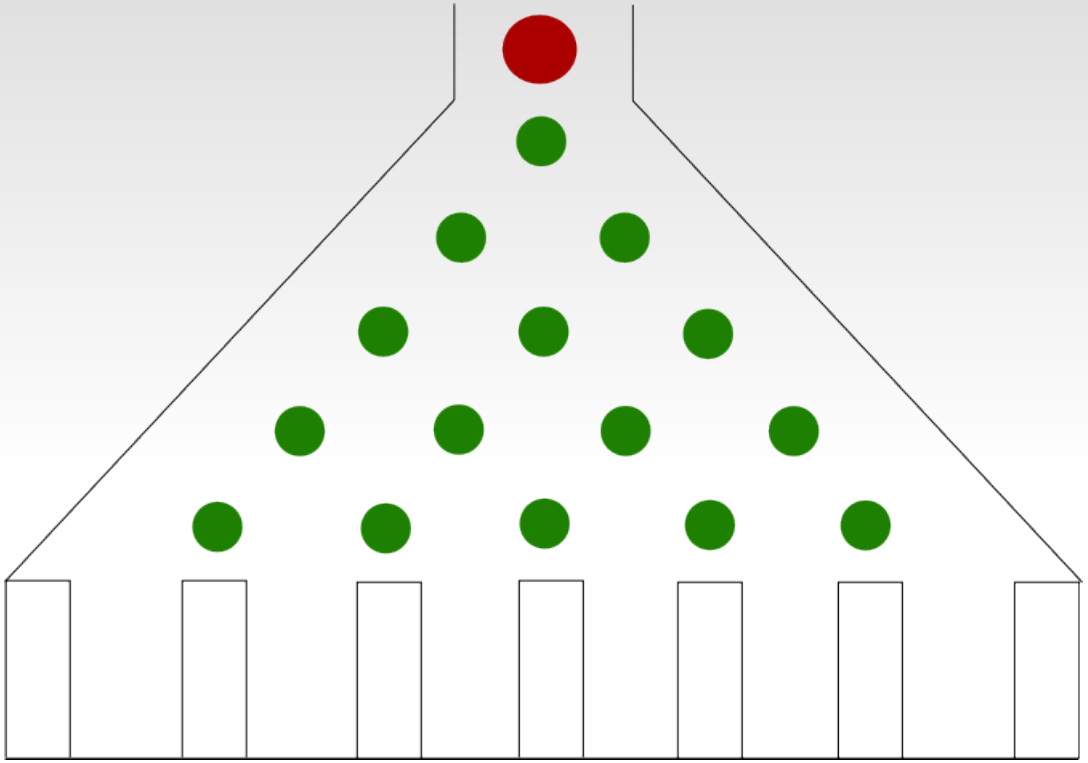
EMP online filters



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Contents:

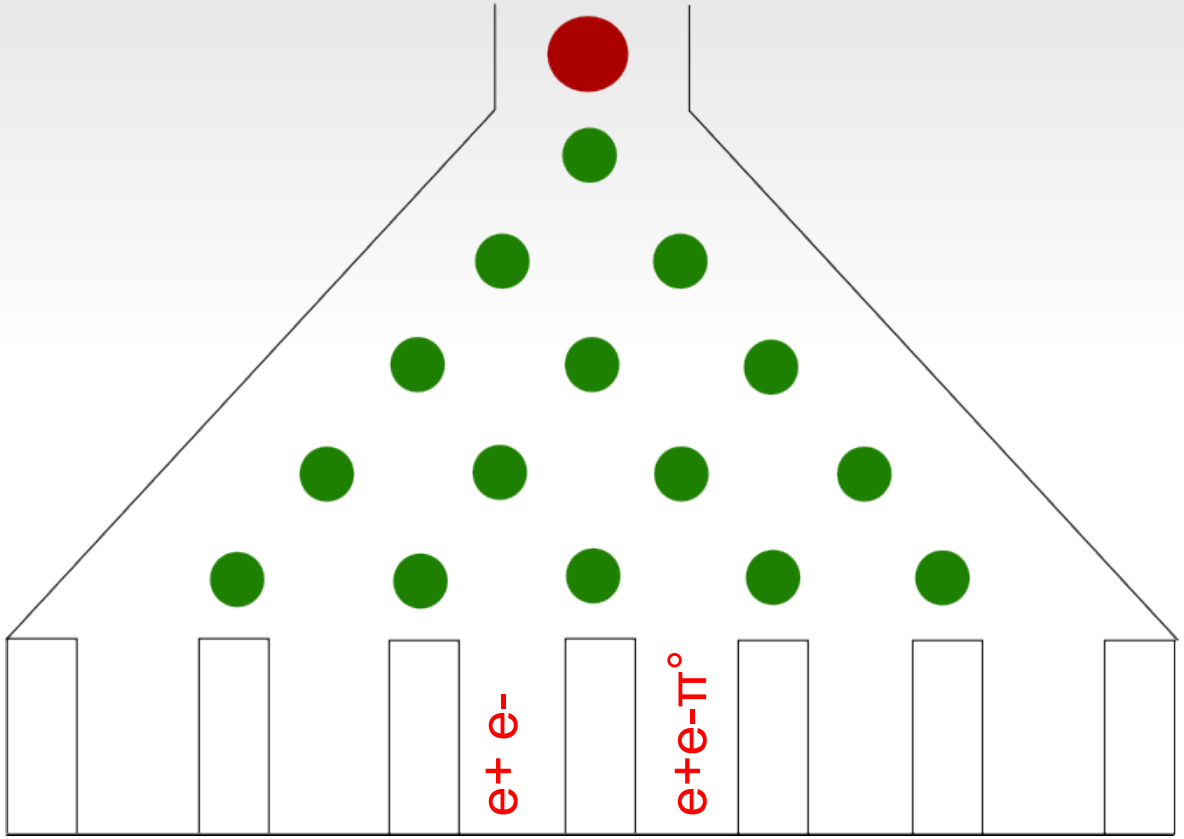
- Readout principles
- Consequences for the EMC and
  Electro-Magnetic Processes
- Towards an EM filter ?

Readout principles

Readout principles

- No hardware trigger

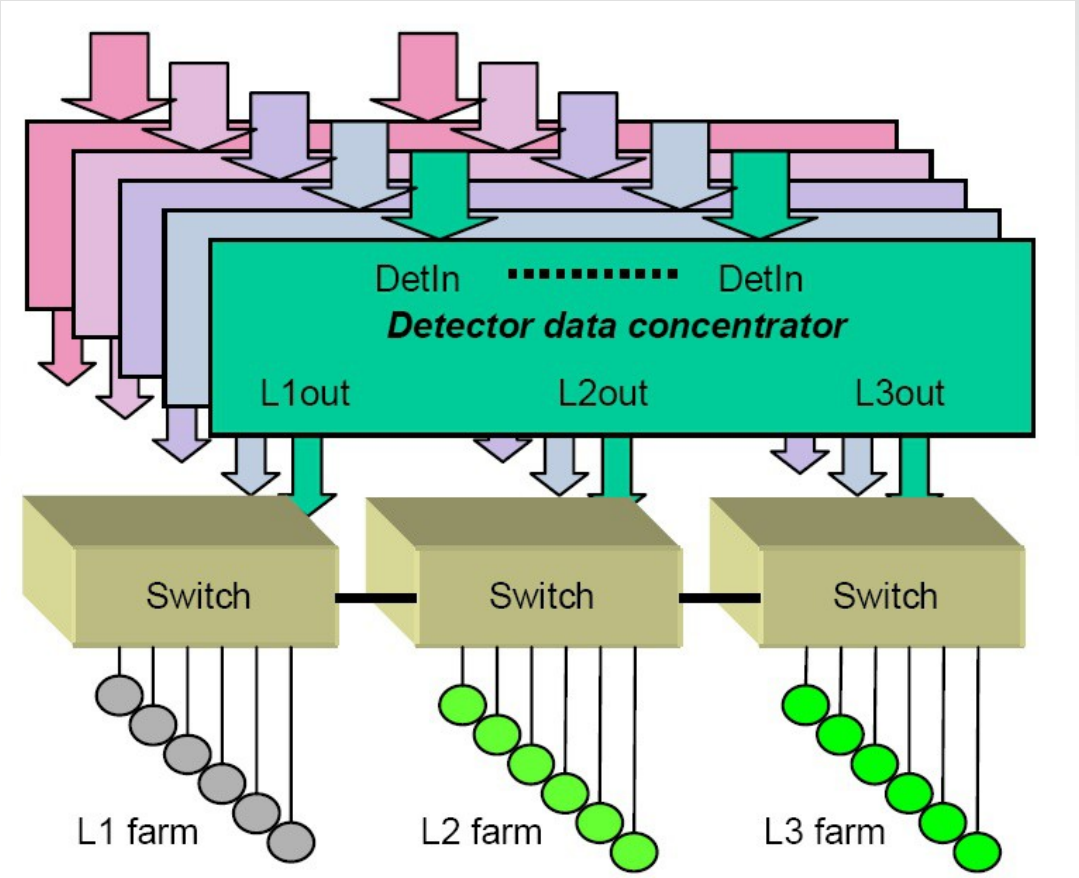
- But an event filter



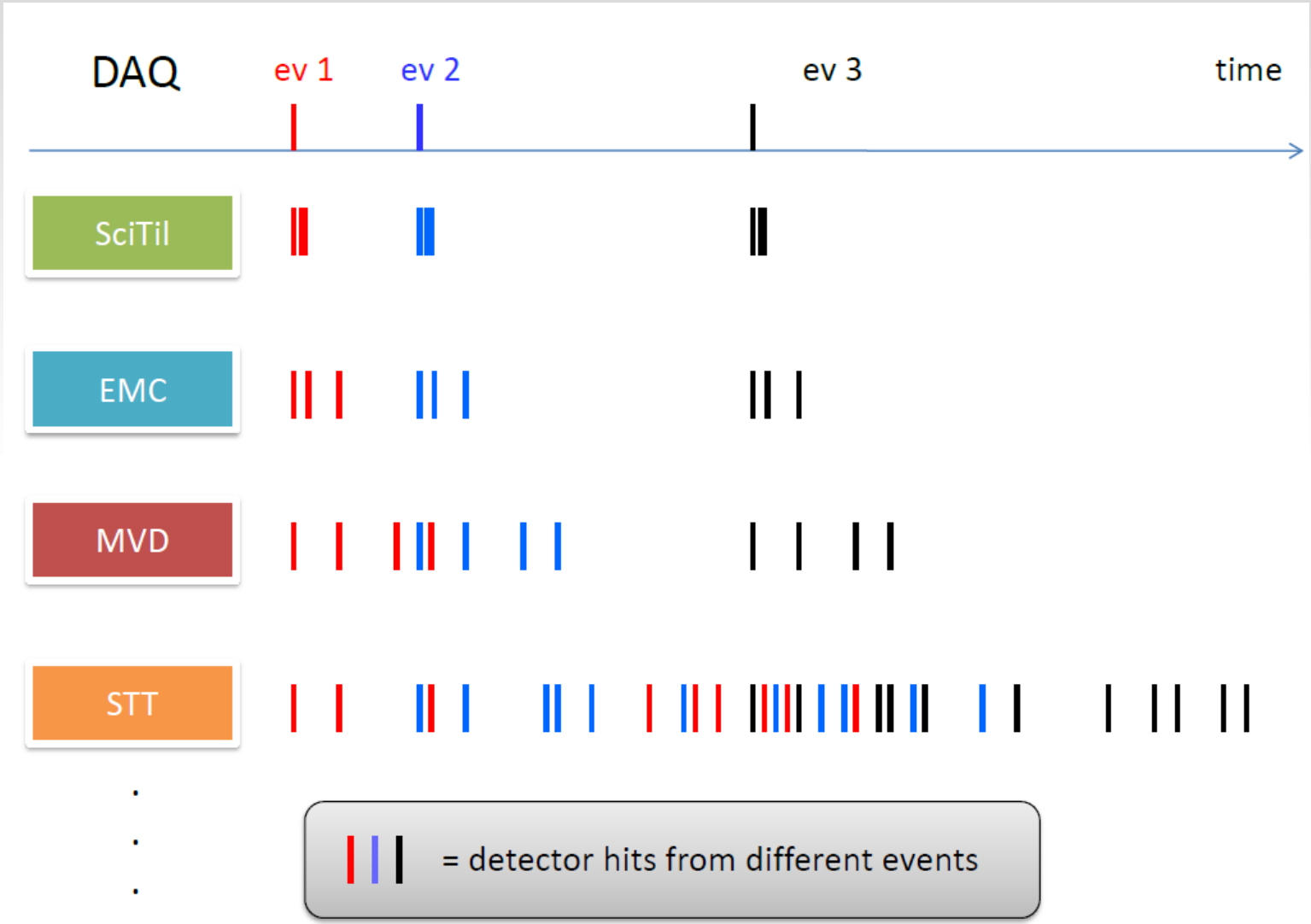
Readout principles

- raw data are streaming into DAQ
- data reduction 1000x using online reconstruction
- algorithms programmed on FPGAs on Compute Nodes

(Field Programmable Gate Arrays)

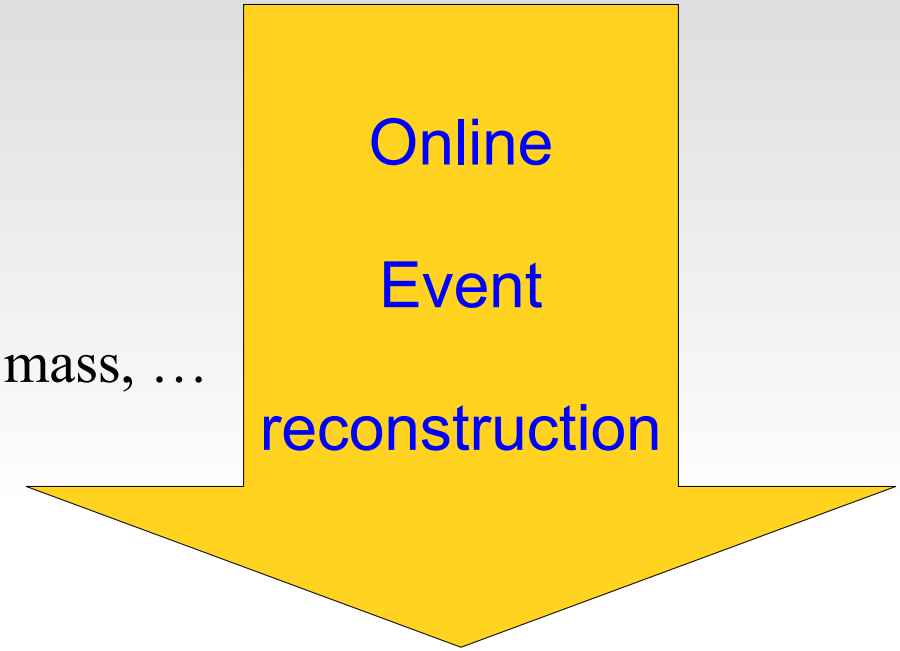


Detector responses are dispersed in time



PANDA processing stages

- Detector raw data collection
- Cluster finding, hit building
- Track finding
- Track feature extraction: Momentum, mass, …
- Event building



- Filter decision <= most event rejection only this late!
- Write to disk

Consequences for the EMC and Electro-Magnetic Processes

Efficient event selection

Signal:

- $\bar{p}p \rightarrow e^+e^-$
- $\bar{p}p \rightarrow e^+e^- \pi^0$
- $\bar{p}p \rightarrow e^+e^- X$
- $\bar{p}p \rightarrow Y(4260) \rightarrow J/\psi\, \pi^0\pi^0$

  $J/\psi \rightarrow e^+e^-$

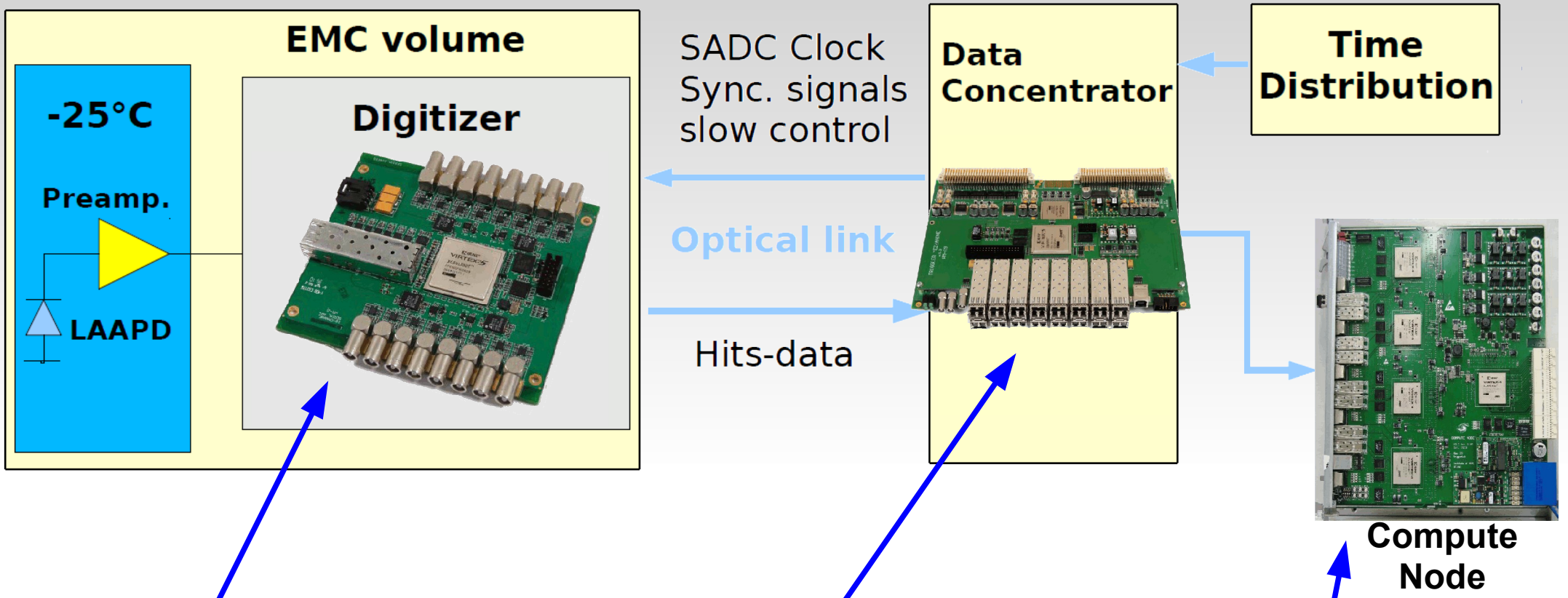
Background:

- $\bar{p}p \rightarrow \pi^+ \pi^-$ n π^0
- $\bar{p}p \rightarrow J/\psi\, \pi^+ \pi^- \pi^0\pi^0$
- $\bar{p}p \rightarrow J/\psi\, \eta\eta$
- $\bar{p}p \rightarrow J/\psi\, \pi^+ \pi^- \pi^0\pi^0$

This requires:

- Efficient and clean electron/positron identification
- Precise reconstruction of final states with π^0

EMC Readout



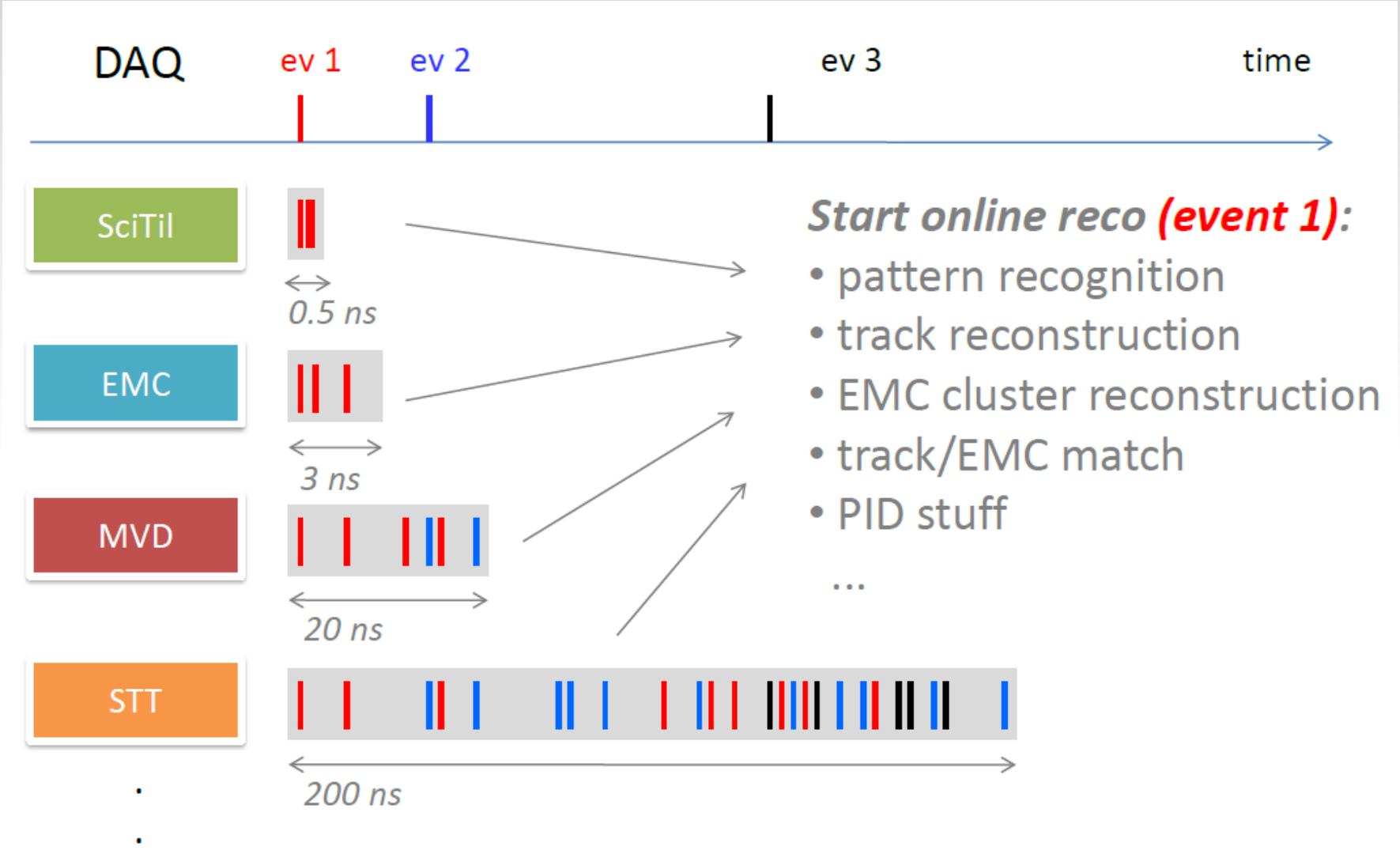
Online pulse/data processing & Feature extraction

Event pre-building Pile-up recovery

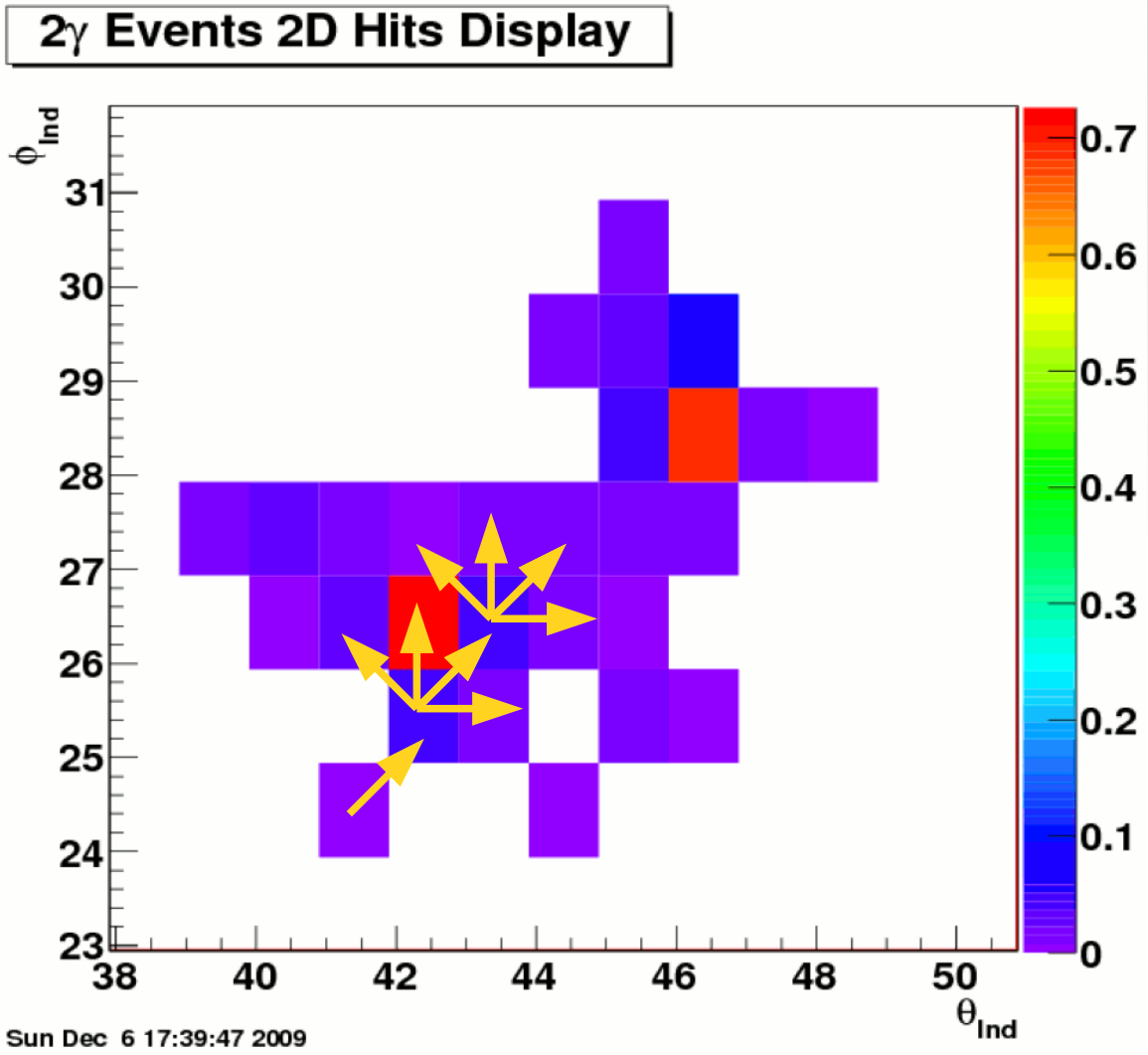
Time sorting Clustering Pattern recognition

M. Kavatsyuk, Groningen

Use info when it comes



Efficient cluster finding

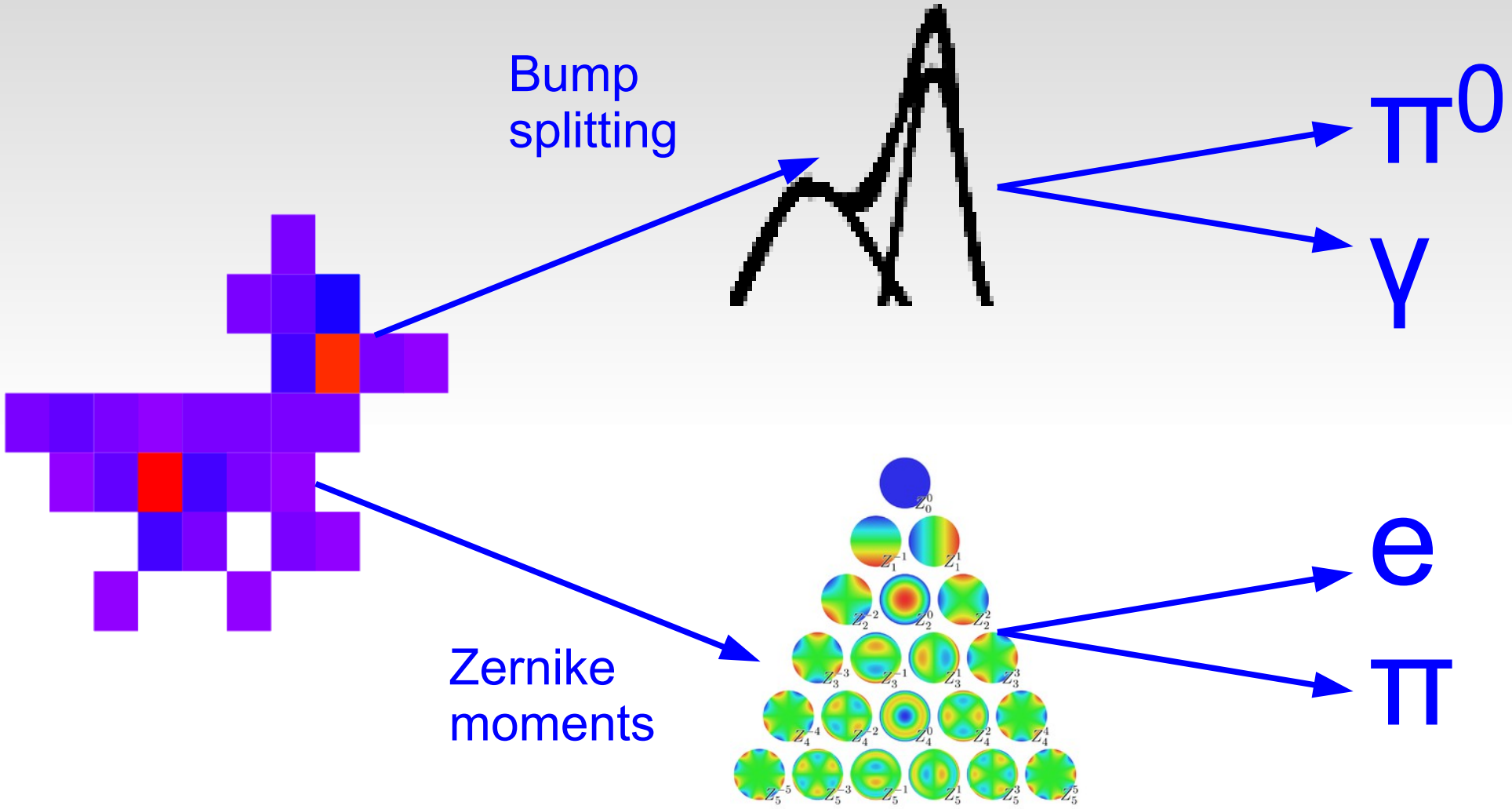


2D Mapping followed by
Spread neighbour searching
Local Maximum Finding

All in one pass

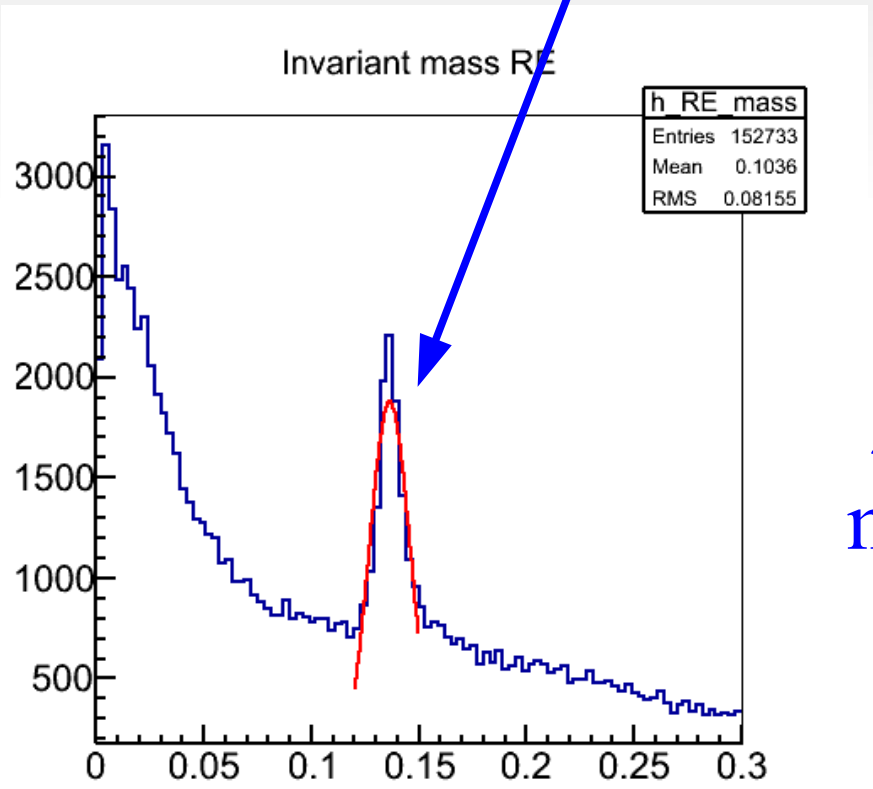
Qiang Wang, Beijing

...and pattern recognition

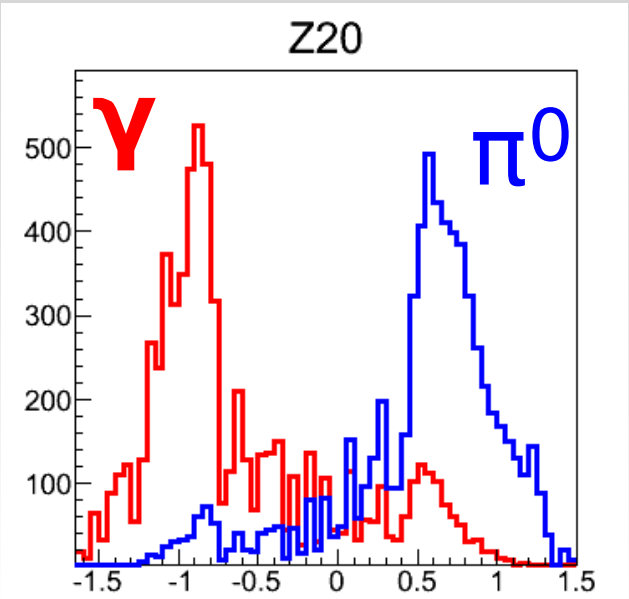


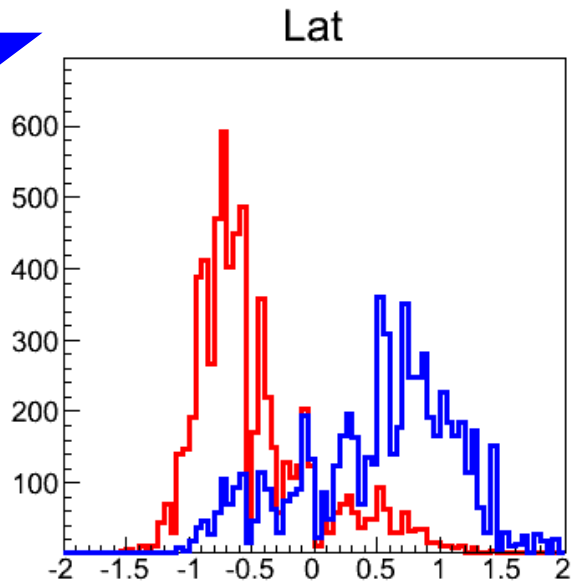
π^0/γ separation

Combining γ clusters



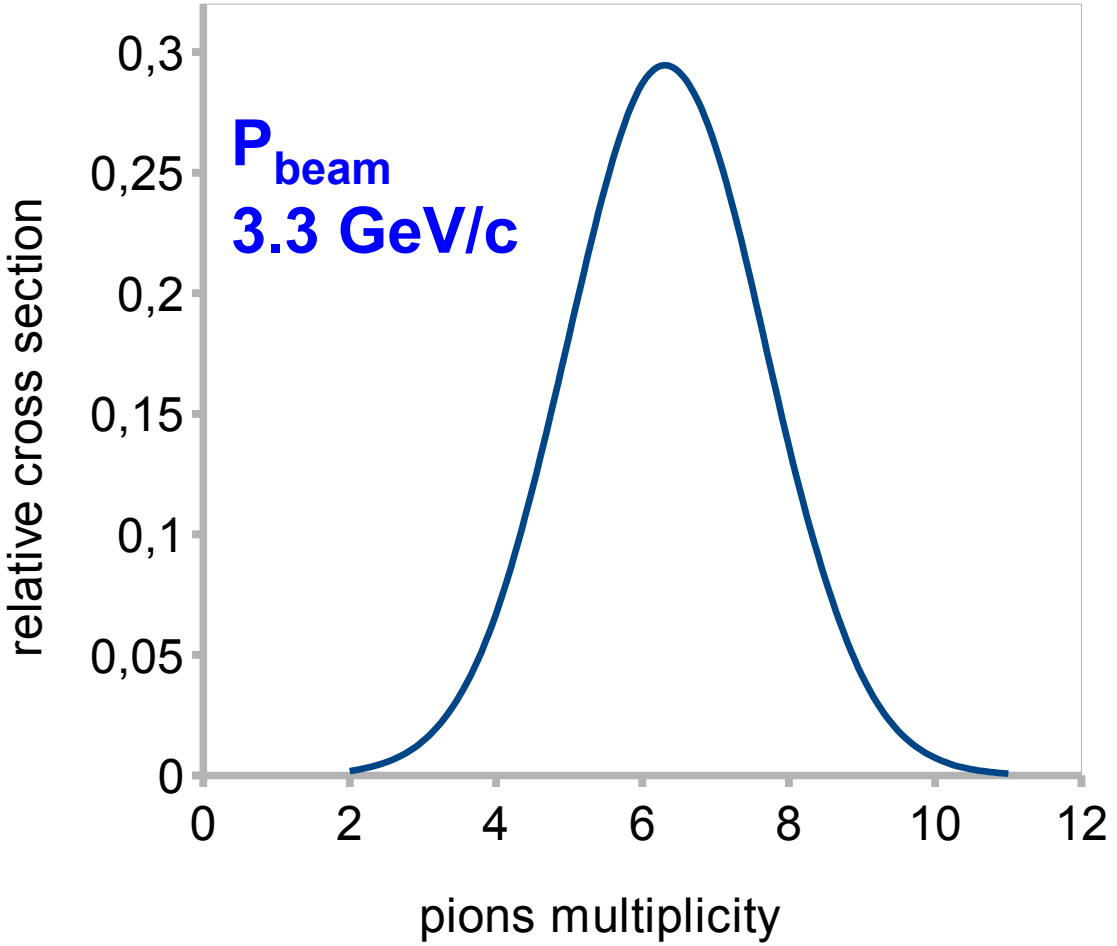
With Zernike moments





Towards an EM filter ?

Multipions are the problem



$\pi^+ \pi^-$: 0.01 mb

6 pions: **20** mb !

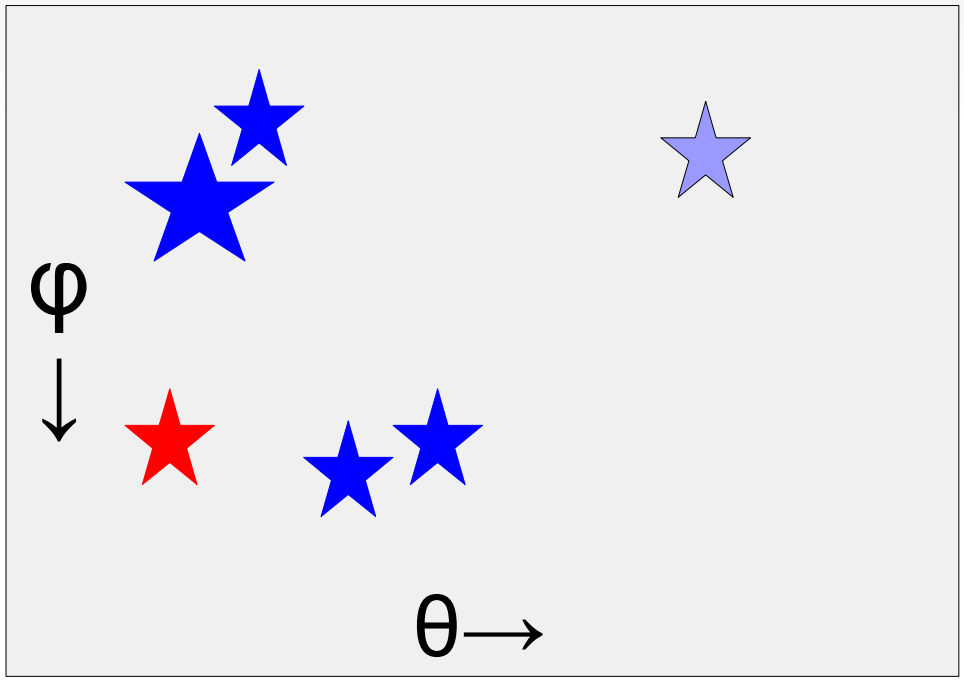
Effective selection of EM events is needed!

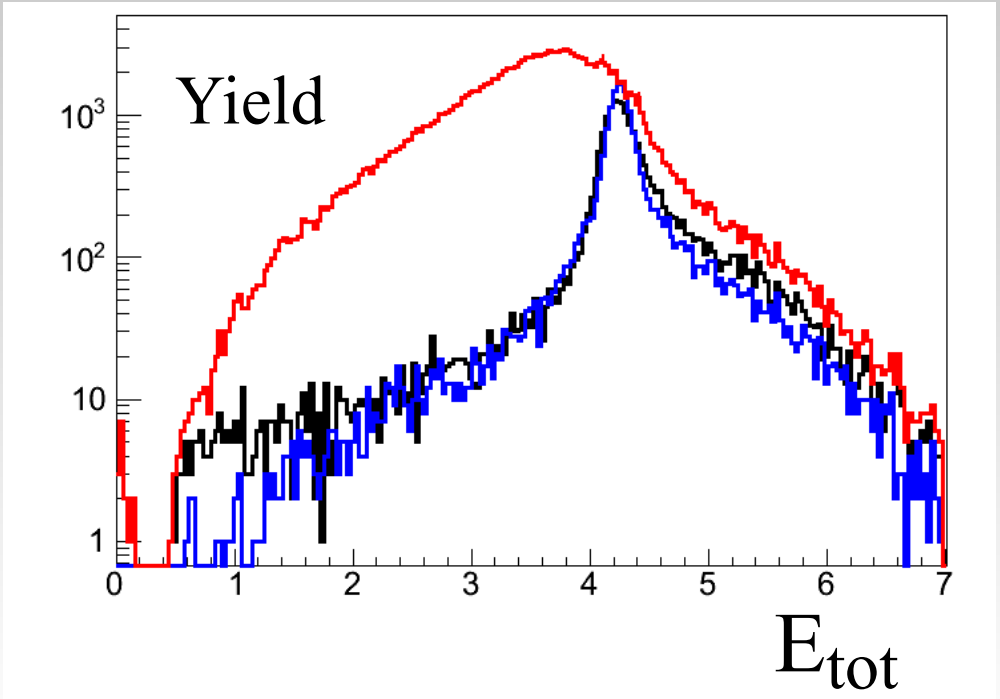
“Quick” filter simulation

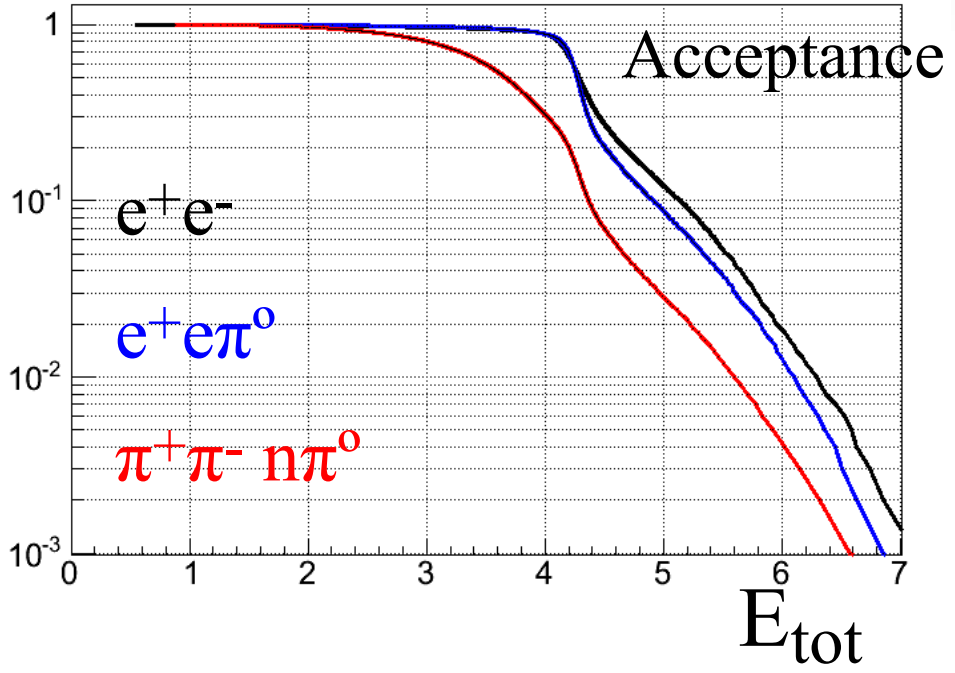
- $P_{beam} = 3.3$ GeV/c
- e^+e^-, $e^+e^-\pi^o$, $\pi^+\pi^-$ and $\pi^+\pi^-\ n\pi^o$ Phase Space events
- Use E/p distributions for EMC cluster energy
- Generate gammas
- Look for useful variables to eliminiate multipions
- Cuts: $0.2<p<5$ GeV/c, $5°<\theta<140°$

Total energy

$E_{tot}(EMP) > E_{tot}(hadrons)$

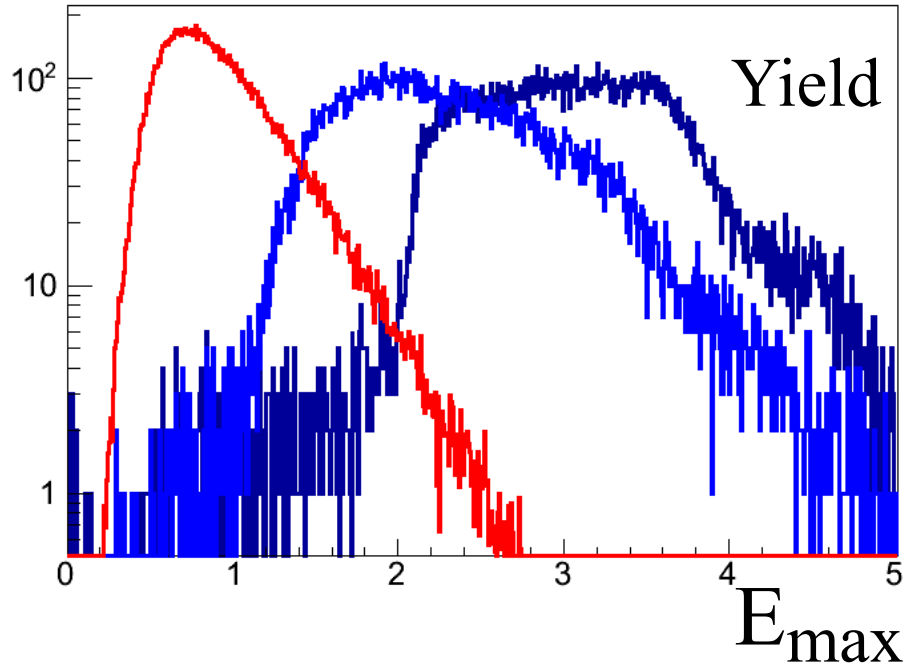


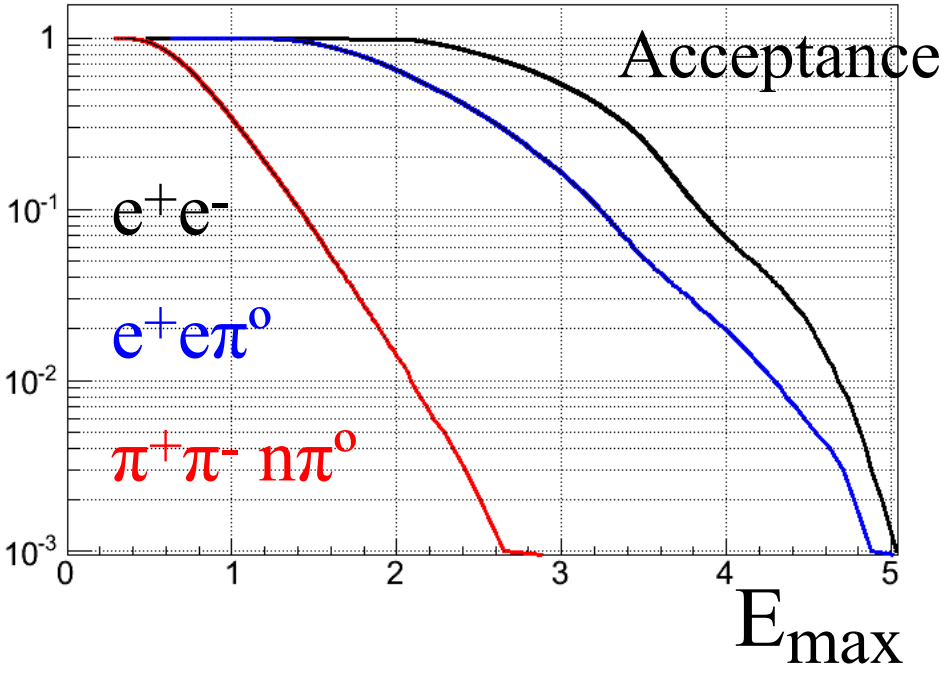




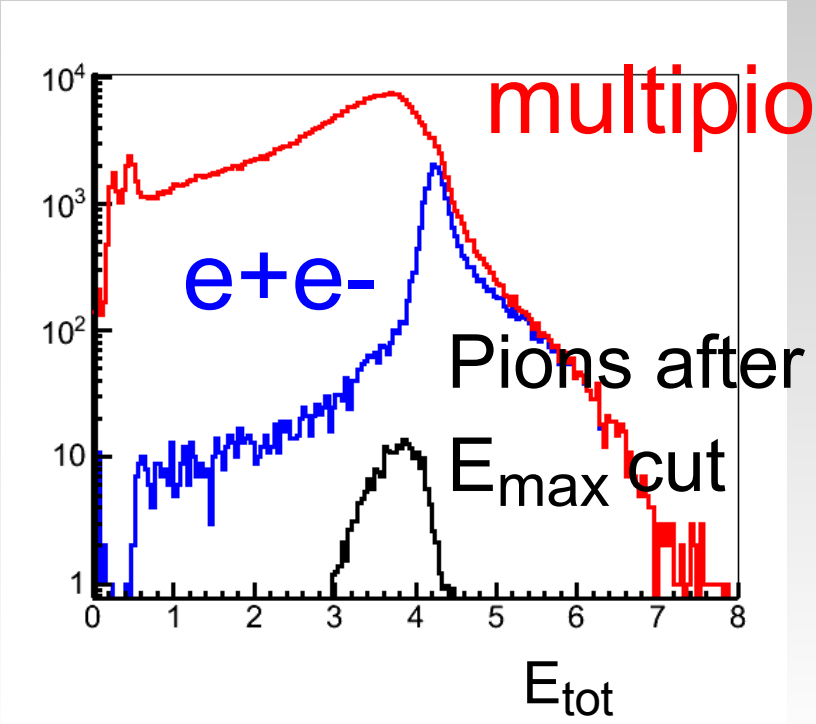
Maximum energy cluster

$E_{max}(EMP) > E_{max}(hadrons)$

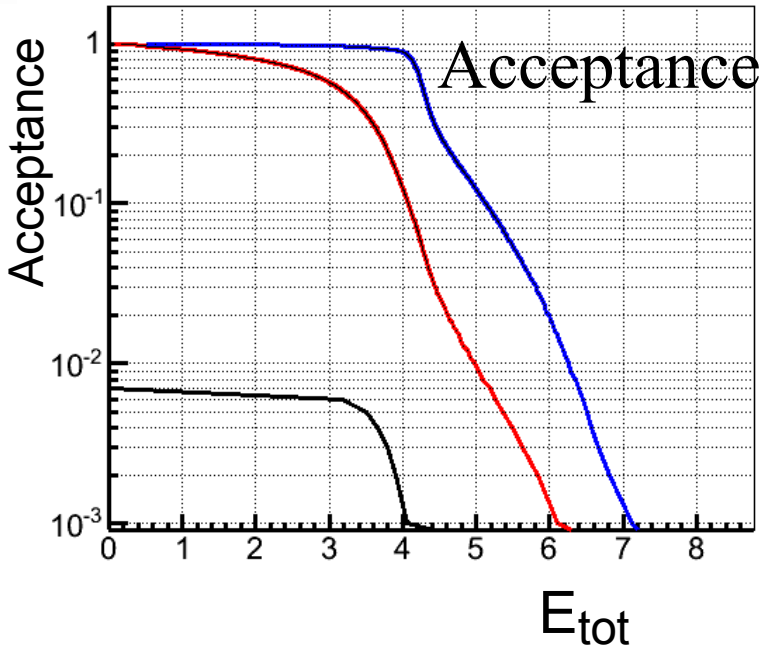




Combining works even better



E_{max} > 2.4 GeV and E_{tot}>4 GeV



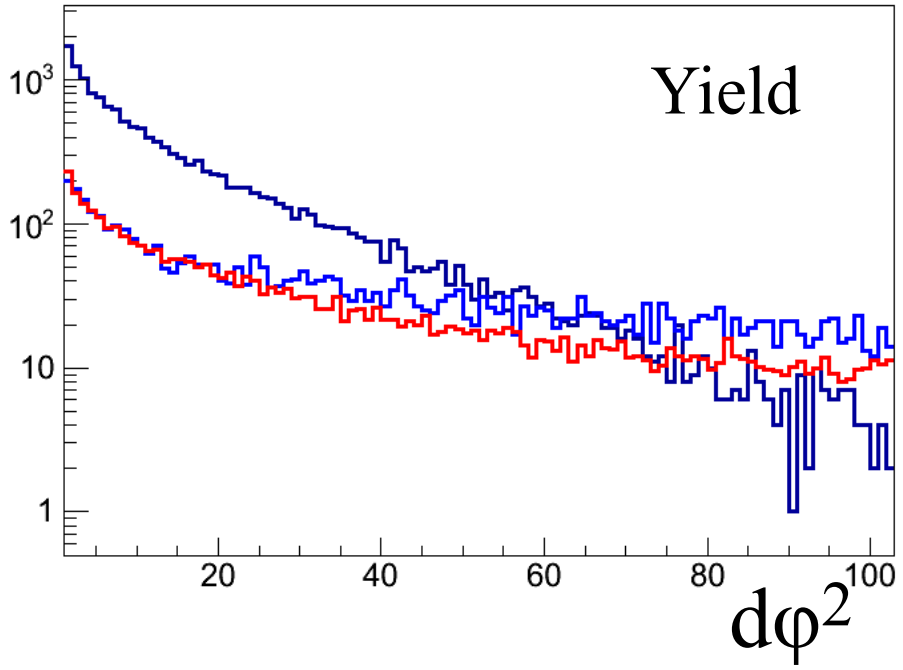
e^+e^-:
Efficiency: 80%

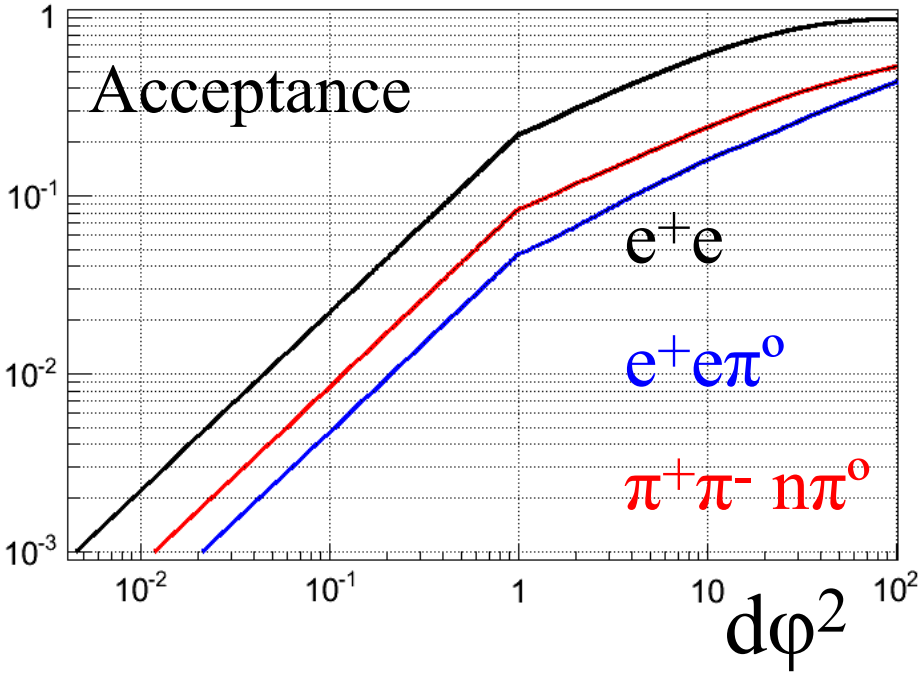
Background divided by 10^3

Coplanarity

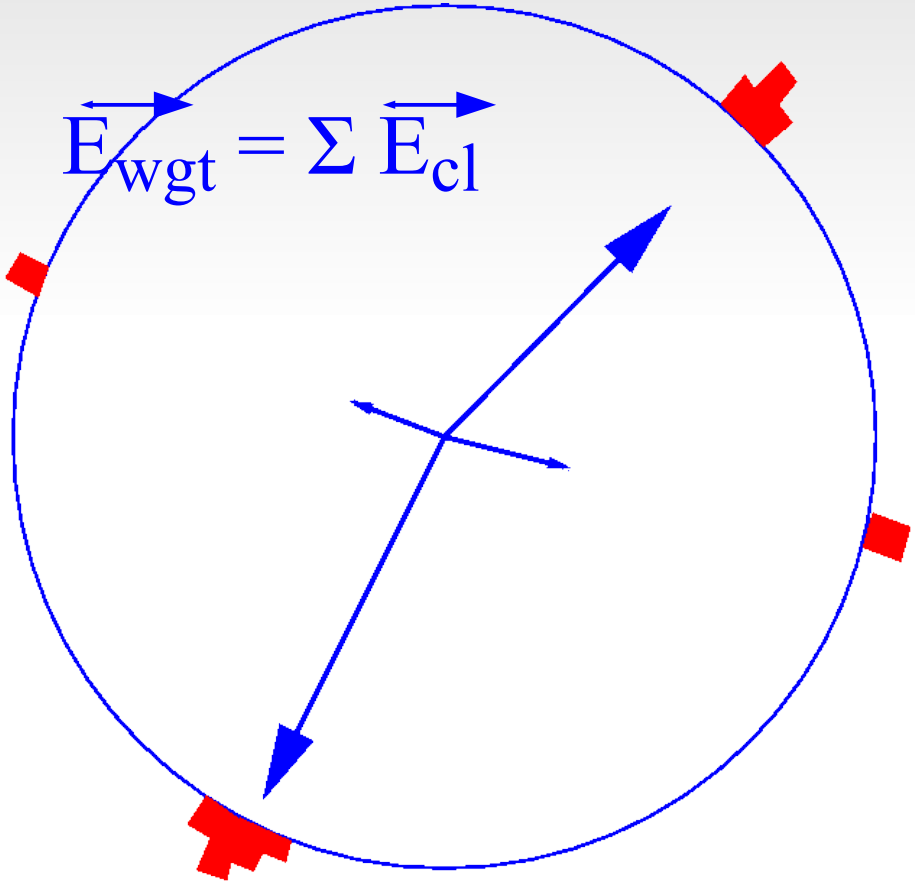
$\varphi 1 - \varphi 2$

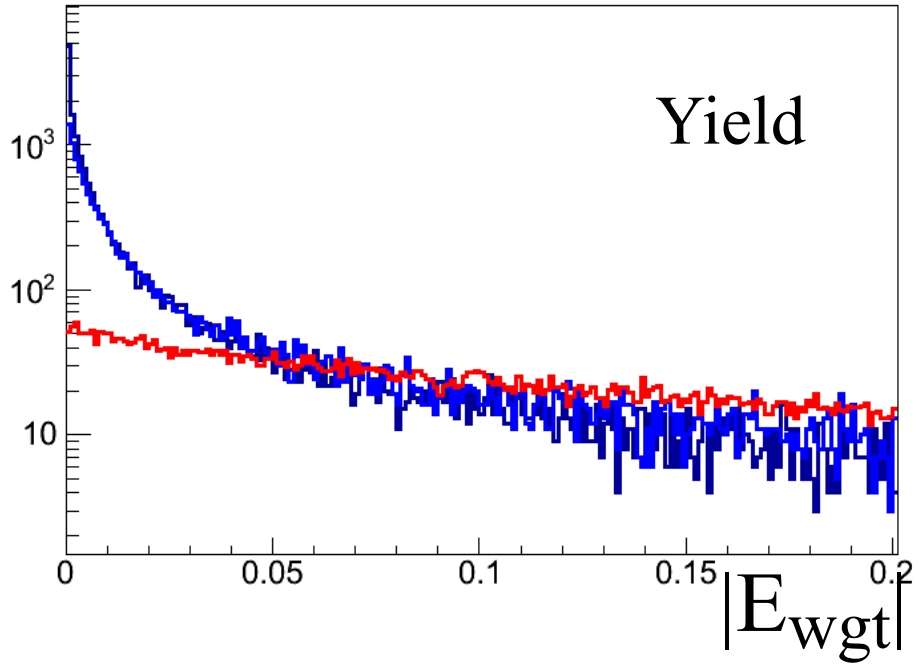
for two clusters
with highest energy

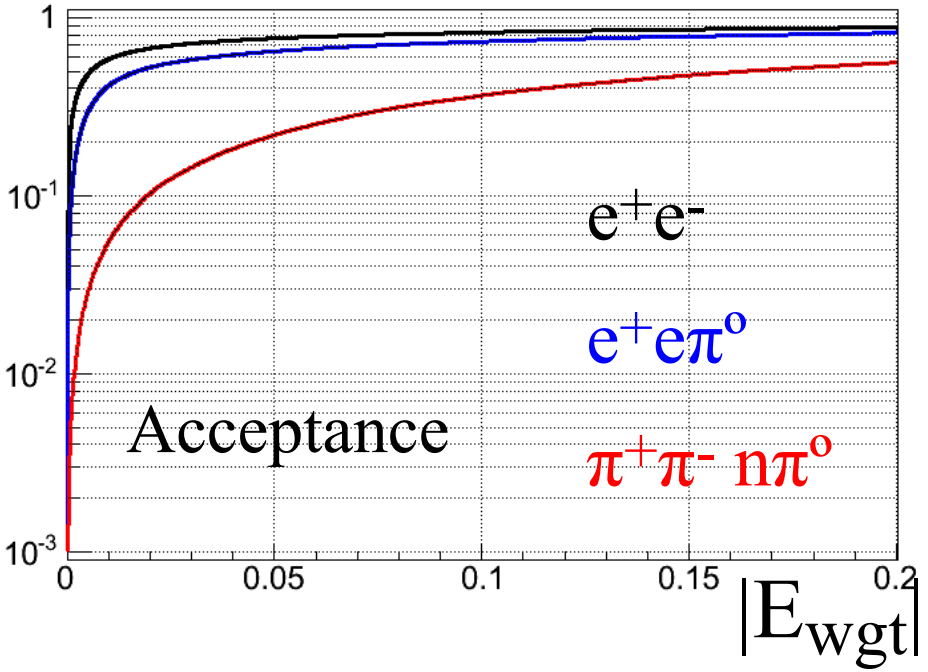




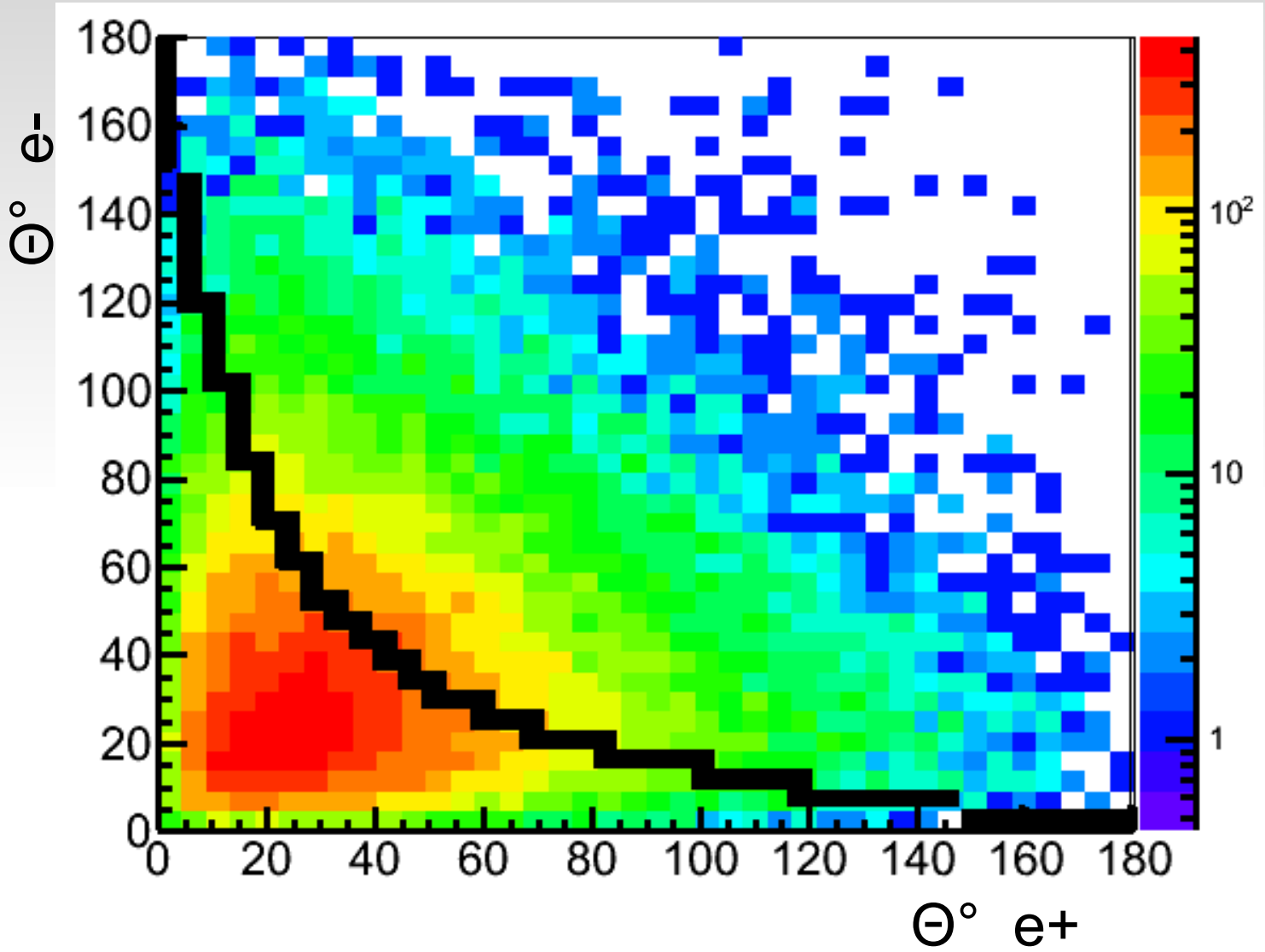
Energy weighted vectorsum





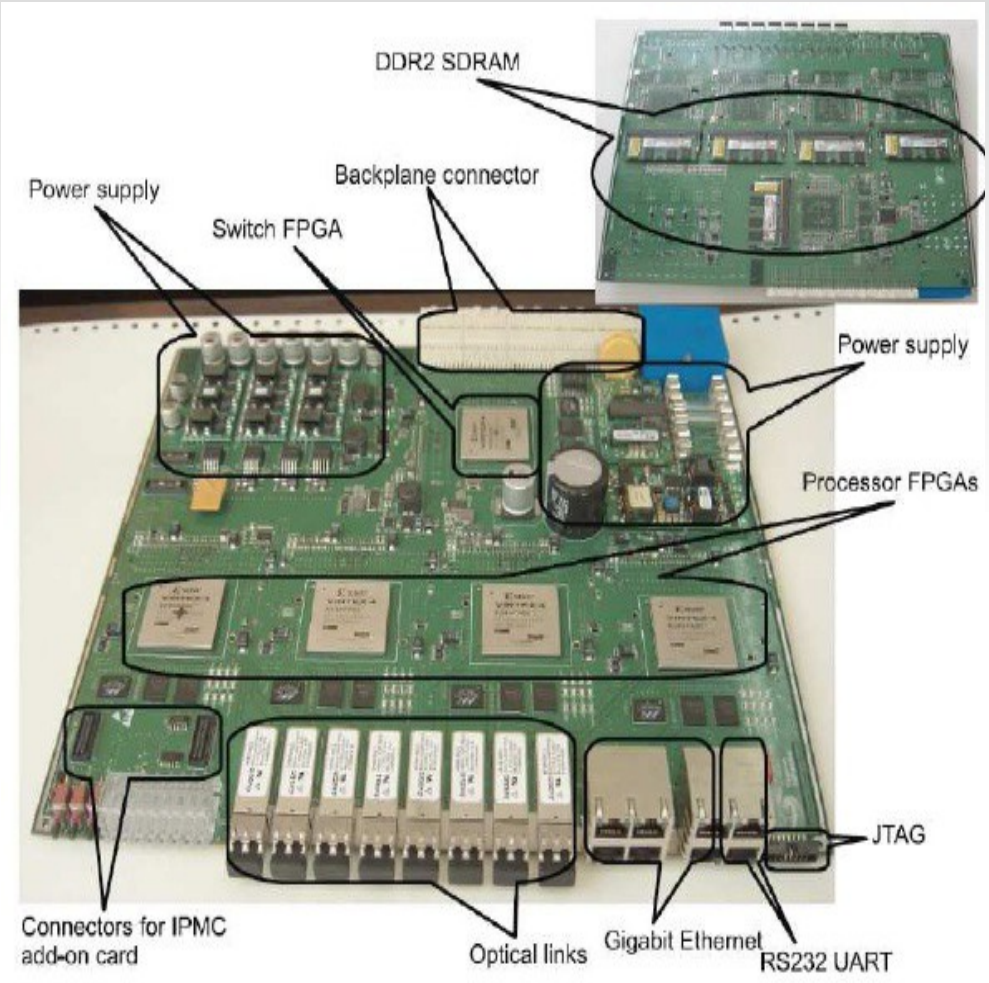


e+ e-: angular correlation



e+ e- (π°) filtering

- EMC front-end and DAQ electronics is well under way (Groningen, Giessen, Beijing)
- Rejection of hadronic channels at the 10-3 level using fast EMC data seem easy
- We need to simulate selection filters for our channels (crucial for efficiency and acceptance...)
- Implement the filter on a Panda computer node (four FPGAs)



Thank you for your attention !