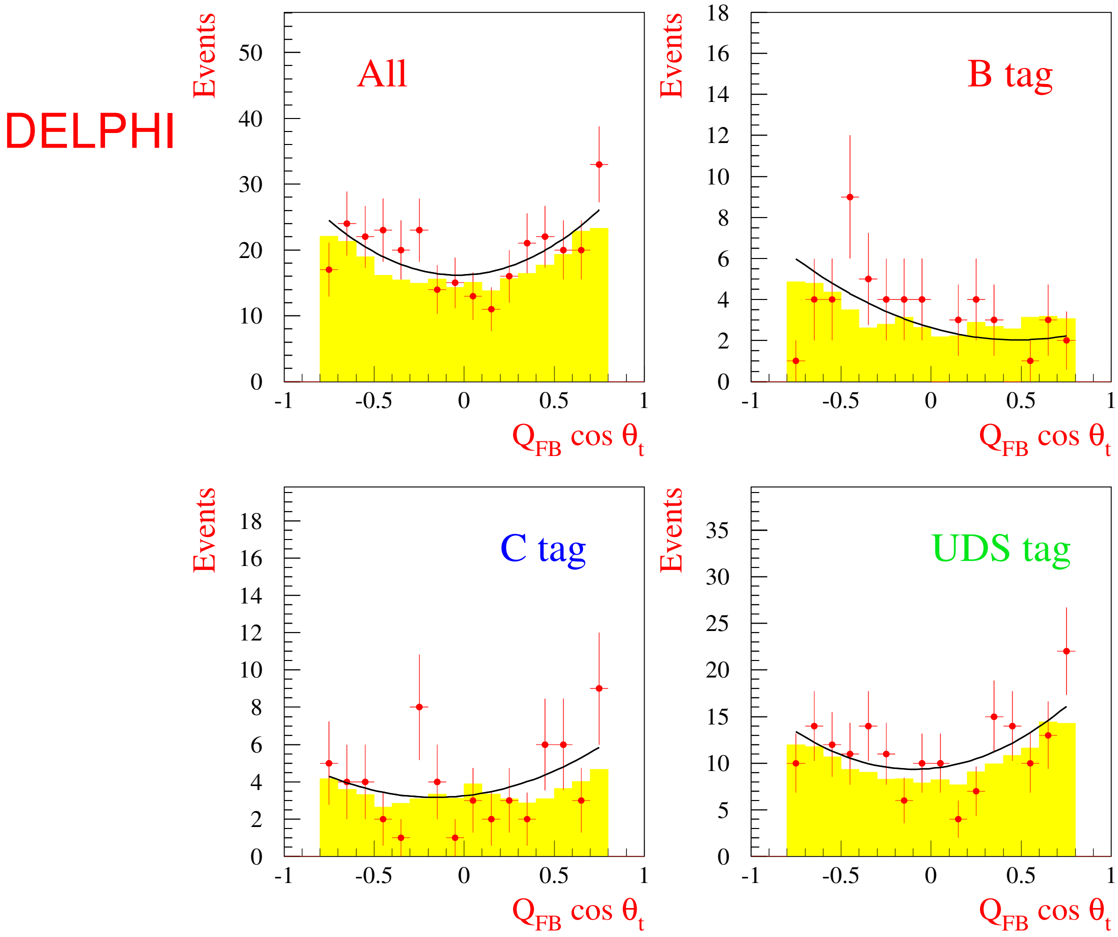


Asymmetry measurements: Q_{jet}

ALEPH, DELPHI, OPAL use Q_{jet} in forward (backward) thrust hemisphere. Q_f (Q_b).

Define $Q_{fb}=Q_f-Q_b$

- DELPHI: fit angular distr. using $|Q_{fb}|>0.2$ events.



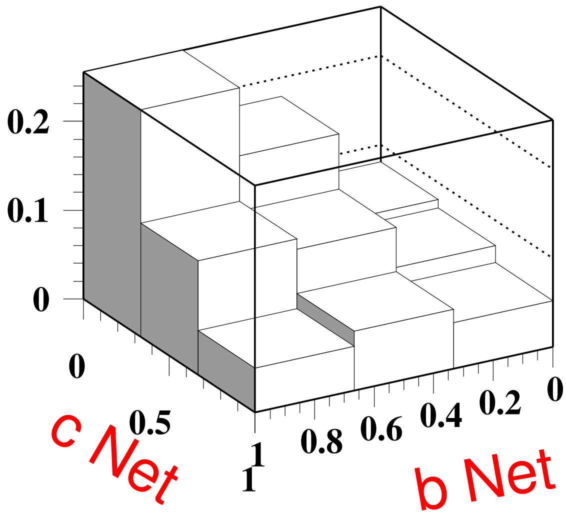
- ALEPH: measure Q_{fb} in b/anti-b-tagged sample. consistent with SM, no explicit $A_{FB}^{b\bar{b}}$ value.

- OPAL: count $\frac{N_F-N_B}{N_F+N_B}$ with *sign*$\{Q_{fb}\}$.

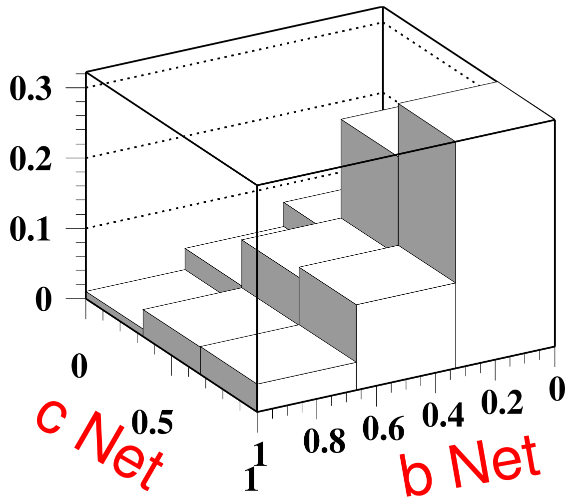
Asymmetry measurements: lepton

- OPAL: lepton tag with 2 ANNs to find source.

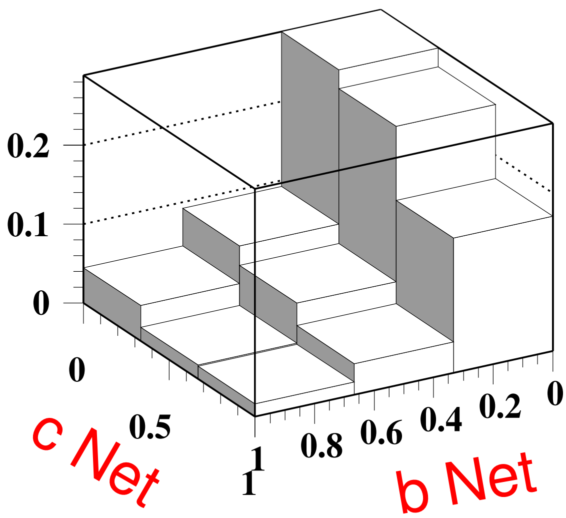
$b \to l$



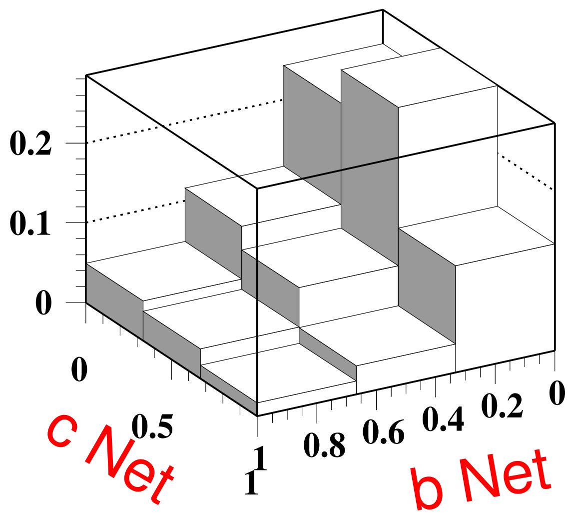
$c \to l$



$b \to c,\bar{c} \to l$



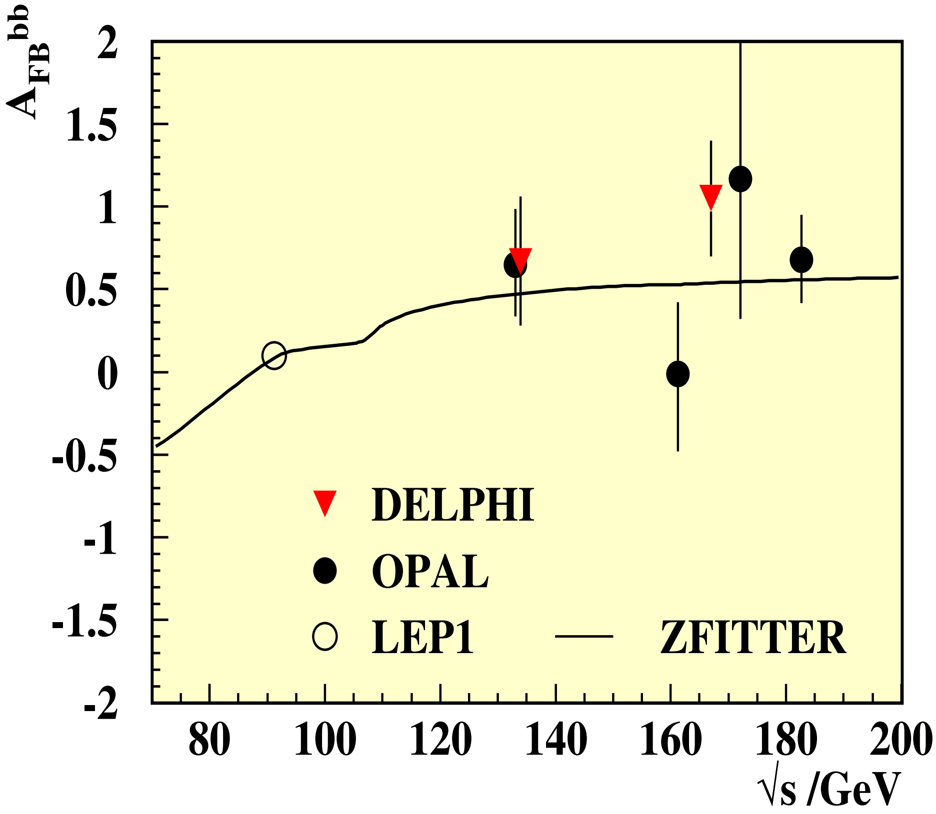
other

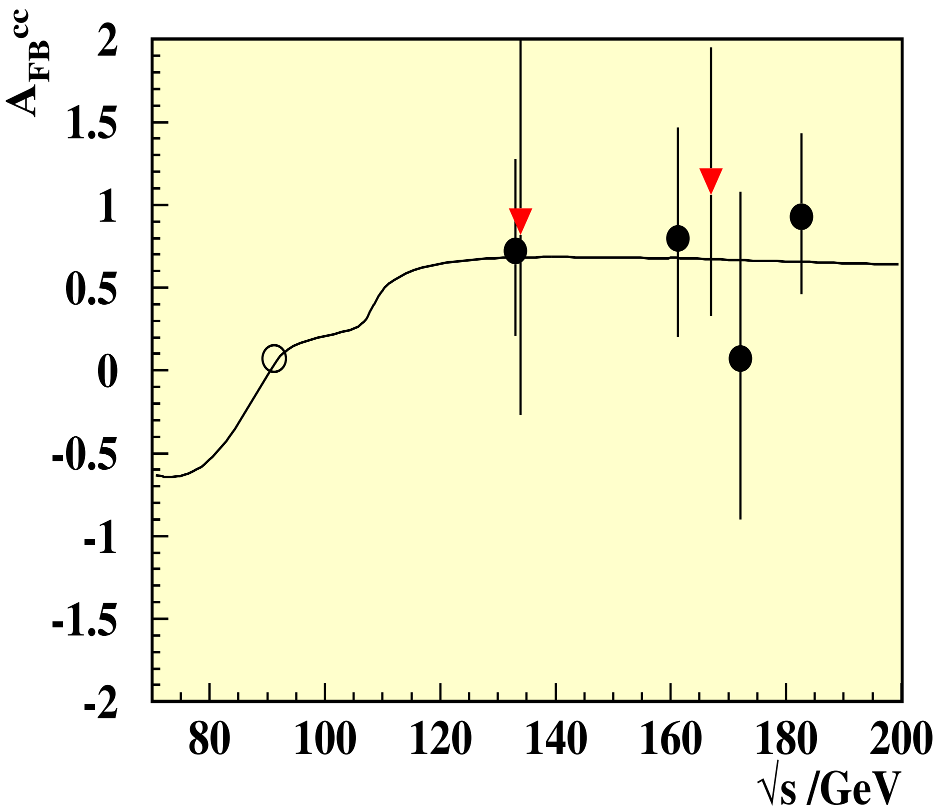


Fit $A_{FB}^{b\bar{b}}$ and $A_{FB}^{c\bar{c}}$ using angular distributions.

Combine with Q_{jet} measurement.

asymmetry results





Conclusions

Measurements consistent with SM. Limits can be made on extensions.

Heavy flavour production tests the SM for b and c quark final states.

Contact Interactions

ALEPH, DELPHI, OPAL use $\sigma(b\bar{b})$: $\Lambda_{+/-}$ >2-4 TeV ($g^2=4\pi$). DELPHI also use $\sigma(c\bar{c})$.

Coupling of electrons and q: LQ and RPV $\tilde{q}$.

ALEPH, DELPHI, OPAL use $\sigma(b\bar{b})$ to limit these processes. DELPHI also use $\sigma(c\bar{c})$.

Eg. ALEPH: scalar LQ $\tilde{S}_{1/2}$ 95% CL