

First step toward

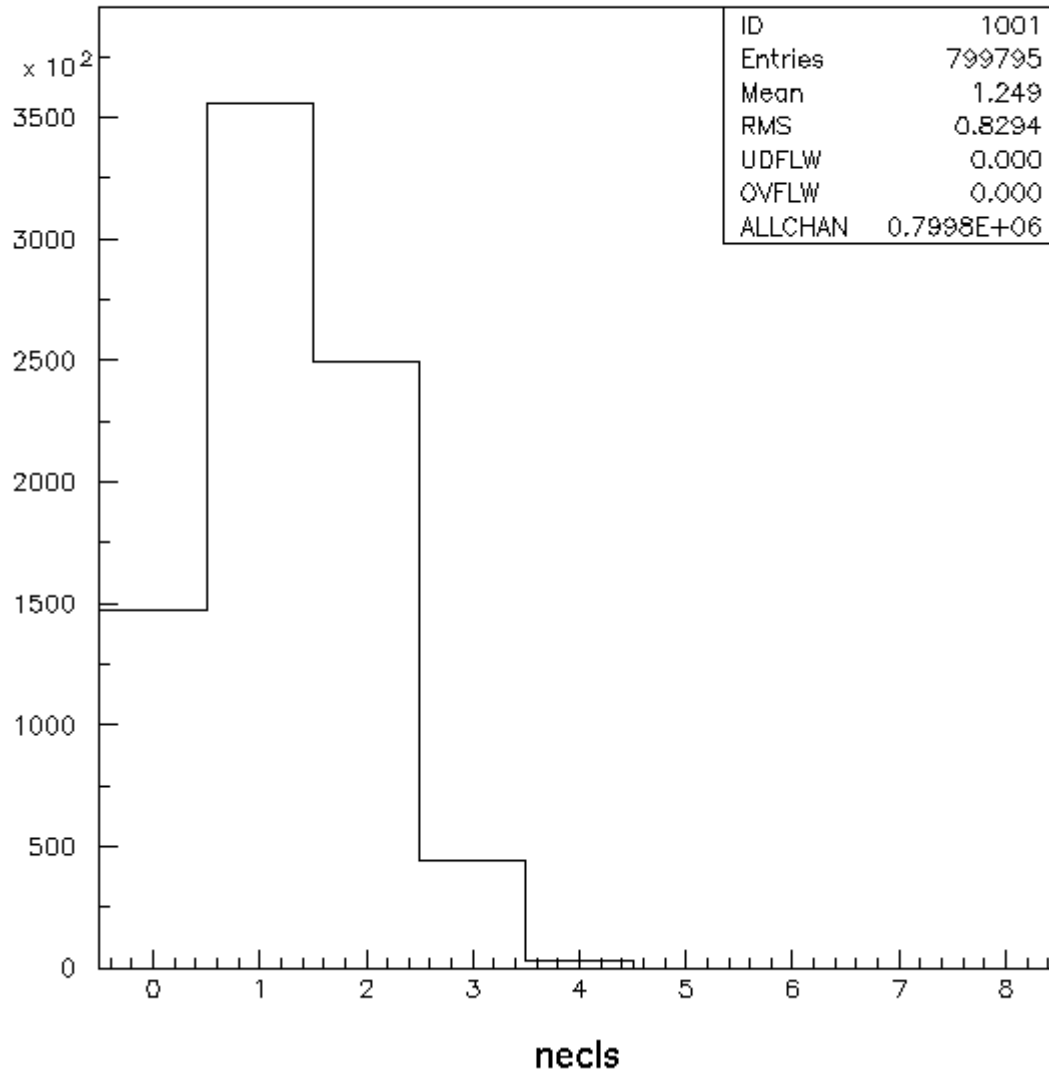
$$\eta \rightarrow e^+ e^- \pi^+ \pi^-$$

Simona Giovannella, R. V.

Phi radiative meeting 28-04-2006

- New generator by Claudio Gatti
(successfully tested)
- Inserted in GEANFI by Caterina Bloise
- 8×10^5 events generated on our own
- First tests

There's something about streaming



necls = 0

147376 events

necls ≥ 0

652419 events

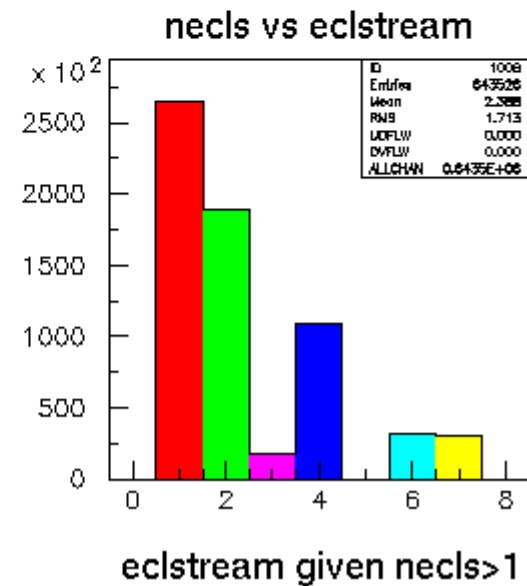
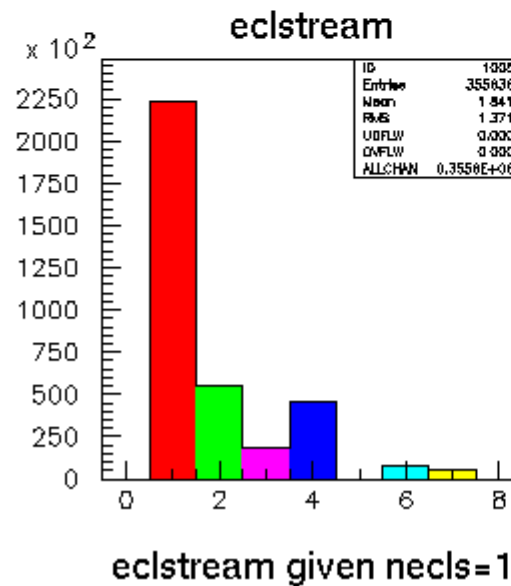
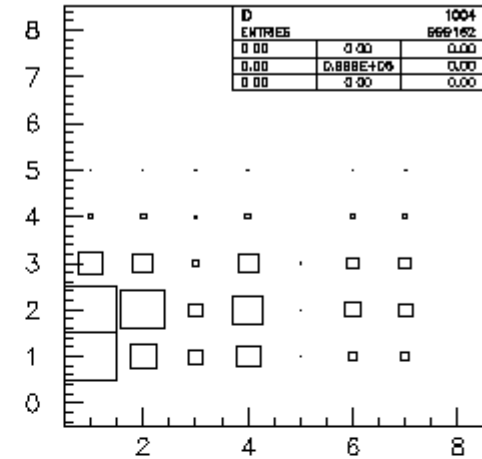
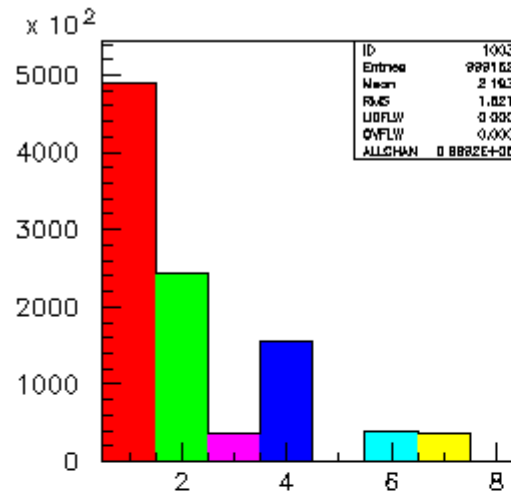
$\epsilon = 0.815$

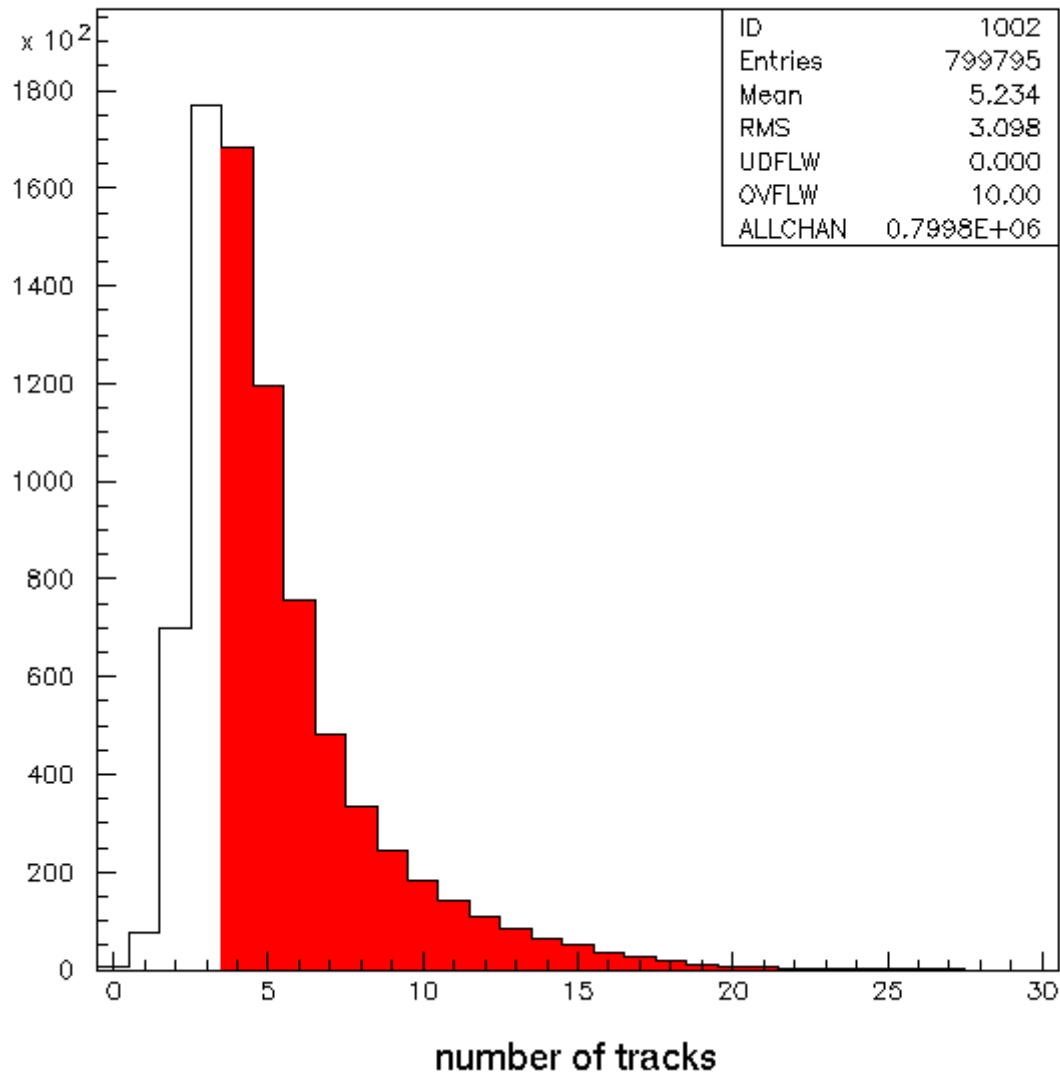
Most events selected by **KPM**

(without retracking i.e. kaons are supposed to be pions)

- 1 **KPM**
- 2 **KLS**
- 3 **RPI**
- 4 **RAD**
- 5 **CLB**
- 6 **UFO**
- 7 **BHA**

No request on the number of tracks yet





tracks ≤ 3

254959 events

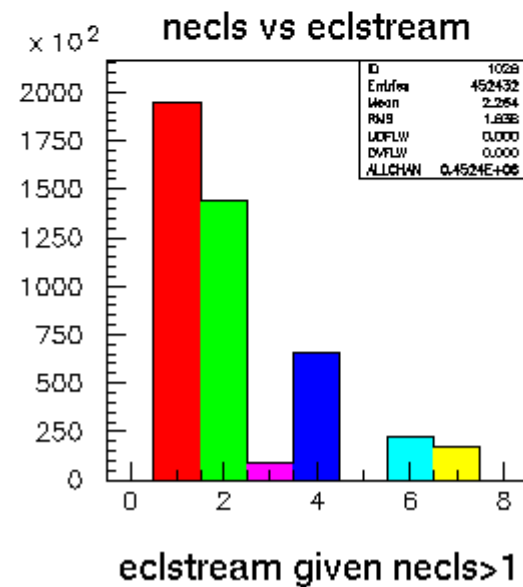
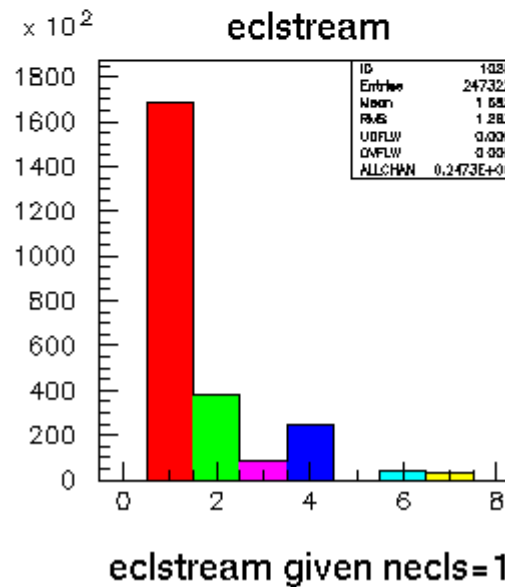
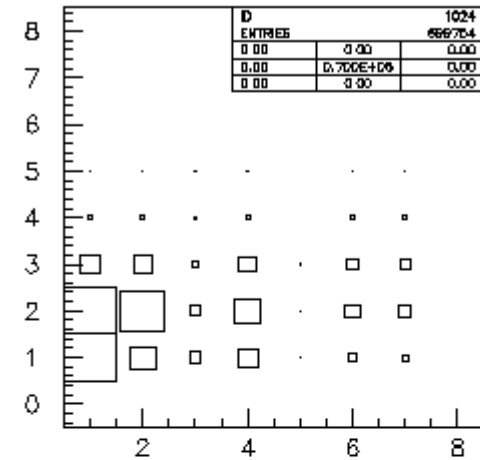
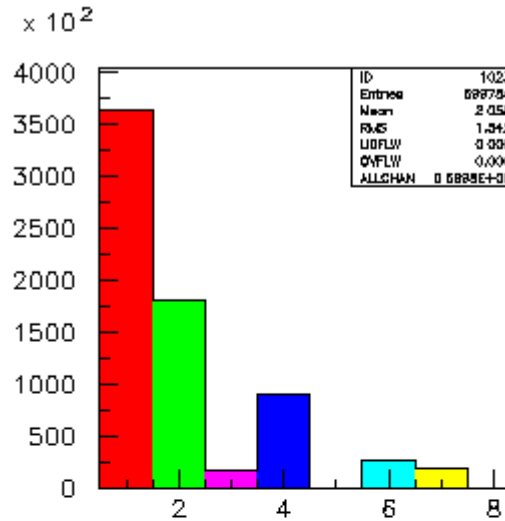
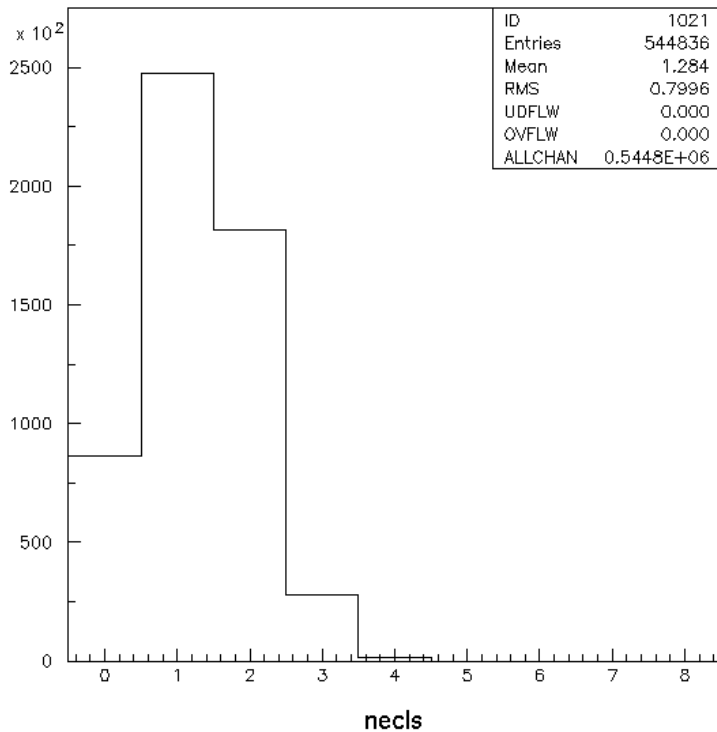
tracks ≥ 4

544836 events

$\epsilon = 0.681$

- 1 KPM
- 2 KLS
- 3 RPI
- 4 RAD
- 5 CLB
- 6 UFO
- 7 BHA

Also requiring at least 4 tracks
the most events are selected by **KPM**



eclstream given necls=1

eclstream given necls>1

Desperately seeking truth

Problem

Given 544836 events with at least four tracks,
how many times were we able
to find the four tracks we are looking for?

Answer

Only in 67481 events.

$$\varepsilon = 0.123$$

The 67481

Event selected for stream 1 = 54076
by tag 1 = 0
by tag 2 = 0
by tag 3 = 0
by tag 4 = 541
by tag 5 = 65
by tag 6 = 54076

Event selected for stream 2 = 34726
by tag 1 = 369
by tag 2 = 28215
by tag 3 = 93
by tag 4 = 19078
by tag 5 = 0
by tag 6 = 28211
by tag 7 = 9
by tag 8 = 0

Event selected for stream 3 = 572

Event selected for stream 4 = 4161
by tag 1 = 1727
by tag 2 = 1
by tag 3 = 2691
by tag 4 = 0
by ppgtag version 1 = 197
by ppgtag version 2 = 2085
by ppgtag version 3 = 1106
by ppgtag version 4 = 165

Event selected for stream 5 = 0
by tag 1 = 0
by tag 2 = 0
by tag 3 = 0
by tag 4 = 0

Event selected for stream 6 = 3280

Event selected for stream 7 = 1626
by tag 1 = 482
by tag 2 = 964

1 KPM = 54076

2 KLS = 34726

3 RPI = 572

4 RAD = 4161

5 CLB = 0

6 UFO = 3280

7 BHA = 1626

All by dE/dx

Mostly by
KLTAG & KSEMIL

1727 by PPFILT
2681 by PPGTAG

Look back in PPGTAG

RAD stream has 4161 events:

- 1727 selected by PPFILT
- 1 selected by NRFILT
- 2691 selected by PPGTAG

197 by new PPGTAG (DTFS)

2085 by old PPGTAG (DTFS)

1106 by old PPGTAG (DVFS)

165 by new PPGTAG (DVFS)

$\exists ! \text{vertex} /$

$$z_{vtx} < 8 \text{ cm} \wedge r_{vtx} < 15 \text{ cm}$$

OLD $150 \text{ MeV} < |\vec{p}_1| + |\vec{p}_2| < 1020 \text{ MeV} \quad \oplus \quad \overline{\text{RPI}}$

$$90 \text{ MeV} < M_{Trk} < 220 \text{ MeV}$$

$\exists 2 \text{ tracks} /$

$$q_1 q_2 < 0 \wedge z_{PCA} < 8 \text{ cm} \wedge r_{PCA} < 15 \text{ cm}$$

NEW $150 \text{ MeV} < |\vec{p}_1| + |\vec{p}_2| < 1020 \text{ MeV}$

$$80 \text{ MeV} < M_{Trk} < 400 \text{ MeV}$$

$$-220 \text{ MeV} < \Delta E_{Miss} < 120 \text{ MeV}$$

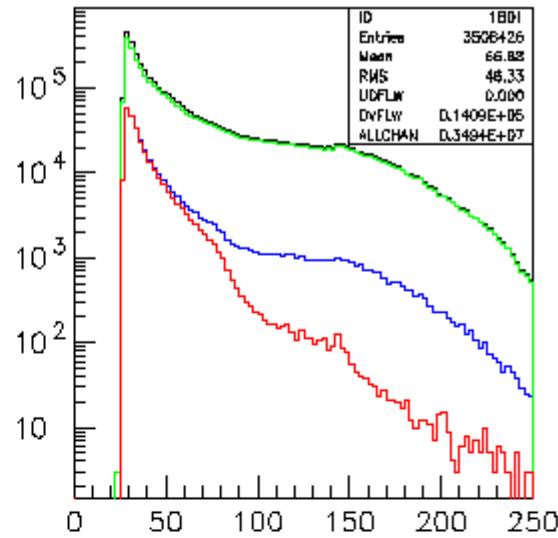
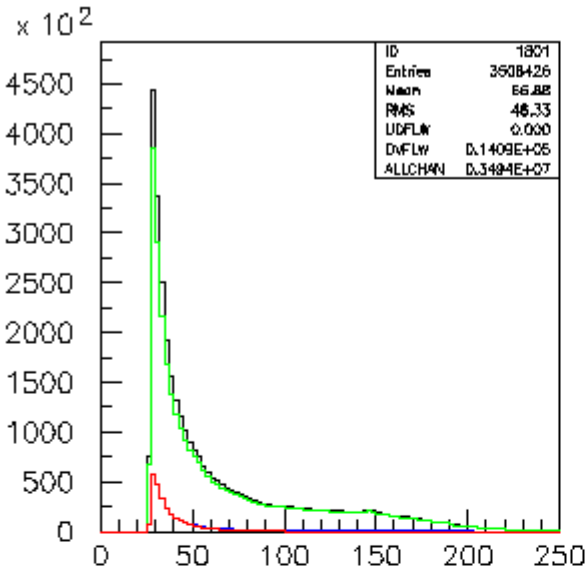
The hard way

What to do?

- Stay with very few events from PPGTAG
- Run on raw charged kaons
- Develop a new RAD tag

(could be useful also for $\eta \rightarrow e^+ e^- e^+ e^-$)

Anyway the features of the events have to be studied

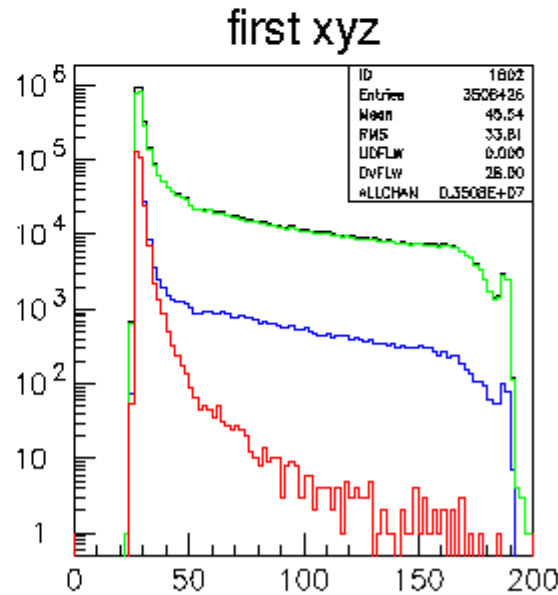
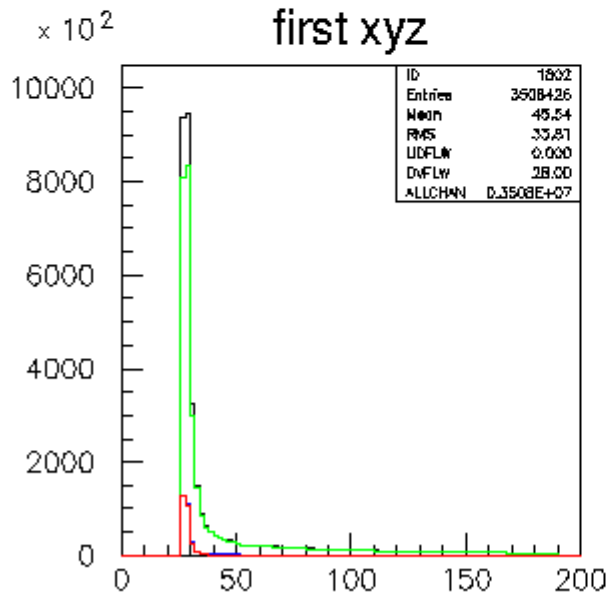


Four true tracks: $e e \pi \pi$

All the tracks

All the tracks for events with the four true tracks

All the tracks for events without the four true tracks



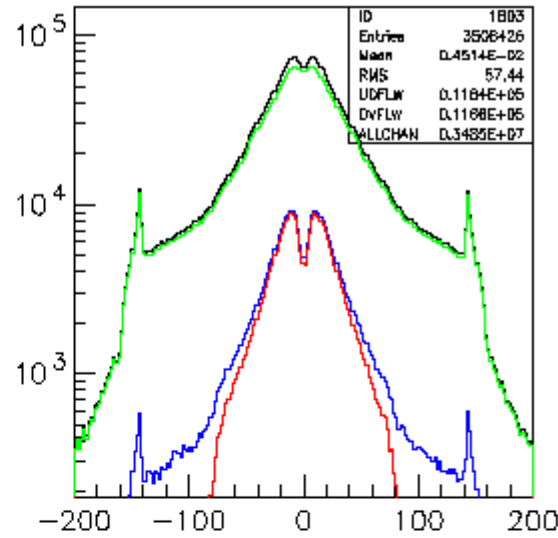
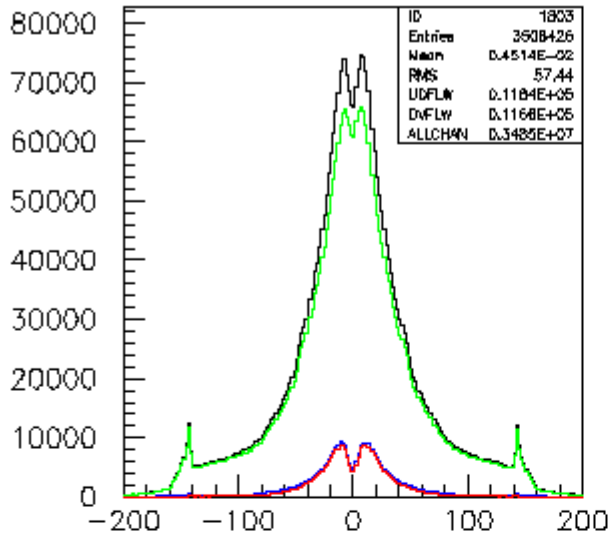
Possible cuts:

first hit 3D < 80

first hit 2D < 50

first xy

first xy

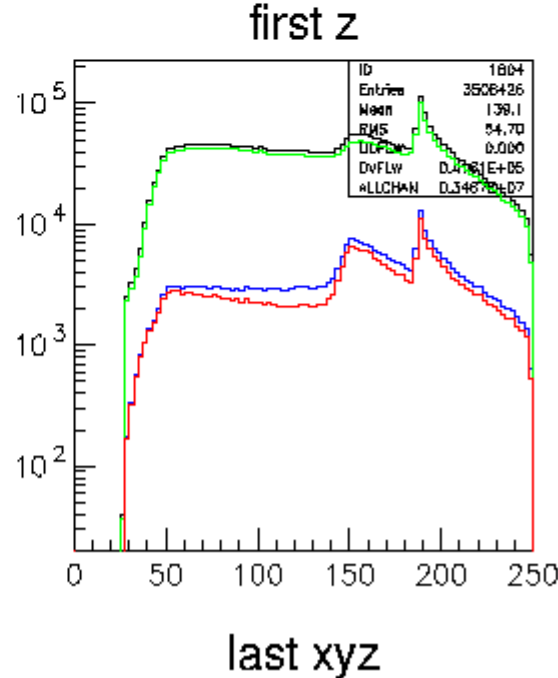
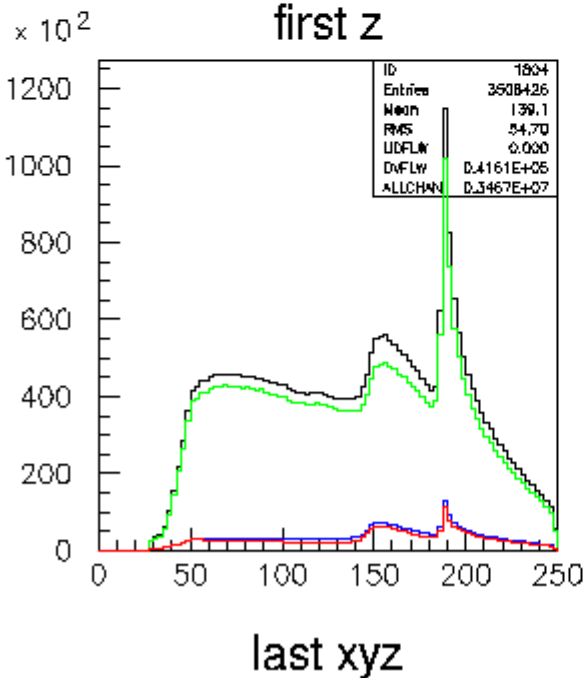


Four true tracks: $e e \pi \pi$

All the tracks

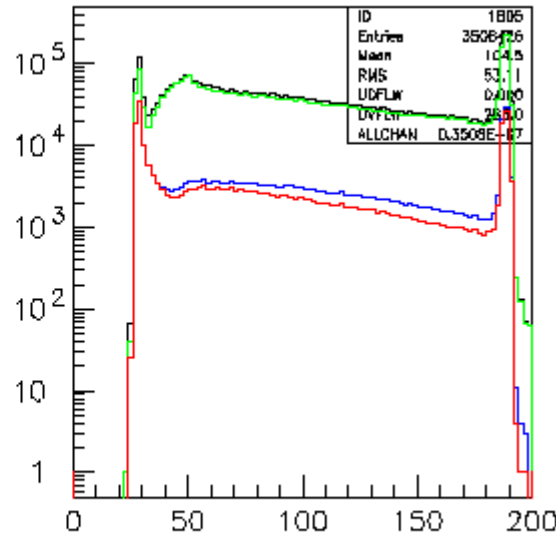
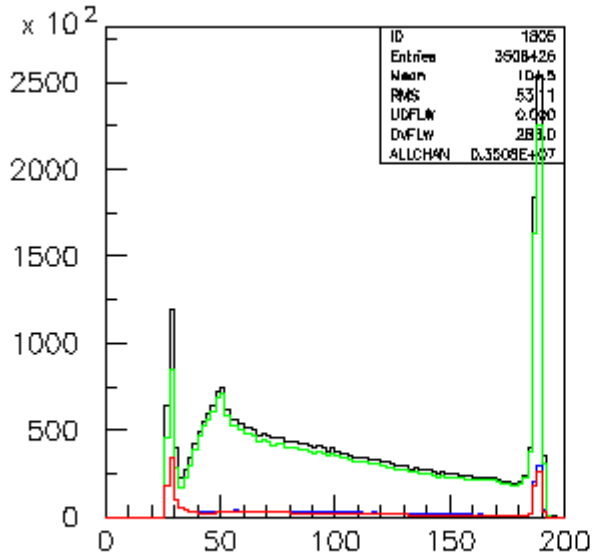
All the tracks for events with the four true tracks

All the tracks for events without the four true tracks



Possible cuts:

first hit $Z < 100$



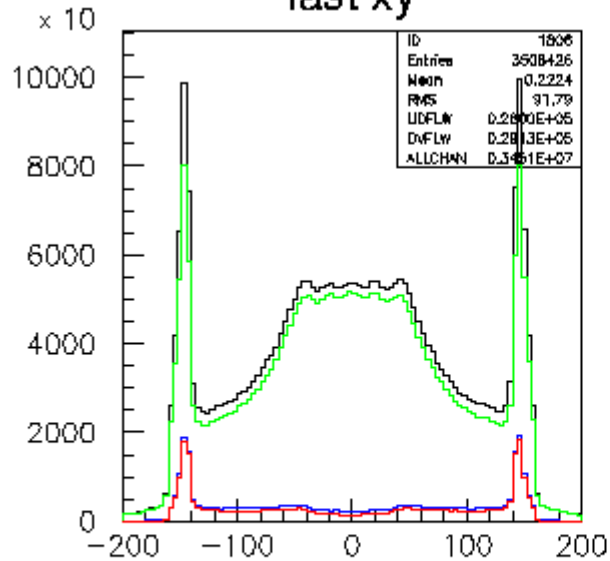
Four true tracks: $e e \pi \pi$

All the tracks

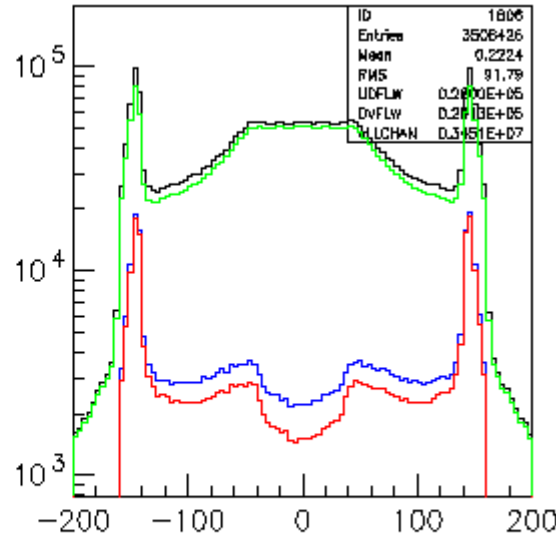
All the tracks for events
with the four true tracks

All the tracks for events
without the four true tracks

last xy

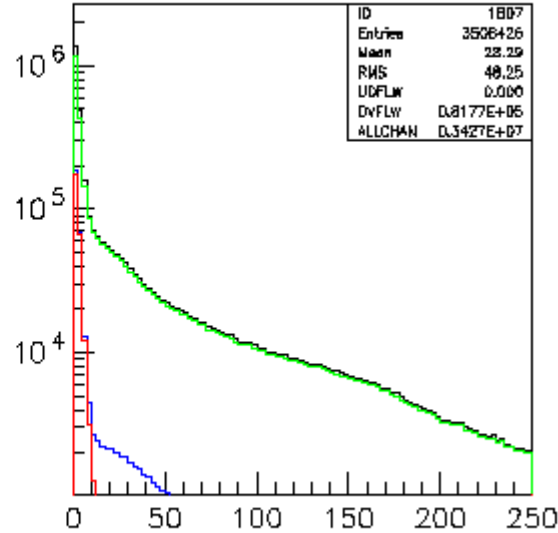
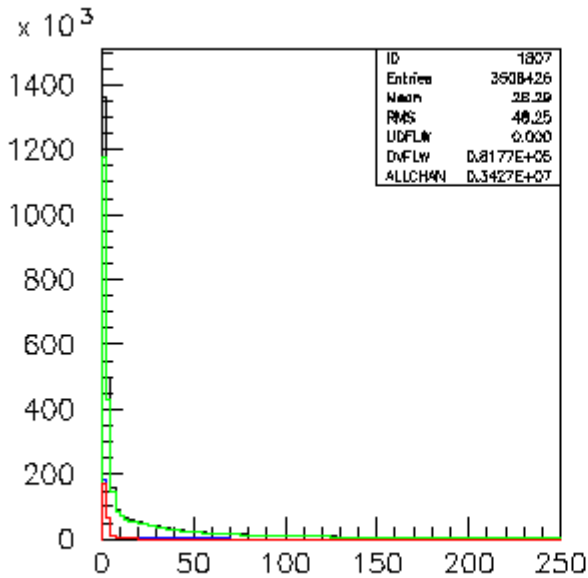


last xy



last z

last z

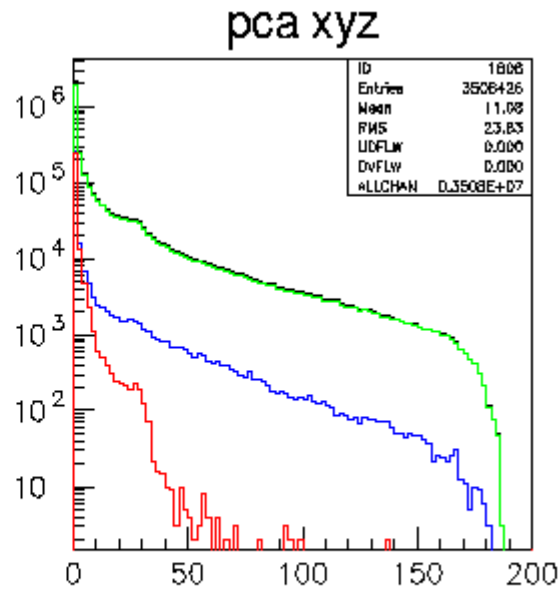
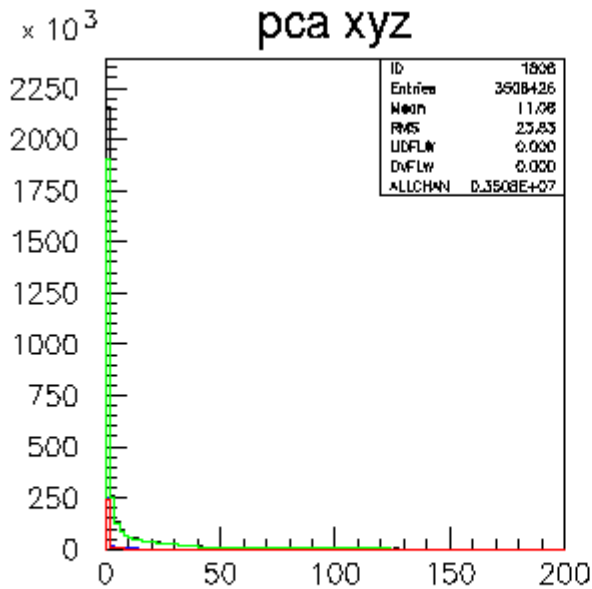


Four true tracks: $e e \pi \pi$

All the tracks

All the tracks for events with the four true tracks

All the tracks for events without the four true tracks



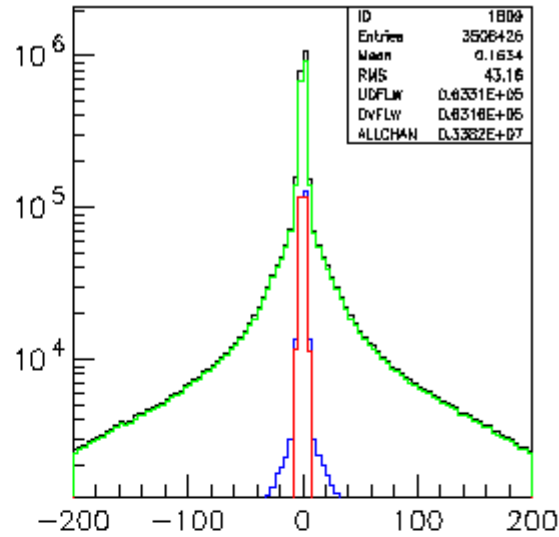
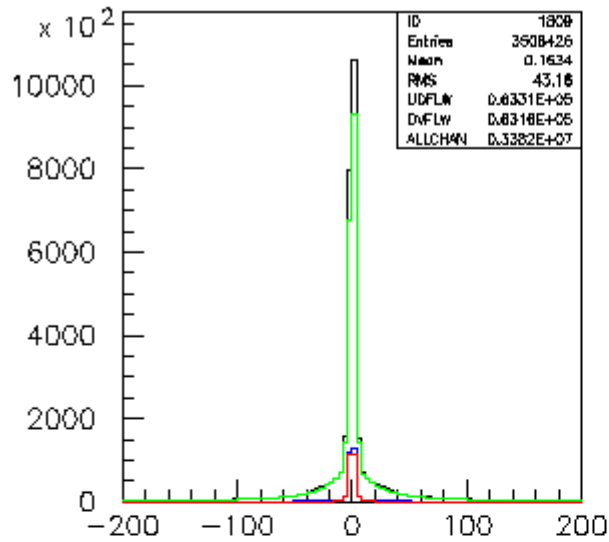
Possible cuts:

PCA 3D < 20

PCA 2D < 30

pca xy

pca xy



Four true tracks: $e e \pi \pi$

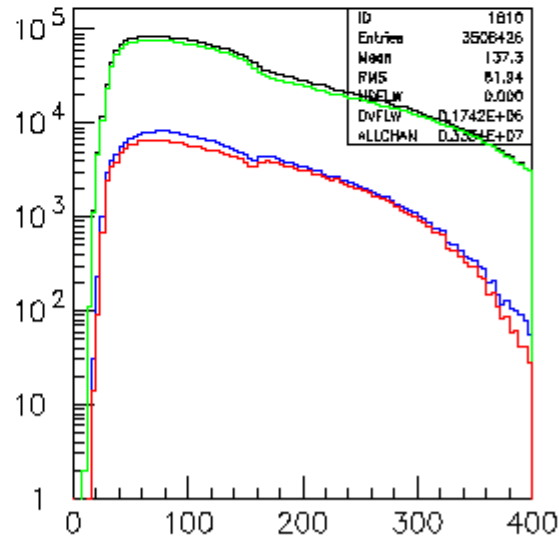
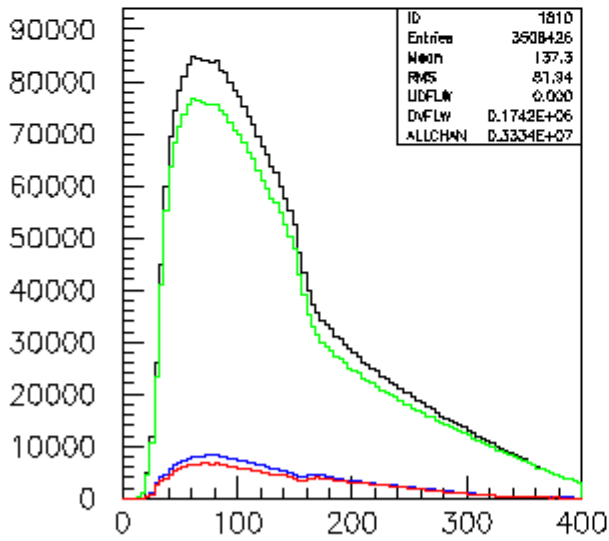
All the tracks

All the tracks for events
with the four true tracks

All the tracks for events
without the four true tracks

pca z

pca z

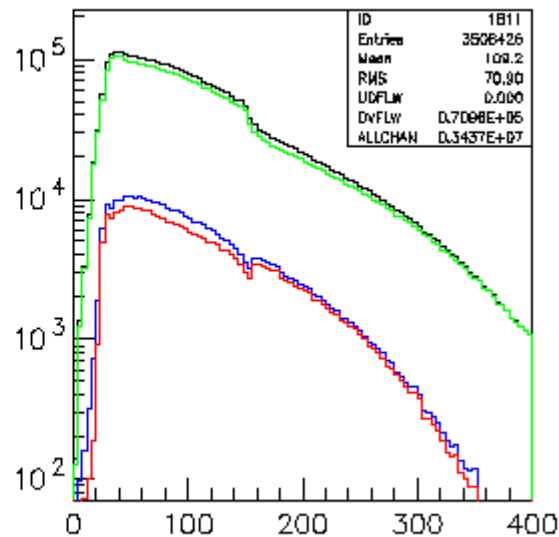
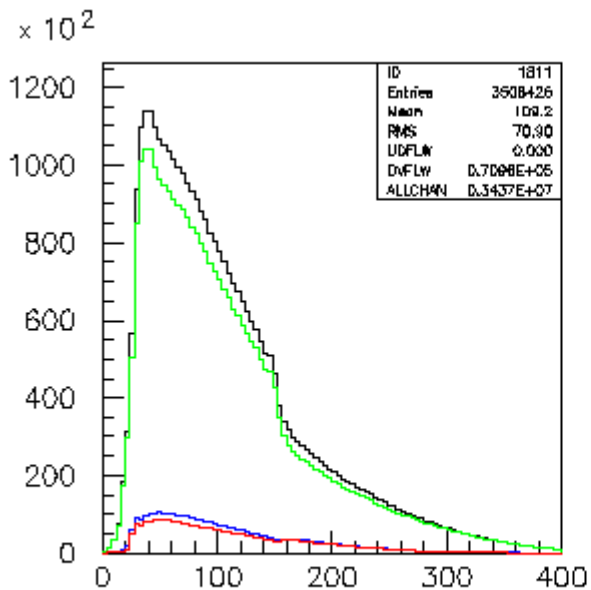


p tot

p tot

Possible cuts:

PCA Z < 15

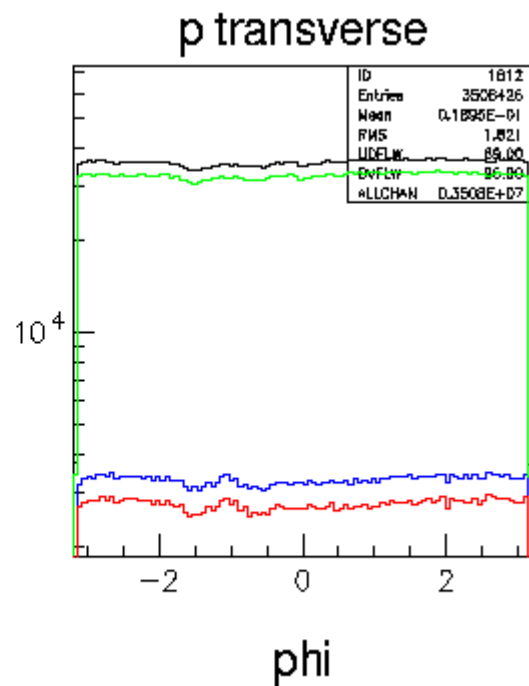
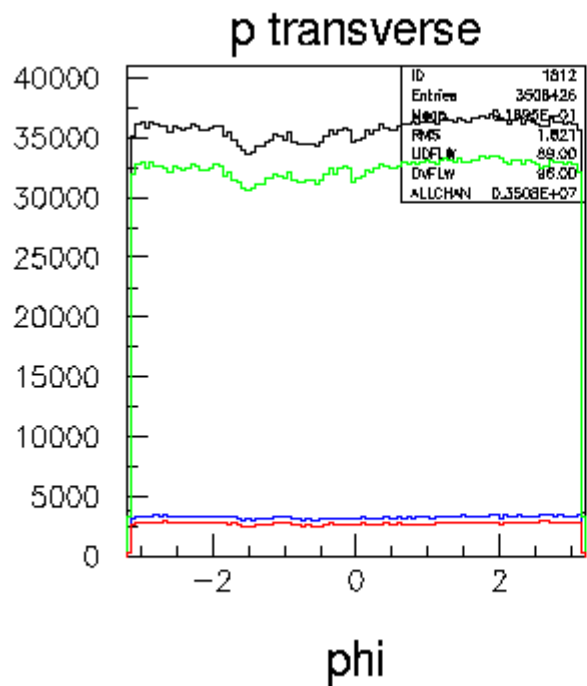


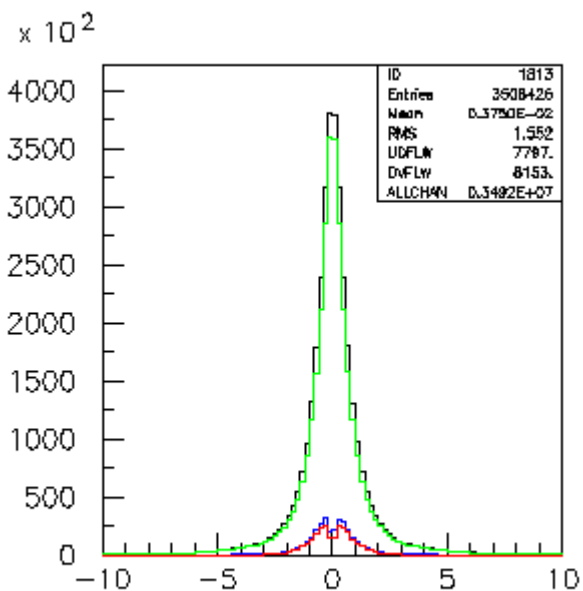
Four true tracks: $e e \pi \pi$

All the tracks

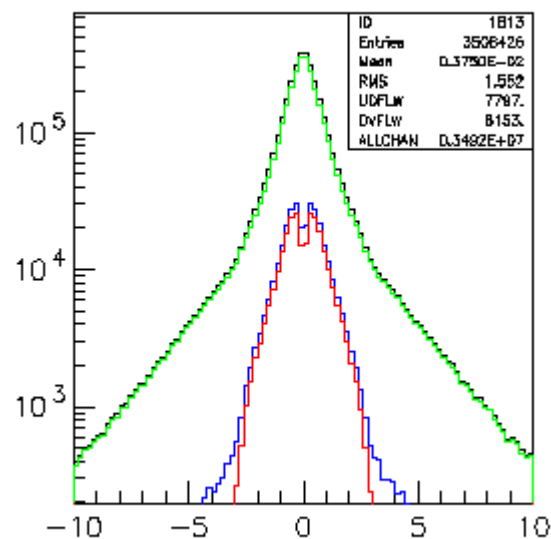
All the tracks for events with the four true tracks

All the tracks for events without the four true tracks





cot theta



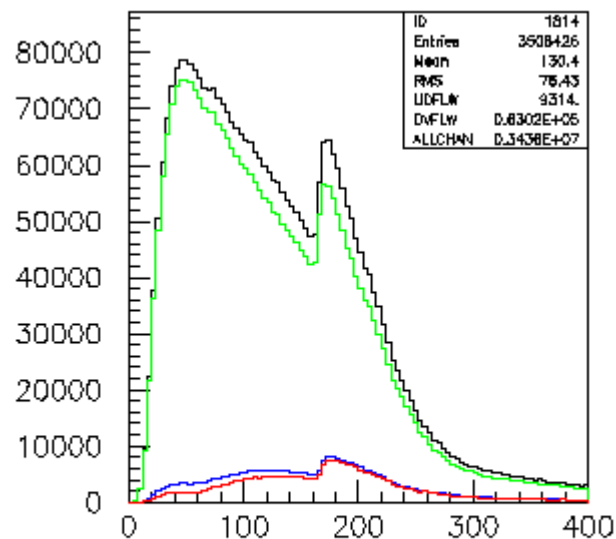
cot theta

Four true tracks: $e e \pi \pi$

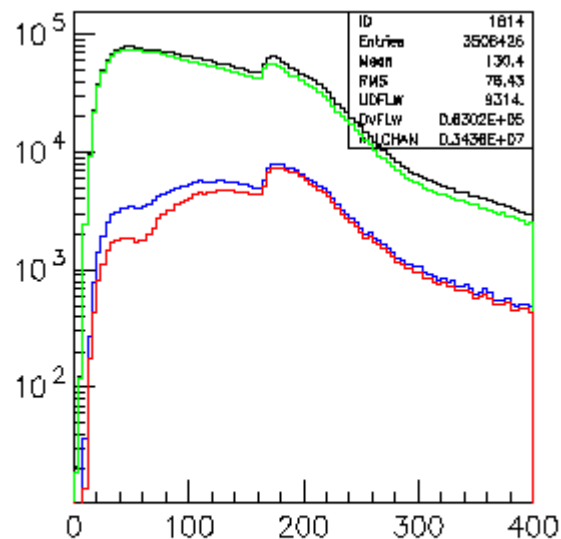
All the tracks

All the tracks for events
with the four true tracks

All the tracks for events
without the four true tracks



track length



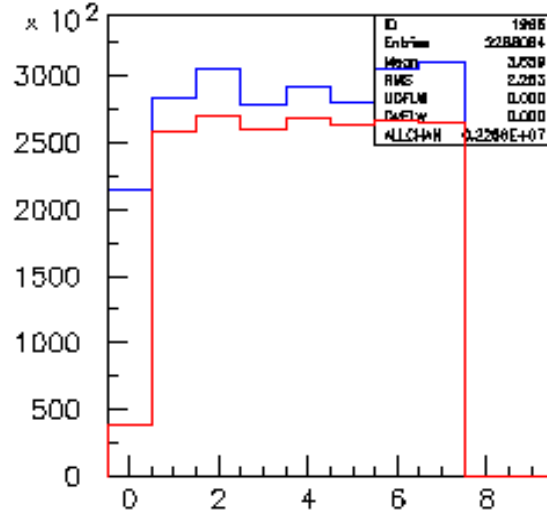
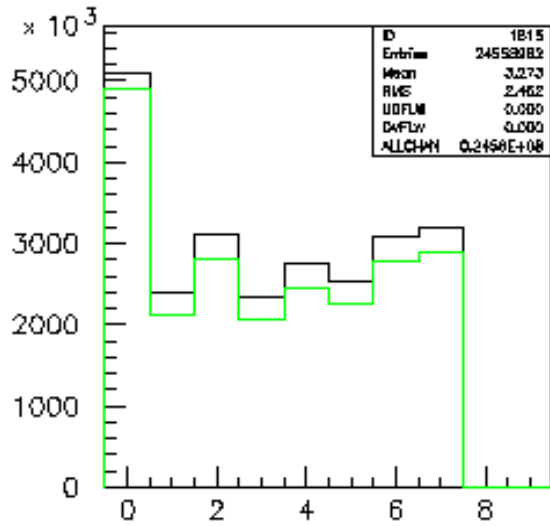
track length

Possible cuts:

$\text{cot theta} < 2.5$

#number of tracks satisfying each cuts

Four true tracks: $e e \pi \pi$



All the tracks

All the tracks for events with the four true tracks

All the tracks for events without the four true tracks

0. fake bin

1. PCA z

2. PCA 2D

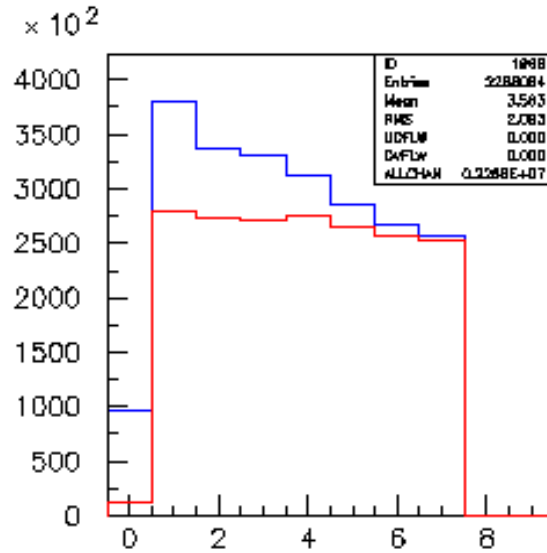
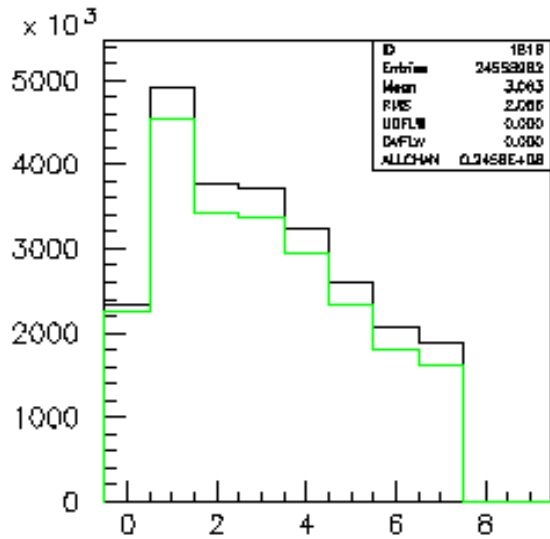
3. PCA 3D

4. FH 2D

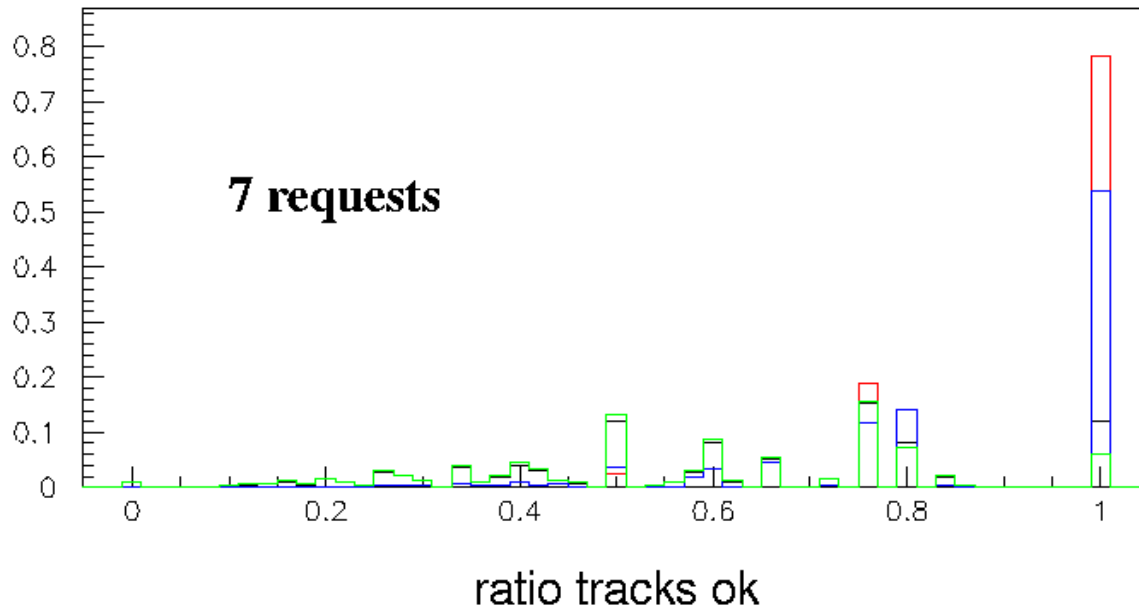
5. FH 3D

6. FH z

7. $\cot(\theta)$



#number of satisfied cuts

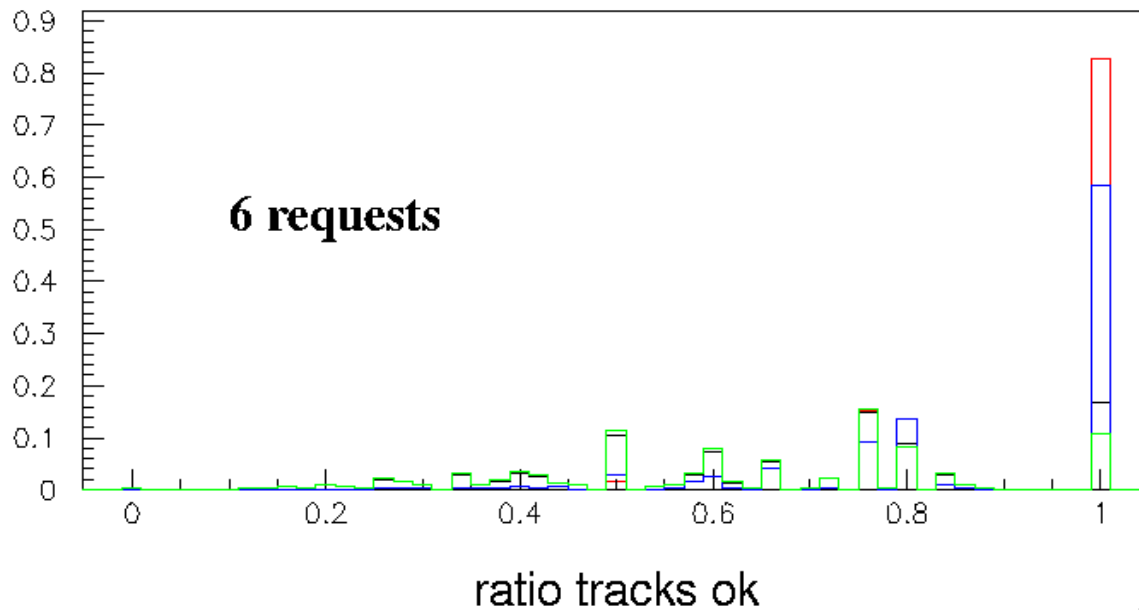


Four true tracks: $e e \pi \pi$

All the tracks

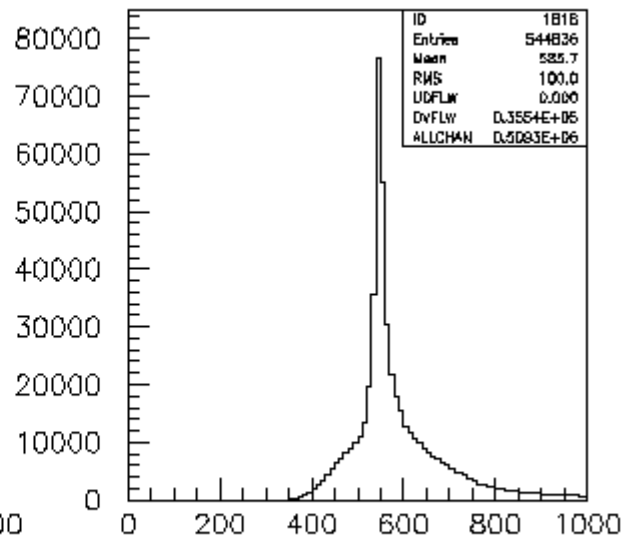
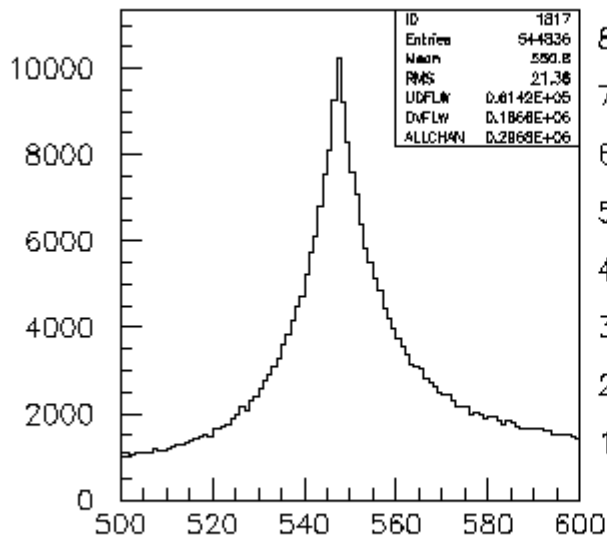
All the tracks for events
with the four true tracks

All the tracks for events
without the four true tracks



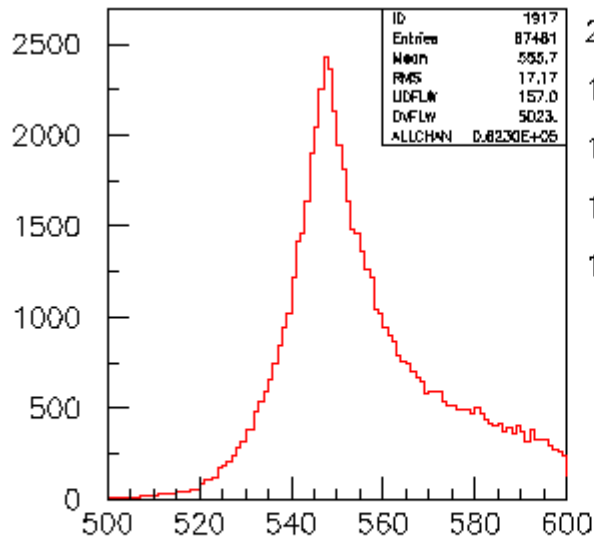
$$R = \frac{\text{\# of tracks satisfying } n \text{ requests}}{\text{Total \# of tracks in the event}}$$

(Total # of true tracks = 4)



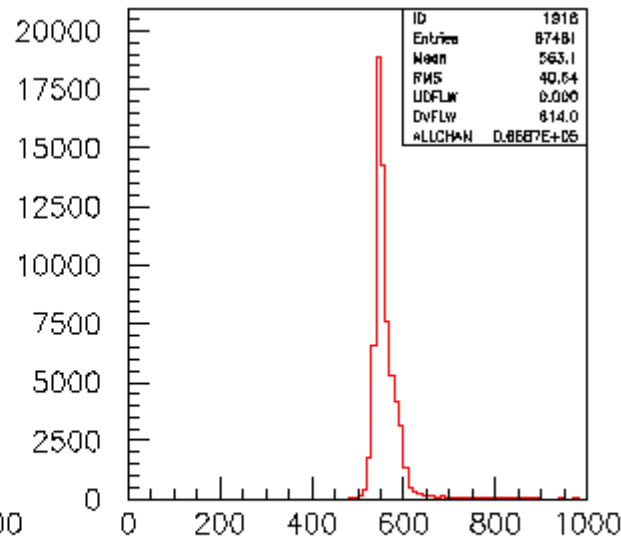
Best eta mass among all the tracks combinations (reconstructed momenta)

eta invariant mass



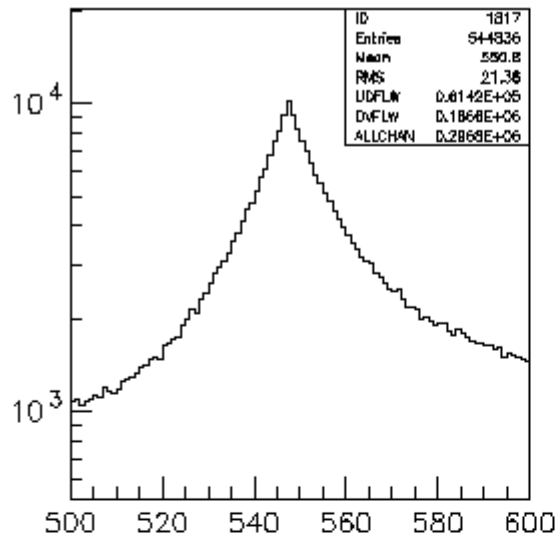
eta invariant mass

eta invariant mass

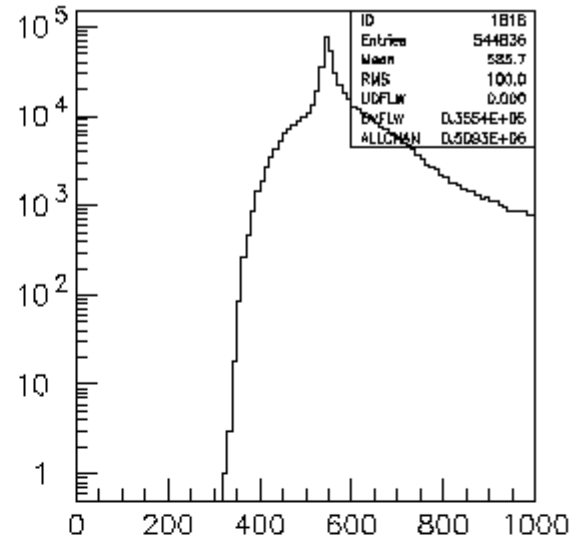


eta invariant mass

Best eta mass among all the four true ($e e \pi \pi$) tracks combinations (reconstructed momenta)

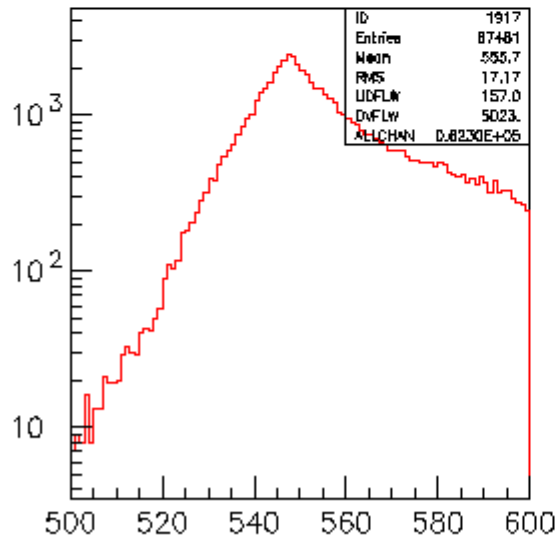


eta invariant mass

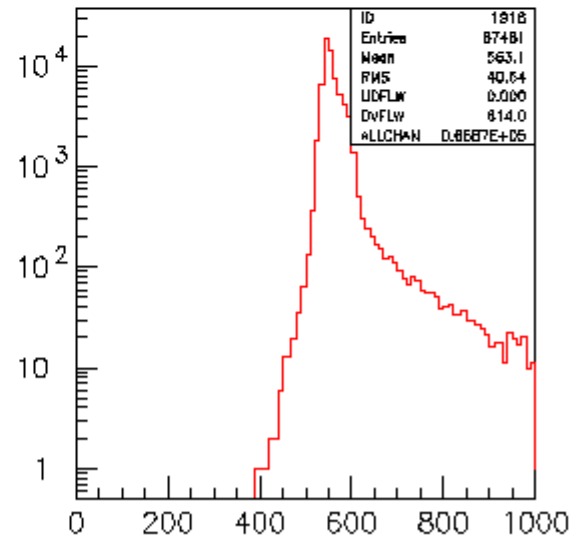


eta invariant mass

Best eta mass among all the tracks combinations (reconstructed momenta)

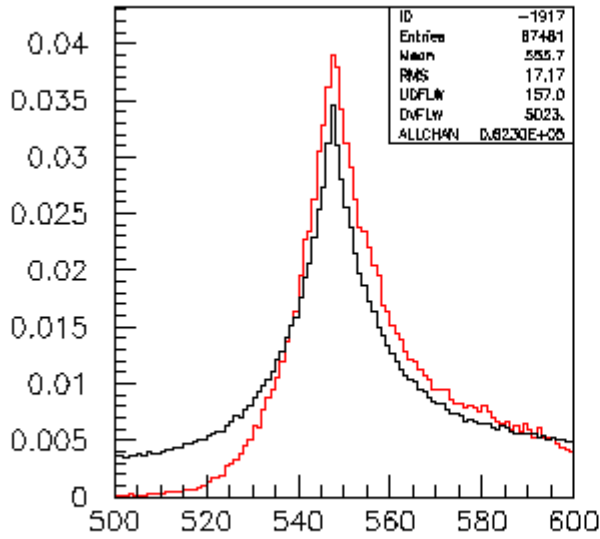


eta invariant mass

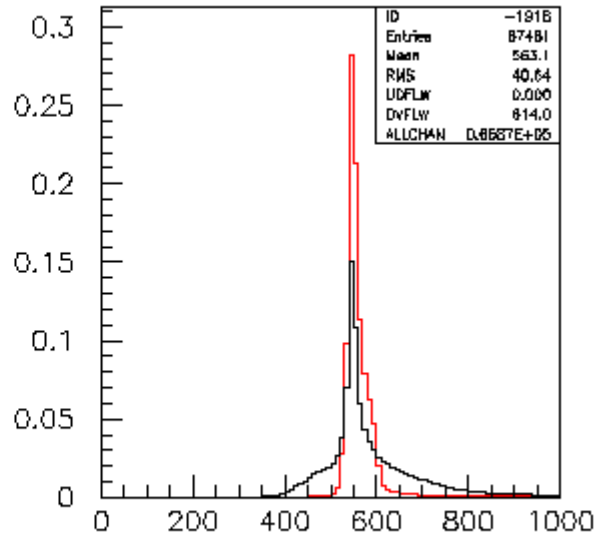


eta invariant mass

Best eta mass among all the four true ($e e \pi \pi$) tracks combinations (reconstructed momenta)

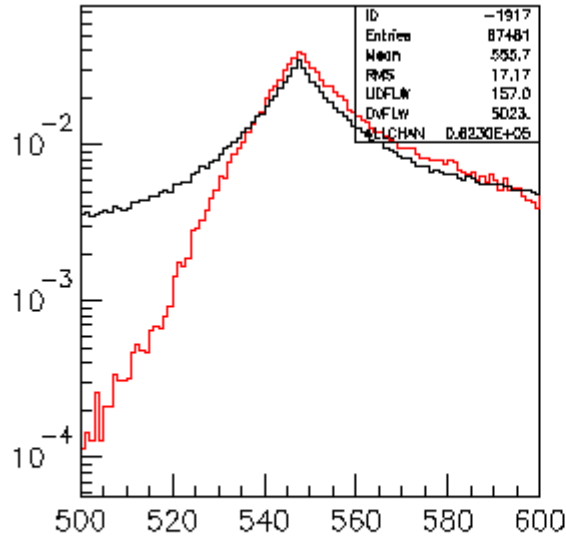


eta invariant mass

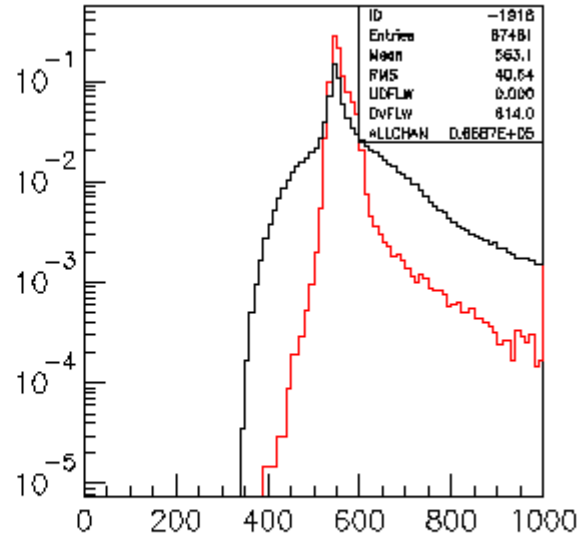


eta invariant mass

Best eta mass among all the tracks combinations (reconstructed momenta)



eta invariant mass



eta invariant mass

Best eta mass among all the four true ($e e \pi \pi$) tracks combinations (reconstructed momenta)

Great expectations

- Find a good combination of cuts
- Use the invariant mass too
- Look for the 363 MeV photon
- Study backgrounds (tons of useless kaons!)
- Buy a new swimsuit

Spare slides

