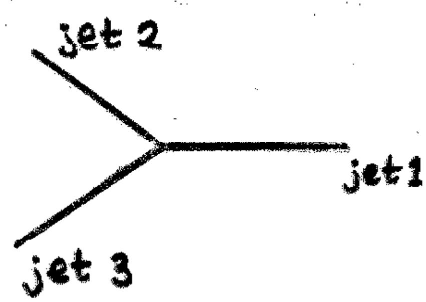
- **The goal of jet tagging :**
  To compare π, K, p production in high statistic samples of gluon jets with light quark jets.

- **To do this, use 3-jet events where E1 > E2 > E3.**

1) Gluon tag :
If jet 2(jet 3) is b or c
→ jet 3(jet 2) is g.
want pure gluon.



2) Light mixture :
If no secondary vertex is found in an event → jet 2 and jet 3 are tagged.
Best we can get is 50% of uds q and 50% of g.

3) B mixture :
If b vertex is found in jet 1 → jet 2 and jet 3 are tagged.
want 50% of b q and 50% g.

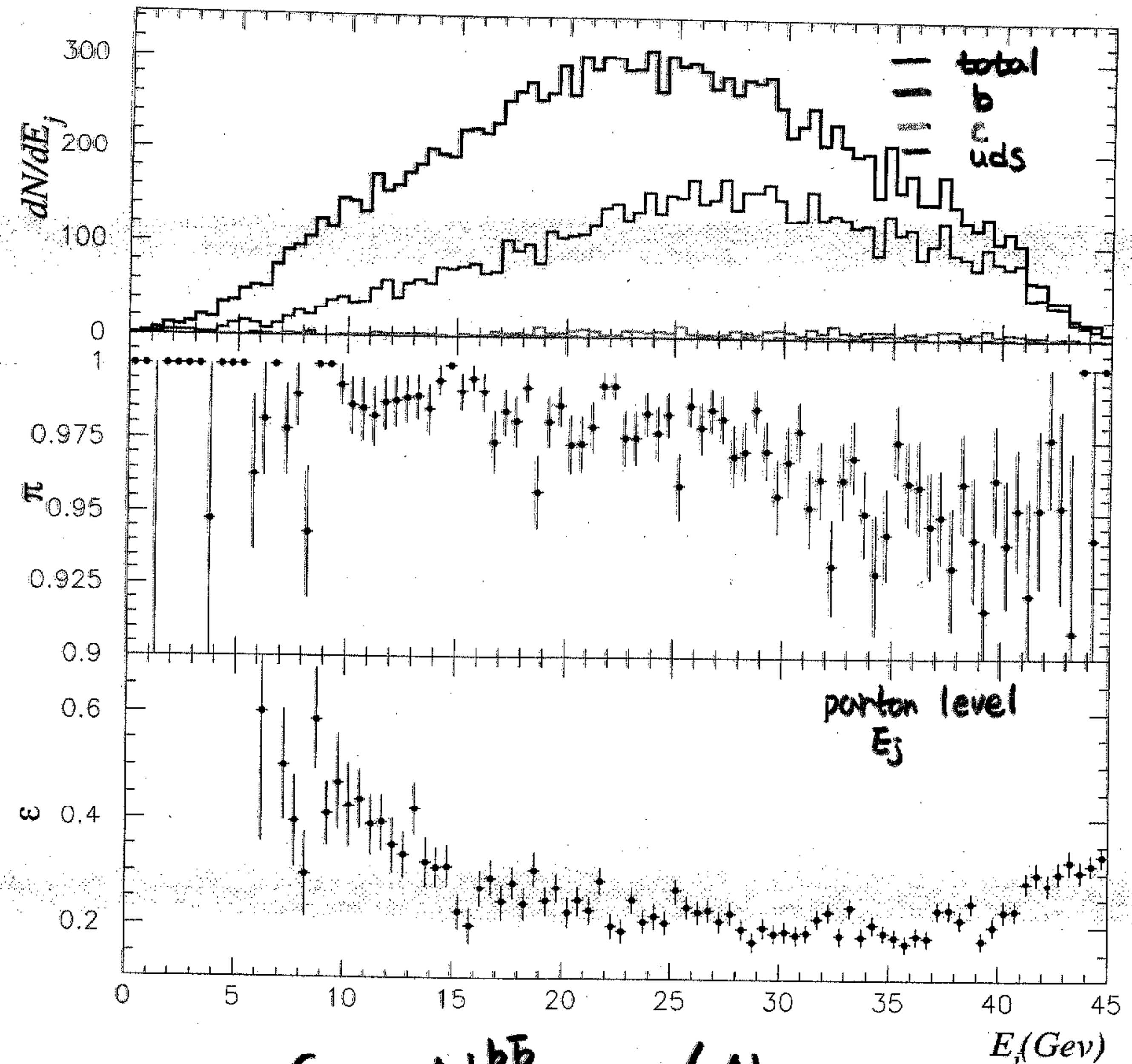
3) C mixture :
If c vertex is found in jet 1 → jet 2 and jet 3 are tagged.
: 50% of c q and 50% g.

1. Select three jet events using Durham algorithm with $Y_{cut} = 0.005$.
   → Rescale jet energies using angles and energy order.

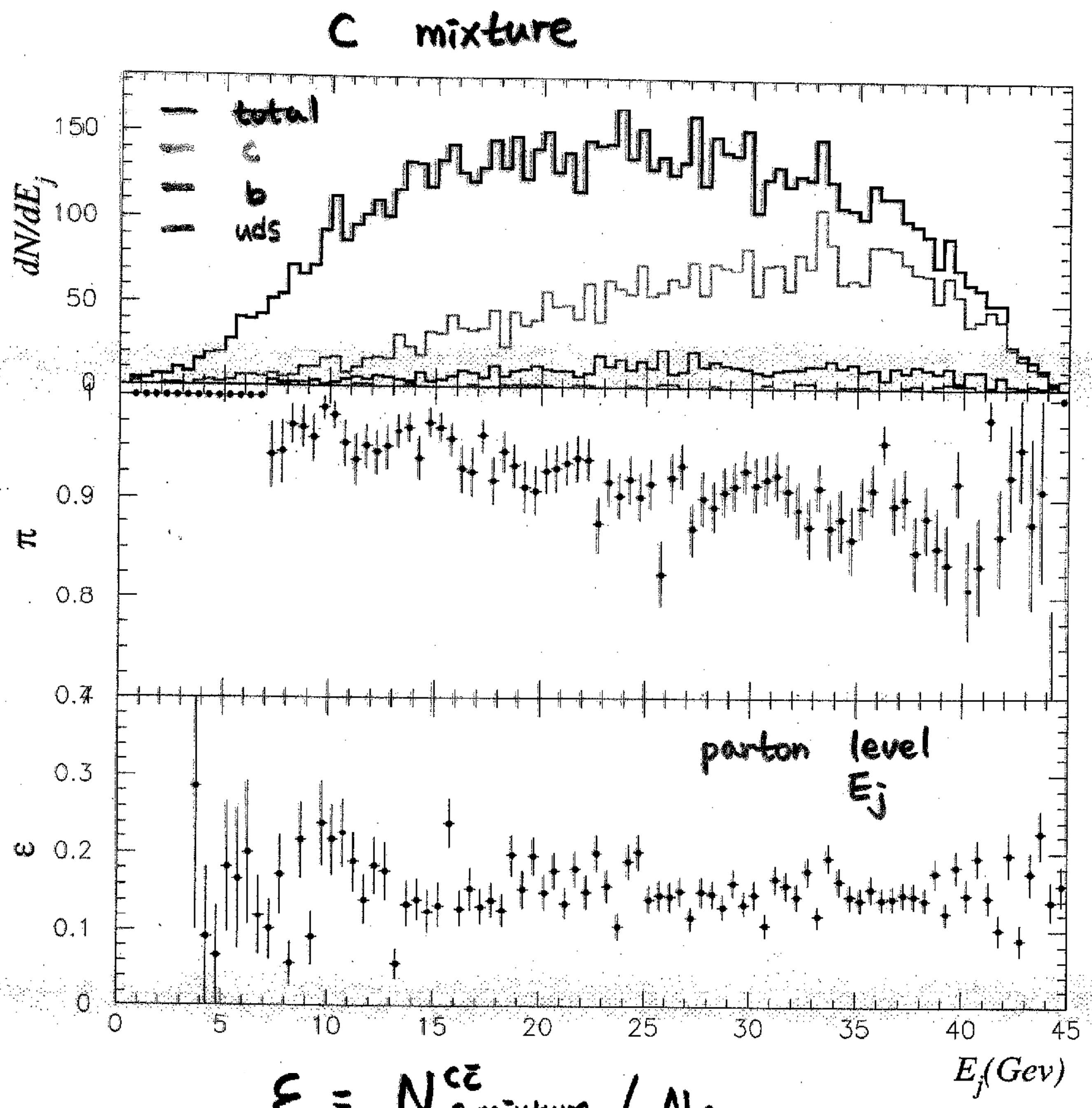
2. B mixture tagging (excluding gluon tagged events)
   : To improve background in gluon and uds jets.
   → Currentley use Tom's routine to find vertex in jet 1 to tag $b(\bar{b})$ with $m_{vt} > 2$ Gev.
   → b mixture : purity = 97.4% efficiency = 25.6%.
   → Investigated Nsig to improve purity and efficiency but little help.
      : vertex finding finds almost all high Nsig and even some of no Nsig jets.

3. C mixture tagging (excluding gluon tagged events)
   → Tag jet 1 as $c(\bar{c})$ with finding standard c vertex.
   → the standard cuts :
      1) $0.5 < m_{vt} < 2$ Gev
      2) $P_{vt} > 5$ Gev
      3) $P_{vt} - 15*m_{vt} > -10$
   → c mixture : purity = 92% efficiency = 18.7%.

B mixture



$$\varepsilon = N^{b\bar{b}}_{b\ \mathrm{mixture}} / N_{b\ \mathrm{in\ jet}\ 2,3}$$



$$\varepsilon = N^{c\bar{c}}_{c\,\text{mixture}} / N_{c \text{ in jet } 2,3}$$

4. Light mixture.

→ **1. Tag as uds events when there is no vertex in any of 3 jets .**

uds mixture : purity = 92% efficiency = 70%

where the efficiency is

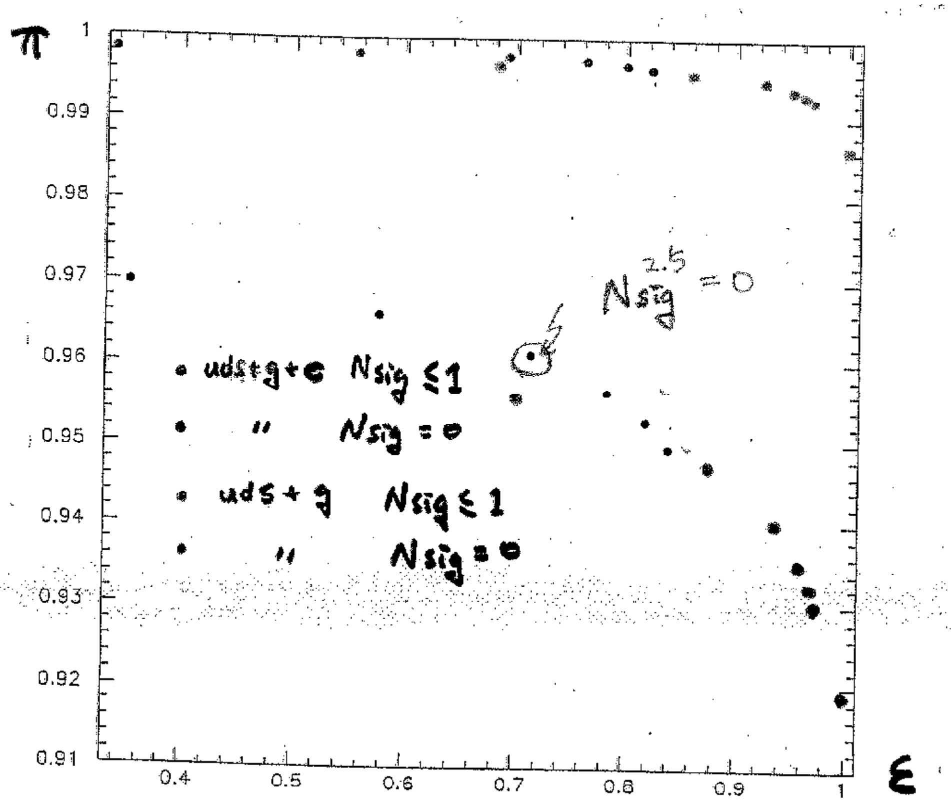
$$N^{\text{tagged uds events}}_{\text{uds mixture}} / N_{\text{3 jet events}}$$

2. Nsig = 0 for an event. ($\sigma/\delta_\sigma > 2.5$)

purity = 96% efficiency = 47.8%

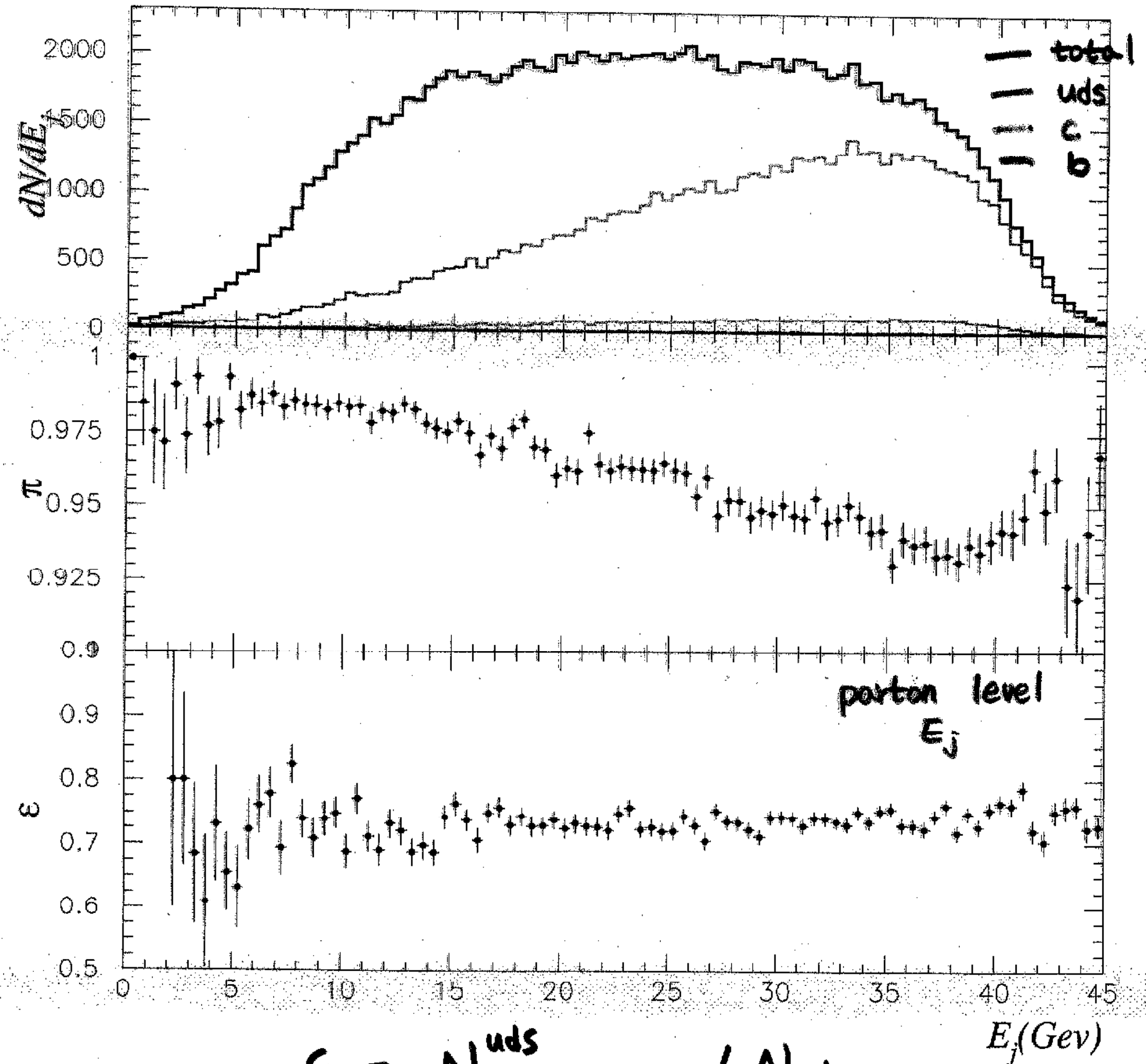
cf) OPAL purity = 80.9%

uds jet tag rate : 0.339 (data)
(to hadronic events) 0.418(MC)



→ The denominator of ε is the # of uds tagged events with no vertex.

Light mixture



$$\varepsilon = N^{uds}_{\text{light mixture}} / N_{uds \text{ in jet } 2,3}$$

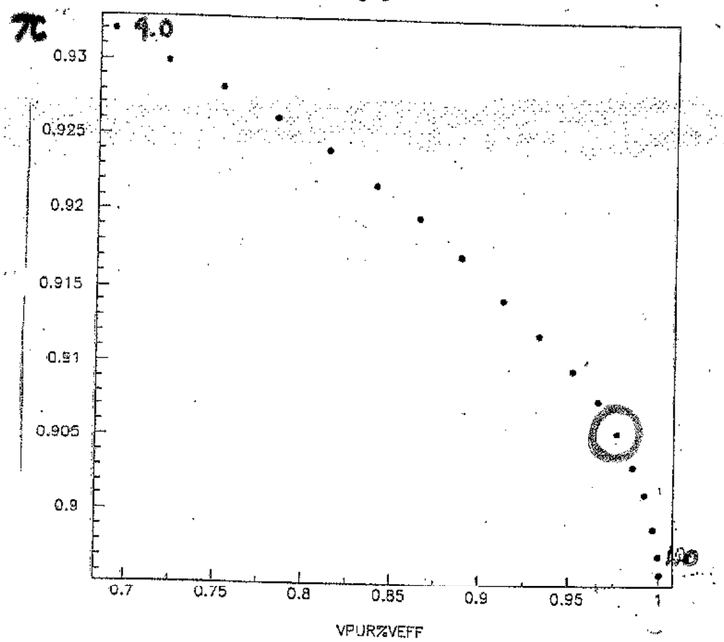
5. Gluon jet tagging

→ E_1 jet is assumed to be a quark(antiquark) jet.

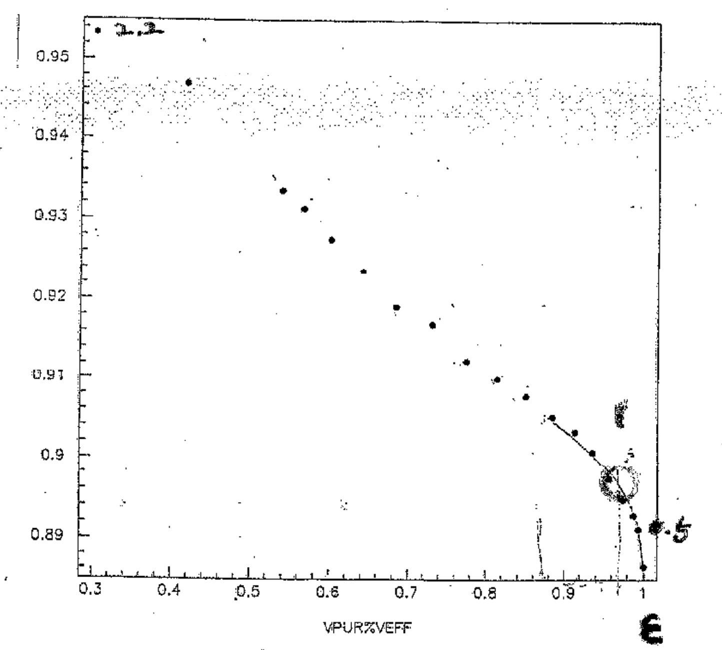
→ 1. Find vertex in a jet. If the vertex is $m_{vt} > 0.75$Gev and $P_{vt} > 3$ Gev the other is tagged as gluon.

: To remove falsely tagged vertex.

Pvt



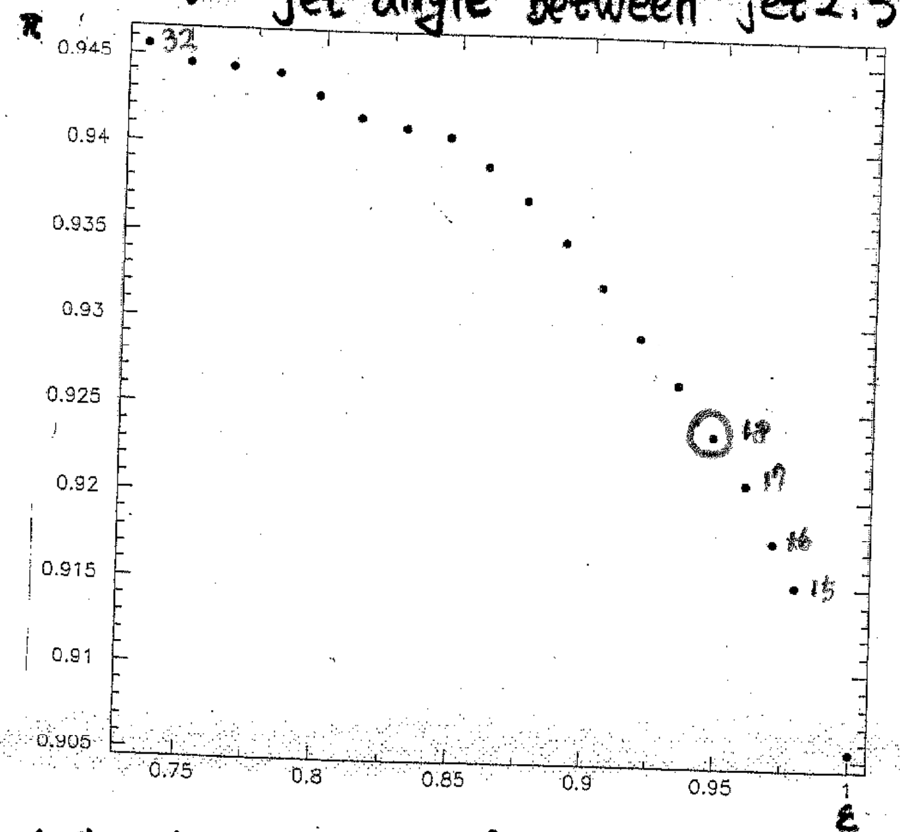
mvt



2. Only one of two lower jets must have a vertex.
   1) To get rid of events that both lower jets are heavy q.
   2) To suppress events that two jet have overlapping region.

3. An angle between two lower jets is > 18 degree.
   1) The same reason of 2) of the second cut.
   2) To remove contaminated signals.
      : g jet which includes tracks from q jet can have poorly measured energy.
   3) Using jet angle instead of high ycut
      : To get higher statistics.

• jet angle between jet2,3



→ The denominator of ε is # of gluon tagged jets with all other cuts

4. Using N_{sig} tagging :

Investigated no vertex either in jet 2 or in jet 3.

: to get more statistics but doesn't help.

To purify the gluon jet sample.

: 10 or 20% background reduction but 6 or 15% signal loss.

→ Decided not to put N_{sig} cuts for the summer.

→ g : purity = 91.5% efficiency = 17.6%

where efficiency = $N^{g}_{\text{g sample}} / N_{\text{3 jet events}}$

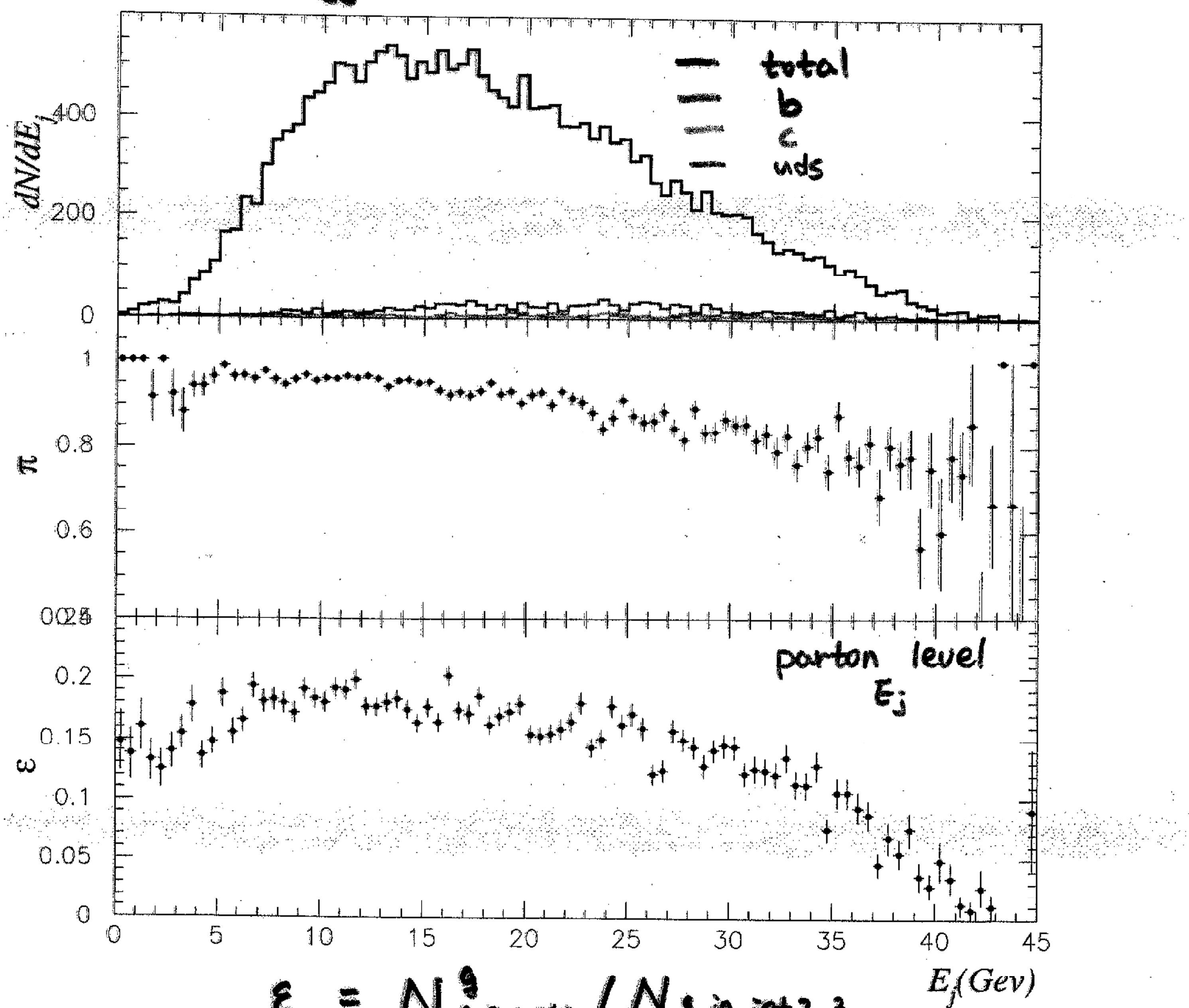
cf) DELPHI purity = 82%

gluon ratio to hadronic events = 0.0024

OPAL purity = 80%

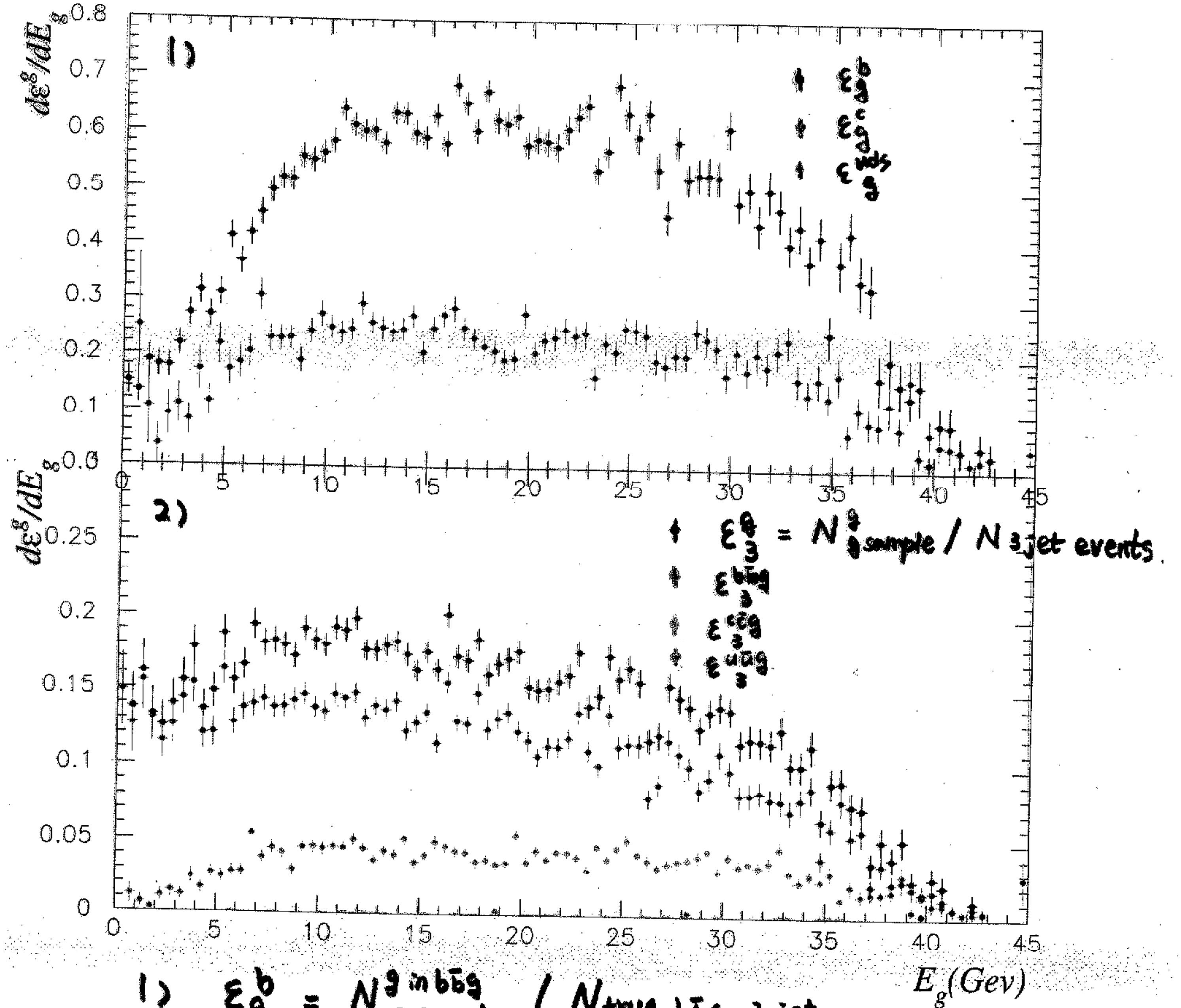
gluon ratio to hadronic events = $8.74\ 10^{-5}$

Tagged gluon sample.



$$\varepsilon = N^{g}_{g\,\text{sample}} / N_{g \text{ in jet } 2,3}$$

Gluon jet tagging efficiencies.



1) $\varepsilon_g^b = N_{g\,sample}^{g\,in\,b\bar{b}g} / N_{true\,b\bar{b}g\,3\text{-jet}}$

$\varepsilon_g^c = N_{g\,sample}^{g\,in\,c\bar{c}g} / N_{true\,c\bar{c}g\,3jet}$

$\varepsilon_g^{uds} = N_{g\,sample}^{g\,in\,u\bar{u}g} / N_{true\,u\bar{u}g\,3jet}$

Plan

1) Collaboration meeting.

   → Study inclusive multiplicitiesof light quark and gluon jet.

   → Study bias of jet tagging.

2) Summer conference.

   → Apply the particle identification to study π, K, p production in quark and gluon jets.