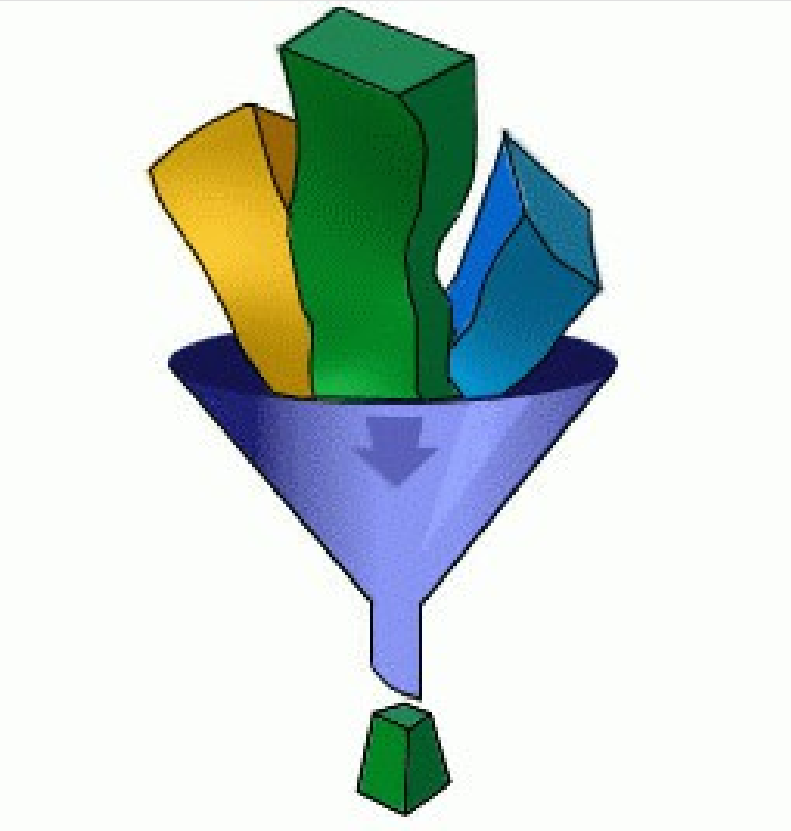
Online filters with the EMC



Ronald Kunne
IPN Orsay, France
CNRS/IN2P3 – Université Paris Sud

Contents:

- Why use the EMC as a pre-filter ?
- Electromagnetic processes:

  => Global variables

  => Partial/complete event reconstruction
- Example of a hadronic channel :

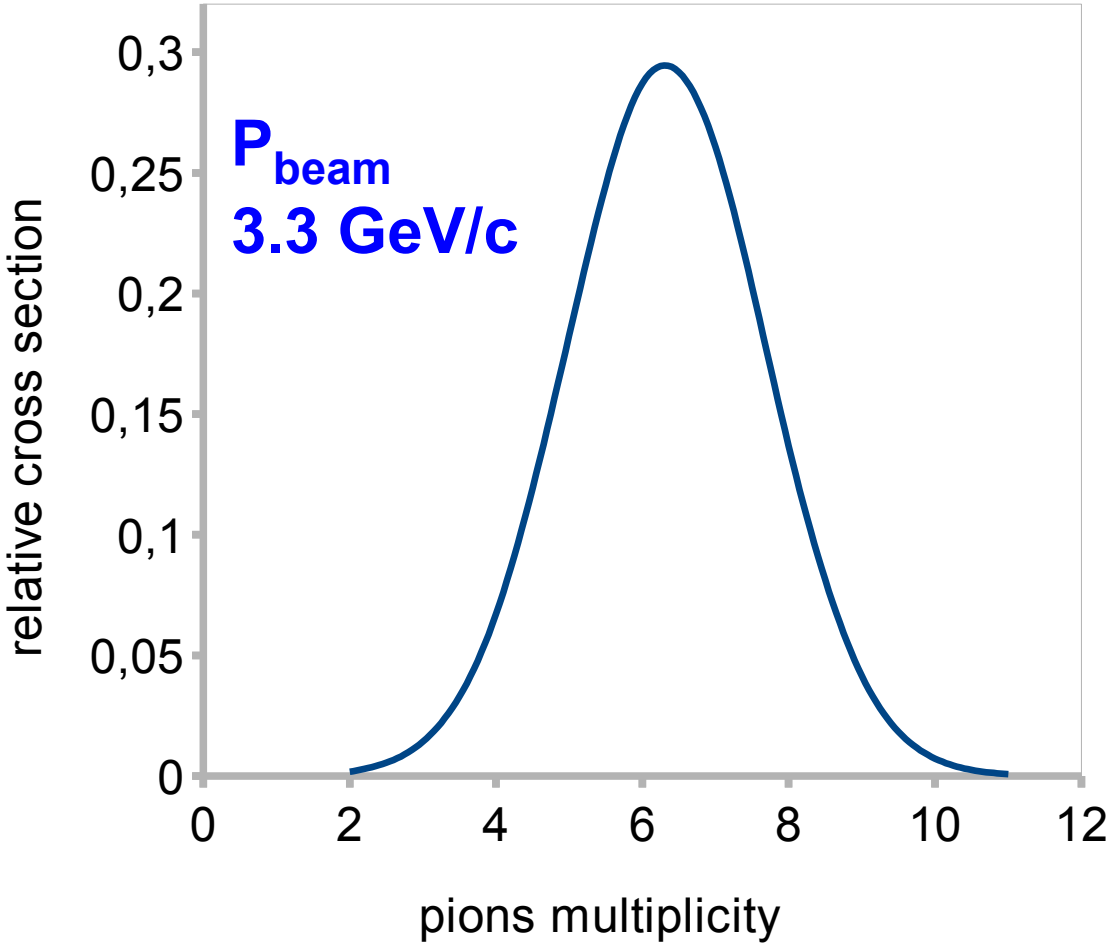
  $\phi\phi \longrightarrow K^+K^- K^+K^-$
- Conclusions

Why use the

EMC

as a pre-filter ?

Multipions are the problem at the filter level



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

6 pions: **20** mb !

Fast reduction

is needed!

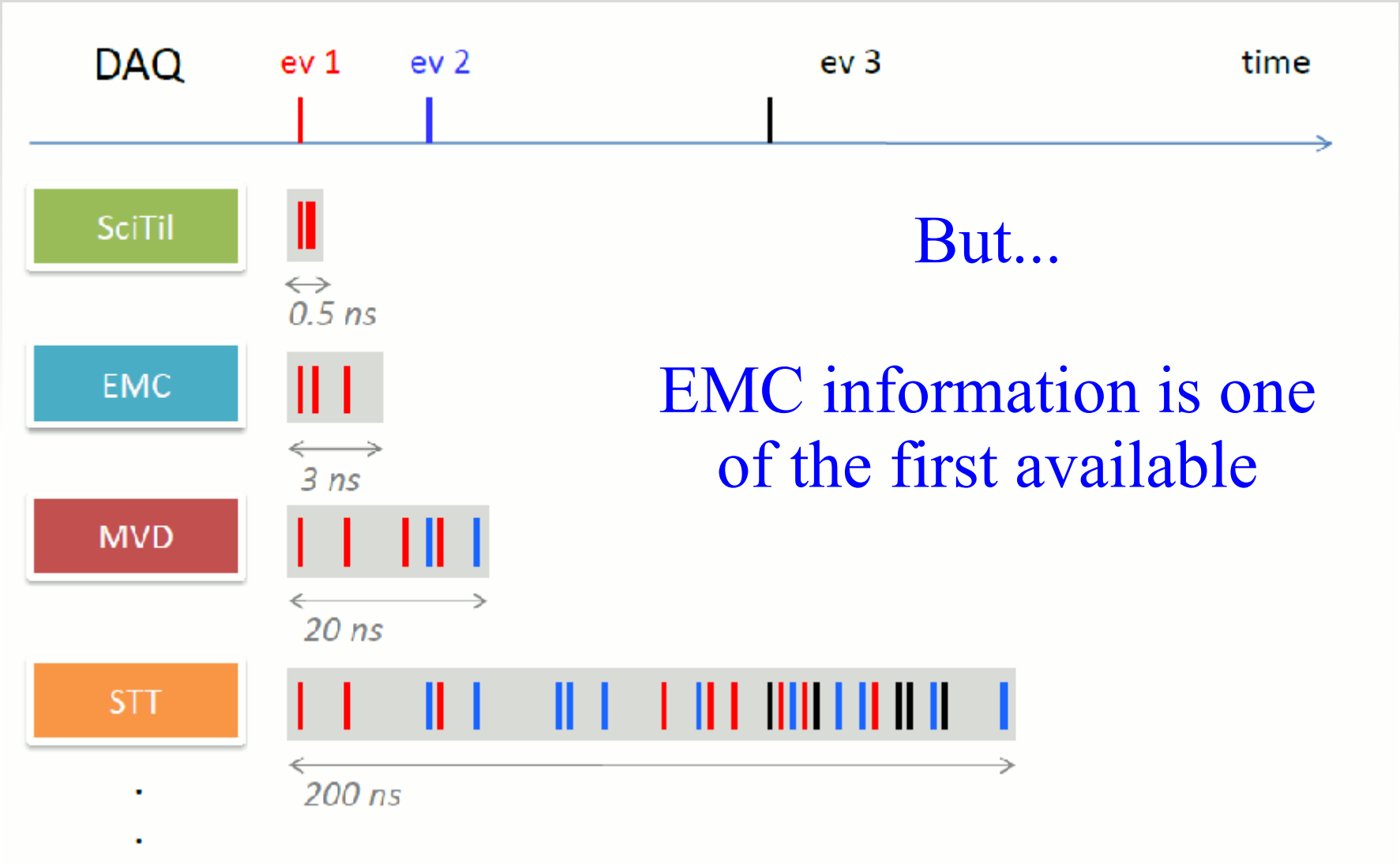
PANDA processing stages

- Detector raw data collection
- Cluster finding, hit building
- Track finding

- Track feature extraction: Momentum, PID, …
- Event building

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

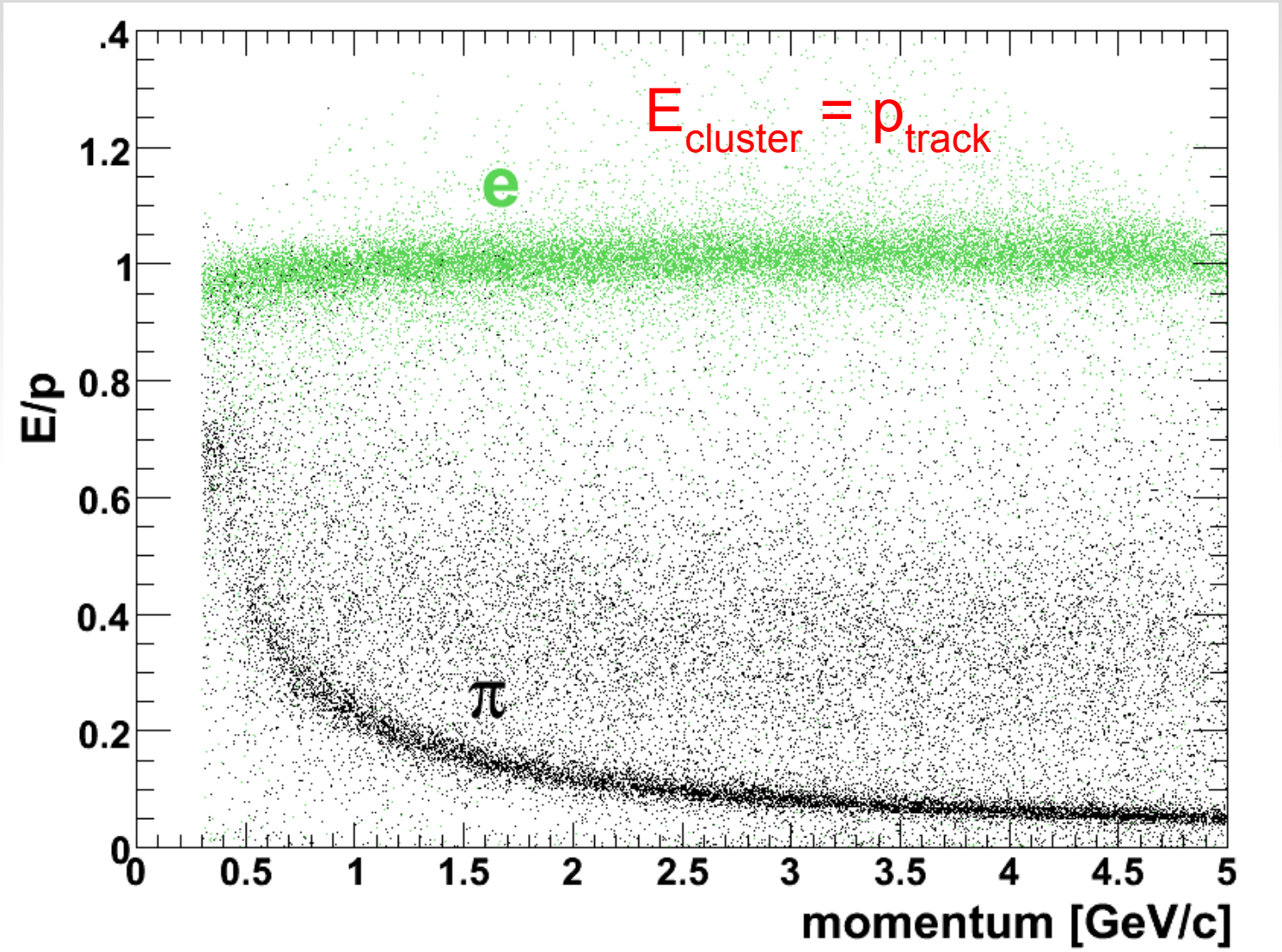
Detector responses are dispersed in time



But...

EMC information is one of the first available

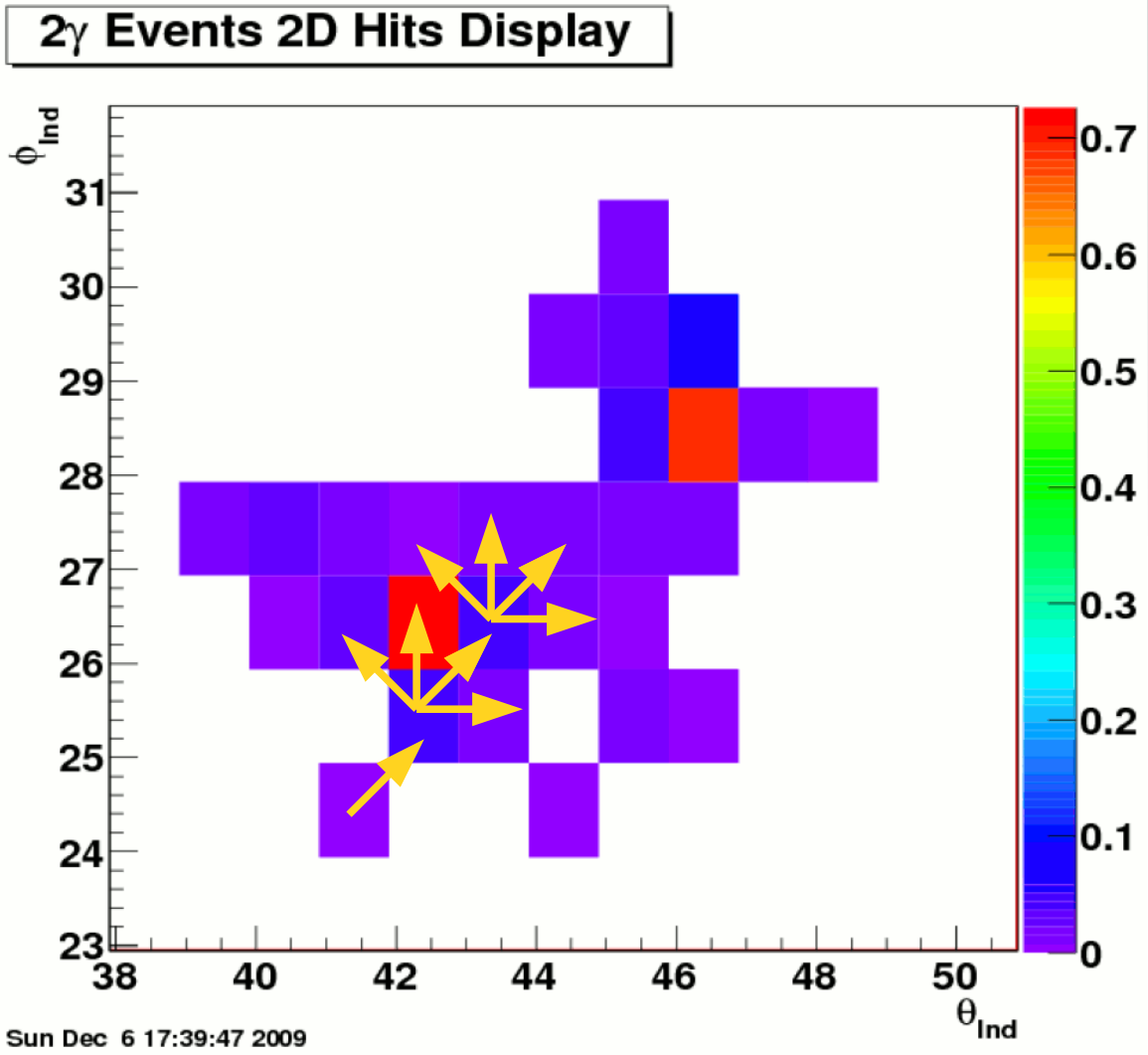
Track info is available from the EMC



p_{track} from $E_{cluster}$ (for e, γ)

$\Theta_{cluster}$, $\varphi_{cluster}$

Efficient cluster finding

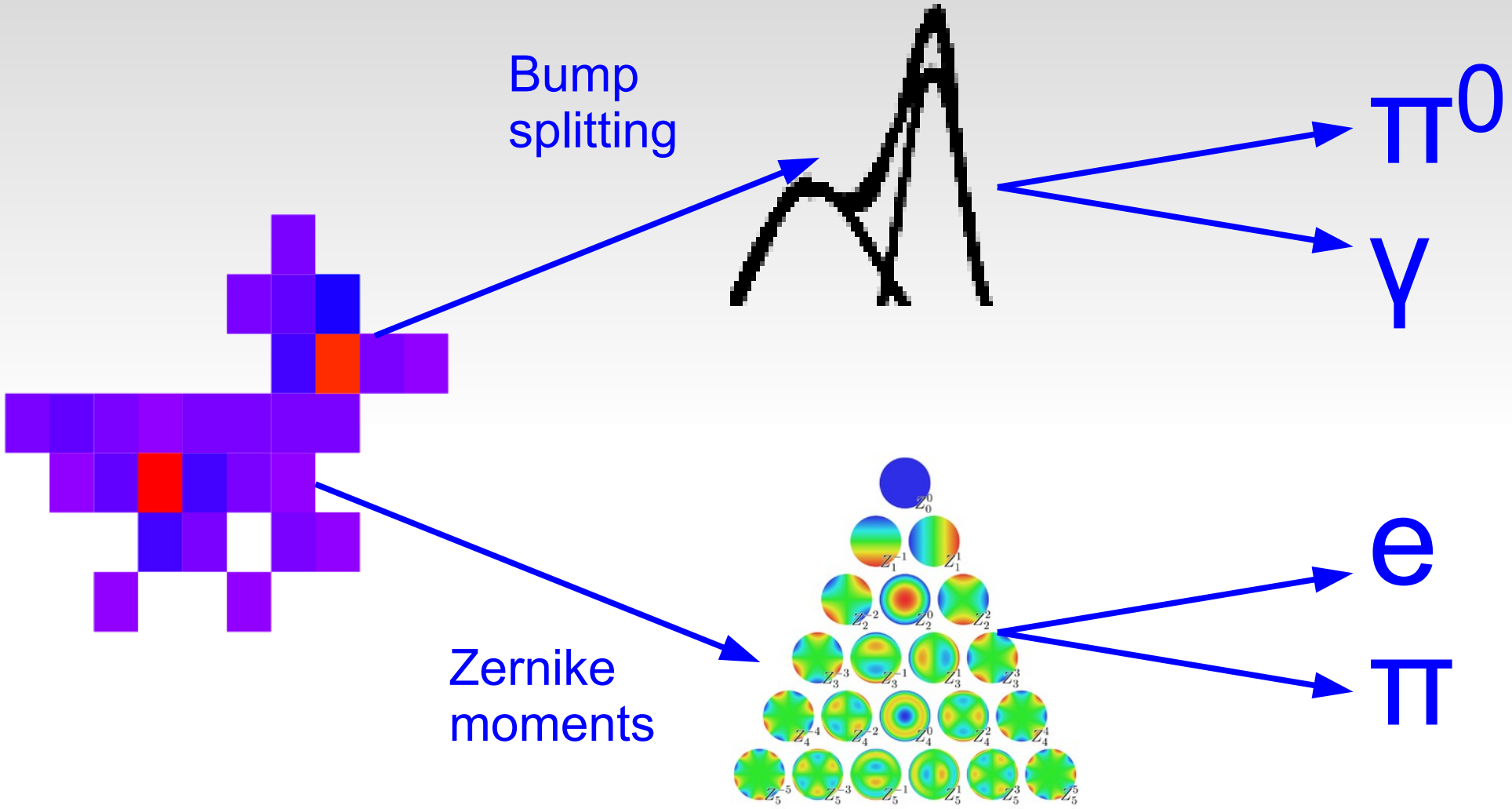


2D Mapping followed by
Spread neighbour searching
Local Maximum Finding

All in one pass

Qiang Wang, Beijing

...and pattern recognition



Electromagnetic processes

=> Global variables

=> Event reconstruction

Filter simulation

- $P_{beam} = 10$ GeV/c
- $\bar{p}p \rightarrow J/\psi\, \pi^+ \pi^-$, $J/\psi\, \pi^0$, $J/\psi\, \gamma$
- $\bar{p}p \rightarrow e^+e^-$, $e^+e^-\, \pi^o$
- $\bar{p}p \rightarrow \phi\phi \rightarrow K^+ K^- K^+ K^-$

10^4 events

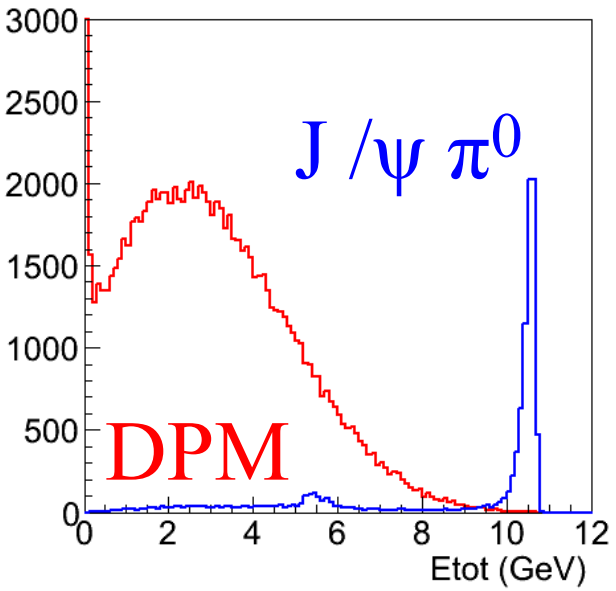
- 10^5 DPM events for background

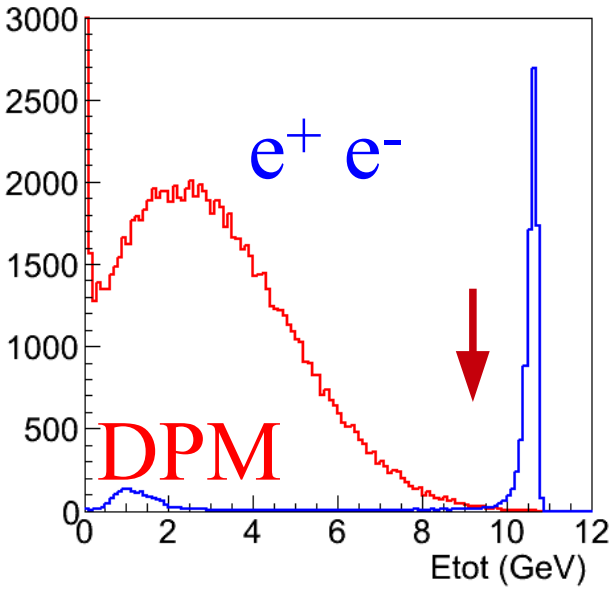
Electromagnetic processes

=> Global variables

=> Event reconstruction

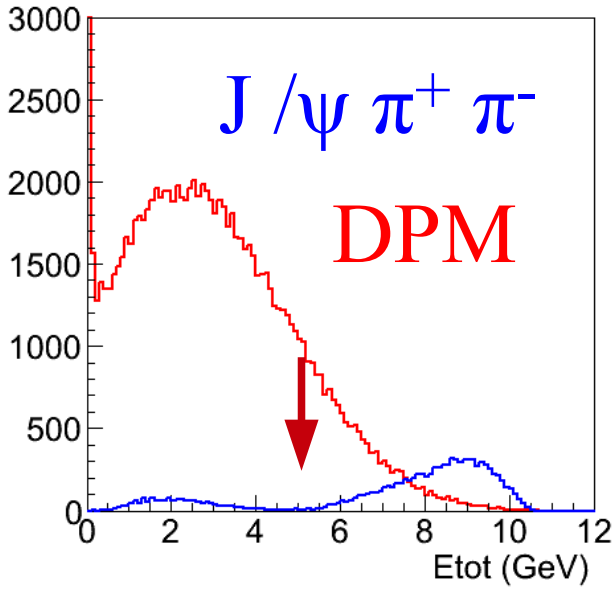
Total cluster energy

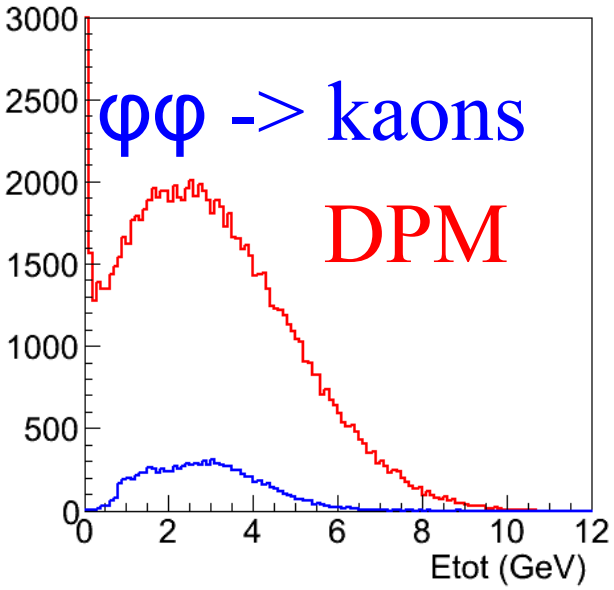




$P_{beam} = 10$ GeV/c

Four channels compared with background from DPM

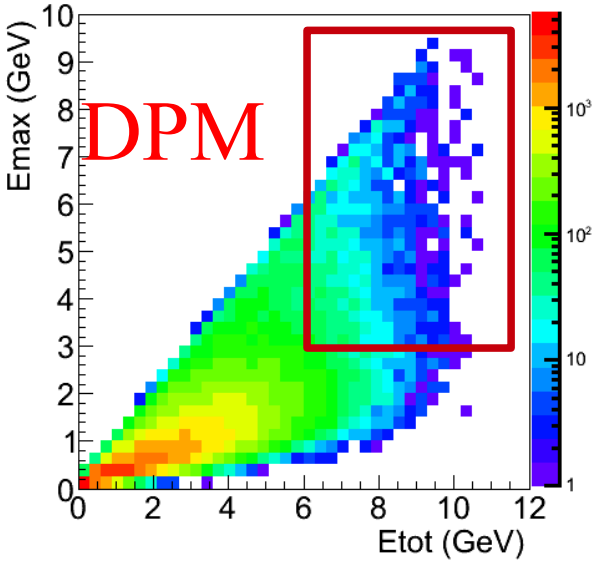


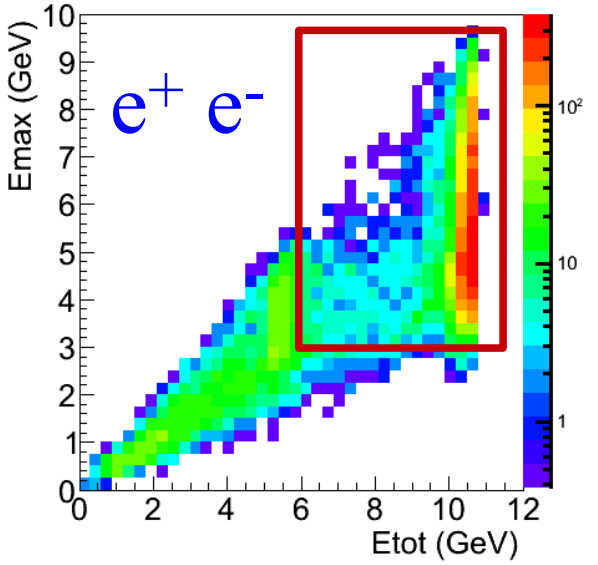


DPM background left:
Etot > 9 GeV/c 3%
Etot > 5 GeV/c 17%

Efficiency: ≈ 80%

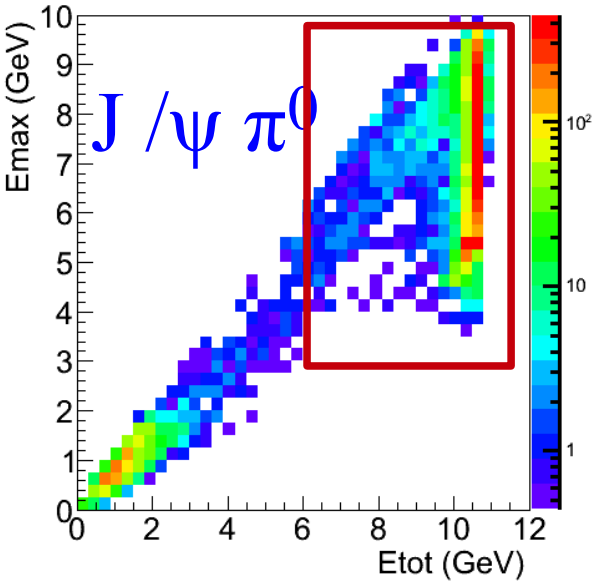
Maximum cluster energy

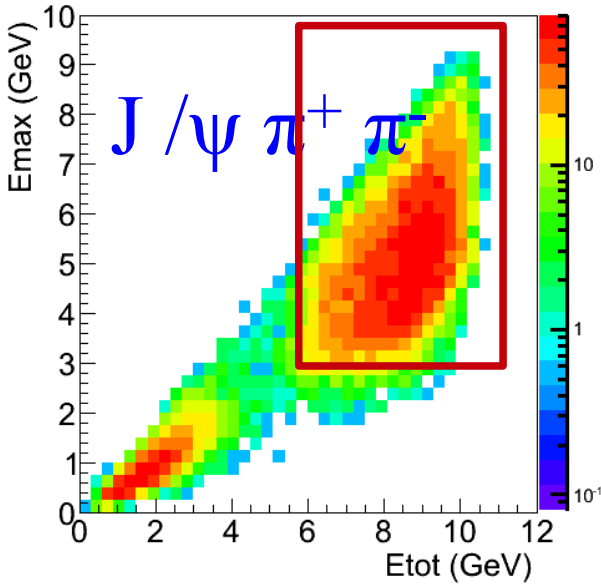




$P_{beam} = 10$ GeV/c

Three channels compared with background from DPM





DPM background left: 5%

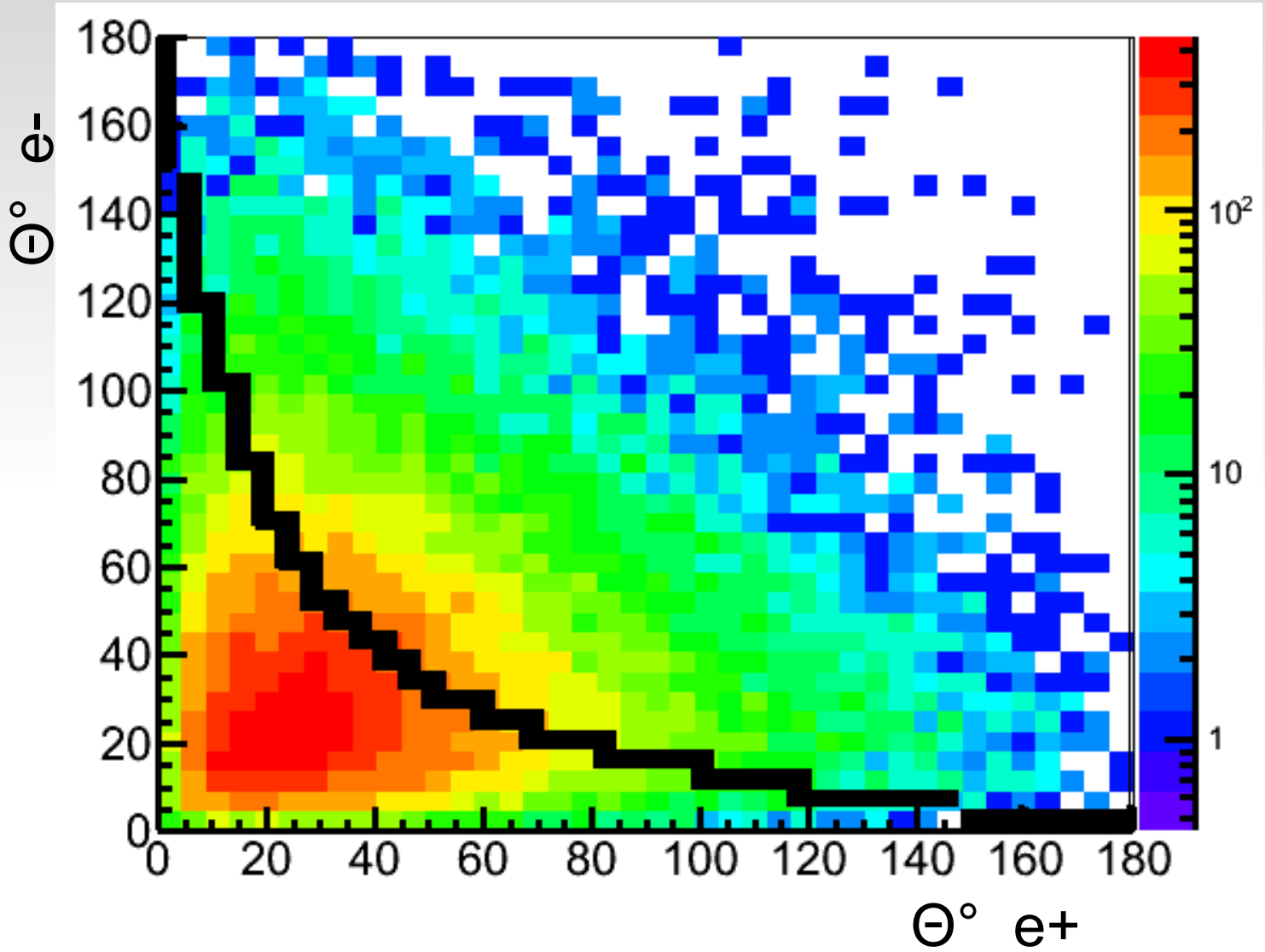
Efficiency: ≈ 80%

Electromagnetic processes

=> Global variables

=> Event reconstruction

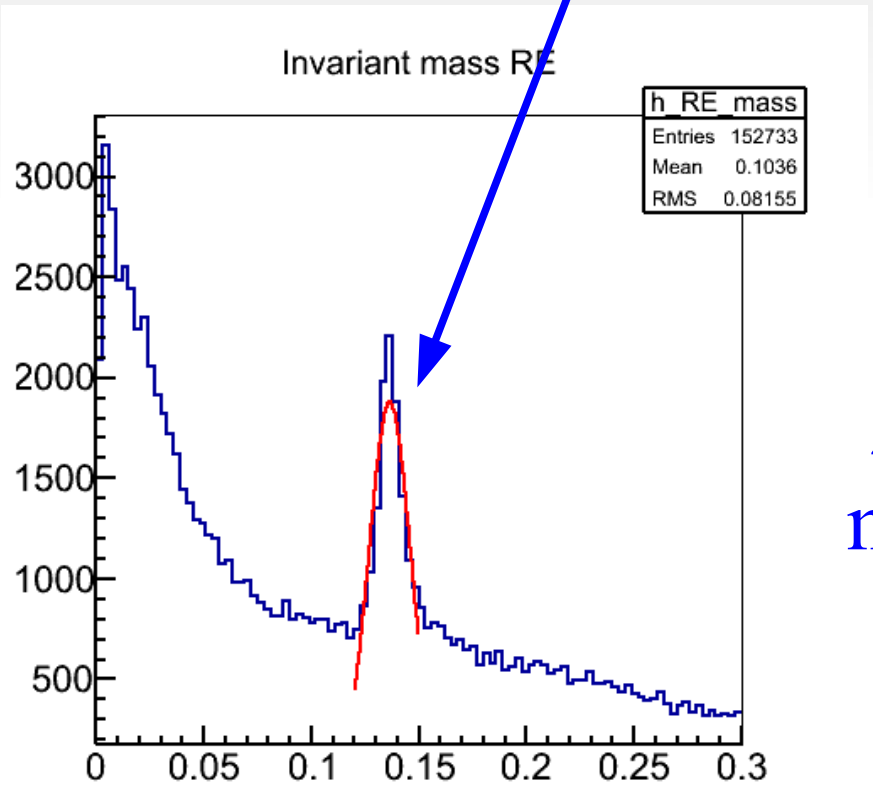
e+ e-: angular correlation



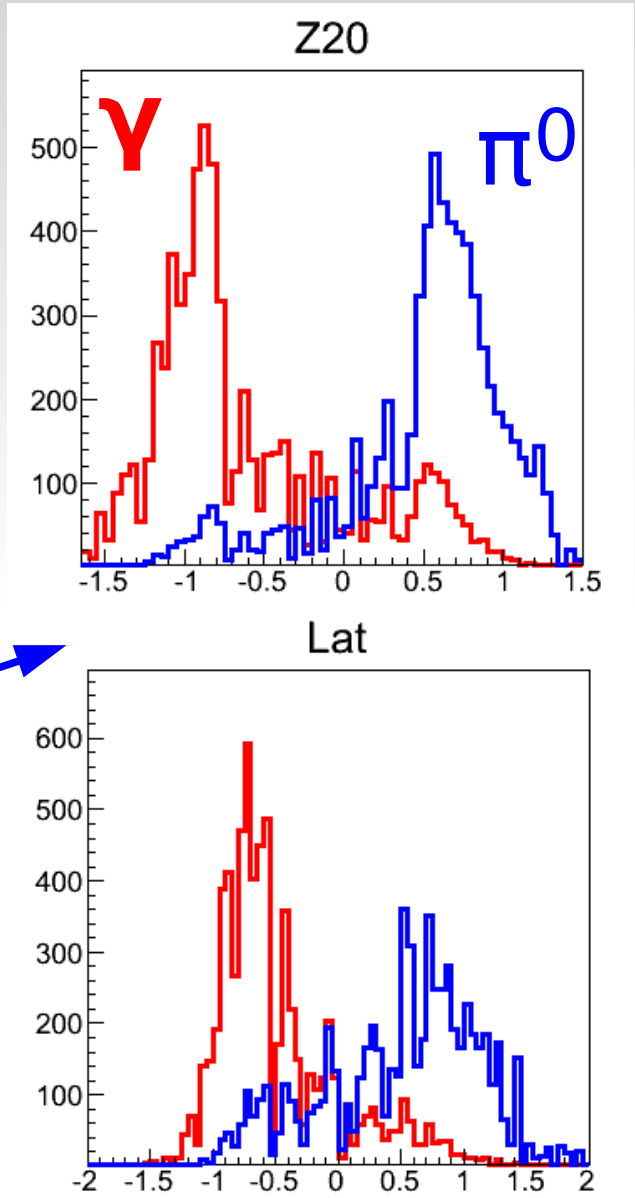
DPM background left: 0.1%

π^0/γ separation

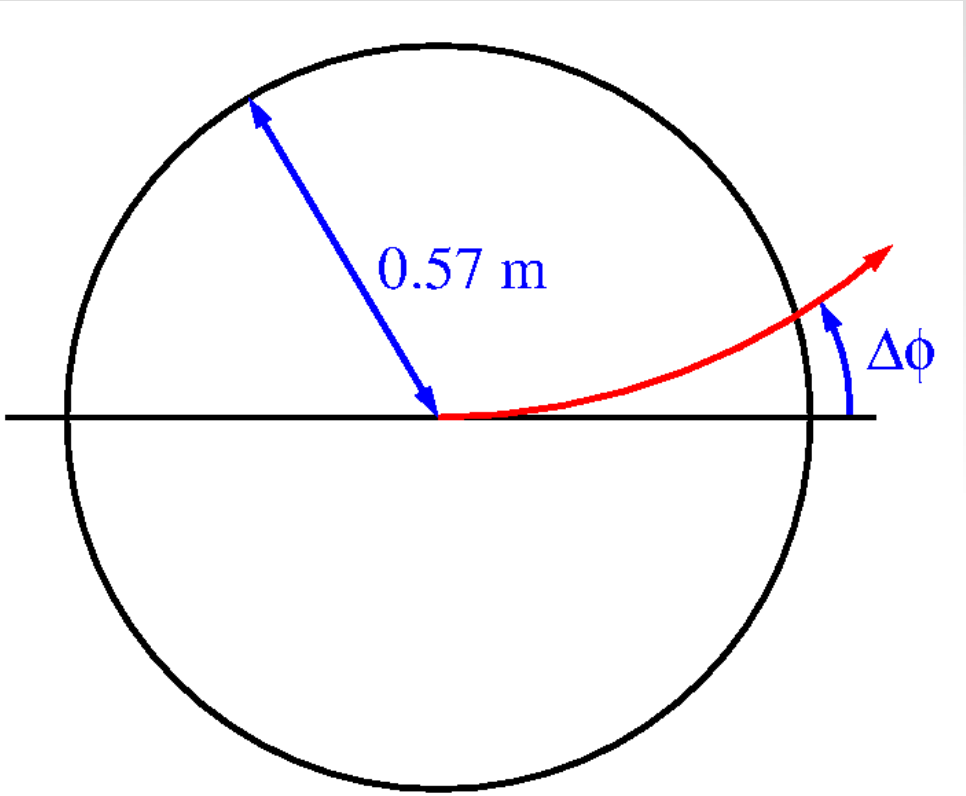
Combining γ clusters



With Zernike moments



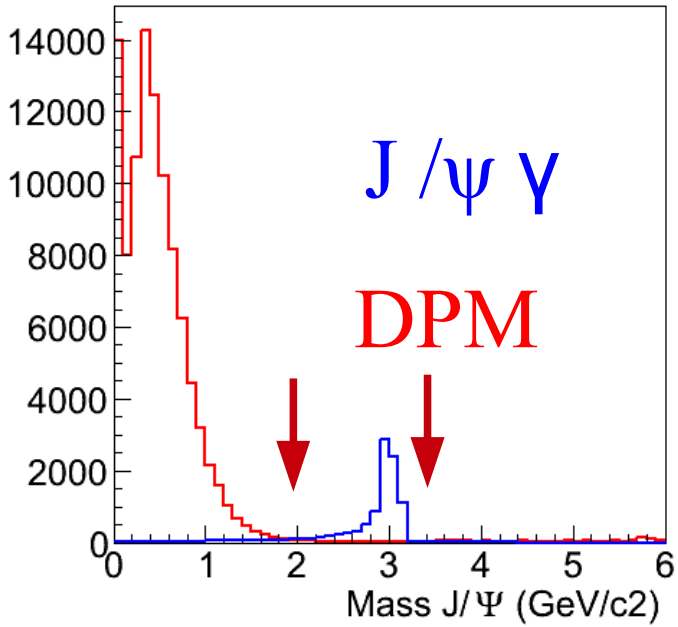
Charged track “reconstruction”

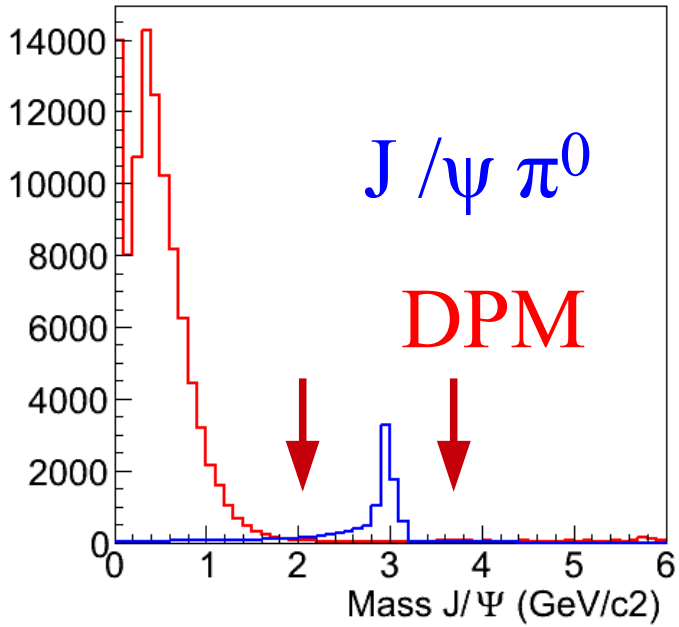


- Given: a cluster with E, θ, and φ
- Hypothesis for particle

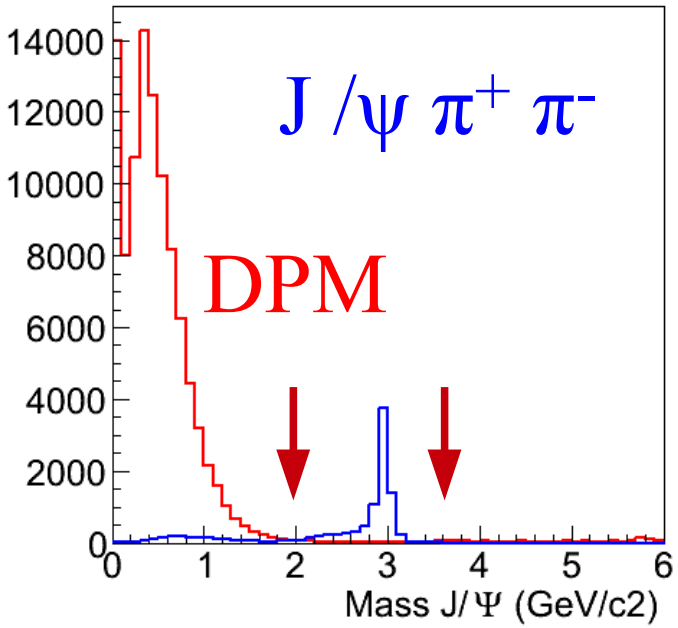
- For an electron p=E
- For a hadron, need some guess

- Correction for φ needed:
  $\Delta\varphi = \pm 2 \arcsin 0.088/p_T$





J/ψ→e+ e- invariant mass



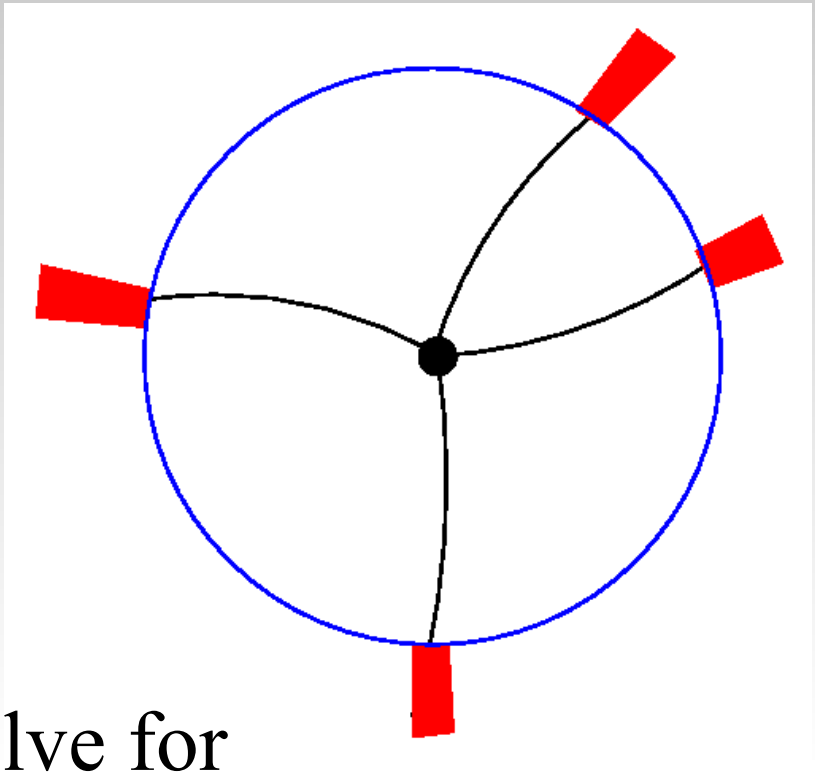
DPM background left: 0.4 %

Efficiency: ≈ 85-90 %

Example of a hadronic channel

$$\phi\phi \rightarrow K^+K^- K^+K^-$$

$\phi\phi \rightarrow K^+K^- K^+K^-$ reconstruction



- 6 particles =>

  24 unknown variables

- 12 E-p equations
- 8 angles measured with EMC
- 4 kaon masses imposed

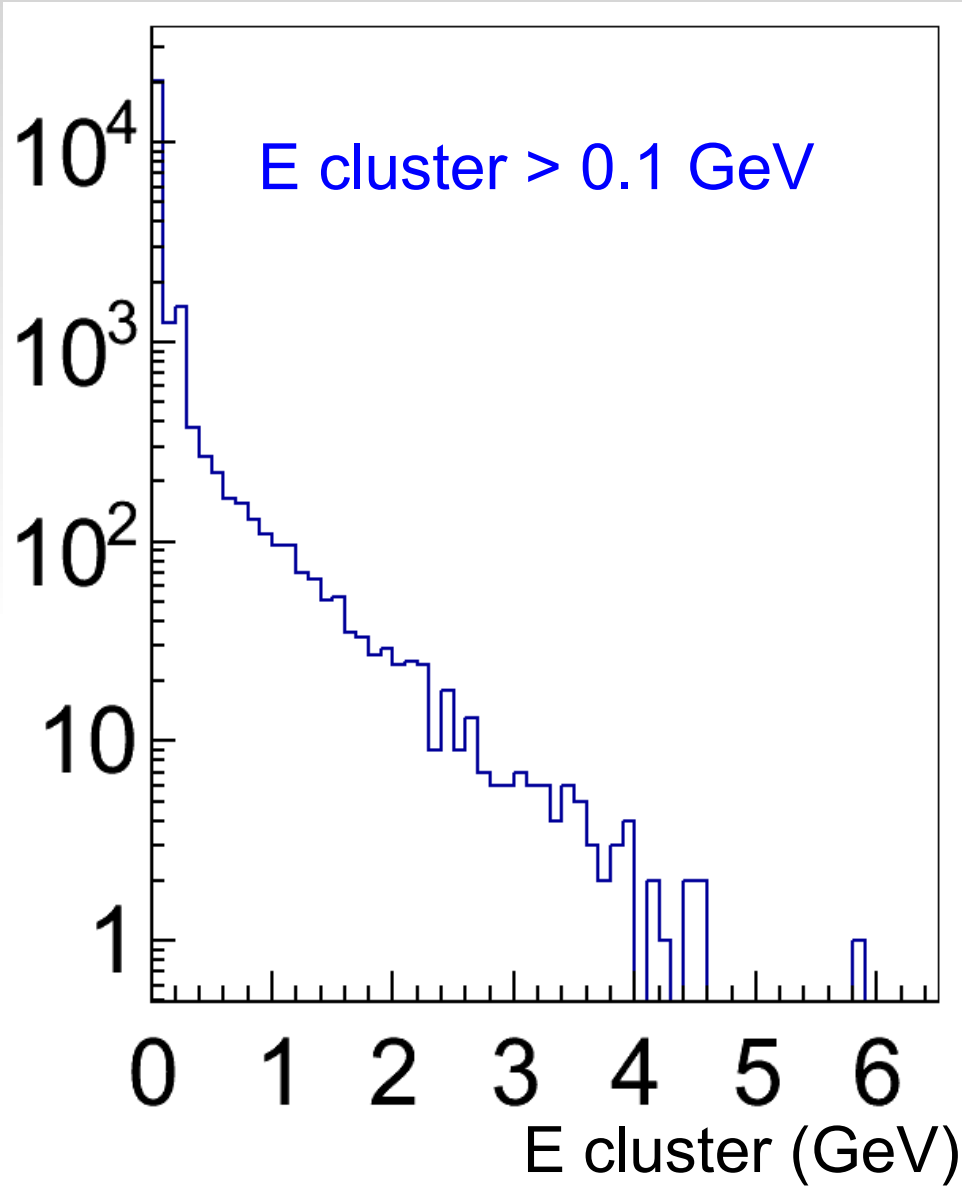
  => 24 constraints

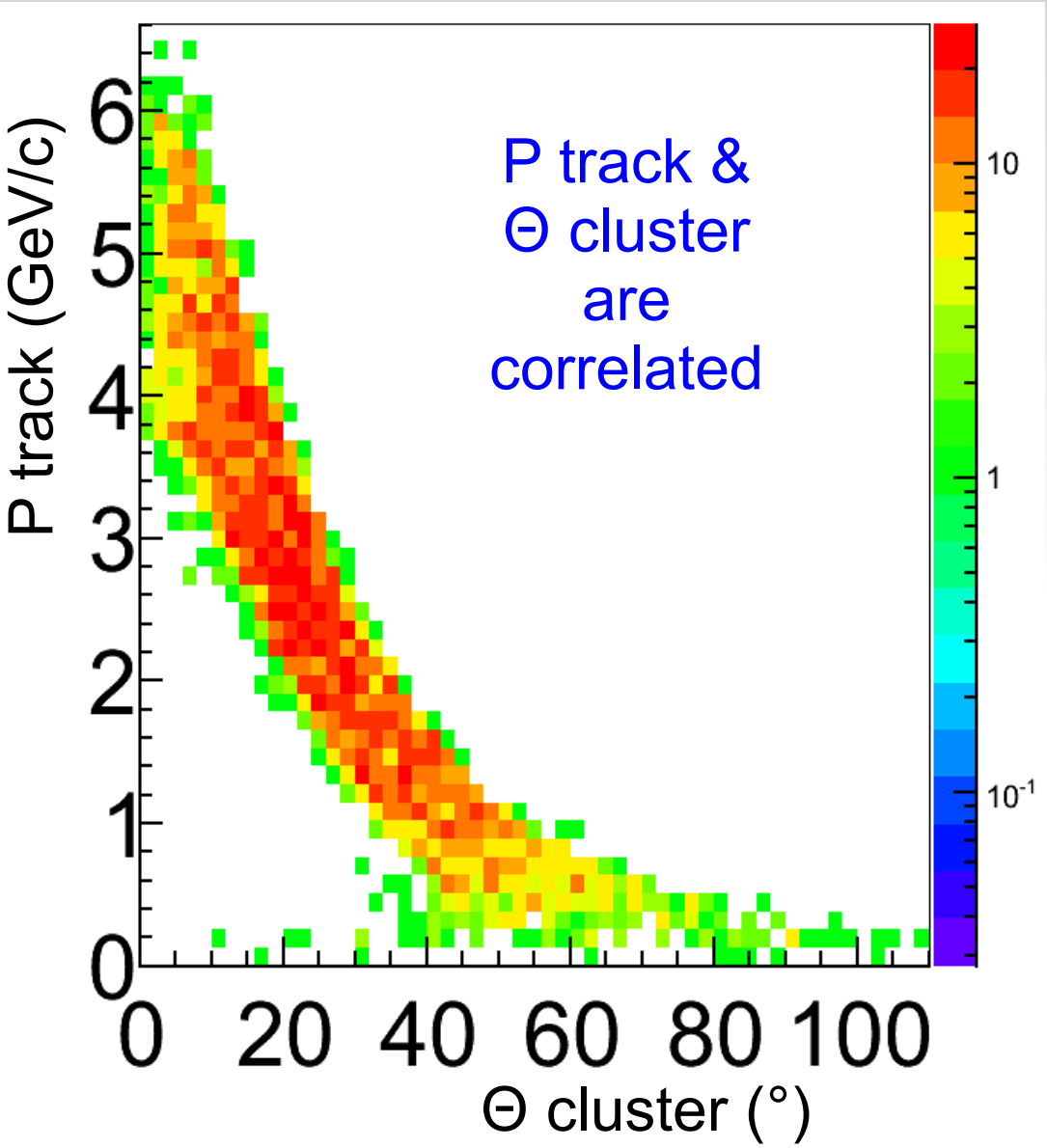
Solve for

ϕ masses

and $\vec{p}$ beam

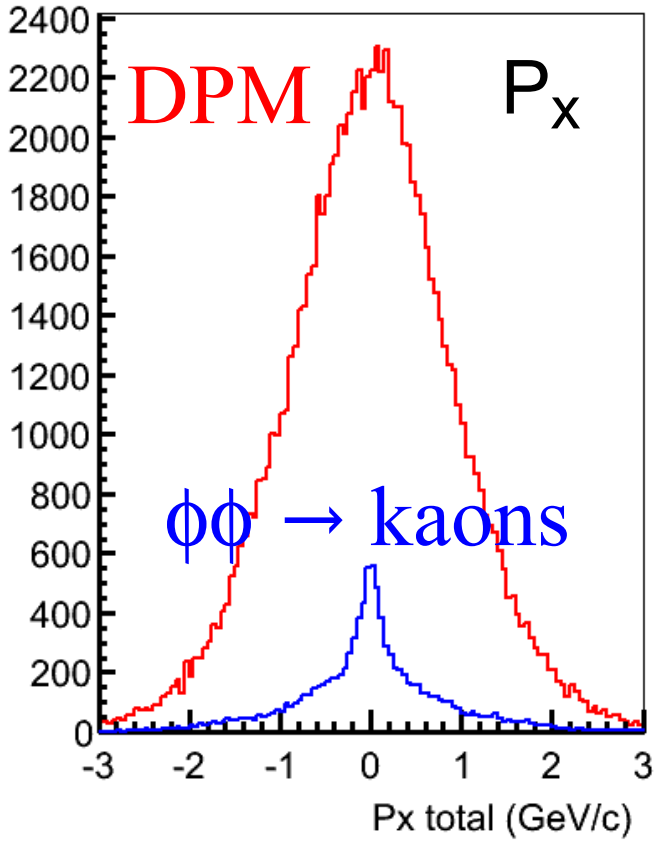
Two tricks to speed things up

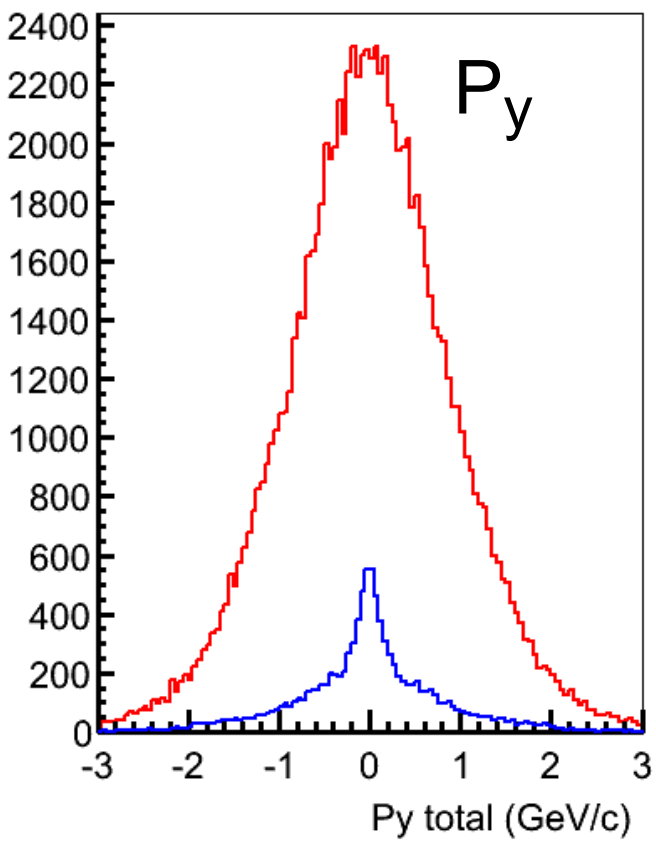


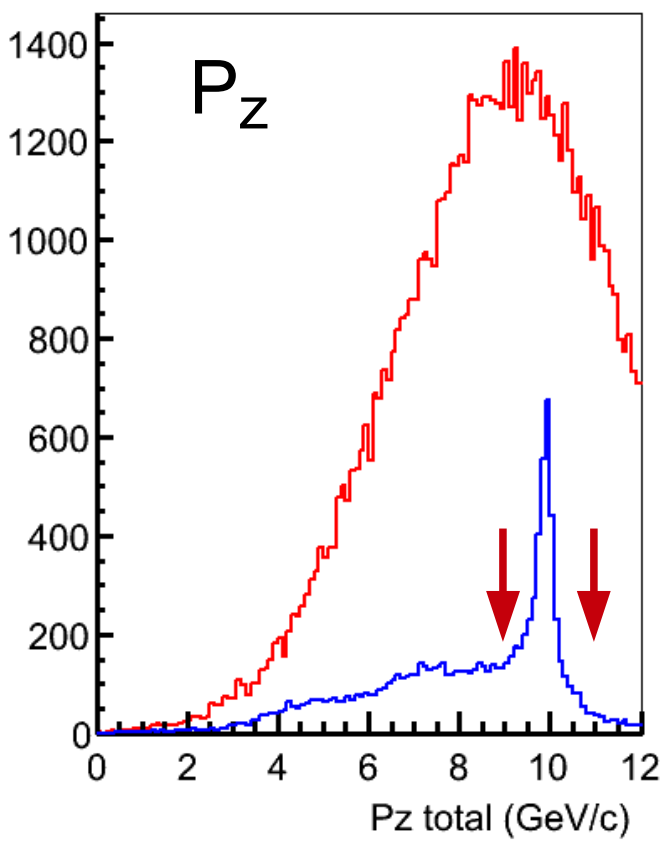


Reconstructed

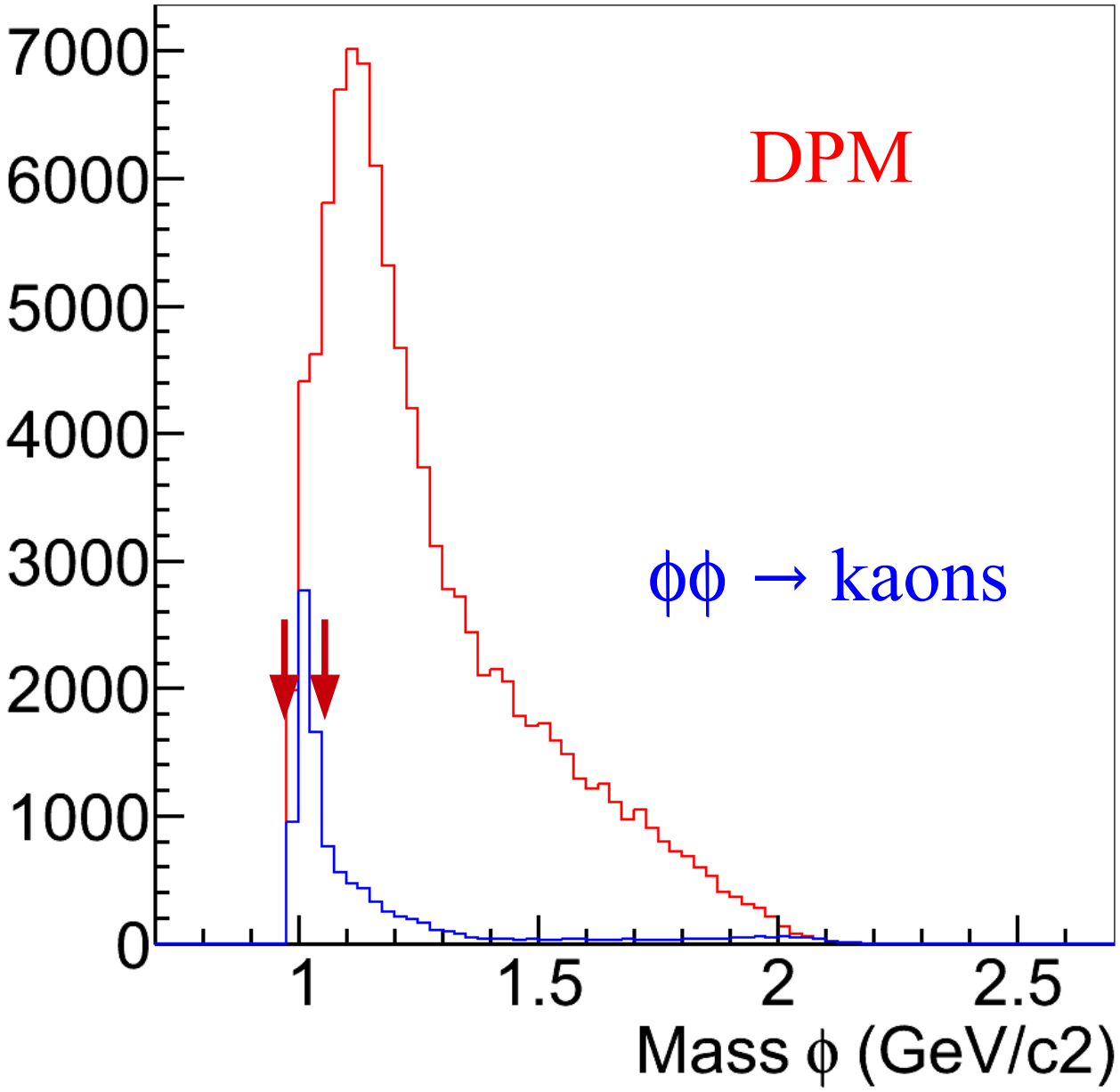
$$\vec{p}_{beam} = \vec{p}_{\phi 1} + \vec{p}_{\phi 2}$$







Reconstructed ϕ mass



DPM Background: 11%

Efficiency: 61%

Conclusions

Using EMC data only ...

- Online EM channel selection looks easy

  => Background reduction: A factor of 100

- Hadronic channel selection seems... feasible
- But need to be optimised channel by channel

  => Background reduction: A factor of ≈ 10

Thank you for your attention !