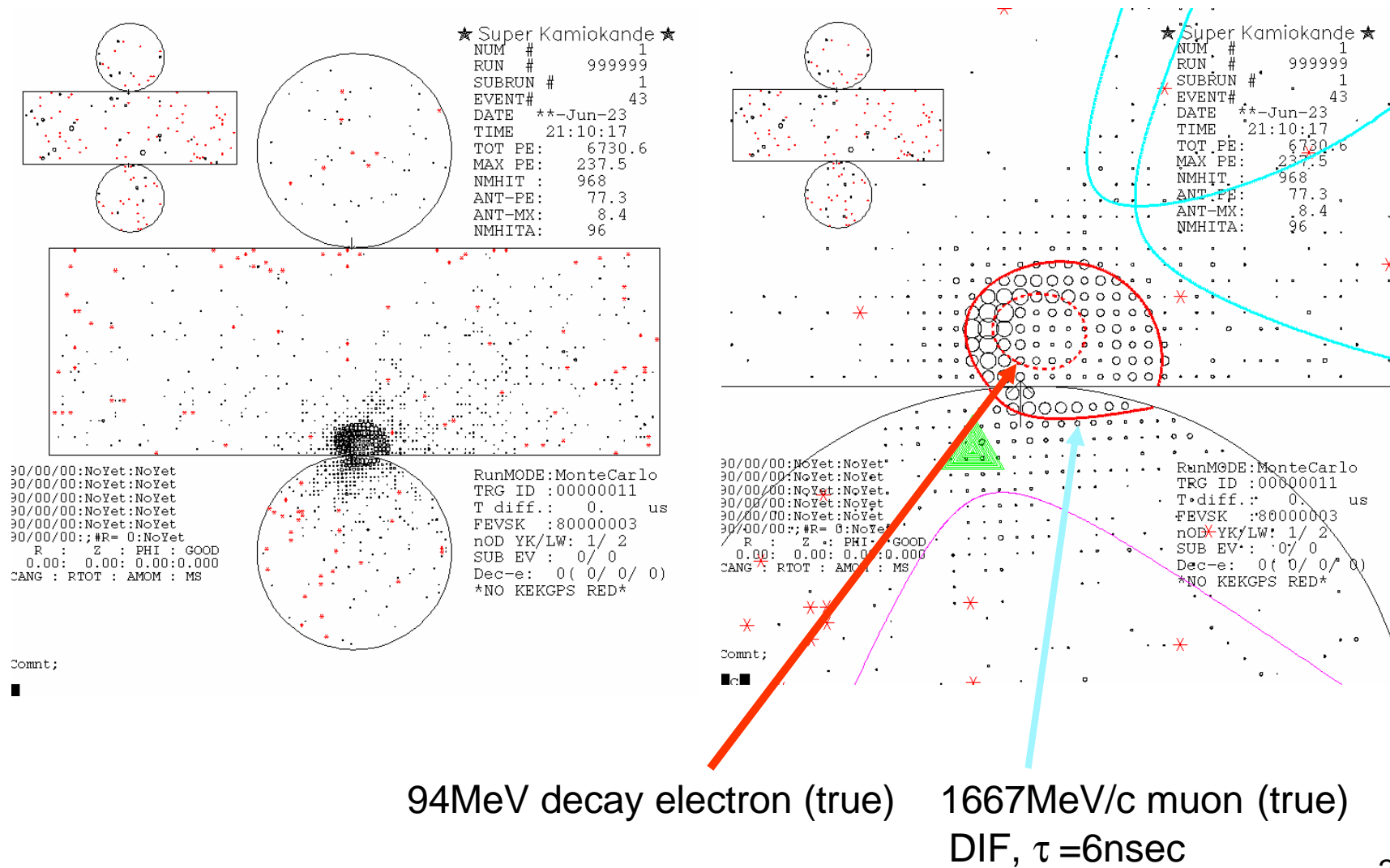


# BG scanning & classification for $\nu_e$ appearance (2)

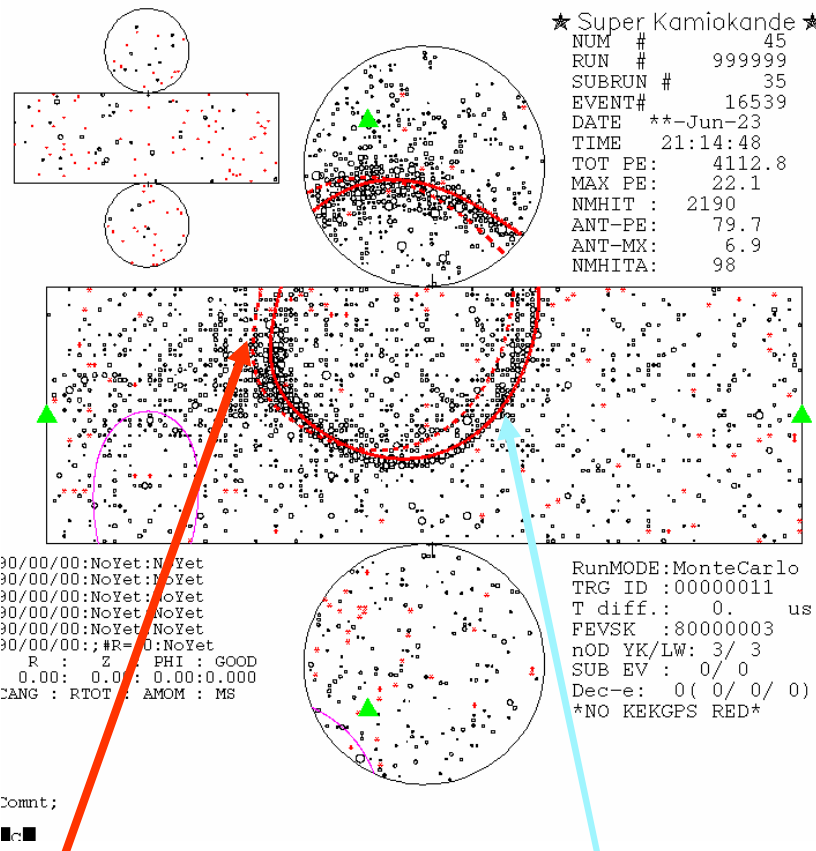
(BG events have been scanned by Obayashi, Shiozawa)

- non-oscillated 209,000  $\nu_\mu$  events in SK 22.5kton fiducial volume (~400kevents in 50kton) have been generated.
- 192 remaining BG after all selection criteria have been scanned.
  - single-ring by eye-scan
    - asymmetric  $\pi^0$  decay or overlapping rings      147 ev(77%)
    - mis-ID muon (single ring)      20 ev(10%) – Decay In Flight 5 ev
  - multi-ring by eye-scan
    - multi-ring classified by eye-scanning      25 ev(13%)
- possible further rejection by improvements of the reconstruction
  - 20 mis-ID muons (5DIF + 15DAT)
  - 2<sup>nd</sup> ring is tagged for 25 events
  - suppression by  $\nu_\mu$  oscillation is not considered here
- interaction modes
  - CC 27events (14%) and NC 165events (86%)
  - NC single  $\pi^0$  production is 132ev (69%)

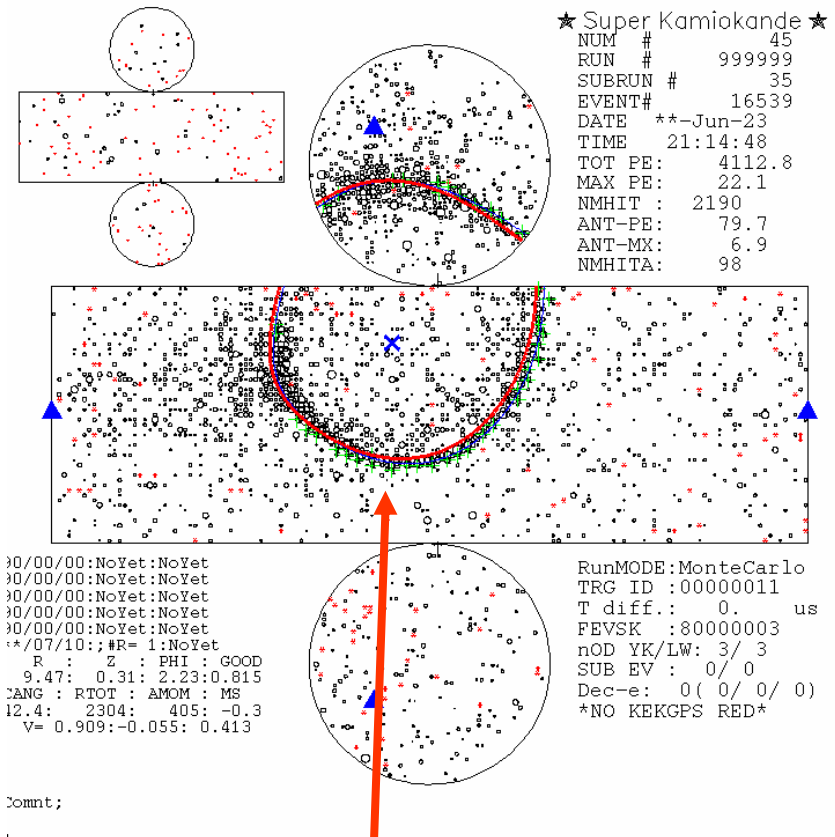
# Mis-ID muon (1), DIF



# Mis-ID muon (2), DIF

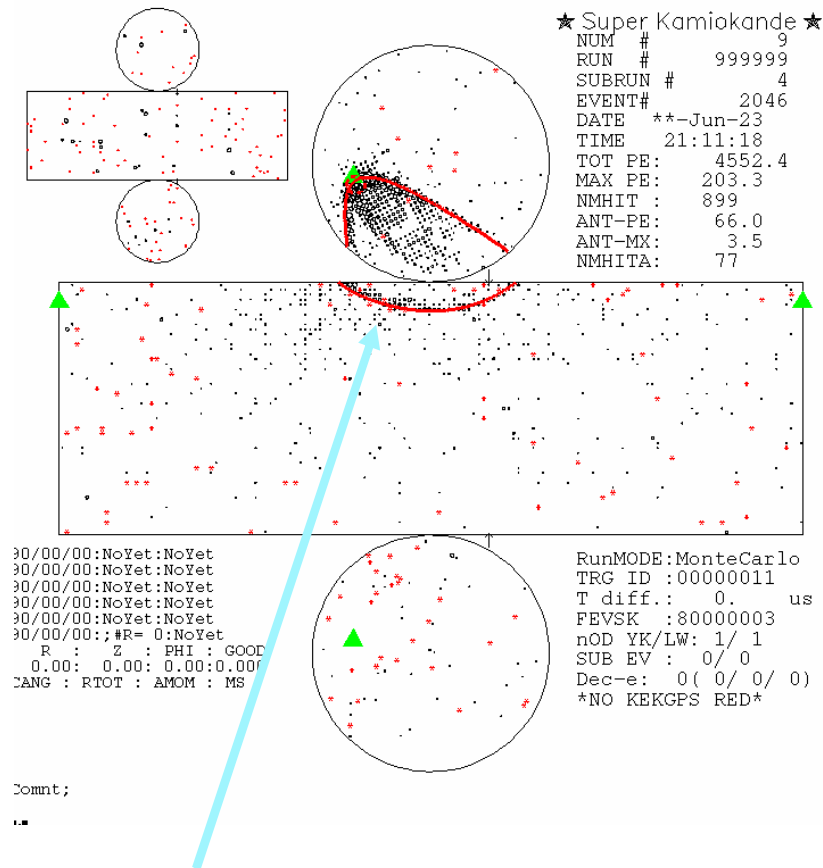


235MeV electron (true)

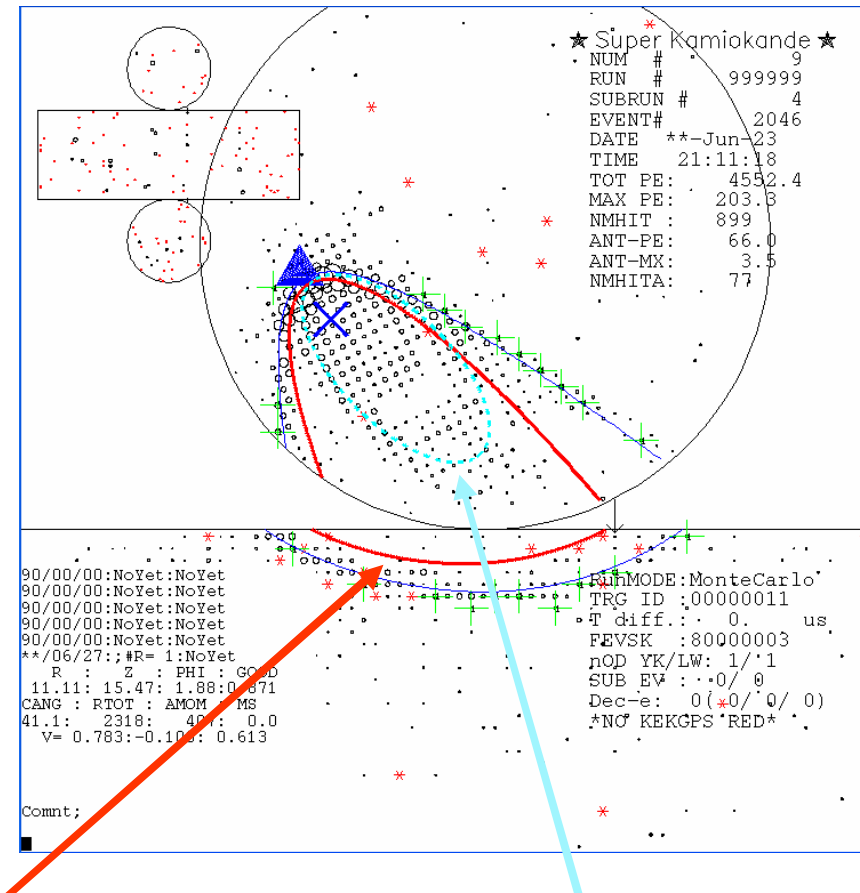
489MeV/c muon  
DIF,  $\tau = 3\text{nsec}$ 

fitted ring (single-ring e-like)

# Mis-ID muon (3), mis-reconstruction



601 MeV/c muon  
 True info.

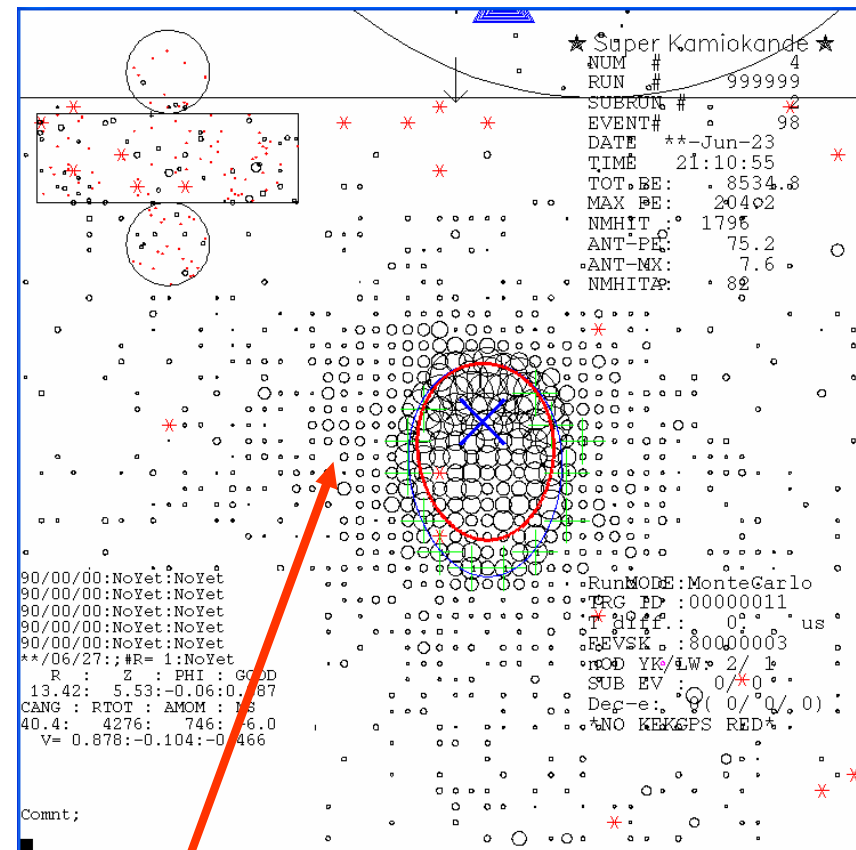
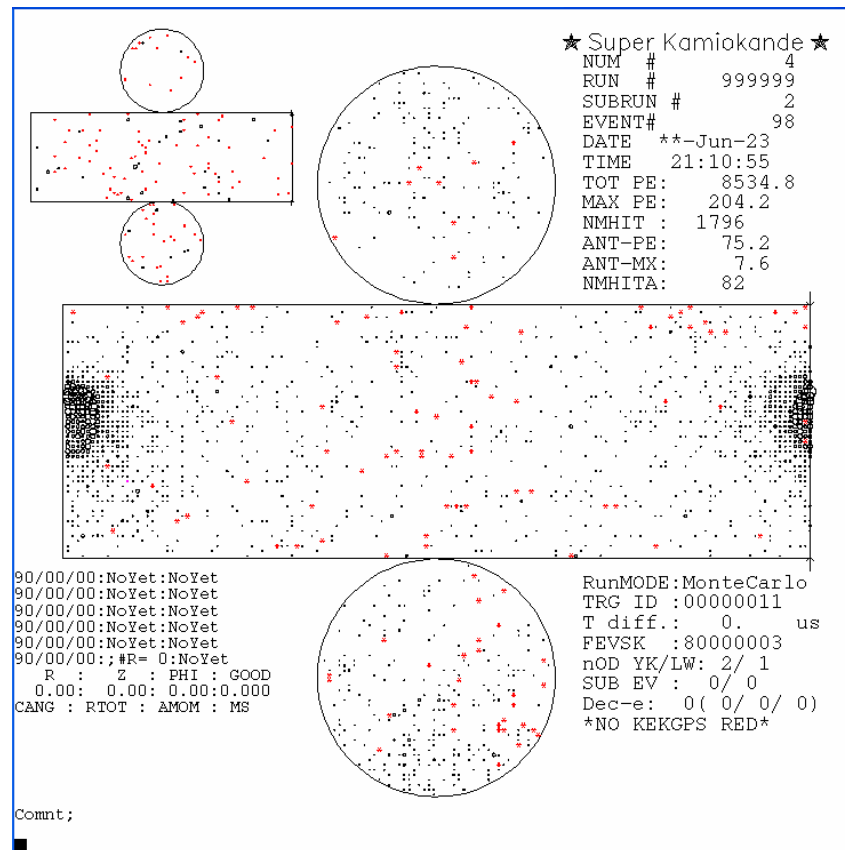


e-like fit  
 e-like by angle likelihood

mu-like fit

# Multi-ring by eye-scanning (1)

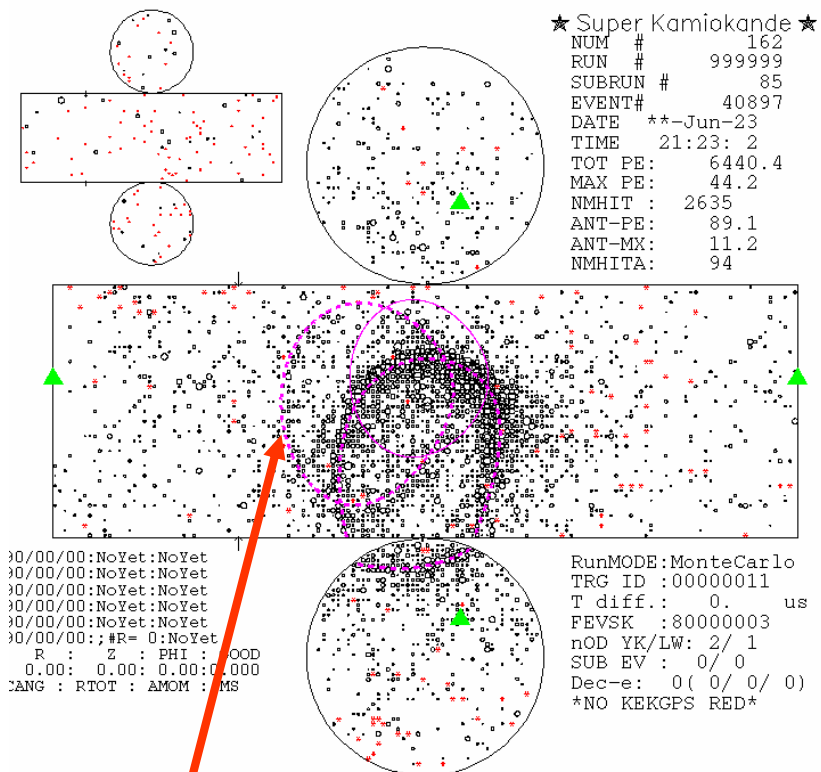
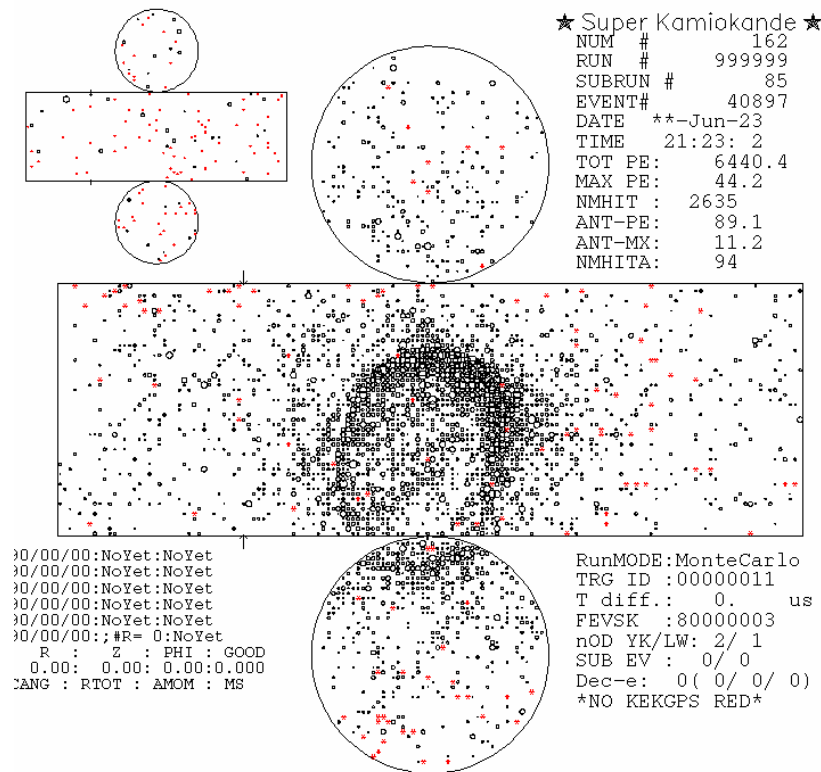
## 2 scanners categorized as 2-ring events



2<sup>nd</sup> ring is not reconstructed.  
787MeV+73MeV

# Multi-ring by eye-scanning (2)

2 scanners categorized as 2-ring events



2<sup>nd</sup> ring is not reconstructed.  
 615MeV+83MeV

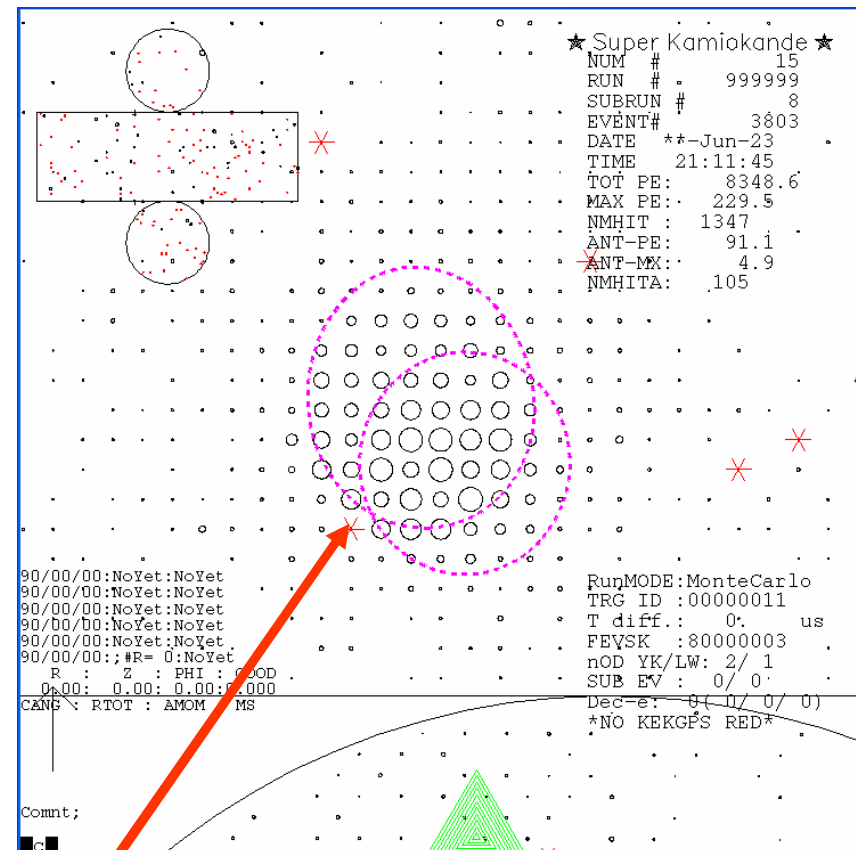
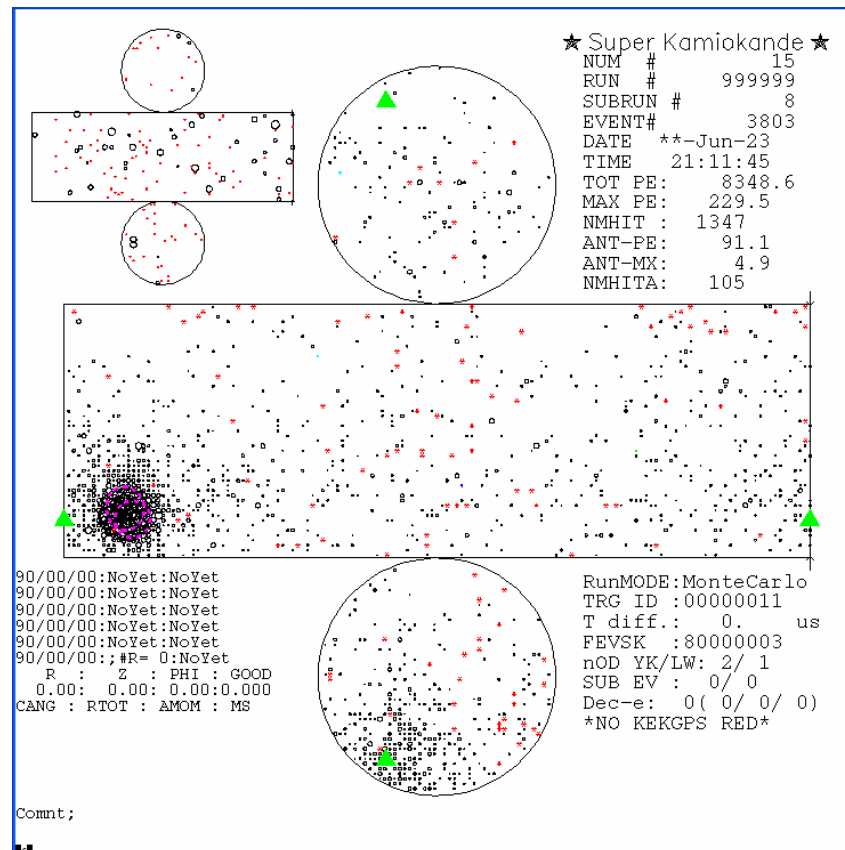
# neutrino interaction modes

Total 192 BG (non-oscillated  $\nu_\mu$ , beam  $\nu_e$  is not included)

- Charged Current 27ev (14%)
  - QE 17ev
  - $\mu\pi^0$  4ev,  $\mu\pi^+$  3ev
  - $\mu$ &multi- $\pi$  3ev
- Neutral Current 165ev (86%)
  - single  $\pi^0$  118ev, coherent  $\pi^0$  14ev ----- 132ev, 69%
  - single  $\pi^-$  4ev, single  $\pi^+$  5ev ---  $\pi$ 's secondary interactions in water
  - multi-  $\pi$  production 23ev
  - elastic  $\nu N \rightarrow \nu N$  1ev ----- N produces  $\pi^0$  in water

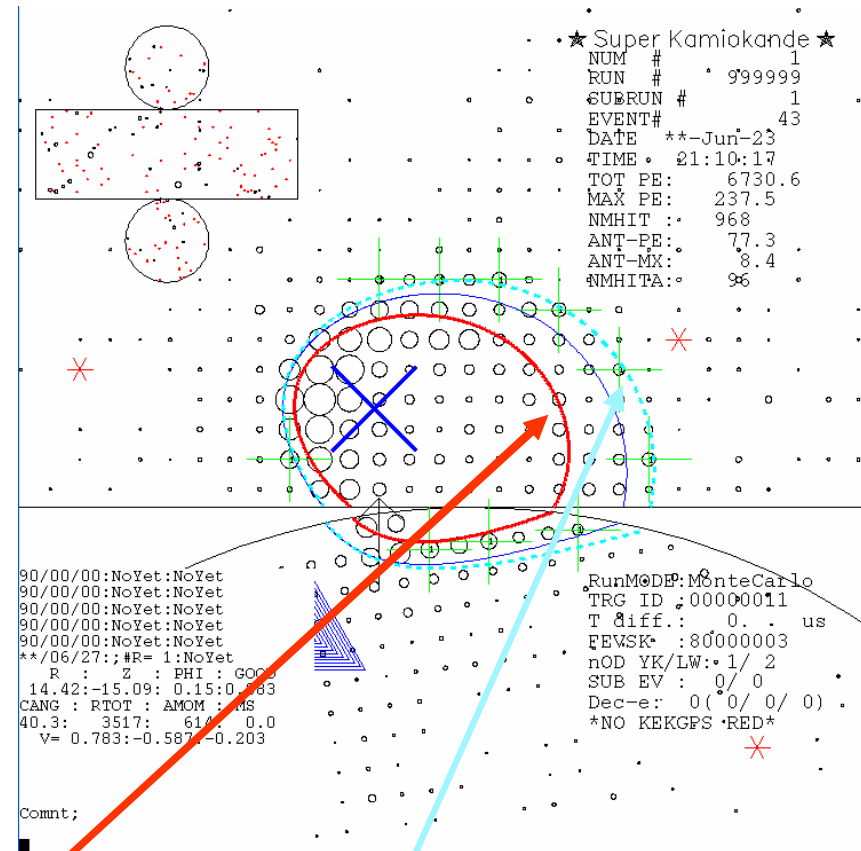
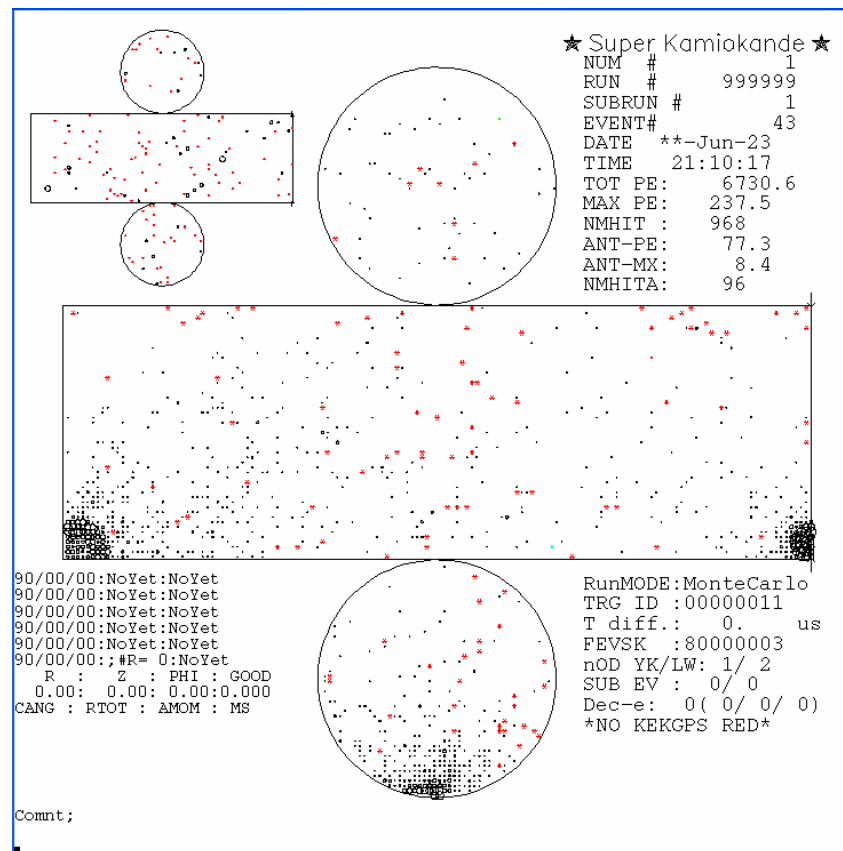
# Supplements

# Overlapping gammas



$\pi^0 \rightarrow 2\gamma(578+271\text{MeV})$   
reconstructed as a 1-ring event

# Mis-ID muon (1)

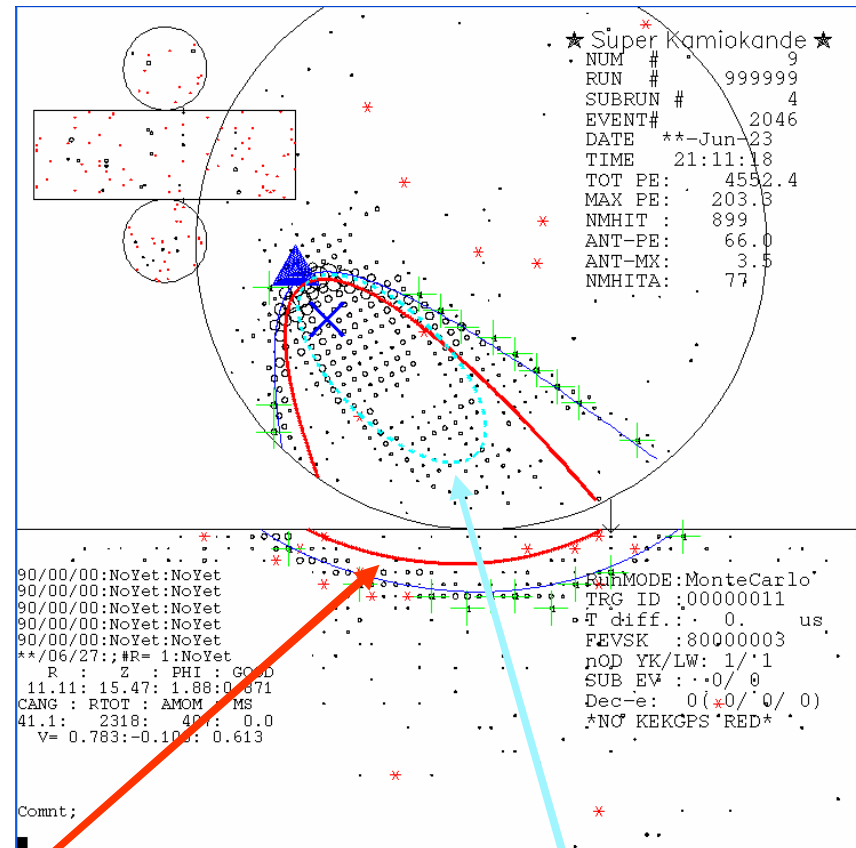
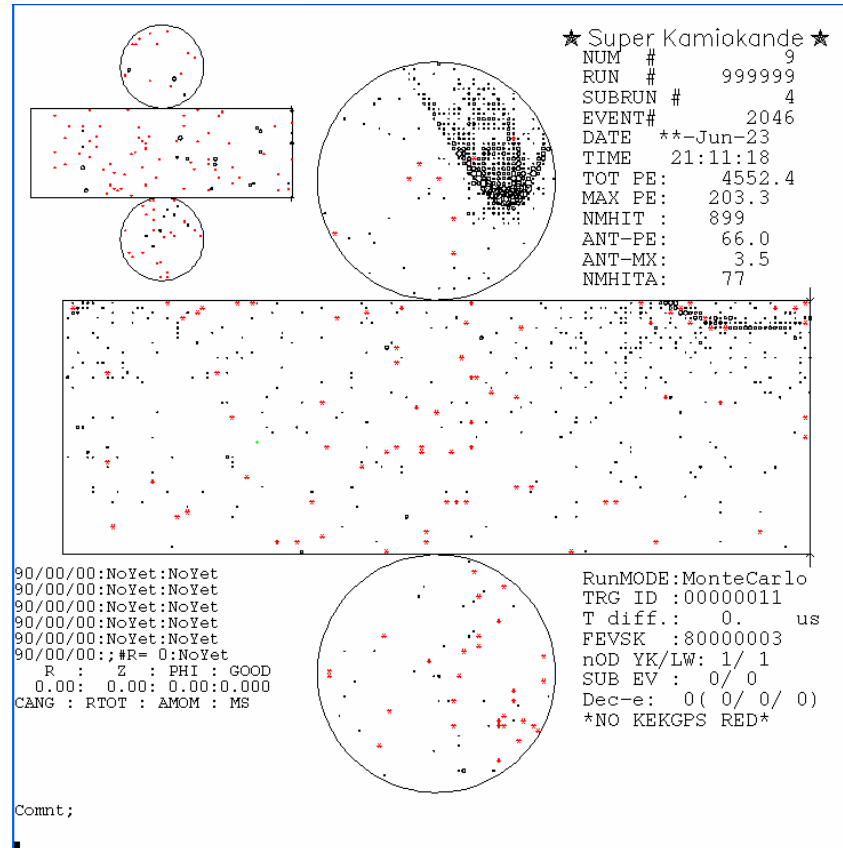


e-like fit

mu-like fit

## e-like by pattern likelihood

## Mis-ID muon (2)



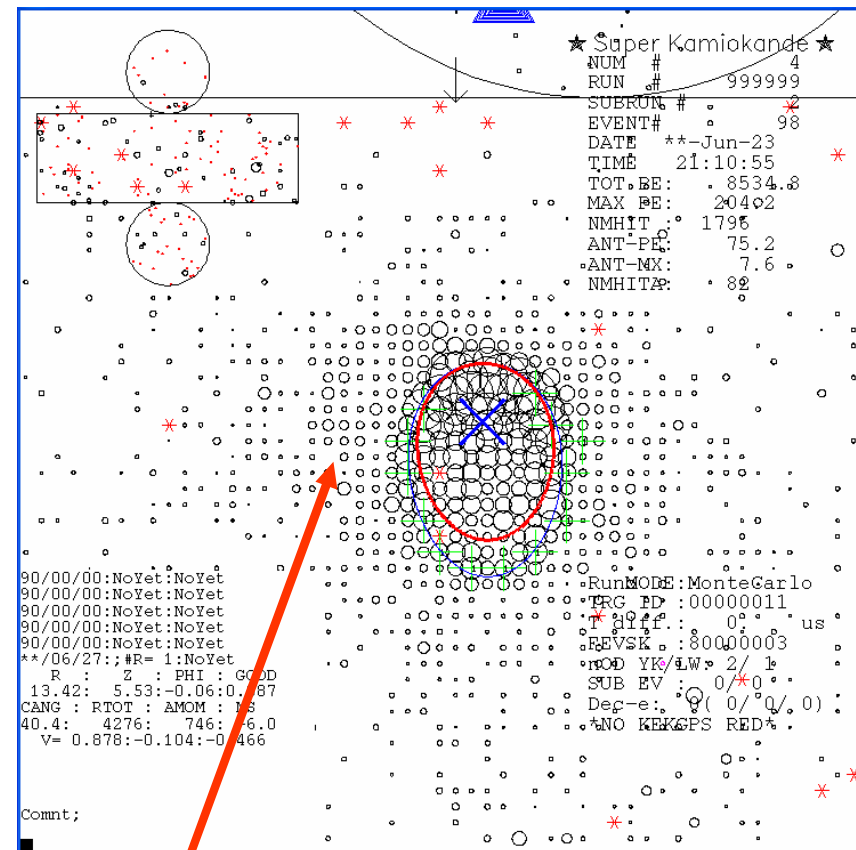
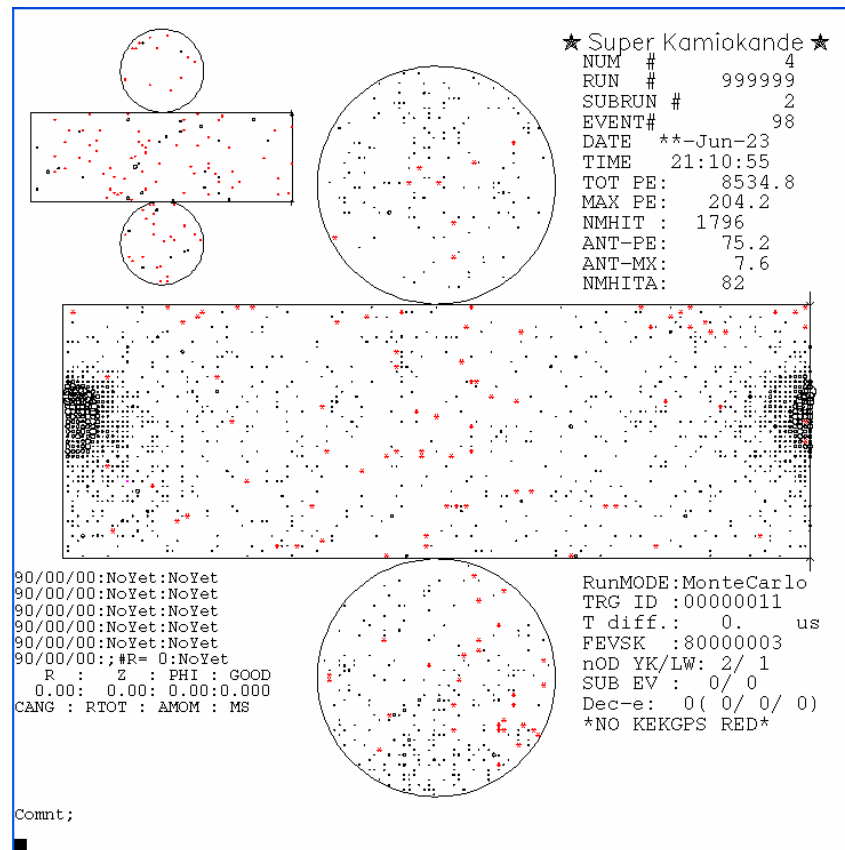
e-like fit

## e-like by angle likelihood

mu-like fit

# missing ring (1)

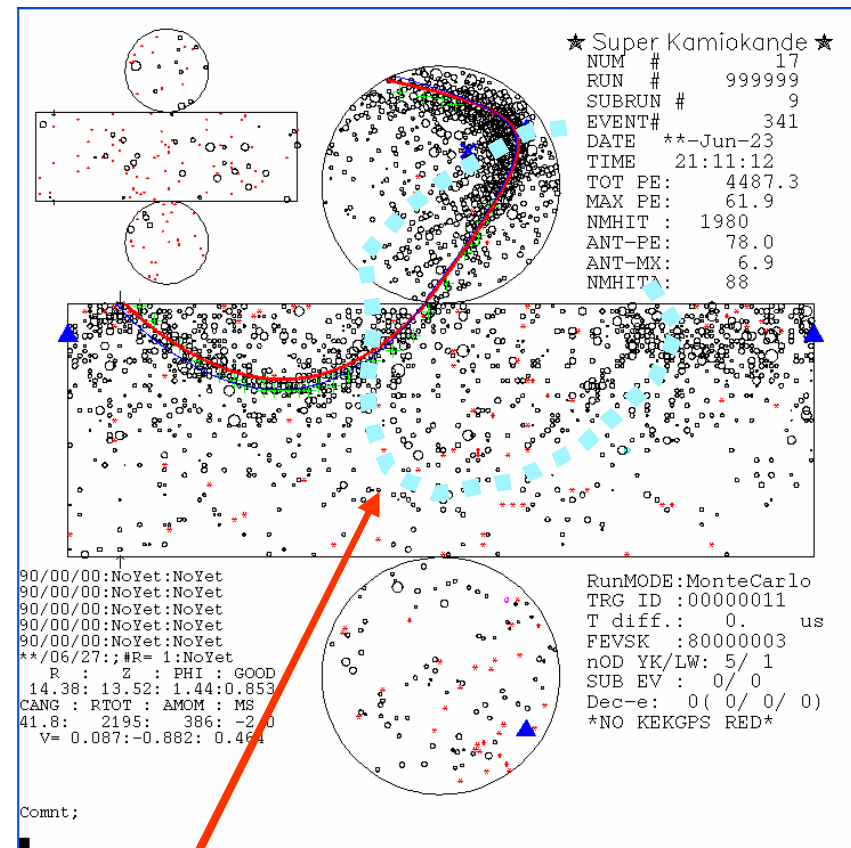
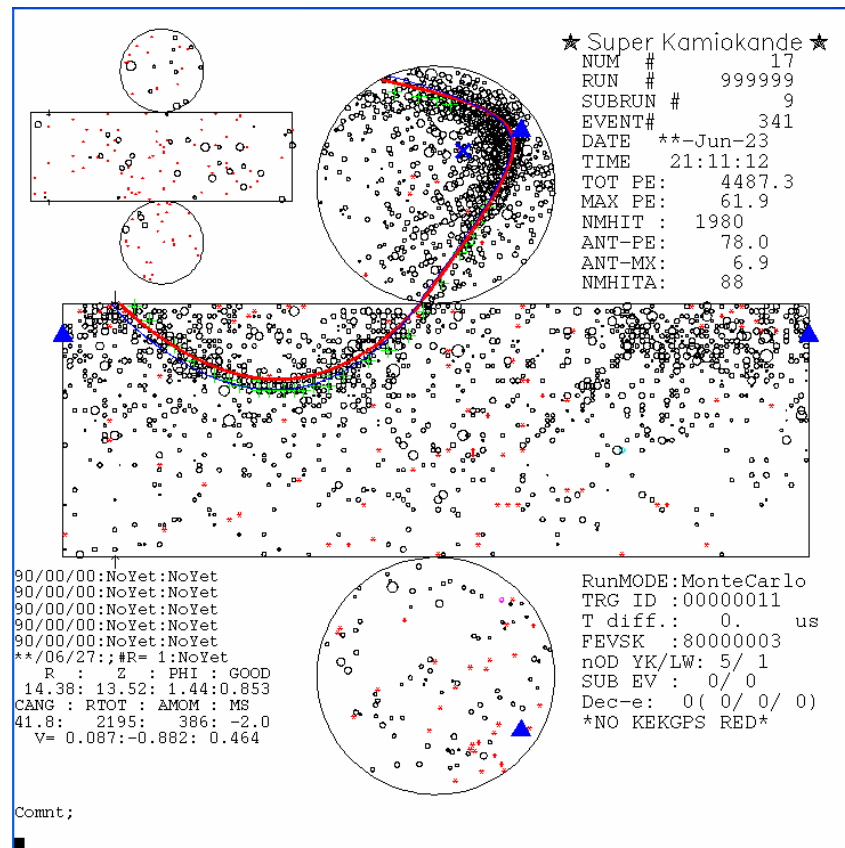
### 3/3 scanners categorized as 2-ring events



2<sup>nd</sup> ring is not reconstructed.  
787MeV+73MeV

# missing ring (2)

2.5/3 scanners categorized as 2-ring events



2<sup>nd</sup> ring is not reconstructed.  
385MeV+42MeV