$e^+e^- \to \omega\pi^0 \to \pi^0\pi^-\pi^+\pi^0$

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ϕ Decay wg meeting 30 Aprile 2004

Why this measurement?

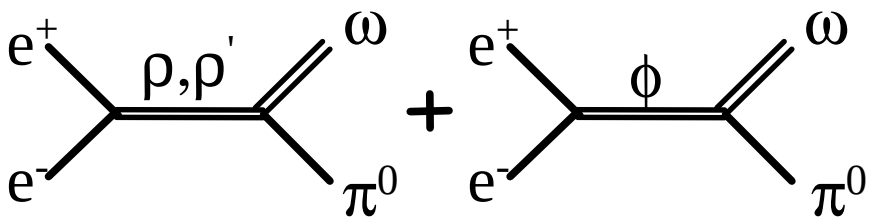
tudying the interference pattern vs $\sqrt{s}$ we can measure BR(ϕ–>$\omega\pi^0$)

hese events are a relevant background in other analisys such as quantun

interferometry KsKl in this final state.

une the simulation of this process in Geanfi

eading amplitude for this process



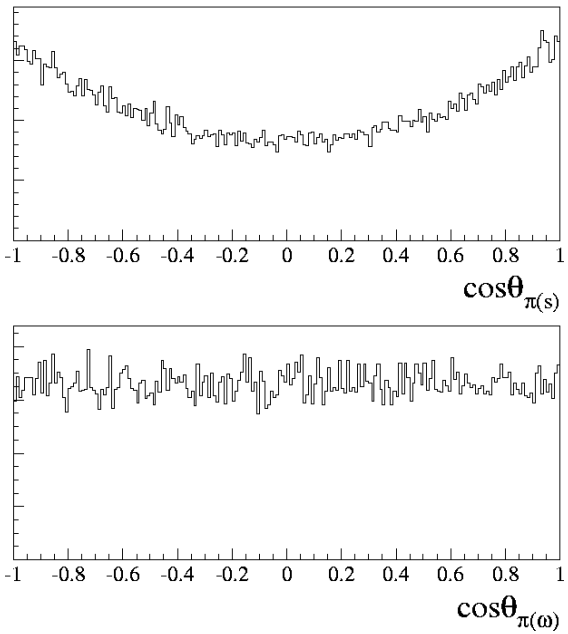
GEANFI

Looking at Geanfi code ... we believe that it works as follo

Two cascade decay imposing $\sqrt{s}$ + BW of ω + ISR radiator

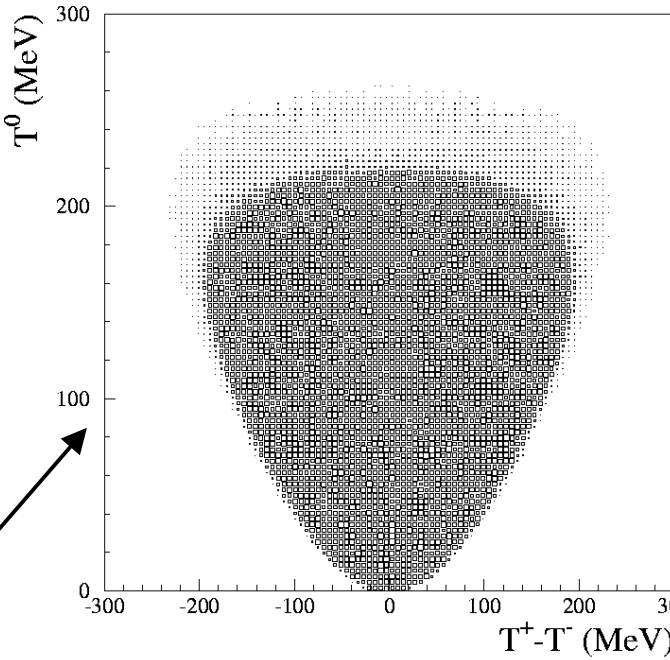
Two body decay ω-π^0 according to cos(θ) = 1+x^2

Three body decay of ω ($\pi^+\pi^-\pi^0$) : pure phase space



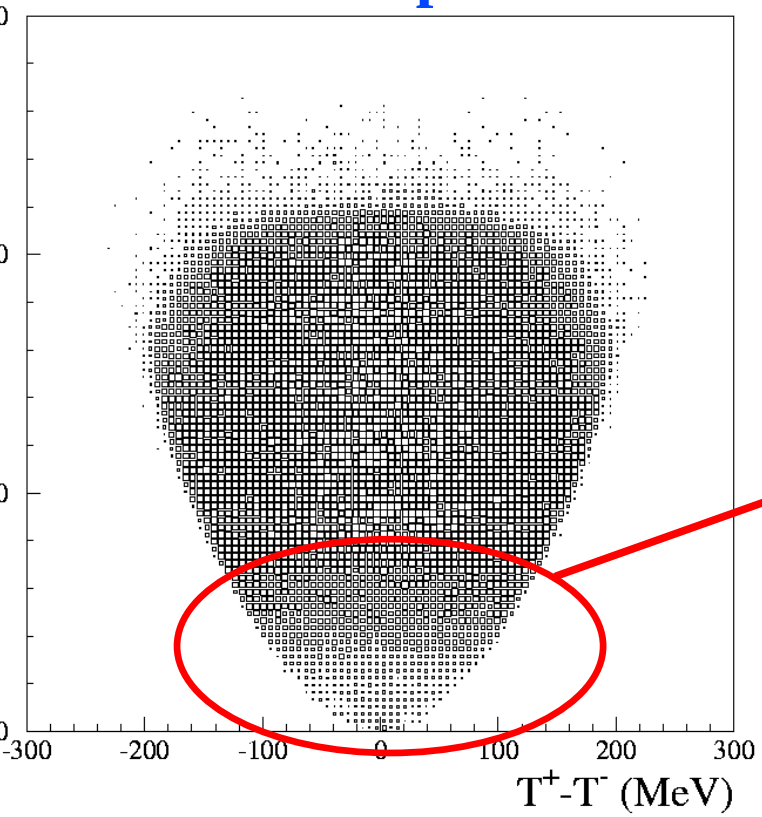
This is what we expect with these hypothesis

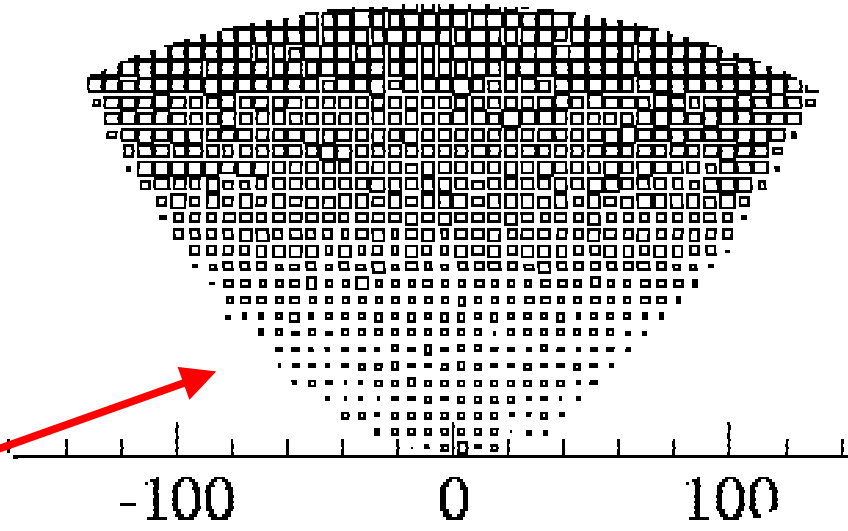
Distributions genereted with our toy-MC



Check MC: what we have in GEANFI

Geanfi Dalitz plot





We observe this strange behaviour
This region appears underpopulated

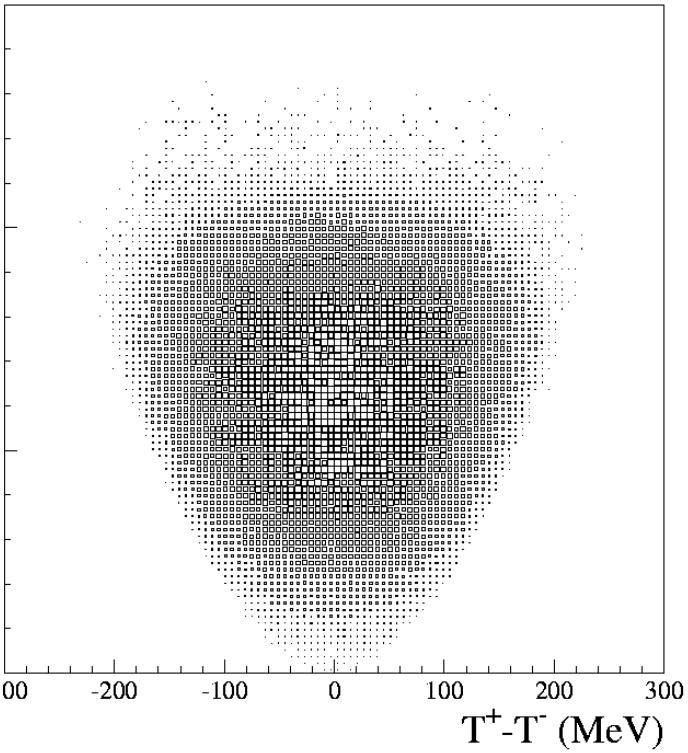
we do not expect such a behaviour for a three body decay generated only with uniform phase space ... investigating

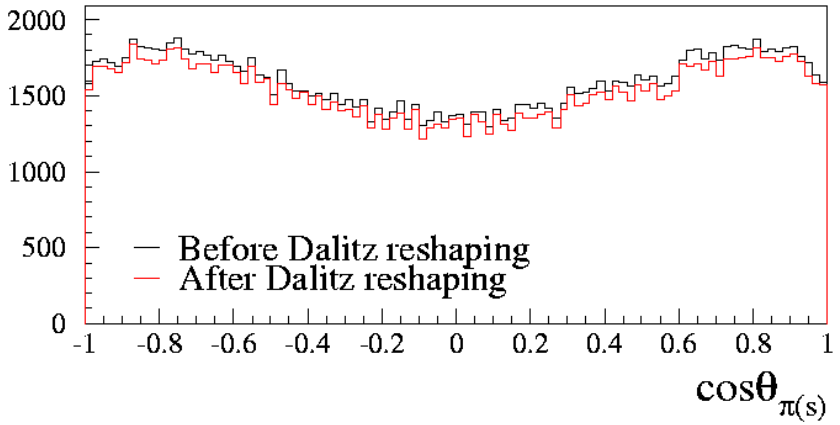
Check MC 2

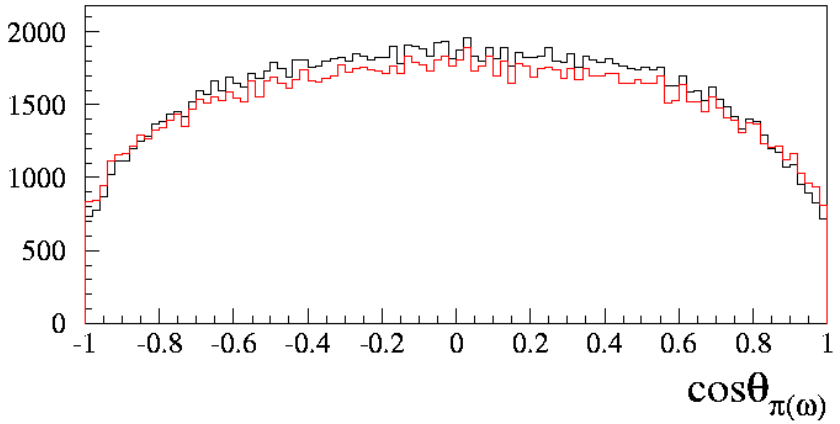
order to correct MC Dalitz we apply a reshaping procedure which we weight the dalitz population with:

$$W = | \vec{P}_{\pi+} \times \vec{P}_{\pi-} |^2$$

eanfi Dalitz plot after reshaping







Analysis strategy: Selection criteria

wo steps:

Acceptance region {

- One vertex at IP
- Two tracks connected at vertex
- Four neutral cluster with: {
  - E_{clu} grater than 10 MeV
  - ToF compatible with prompt γ
  - $|\cos(\theta_j)| < 0.93$

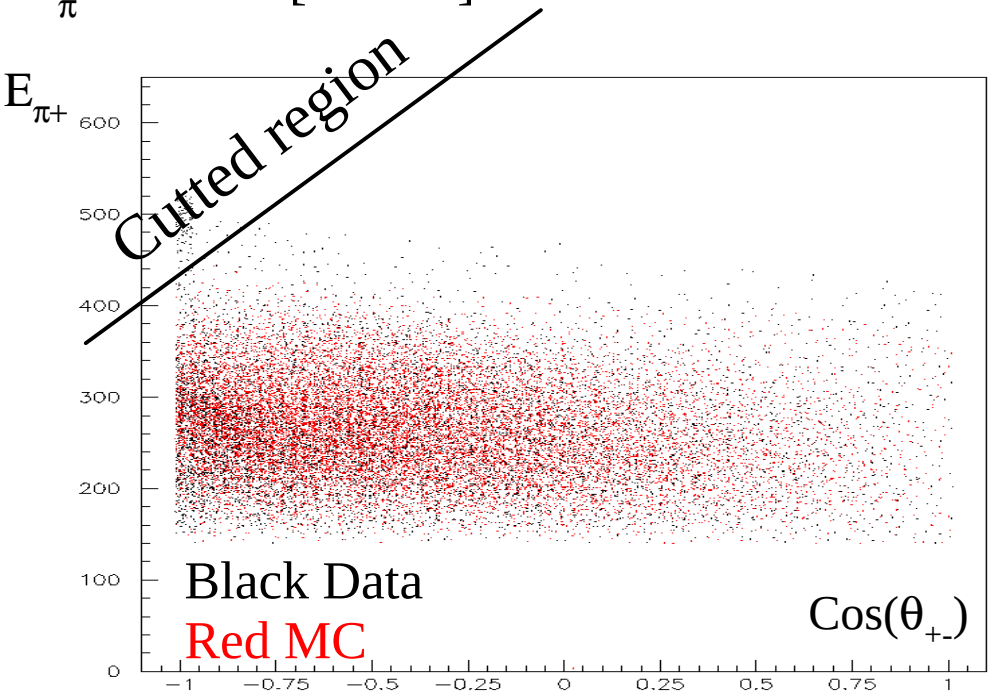
Global Kinematic Fit {

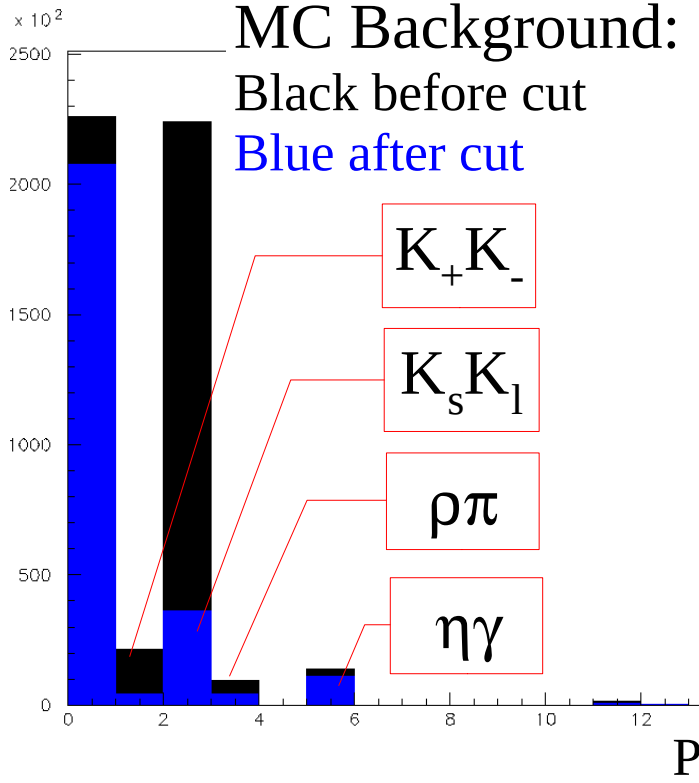
- Improve resolutions and improve rejection of background events

Analysis strategy: final cuts

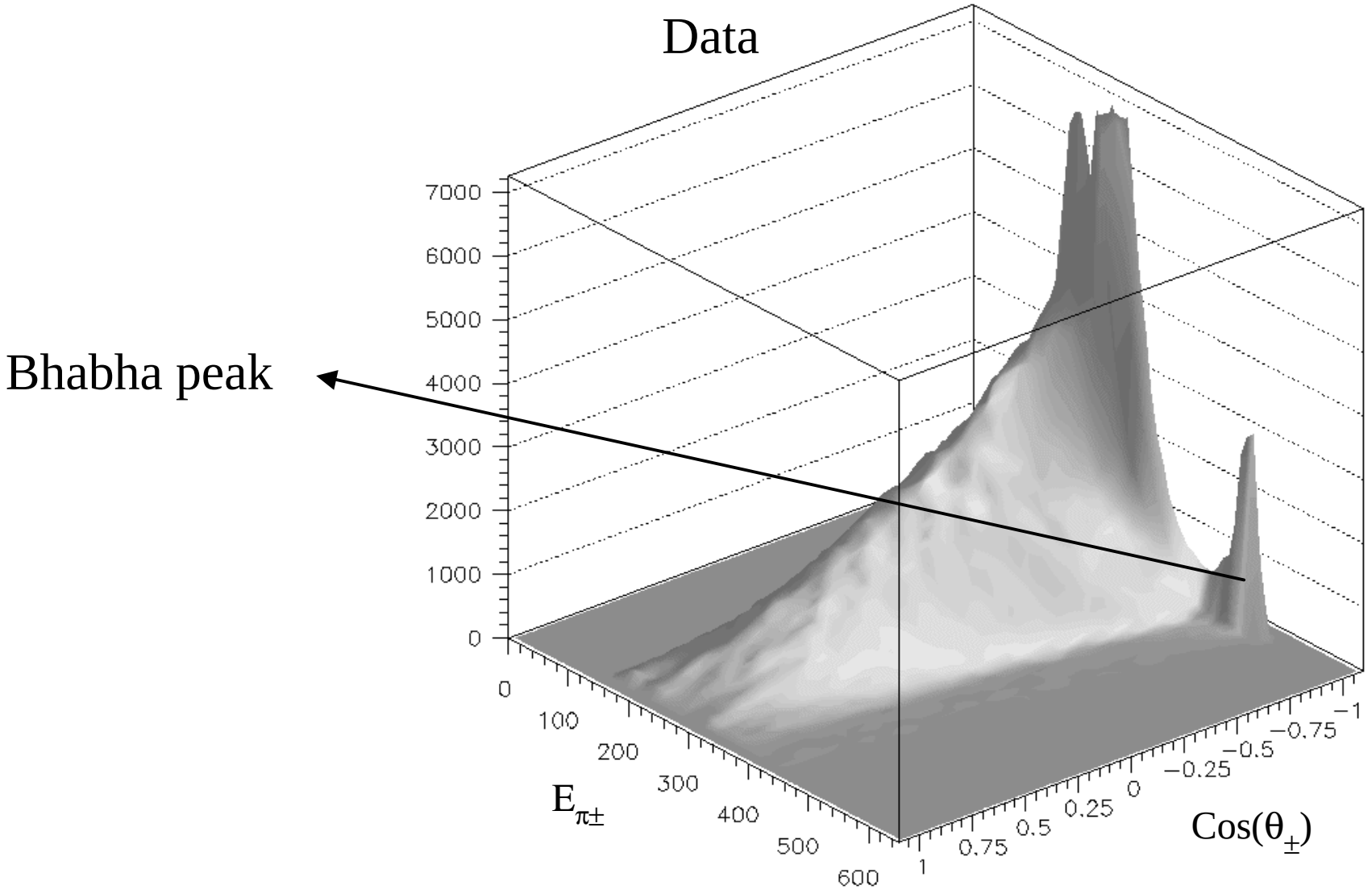
Three different cuts:

- c^2 cut [LT 50] (c^2 from kinematic fit)
- Bhabha filtering (cut in $\cos(\theta_{\pm})$ vs $E_{\pi\pm}$ plane)
- M_{π} mass cut [80-190] MeV





A nice plot for a better view of "bhabha filter"



Background evaluations

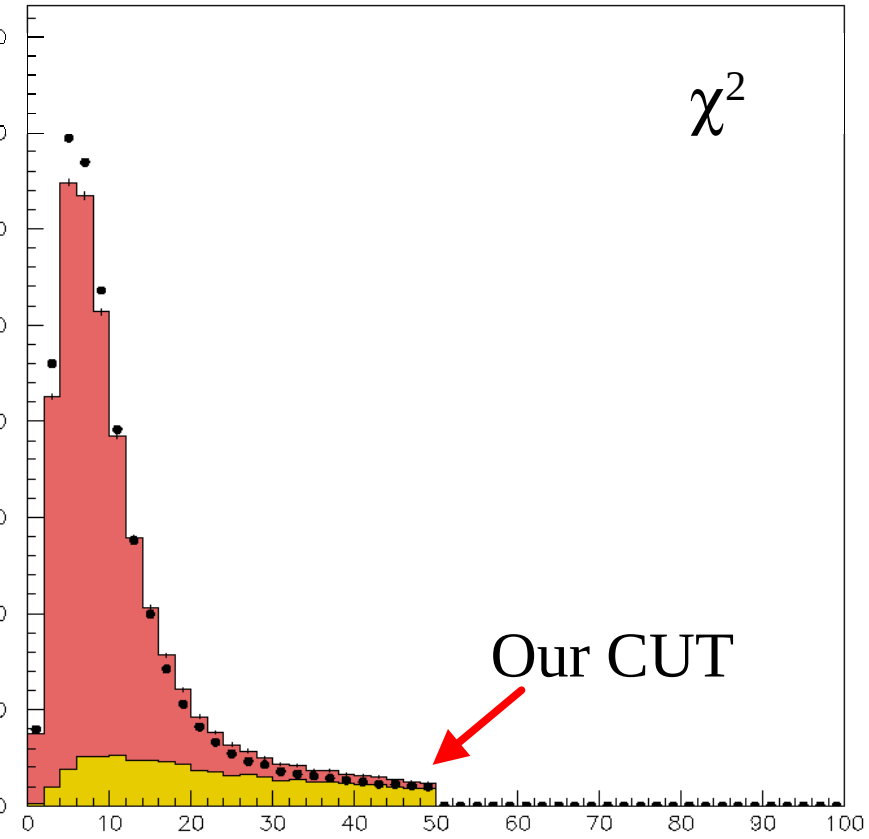
We use MC shape for signal and backgroud to fit data distributions.
After a 100 KeV sampling in $\sqrt{s}$ of all relevant variable, we have chosen to fit ω mass distributions .
We fit data as linear combinations of MC signal and background evaluat
scaling factor (w_i) for these distributions.
Fit procedure take into account also statistical fluctuations of MC .

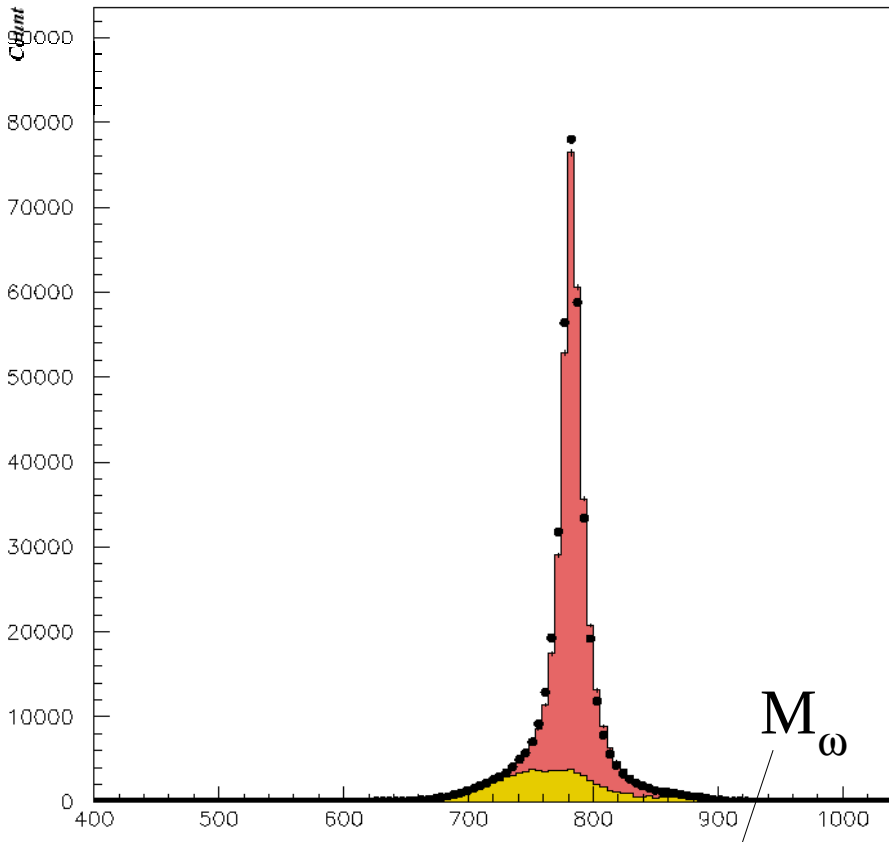
$$d_i = f_s \cdot s_i \cdot \left(D_T / S_{MC}\right) + \sum_j f_b^j \cdot b_i^j \cdot \left(D_T / B_{MC}^j\right)$$

where d_i, s_i, b_i are respectively data, signal and background, and f_k are normalized fractions of signal and background in data (fit result) and D_T, S_{MC} and B_{MC} are integrals af these distributions,

$$d_i = w^s \cdot s_i + w^b \cdot b_i \qquad \text{where} \quad w^k = f_k \cdot \left(D_T / S_{MC}^k\right)$$

Data – MC Comparison (all cuts applied)

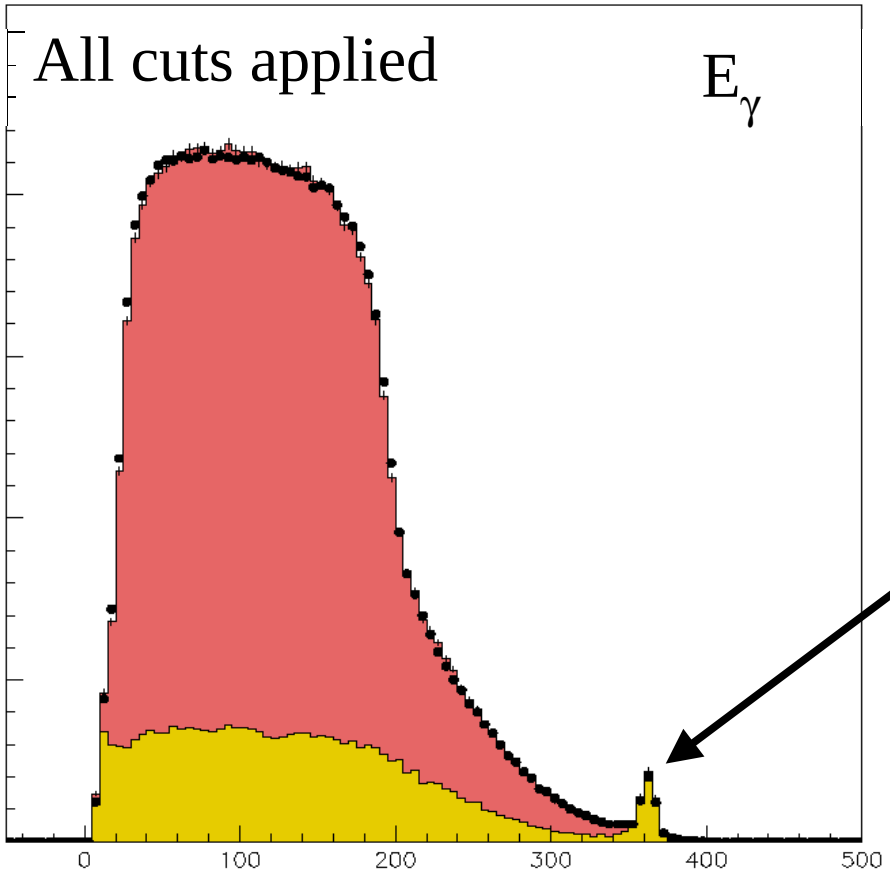




Black dot: Data
Pink: MC-Data fit result
Yellow: Background

Our Fitting distribution

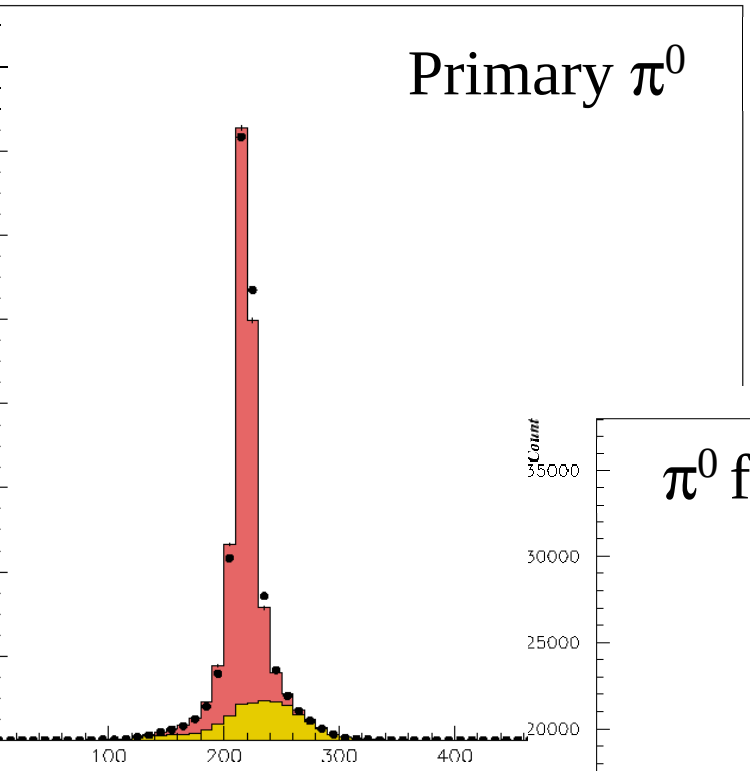
Data – MC Comparison

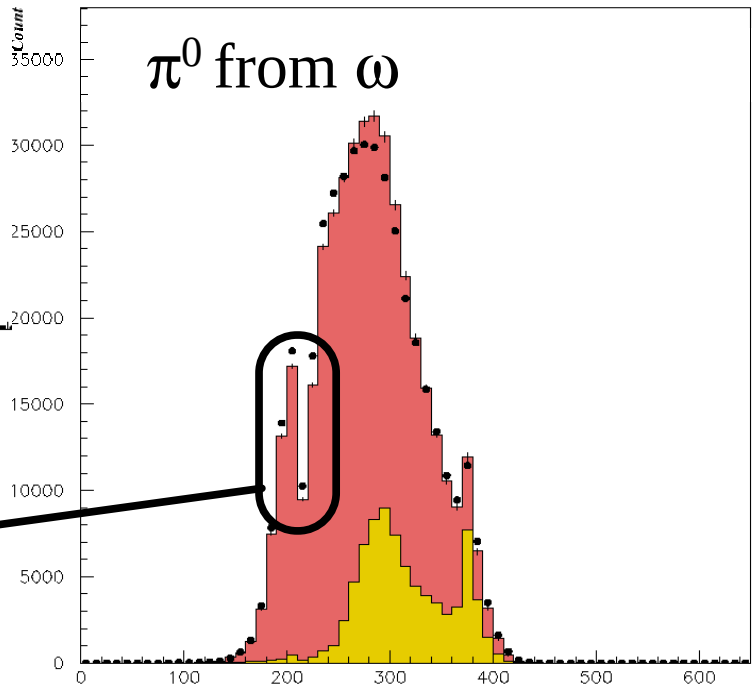


ηγ peak

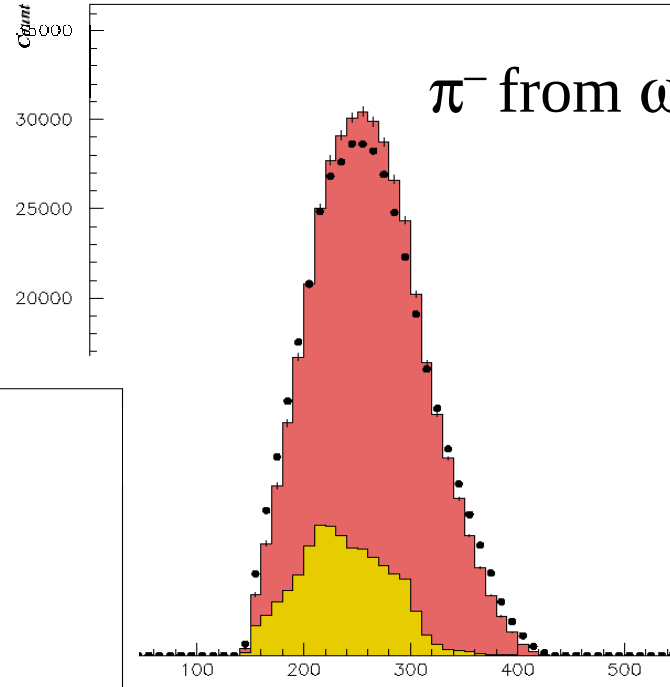
Black dot: Data
Pink: MC-Data fit result
Yellow: Background

Data vs Mc: all other variables



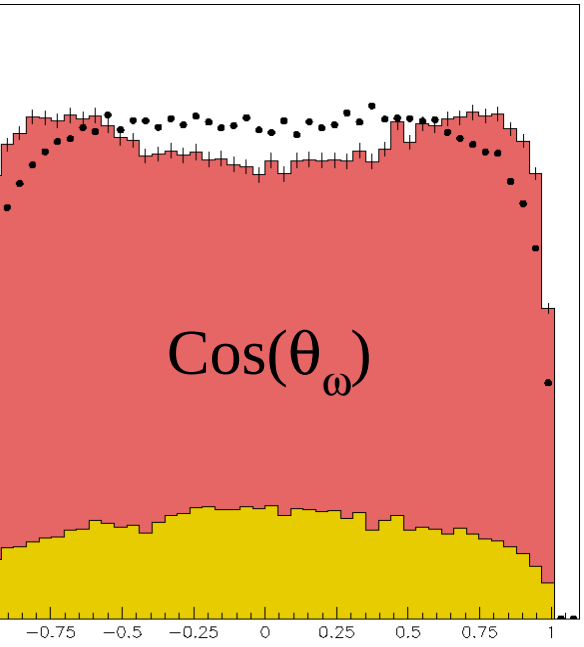


Wrong pairing effect



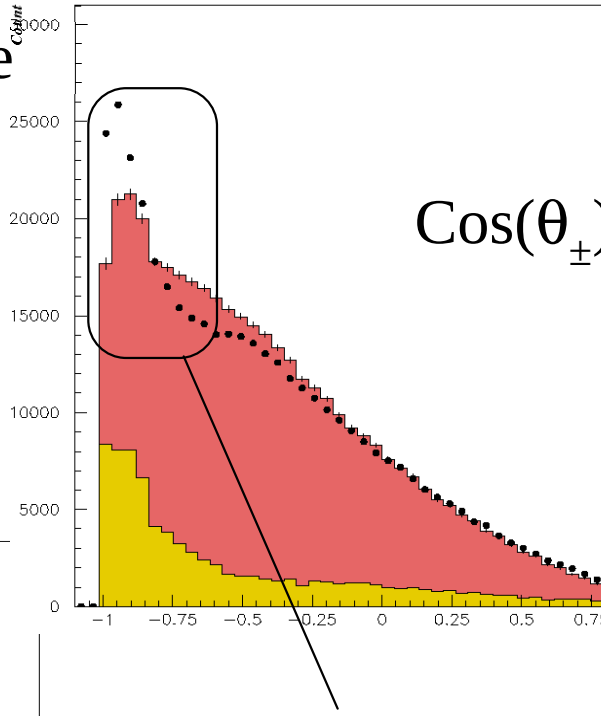
All scale are in Mev

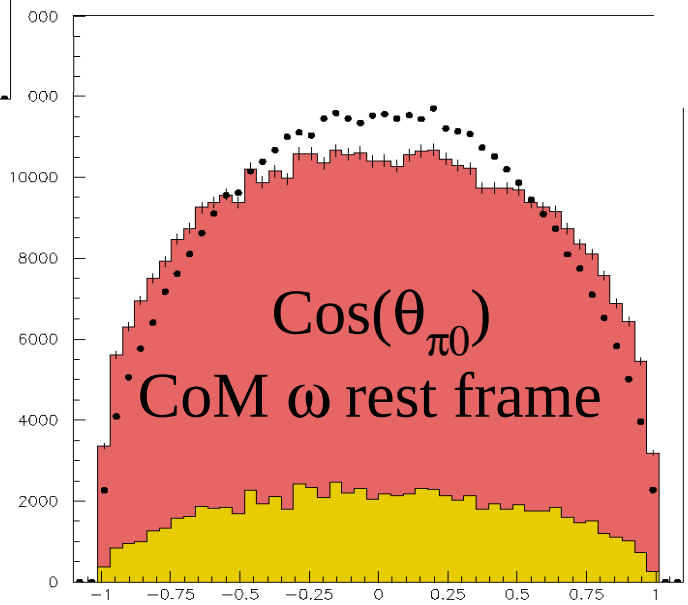
Angular distribution



C.M.S of ϕ rest frame

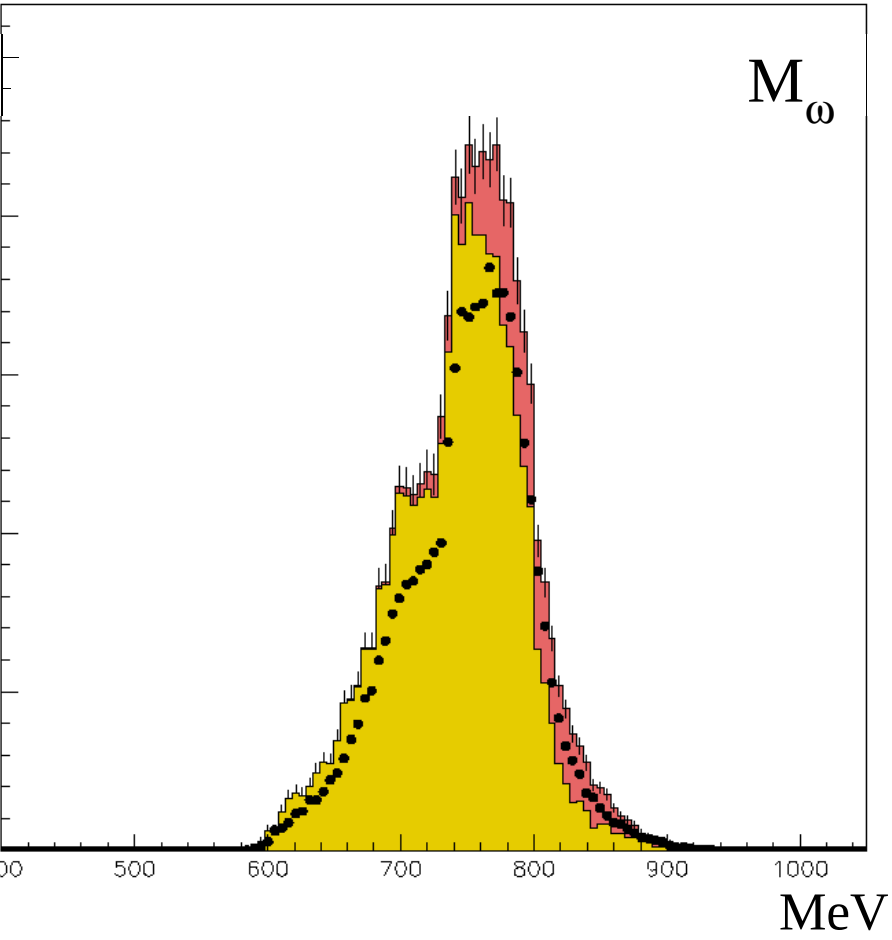
Large discrepancy!
we have not any cure
for this at present.



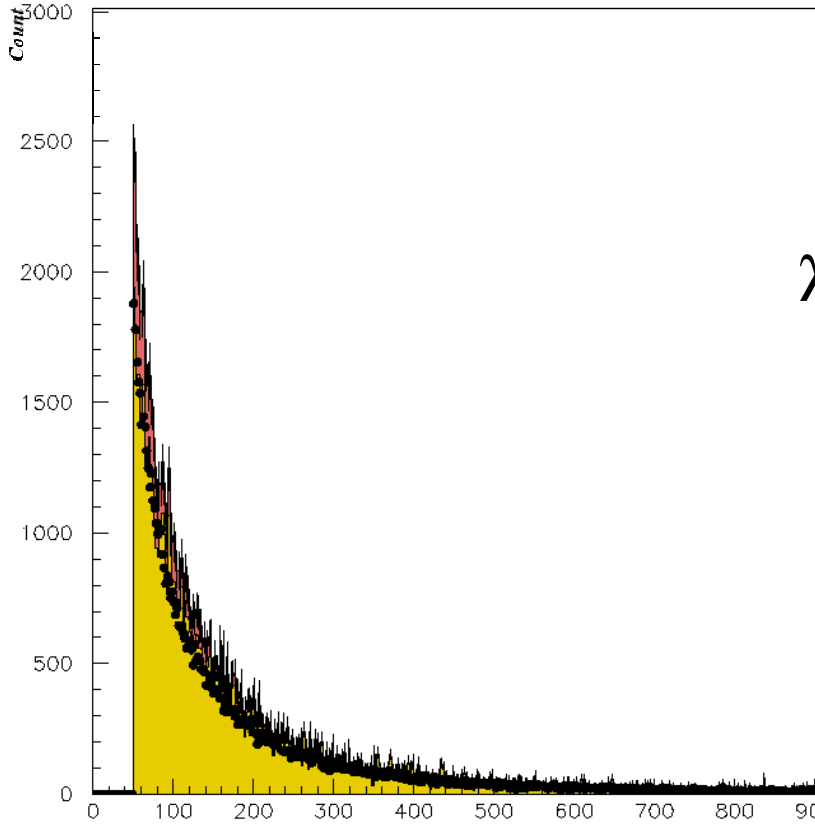


This can also be due to
incorrect background
evaluation but we belie
to be dominated by the
generator of the signal

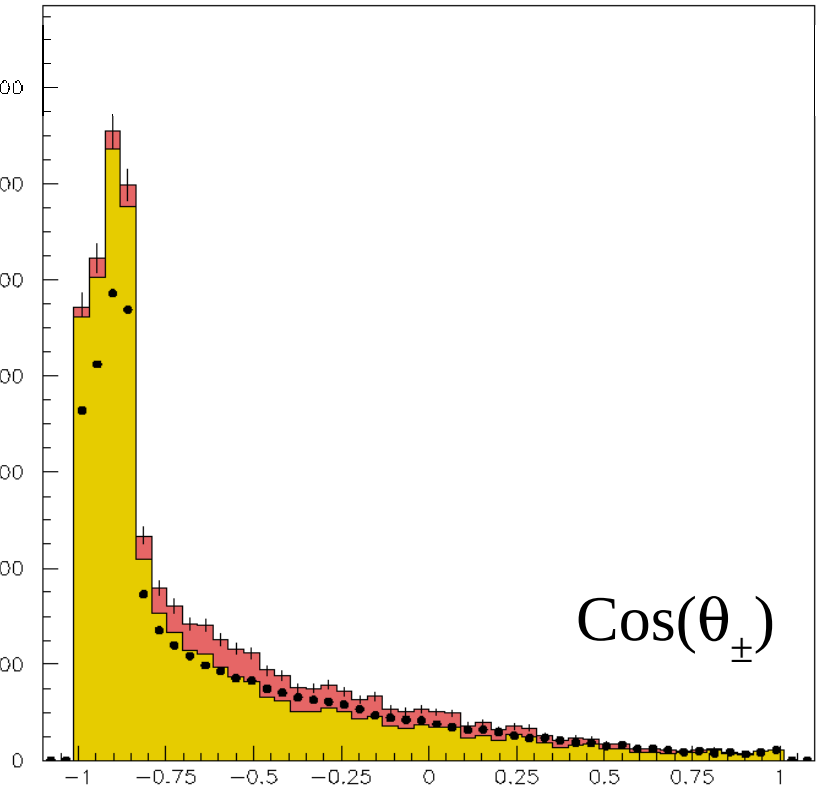
Outer selection



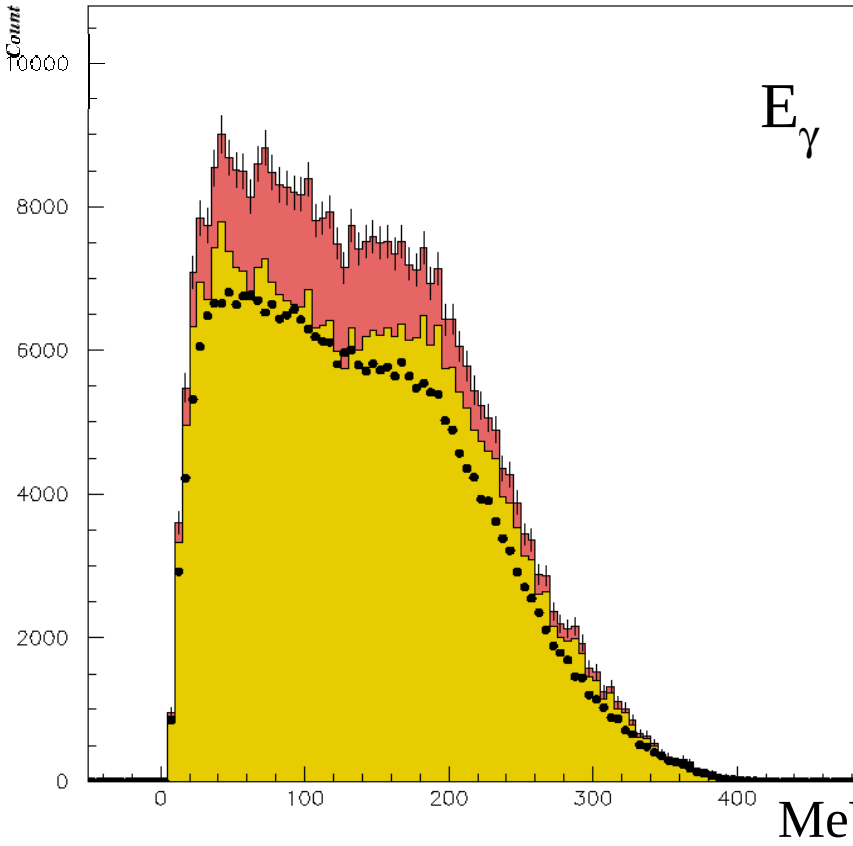
Mass cut and bhabha cut appli
Complementary selection in χ^2



Outer selection 2



Mass cut and bhabha cut appli
Complementary selection in χ^2



These plot show that we overestimate background at least 15-20%

Efficiency

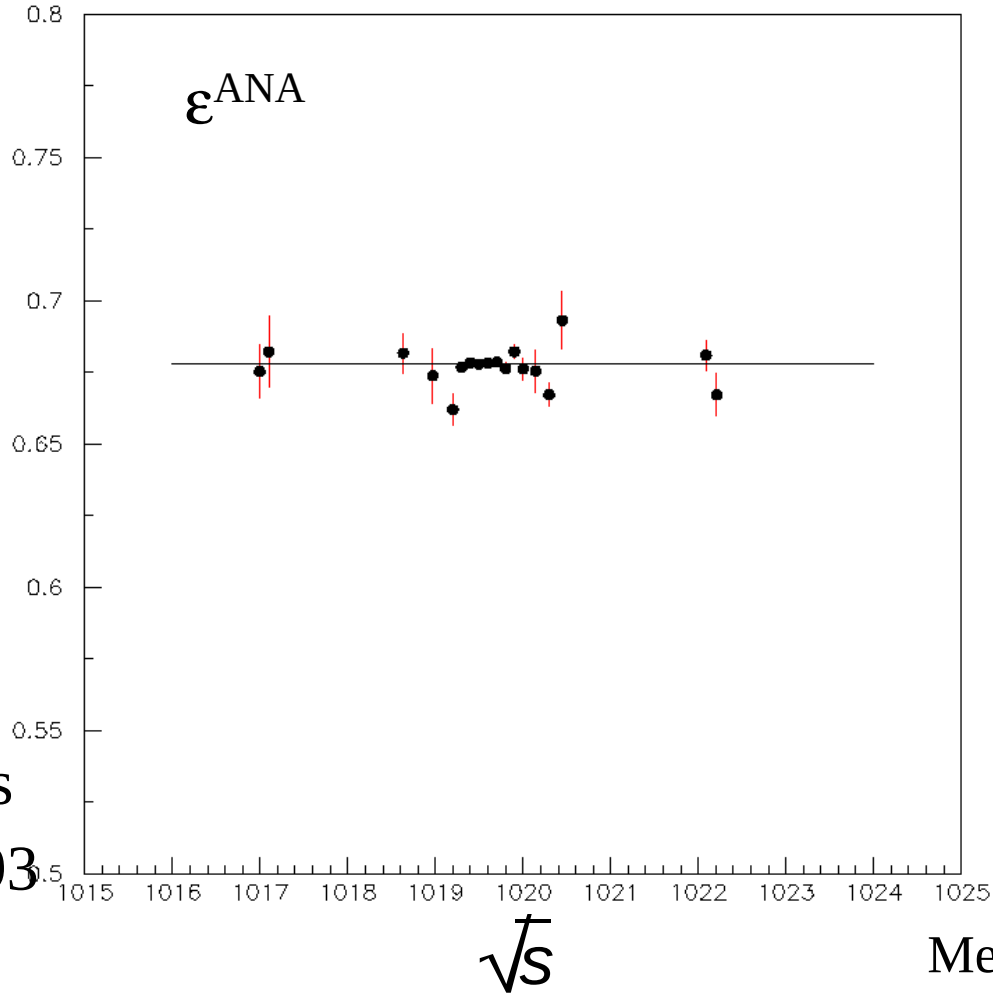
Efficiency for signal evaluated by MC only. We believe that acceptance can have still some problem due to the not final shape of the generator.

$\varepsilon^{ANA} = 0.67799 \pm 0.00034$

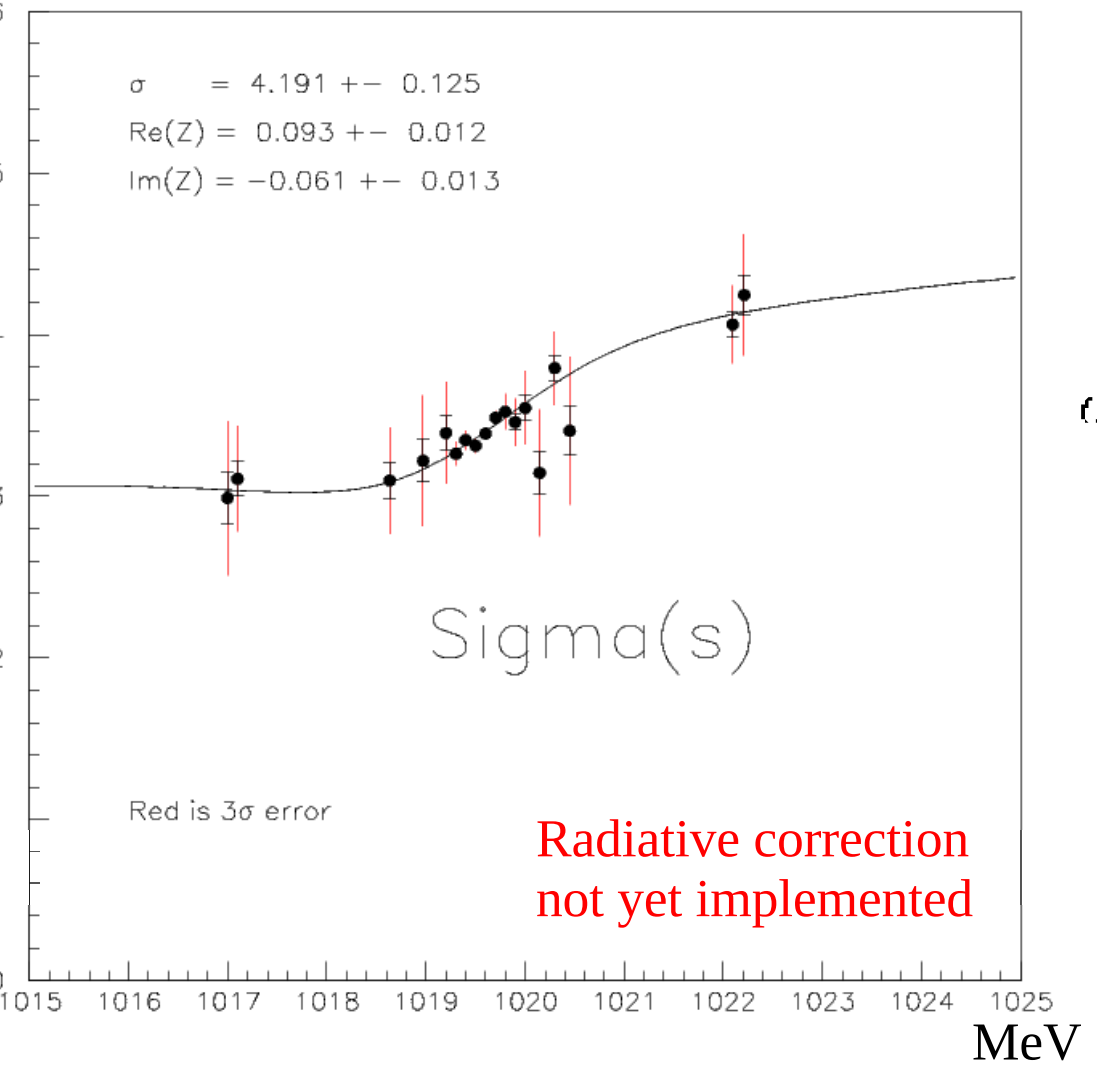
- $\varepsilon^{ECL} = 0.99963 \pm 0.00005$
- $\varepsilon^{CosmicVeto} = 0.9959 \pm 0.0001$
- Trk/vertex to be evaluated

ECL from 2003MC productions

Cosmic from Run# 17845-22293 without T3filter



Cross sections



Radiative correction not yet implemented

This is our result...
...for the moment

Fitting function:

$$\sigma(E) = \sigma_0(E) \cdot \left|1 - Z \frac{M_\phi \Gamma_\phi}{D_\phi}\right|^2$$

Conclusions

Our preliminary results are:

$\sigma = 4.19 \pm 0.13$

$Re(Z) = 0.093 \pm 0.012$

$Im(Z) = -0.061 \pm 0.013$

$\longrightarrow$ $BR(\phi \to \omega\pi^0) = (1.228 \pm 0.070) \cdot$

For comparison:

$\sigma = 8.2 \pm 0.2$

$Re(Z) = 0.104 \pm 0.028$

$Im(Z) = -0.118 \pm 0.030$

$BR(\phi \to \omega\pi^0) = (4.8 \pm 0.8) \cdot 10^{-5}$

These results come from VEPP group)

Charged-neutral comparison

- Si potrebbero mostrare insieme le due curve… forse

Toy MC (no radiator) vs-GEANFI

To be tested the effect of $\sin^2(\theta)$
respect to the normal of the
decay plane provided by $\pi^+\pi^-$ ...
difficult since this should be
done in the omega rest-frame ...

Bhabha filter effect