Status of the hadronic cross section Measurement at small and large angle

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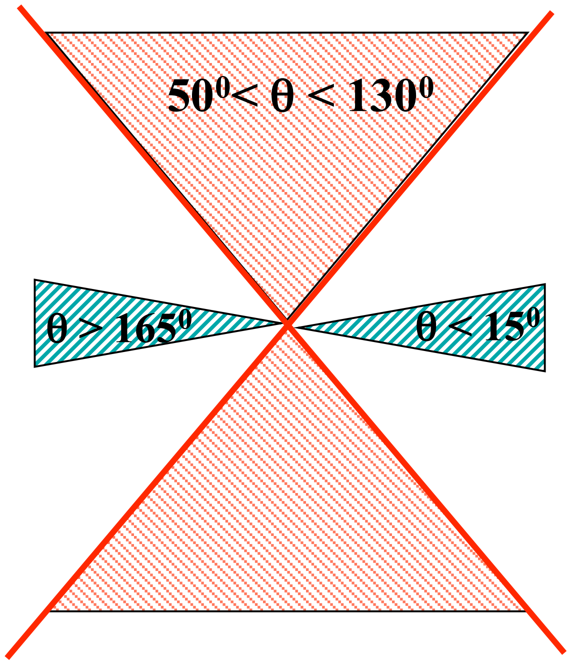
for the
PPG-Group

PHI radiative working group meeting
28.4.2006

small angle



Small Angle: Items...

1. Selection: *New are L3FILT (instead of COSMVETO), new FILFO, also select muons* ***+ we use the new PPGTAG! (KM 305)***

$$\Rightarrow dN/dM^2_{XX}$$

xx= $\pi\pi,\mu\mu$

2. ε_{FILFO}: *obtained from unbiased control sample (KM 288)*
3. Background subtraction: *fitting MC histograms to data histogram in*
4. $\varepsilon_{Trackmass}$ *and* $\varepsilon_{\Delta Emiss}$: *from MC…*
5. Transition $M^{Rec}_{XX} \rightarrow M^{Kine}_{XX}$: *from MC…*
6. $\varepsilon_{Likelihood/TCA}$ **:** *we use the .or., so it is ≈100%*
7. ε_{Vertex}
8. $\varepsilon_{Tracking}$
9. $\varepsilon_{Trigger}$

} *From Control samples (data)*

10. Acceptance-Correction**:** *from MC…*
11. Luminosity: *from VLAB-events*

$$\Rightarrow d\sigma(xx\gamma)/dM^2_{xx}$$

12. *Tedious details: FSR contamination,* ε_{L3FILT}, *add. Background, etc.*

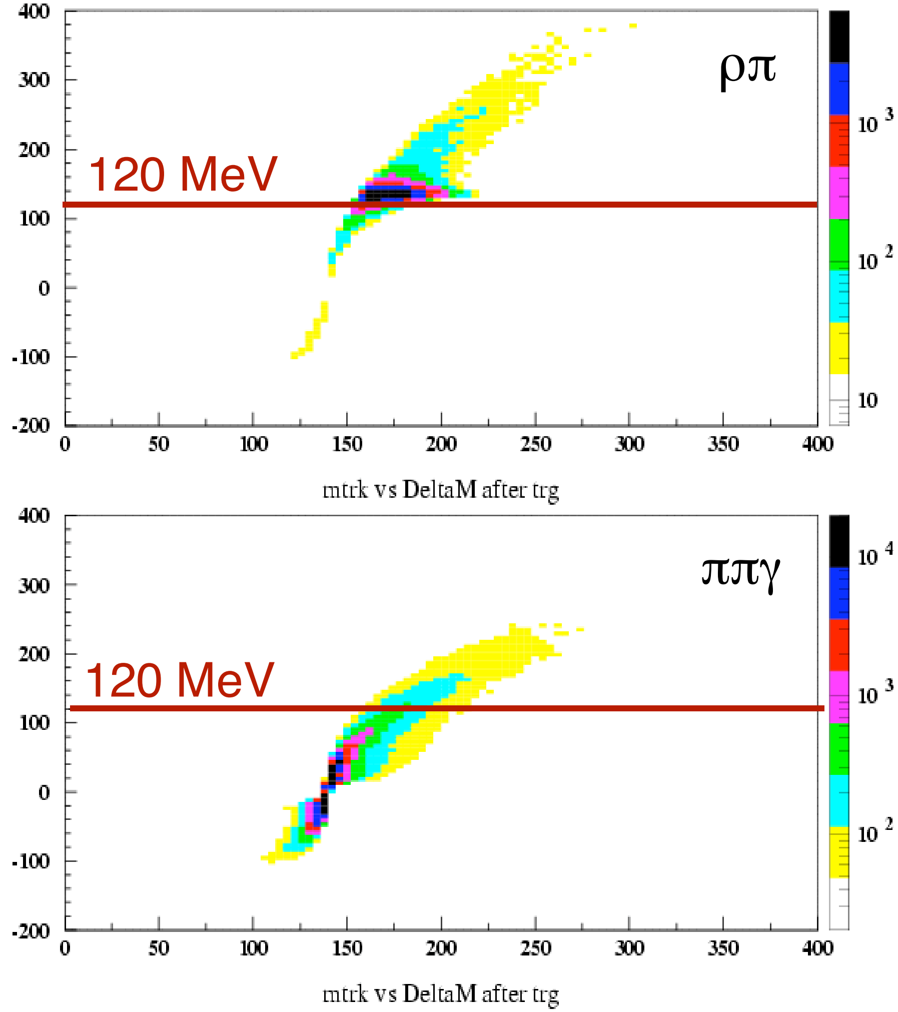
New PPGTAG...

The data is selected with the new PPGTAG. This filter is very efficient in rejecting πππ events (and Bhabhas) by a cut in ΔEmiss<120 MeV.

$$\varepsilon^{\pi\pi\gamma} = 81\%$$

$$\varepsilon^{\rho\pi} = 4\%$$

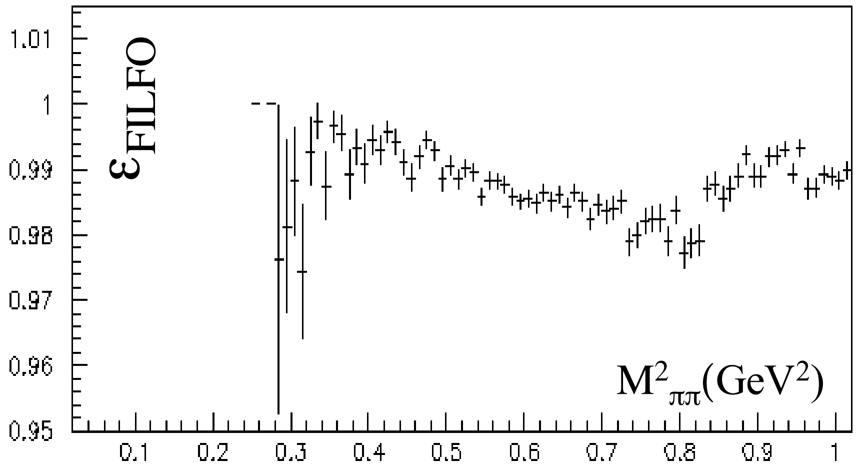
In addition, one becomes independent from the anti-coincidence with the RPITAG-filter and its timing issues (which was a requirement in the old PPGTAG).



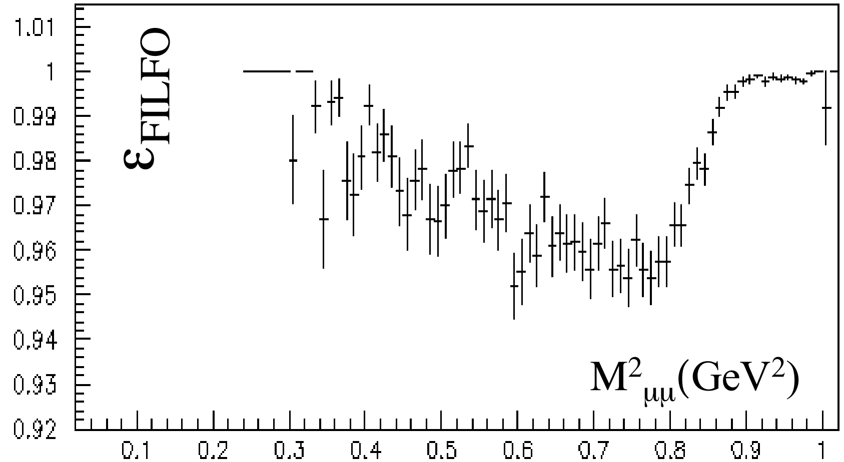
Some words on FILFO...

The efficiency for the FILFO filter can now be very easily obtained by selecting the unbiased events provided by the downscale mechanism:

For $\pi\pi\gamma$ events:



For $\mu\mu\gamma$ events:



Applying this efficiency for FILFO directly to the dN/dM^2_{XX} spectra should be the right thing to do, since in this way the composition of the downscaled sample matches exactly the selected events.

One can then estimate the residual background contributions from different sources by fitting data histograms (corrected for ε_{FILFO}) with MC histograms (after full selection except FILFO)

Fitting Background 2002 (prelim.)...

Essentially Federico's method (and code) is used. Main difference is the Filfo efficiency for data (as function of M_{Trk}) with which the MC histograms get multiplied („weighted").

$$
\begin{aligned}
Data(M_{Trk}) = par(1) \cdot MC_1(M_{Trk}) \cdot WT_1(M_{Trk}) &+ \\
par(2) \cdot MC_2(M_{Trk}) \cdot WT_2(M_{Trk}) &+ \\
par(3) \cdot MC_3(M_{Trk}) \cdot WT_3(M_{Trk}) &+ \ldots
\end{aligned}
$$

The WT are defined as

$$
WT_J(M_{Trk}) = \varepsilon_{FILFO}^{Data}(M_{Trk}) \cdot \frac{L_{Data}}{L_{MC,J}} \cdot \frac{1}{LSF}
$$

These are constants, which could be also absorbed in the par(J)

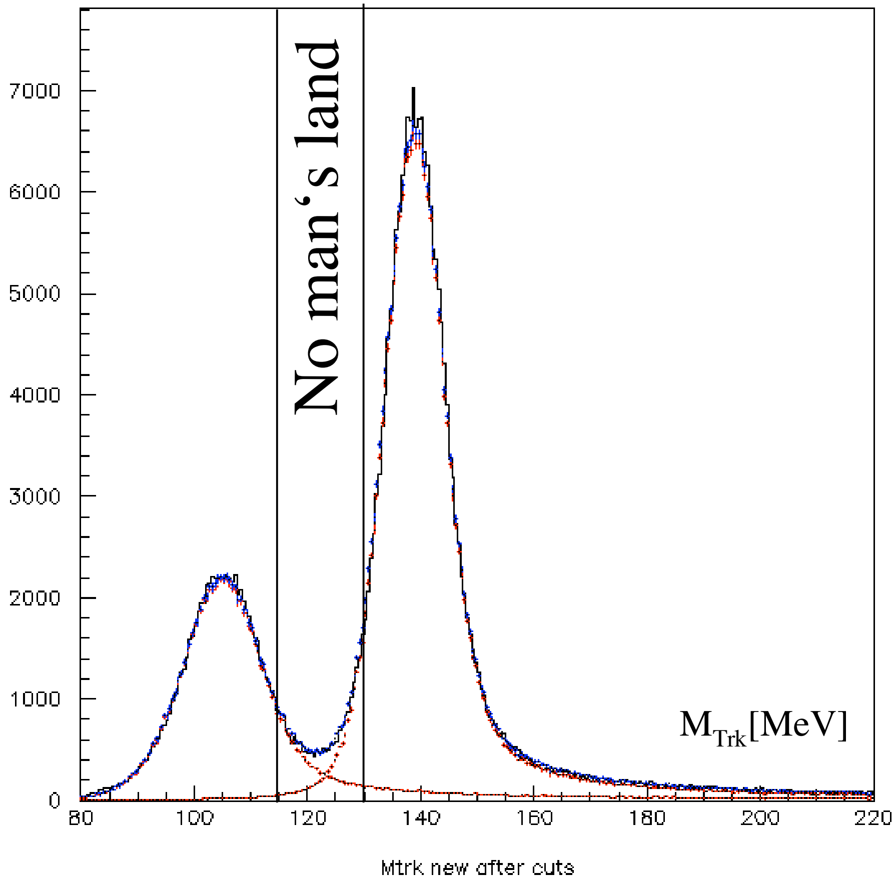
J is the index of the MC source.

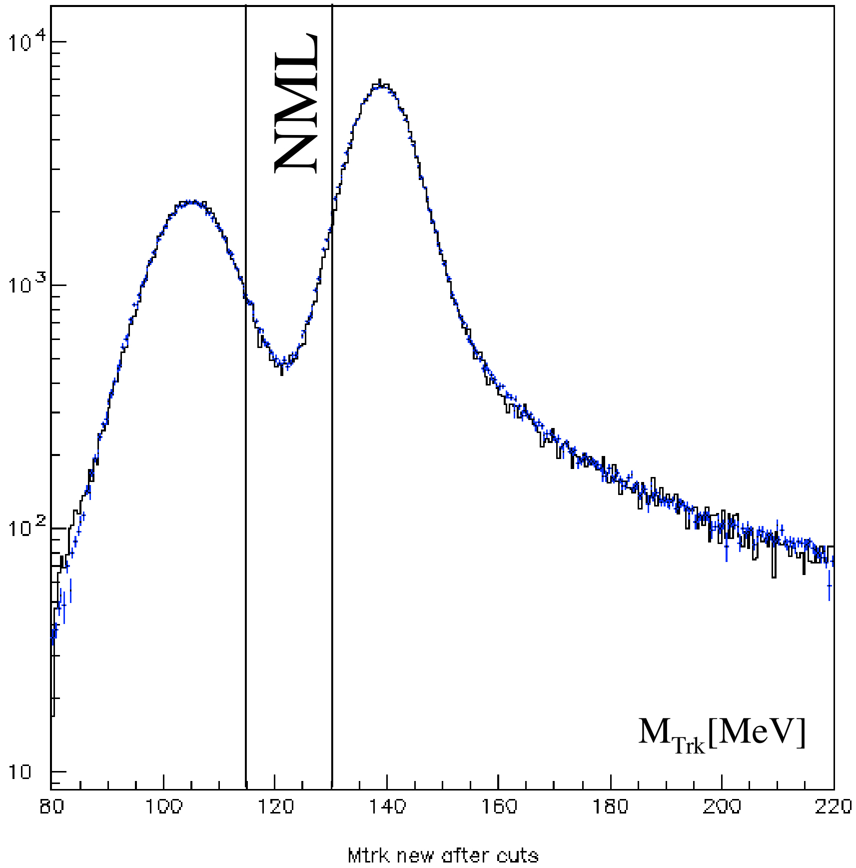
MC samples for now are $\pi\pi\gamma$, $\mu\mu\gamma$, $\pi\pi\pi$. The fit is done in slices of $M_{\pi\pi}{}^2$, and for technical reasons, neither MC nor Weight-Histograms may have bins with 0 entries within the fitted range (this determines the range of bins in trackmass which can be fitted).

Fitting Background 2002 (prelim.): 2 Sources

$0.82 < M^2_{\pi\pi} < 0.87$ GeV^2

Fit done in 280 bins of trackmass, with two MC sources: $\pi\pi\gamma$, $\mu\mu\gamma$ (no $\pi\pi\pi$ events in this bin!)





par(1)=1.0087+-0.0024 (pions)

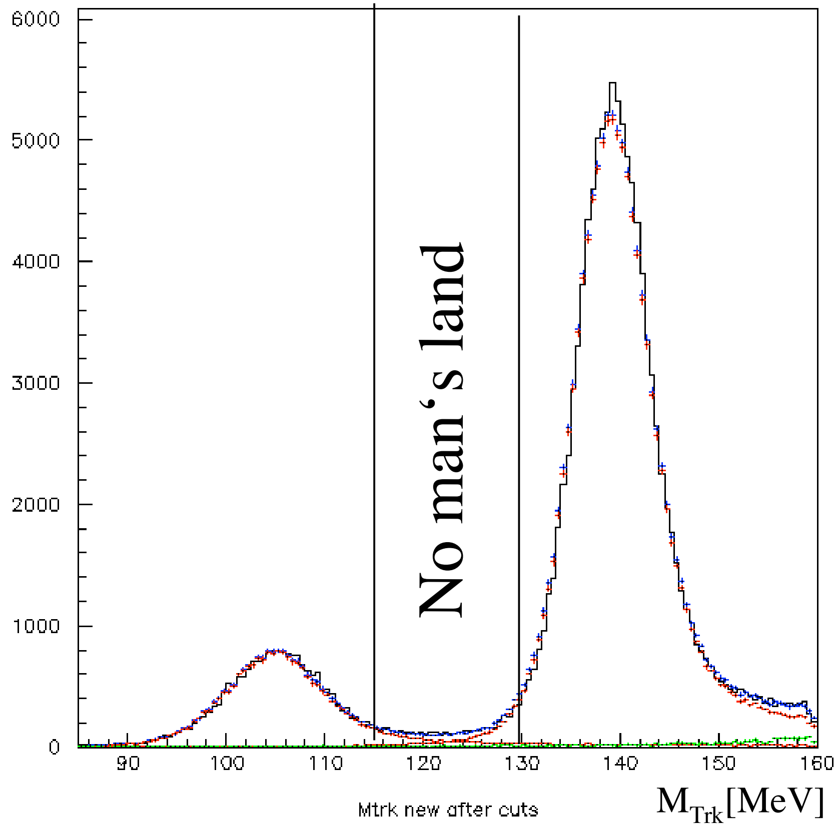
par(2)=0.9869+-0.0039 (muons)

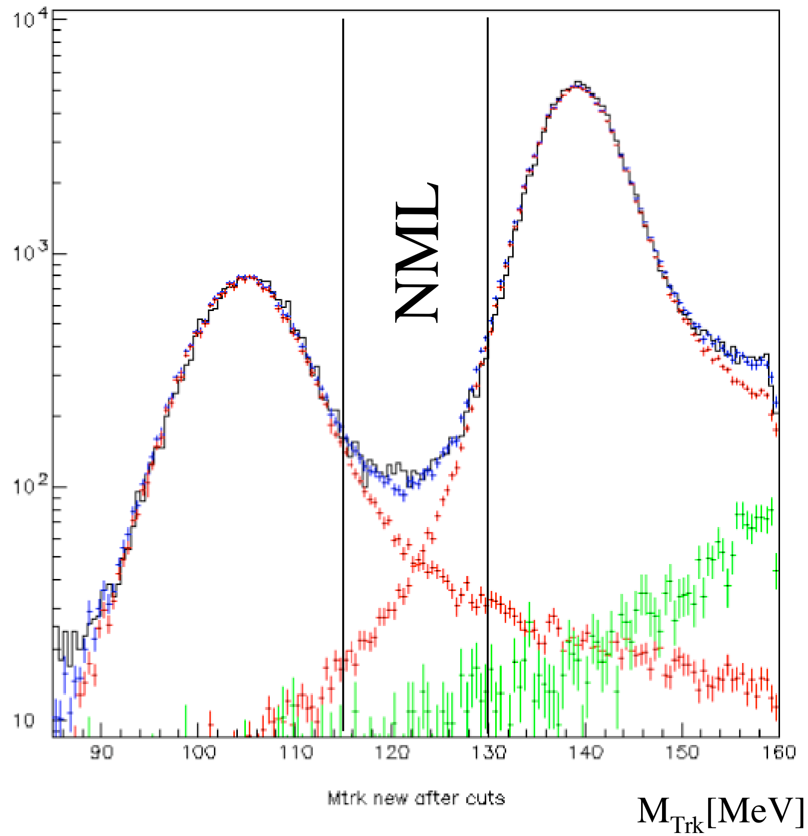
χ^2=656/278...

Fitting Background 2002 (prelim.): 3 Sources

$0.42 < M^2_{\pi\pi} < 0.47\ GeV^2$

Fit done in 150 bins of trackmass, with three MC sources: $\pi\pi\gamma$, $\mu\mu\gamma$, $\pi\pi\pi$





Par(1)=1.0641+-0.0043 (pipig)

Par(2)=0.9967+-0.0076 (muons)

Par(3)=1.209+-0.067 (pipipi)

χ^2 =431/147...

Fitting Background 2002 (prelim.): Next...

- Play around…
  - Determine number and range of bins to be fitted for each slice of $M_{\pi\pi}^2$
  - Optimize χ^2 by increasing slices in $M_{\pi\pi}^2$, bins in M_{Trk}
  - Include contribution from rad. Bhabhas (from MC or data control sample)

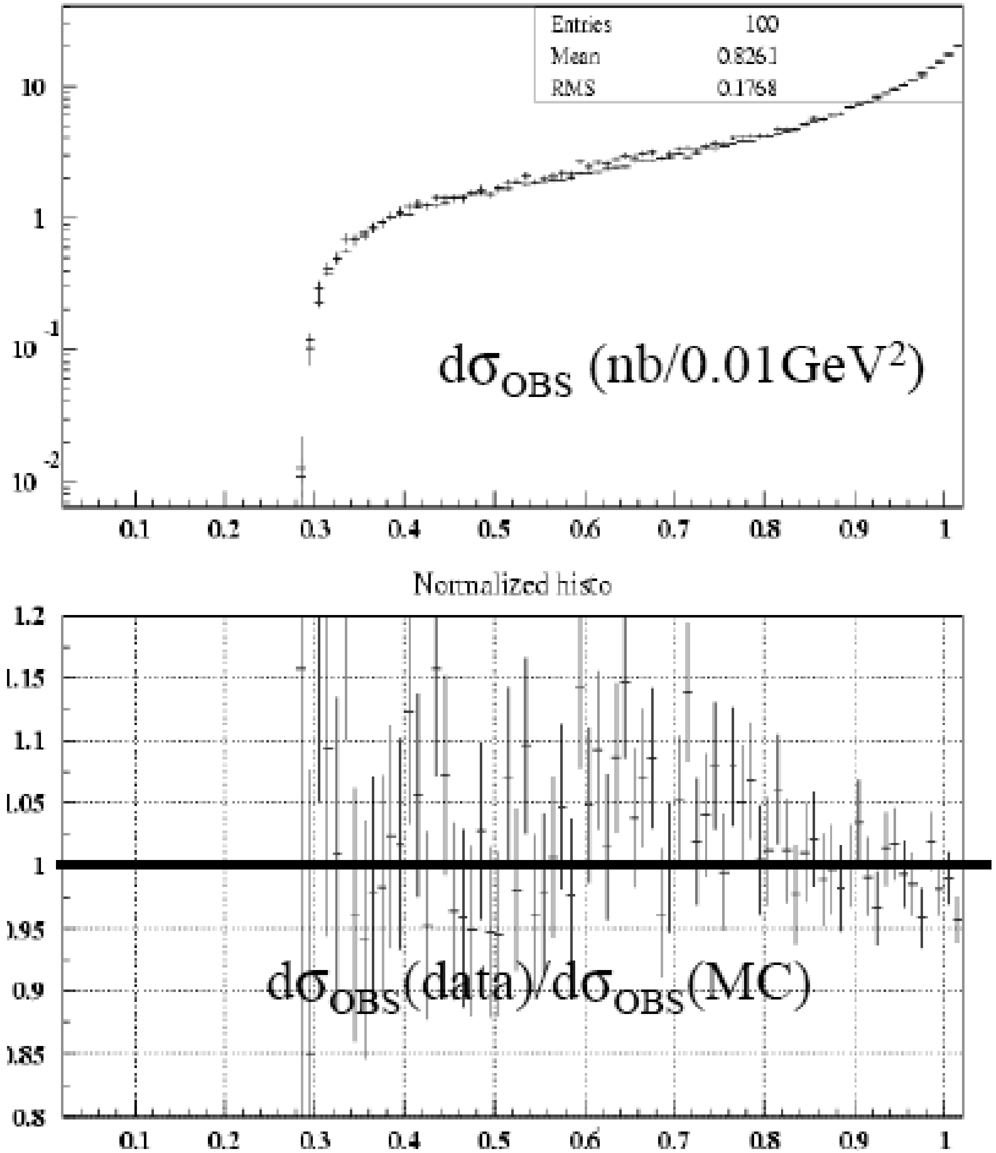
- Improve usability of fitting program!!

- Check/Improve "quality" of MC sources

Comparisons MC-Data: μμγ

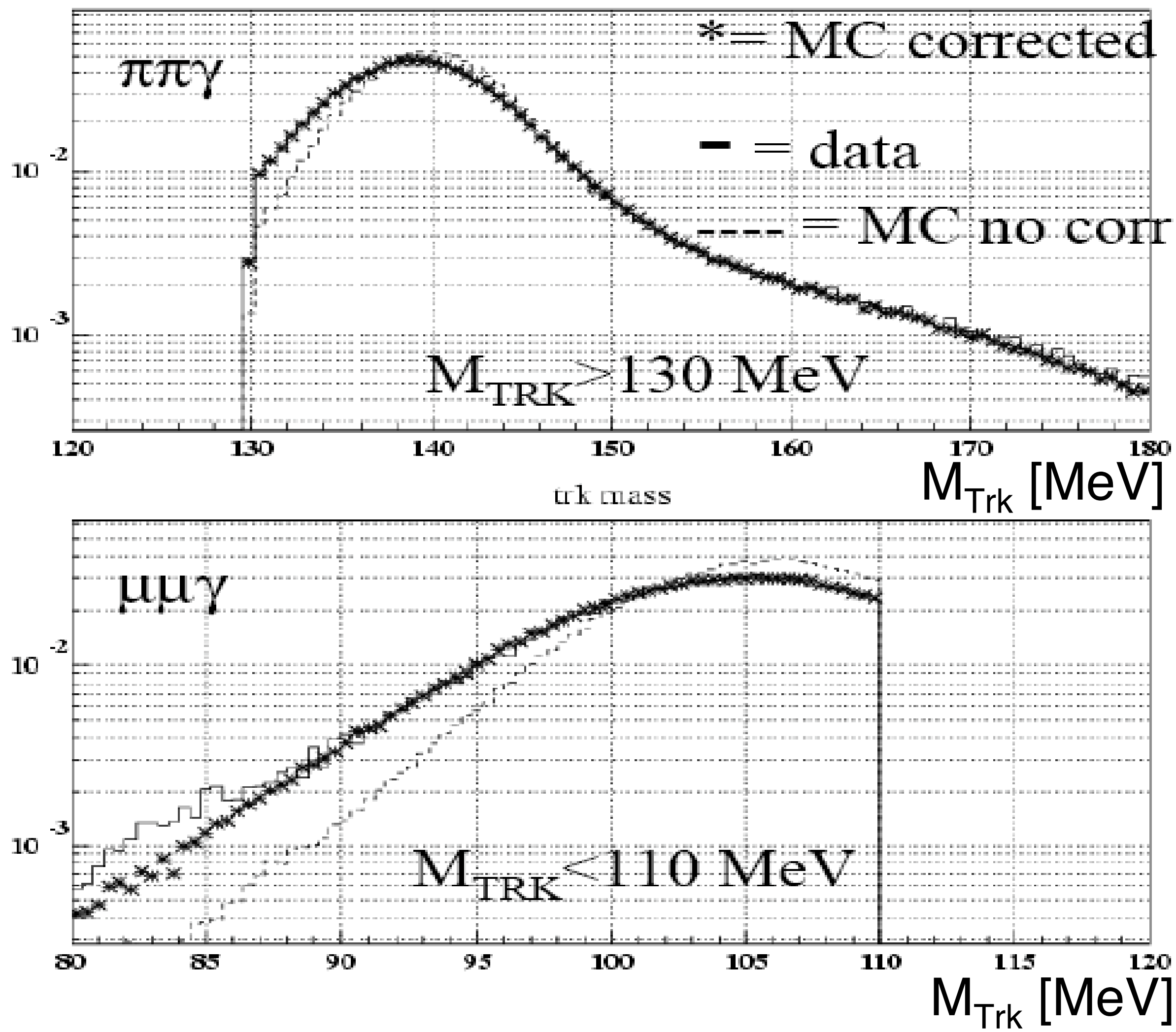
- Goal: test of Radiation functio
- Data sample (15.6 pb-1 (VLAB) from 2002:
  - ppg selection (or like)+ **m_{TRK}<110 MeV**
- MC sample (pho5mmg, 15.1 from TRGMON):
  - ppg selection (or like)+ **m_{TRK}<110 MeV**
- NO efficiency correction
- ππγ background subtracted

Effects of efficiencies and background from eeγ to be studied!



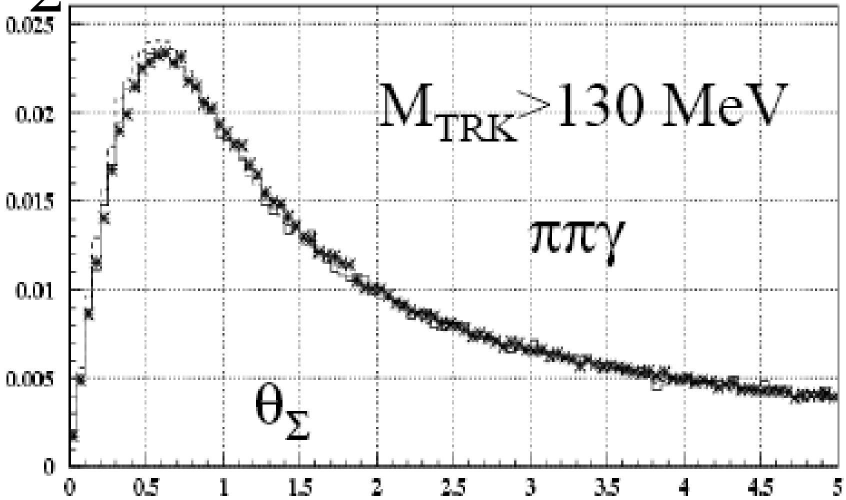
Comparisons MC-Data: Corrections

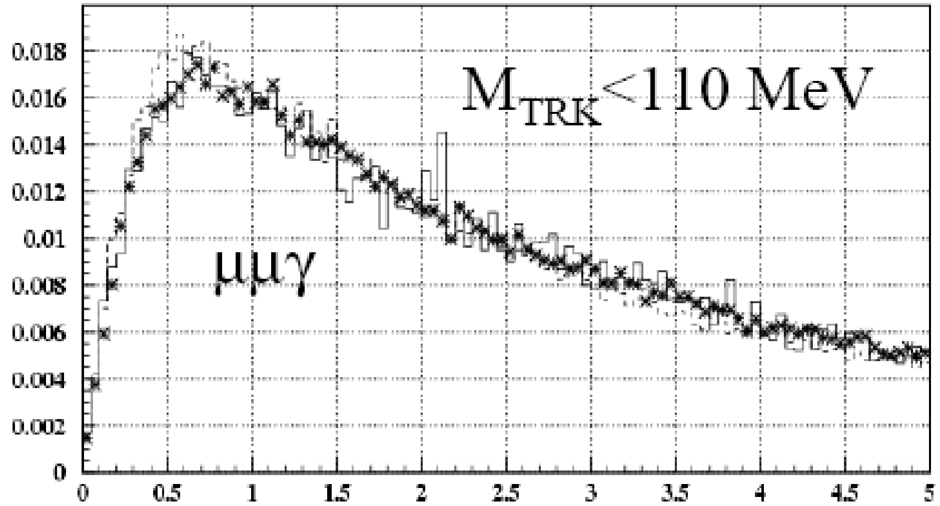
Based on studies done by Cesare,Barbara Valeriani has developped a set of corrections applied to the momenta of the tracks in MC in order to improve the behavior of MC when compared to data.



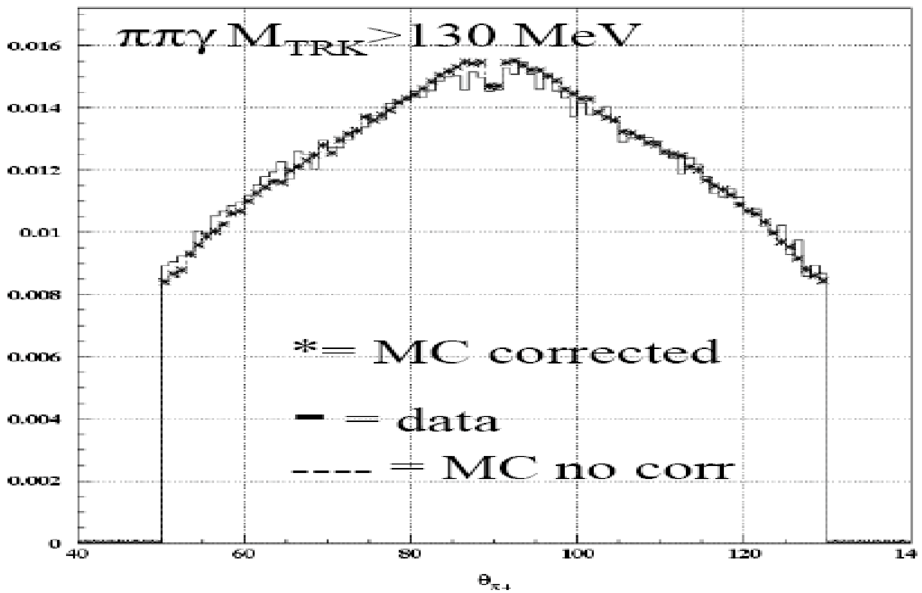
Comparisons MC-Data: Corrections

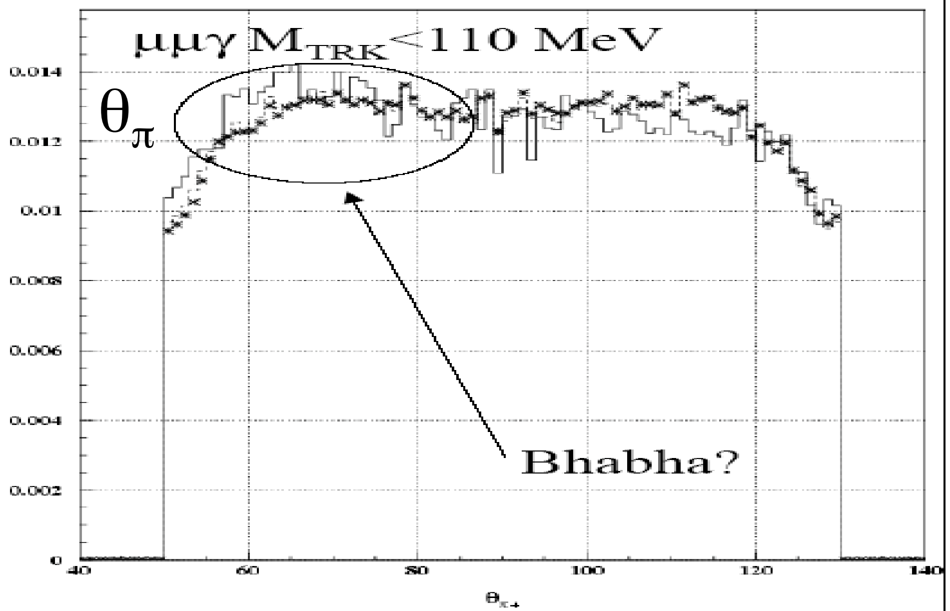
θ_Σ:



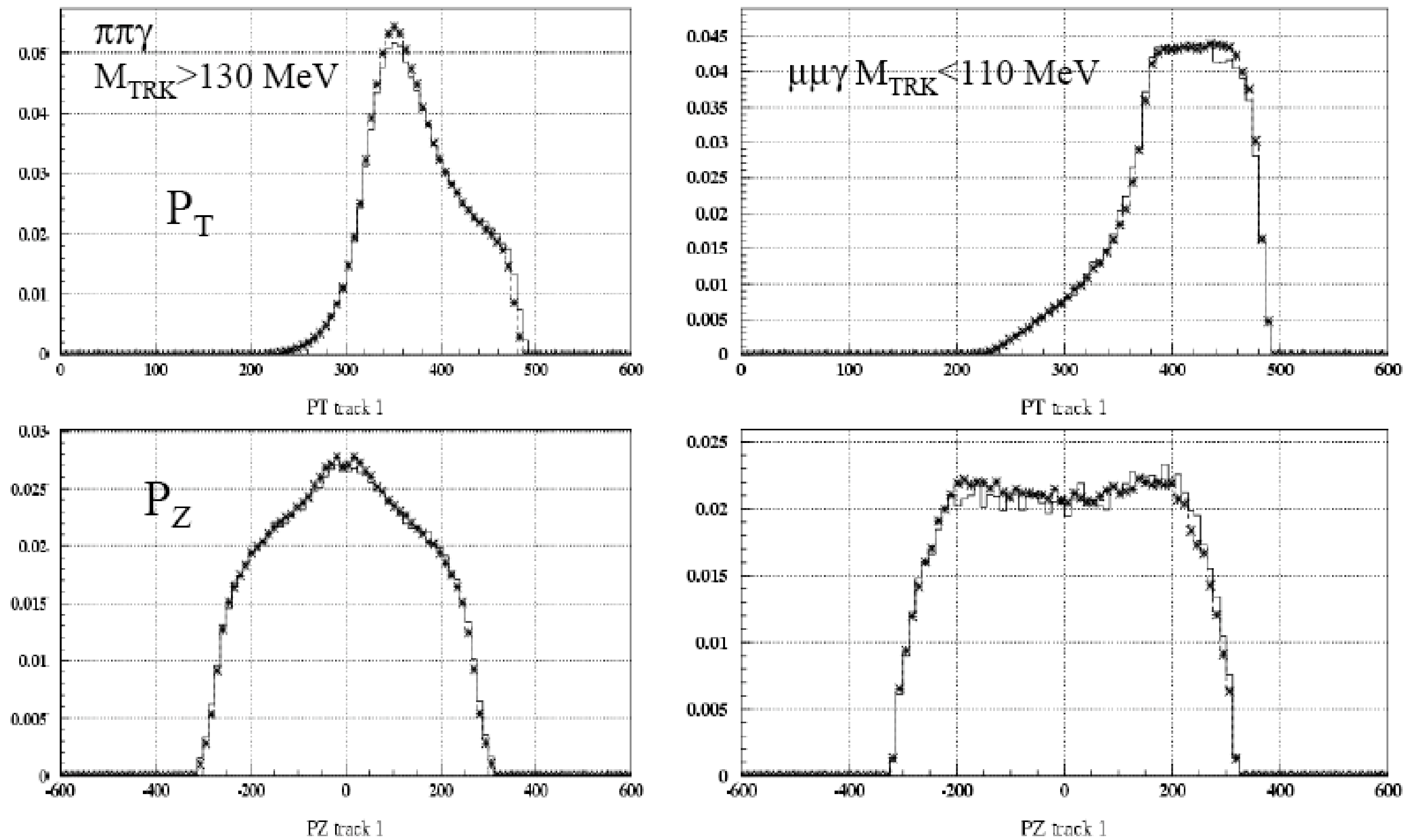


θ_π:



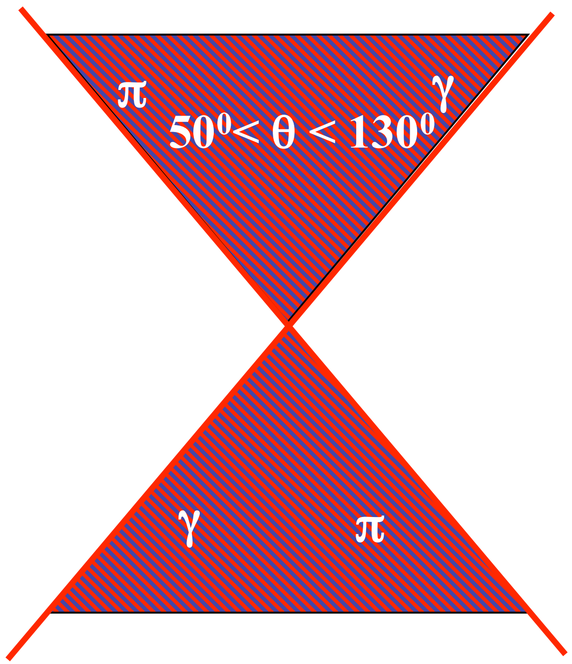


Comparisons MC-Data: Corrections



Summary: Corrections by Barbara work astonishingly well (especially in M_{Trk} and θ_{Σ}), while having negligible effect on the event count after selection.

Large angle



Tracking efficiency studies:

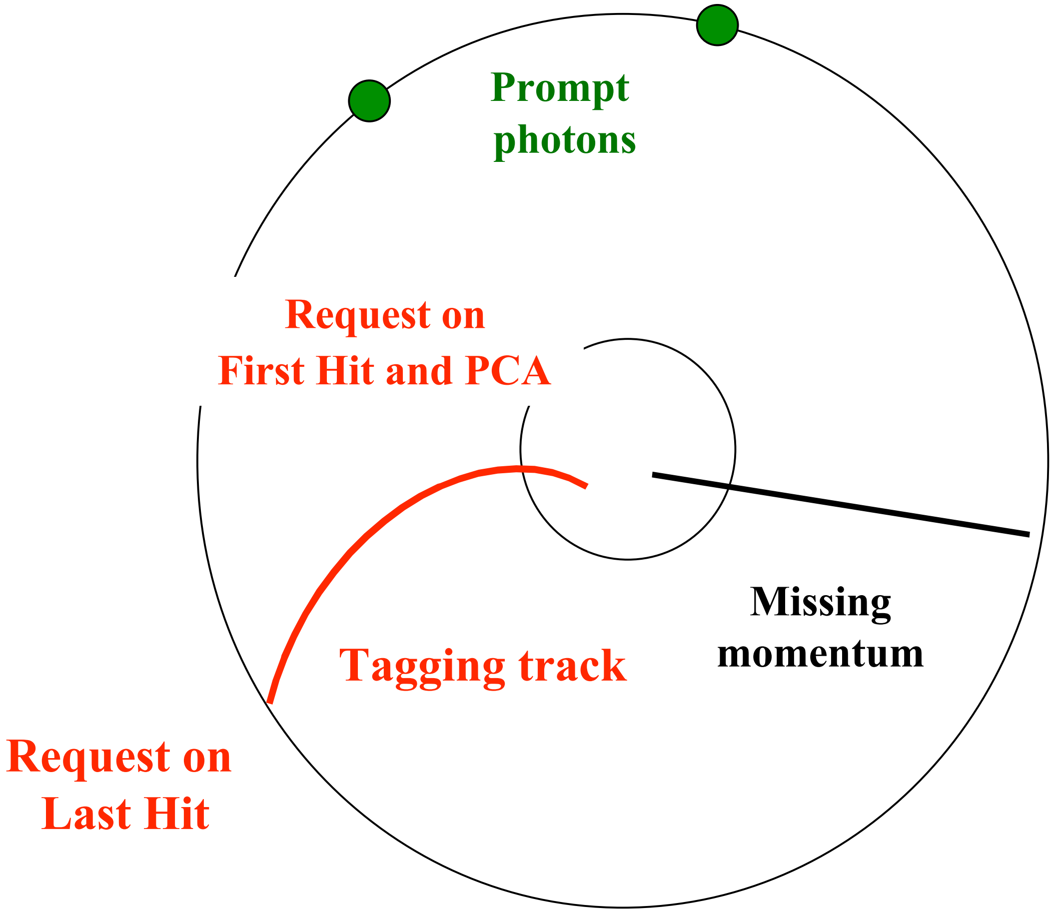
1^{st} step: selection of an unbiased sample of events with at least ONE track
Control sample: $\pi^+\pi^-\pi^0$ (the pions momenta cover a big part of our momenta range)

Definition of TAGGING track:
- from DTFS bank
- first hit radius < 50 cm
- PCA to the beam line with $|r_{PCA}| < 8$ cm and $|z_{PCA}| < 7$ cm
- last hit radius >170 cm

→ ONE (clean) track from the IP crossing the whole chamber

- 2 prompt photons (if more, the 2 with closest invariant mass to $m(\pi^0)$)

- evaluation of missing momentum (at the PCA to the beam line)



If more than one tagging track, we choose randomly one

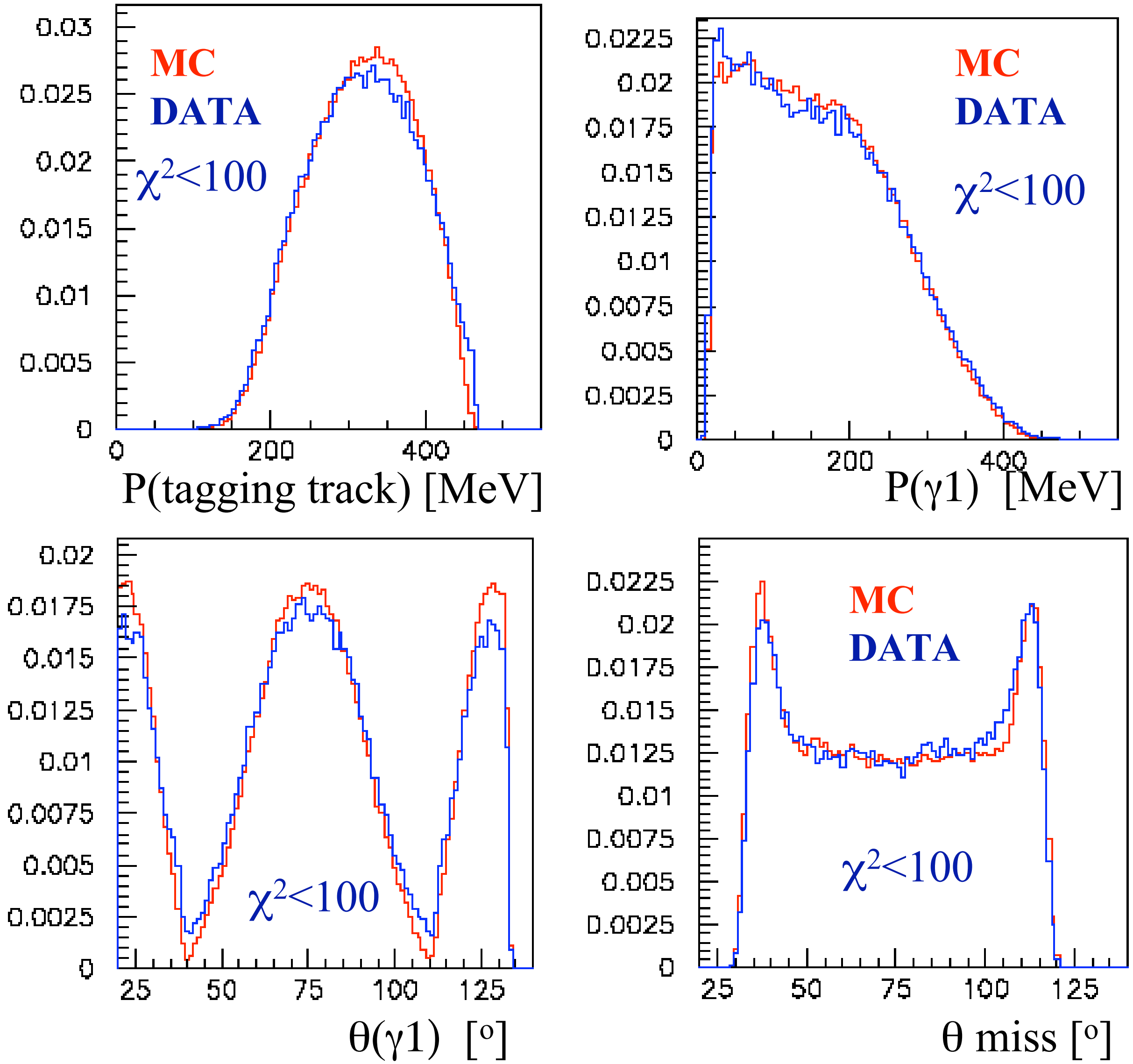
Tracking efficiency studies:

If (ONE tagging track + 2 prompt γ) **AND**

$40^o < \theta$(tag track)$<140^o$ and $40^o<\theta$(miss) $<140^o$ and $21^o< \theta(\gamma1,\gamma2) <159^o$)

kinematic fit in the $\pi^+\pi^-\pi^0$ hypothesys

Cut on χ^2 → comparison data-MC

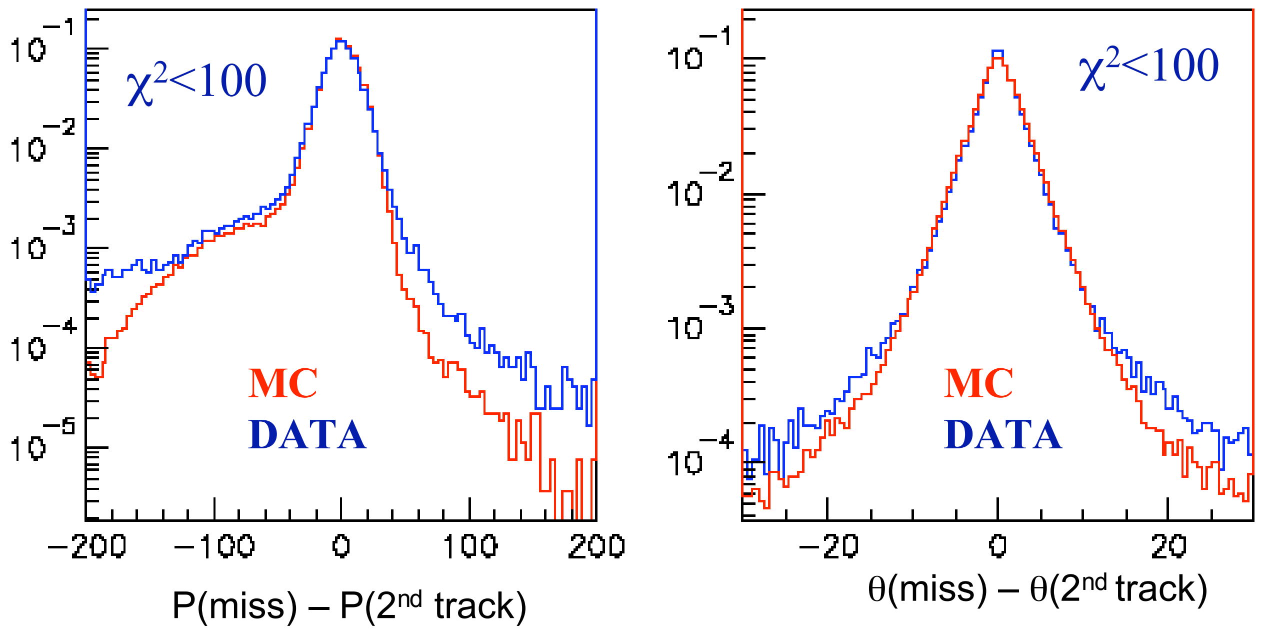


All the variables after the fit

Good data/MC agreement **no contamination of background** in the data sample

Further checks on the behaviour of the kinematic fit
(N.B. In the original version it works on events completely detected,
i.e. 2 tracks and 2 photons)

Taking the second track from the DTFS we can evaluate the difference between the missing momentun/angle and the measured ones



Small difference in the tails, but both the distributions centered at 0
Overall agreement data/MC

2nd step: definition of the test track

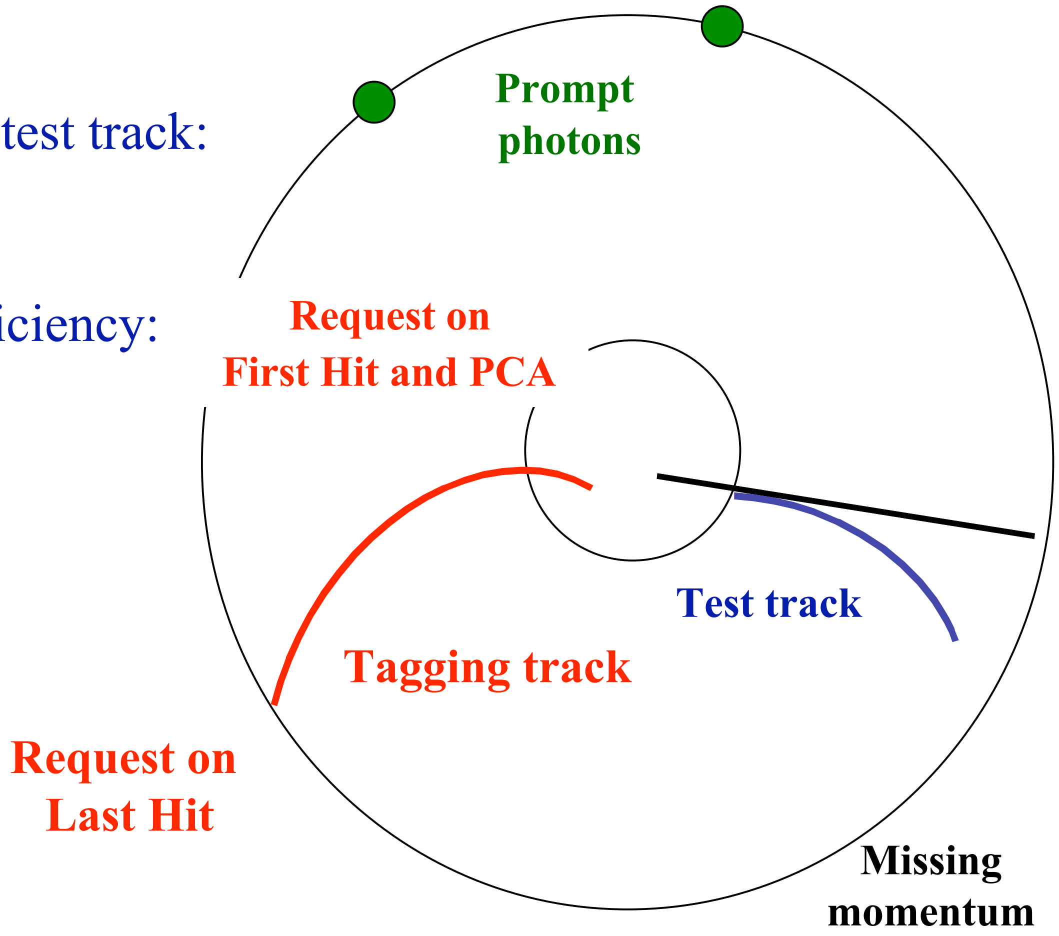
For the events which fullfill the cut on the χ^2 we look for a second (at least) track

The test track is the detected track corresponding to the missing momentum

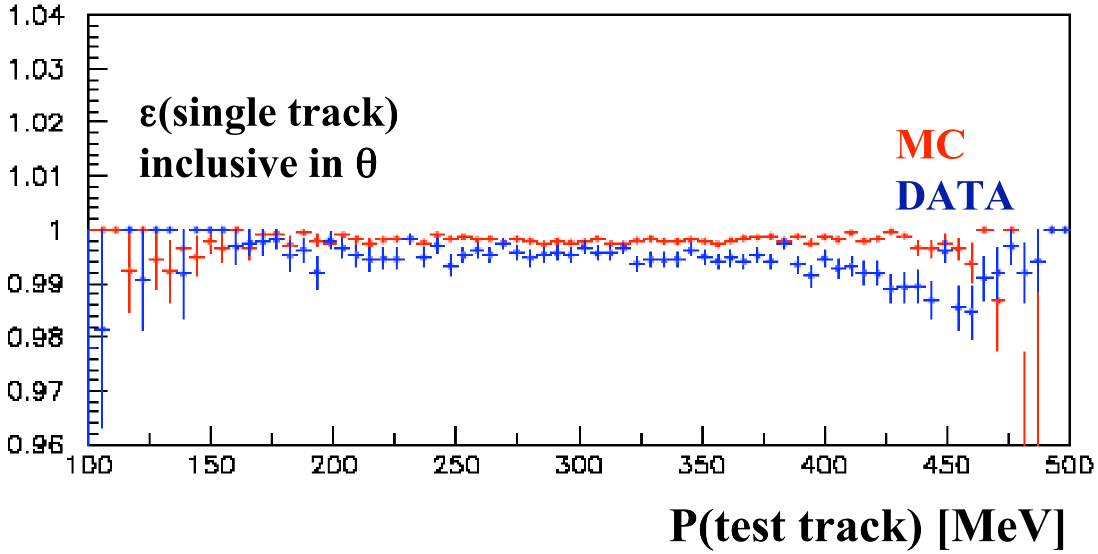
At the moment no requests on the test track: its existence is enough

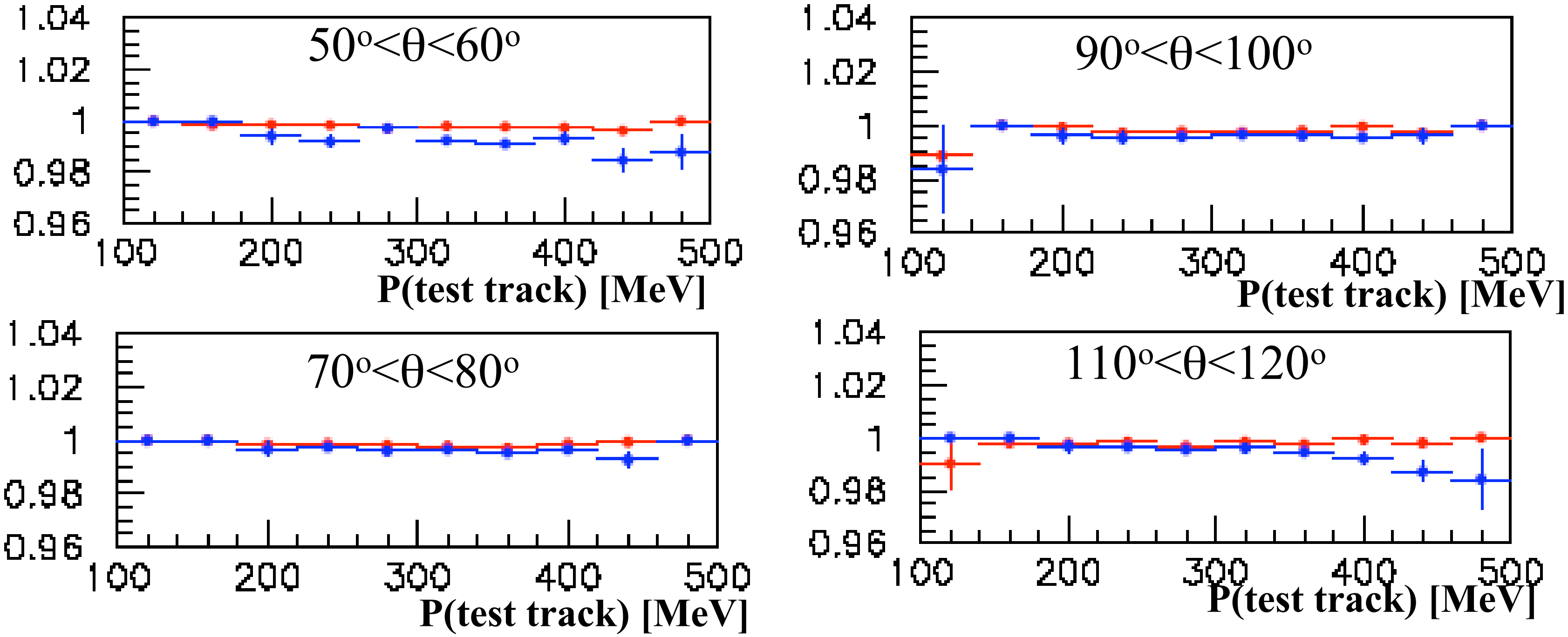
First evaluation of single track efficiency:

events with at least one test track normalized to the sample with the tagging track



Efficiency above 99% both for data and MC exept at high momenta but in average 1% discrepancy between data and MC





Furhter studies are in progress

Vertex efficiency studies:

Schöne Straßenbahne!

Selection of candidate tracks:

- based on DTFS information
- PCA: R<8 cm; |z|<7 cm
- First Hit with R < 50 cm
- Last Hit with R > 170 cm
- associated to a cluster in EMC-Barrel

Since in the large angle analysis the .and. of the likelihood is used, in all selected events both tracks have an associated cluster.

To reject $ee\gamma$ events from $\pi\pi\gamma$ events without using the likelihood (which always requires a vertex, since it calculates the tracklength using the distance between FH and Vertex), a “home made” particle ID is used, based on β and E_{tot}/P:

$$\beta = \frac{L_{trk}}{T_{cl} \cdot c}$$

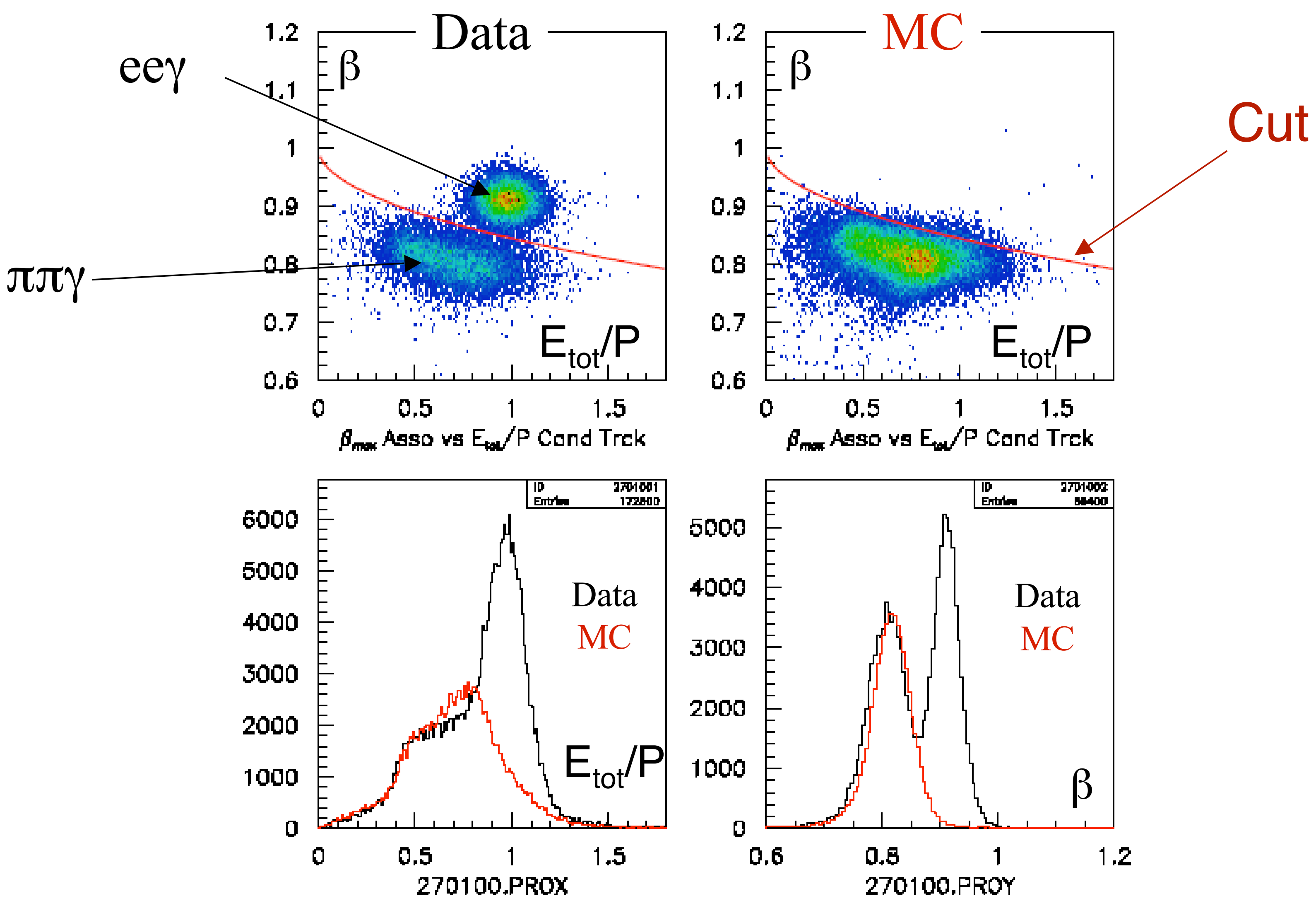
T_{cl} of the most energetic cluster

$$\frac{E_{tot}}{P}$$

E_{tot} sum on all the associated cluster

To calculate the tracklength, a simple straight line between FH and IP is used.

Vertex efficiency studies: „Home-made“ PID

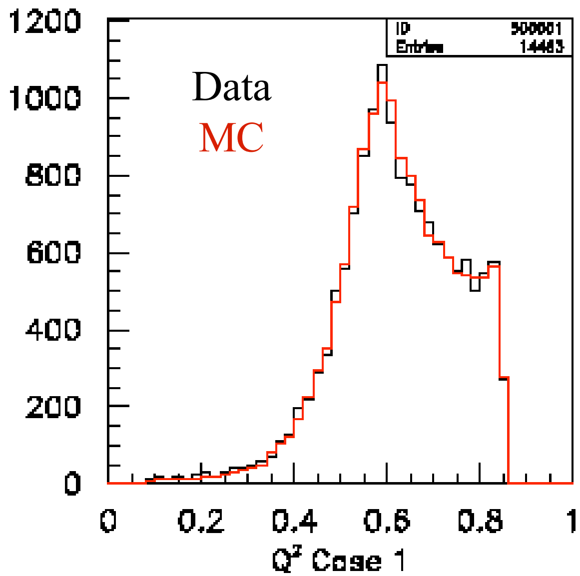


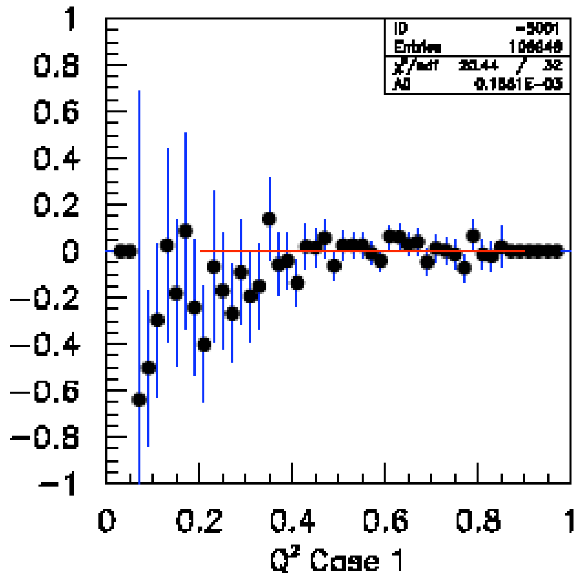
Vertex efficiency studies: Comparison MC-Data

- Vertex is existing
- Tracks associated with vertex correspond to the candidate tracks

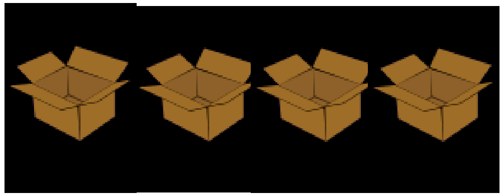
Large Angle Analysis cuts:
- Omega cut
- Trackmass
- but NOT kinematic fit

β vs E/p ("home made PID")





Vertex efficiency studies: 4 Cases



CASE 1:

- For two candidate tracks with opp. charge a vertex exists
- “candidate tracks” (DTFS) CORRESPOND to the “vertex tracks” (DVFS)

OUR DEFINITION OF EFFICIENCY!!!

CASE 2:

- Vertex IS NOT existing
- only two “candidate tracks”

CASE 3:

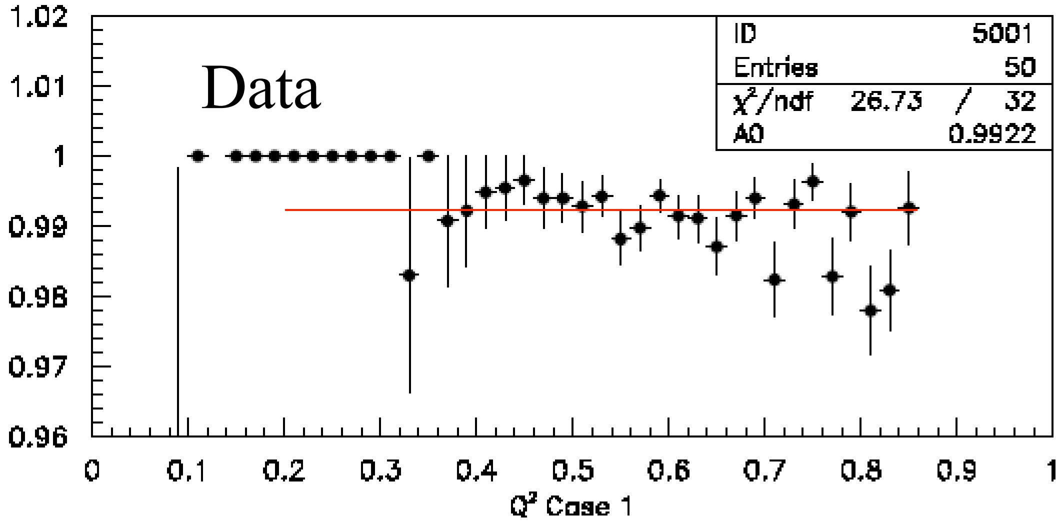
- Vertex IS NOT existing
- more than two “candidate tracks”

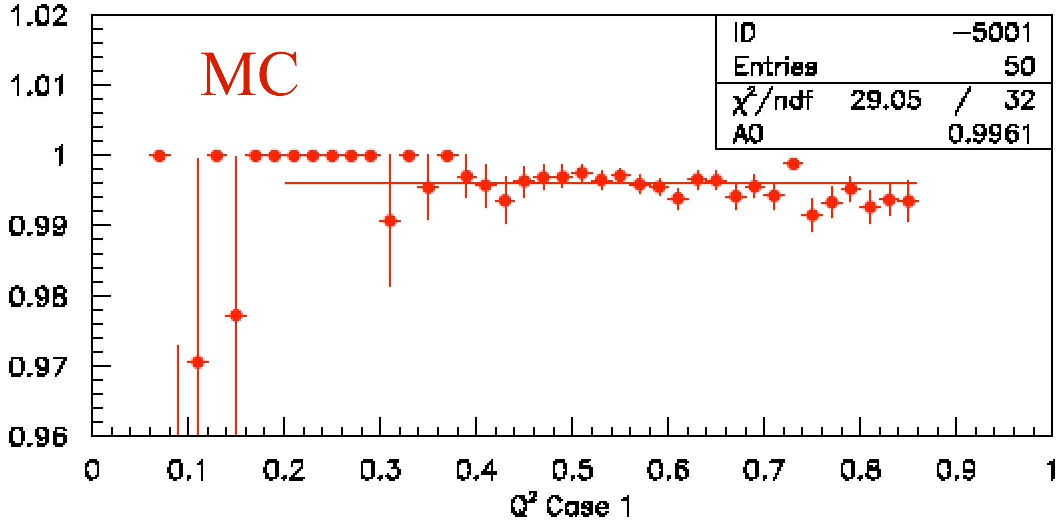
CASE 4:

- Vertex IS existing
- “candidate tracks” (DTFS) DO NOT correspond to “vertex tracks” (DVFS) (mismatching)

Less than 0.1%

Vertex efficiency studies:

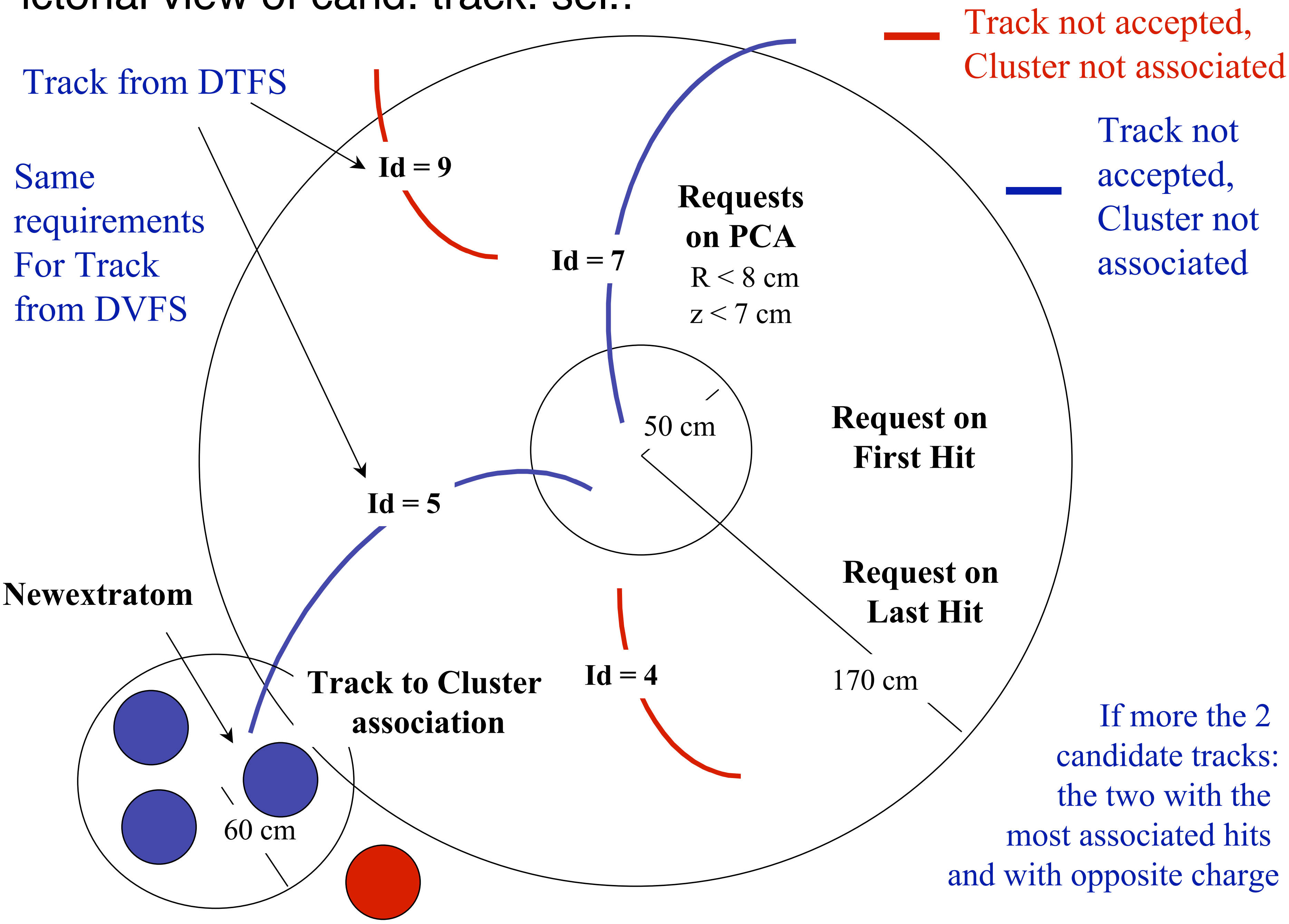




Preliminary efficiency
Good agreement
between Data and MC

Next step:
Release request for
R (Last Hit) >170 cm

Pictorial view of cand. track. sel.:



Conclusions:

- Both small and large angle analysts are working hard to obtain results as soon as possible
- “Reshuffling” of tasks compared to 2001 may not be the most time efficient strategy, but provides an additional cross check (and is often necessary, since some people left)
- We are on a good way…