



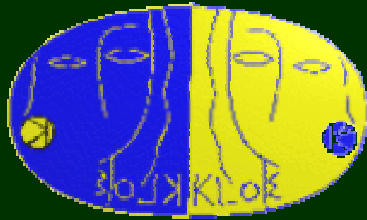
GENERAL

MEETING

Φ Decays Working Group Activities

Federico Nguyen - October 10th 2002

1. systematics studies concerning the σ_{had} measurement
2. first results in $\eta \rightarrow \pi^+ \pi^- \pi^0$ Dalitz plot parameters
3. $\eta \rightarrow \gamma \gamma \gamma$: $\omega \gamma$ background and a new upper limit



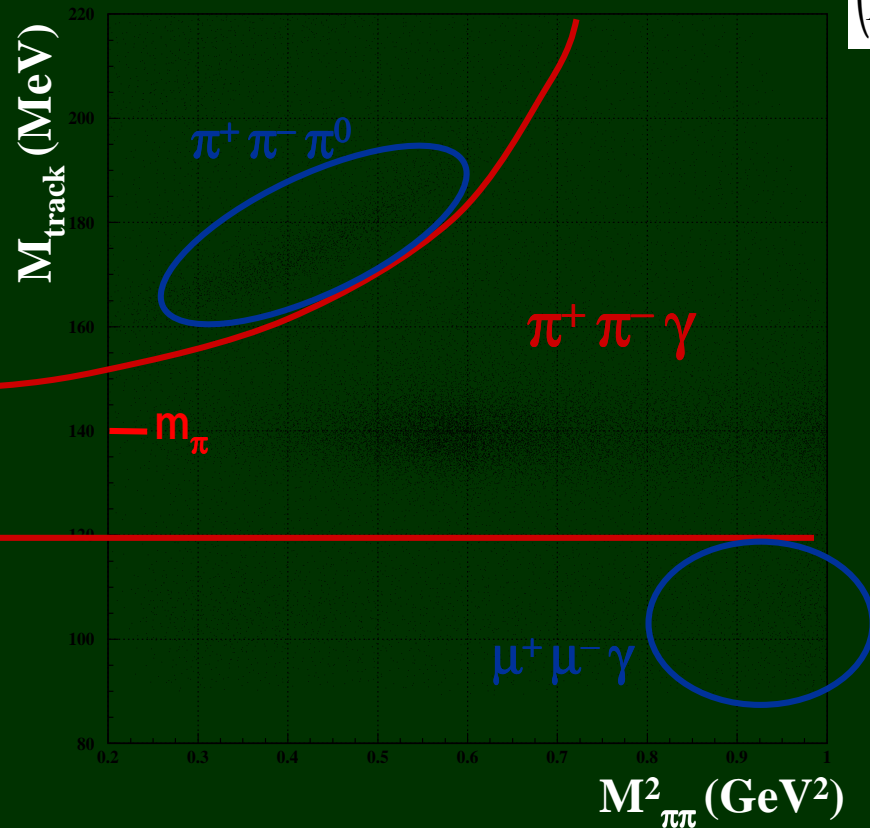
GENERAL

MEETING

Trackmass, Acceptance and Filfo
studies for the σ_{had} measurement

Trackmass Systematics (I)

$$\left(M_\phi - \sqrt{|p_1|^2 + M_{\text{trk}}^2} - \sqrt{|p_2|^2 + M_{\text{trk}}^2} \right)^2 - (p_1 + p_2)^2 = q_\gamma^2 = 0$$

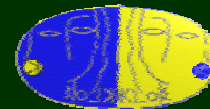


some sources of background can be seen in the M_{trk} - distribution:

- $\pi^+ \pi^- \pi^0$: at high values of M_{trk} which is $M_{\pi\pi}^2$ dependent
- $\mu^+ \mu^- \gamma$: at $M_{\text{trk}} \approx 104$ MeV



$$M_{\text{trk}} > 120 \text{ MeV} \text{ .AND. } \left[\left(\frac{M_{\pi\pi}^2}{0.85 \text{ GeV}^2} \right)^2 + \frac{M_{\text{trk}} - 250 \text{ MeV}}{105 \text{ MeV}} \right]^2 > 1. \text{ AND. } M_{\text{trk}} < 220 \text{ MeV}$$



Trackmass Systematics (II)

2 MC samples differing only for F_π values

$$F_\pi = \frac{BW_\rho \frac{(1 + \alpha BW_\omega)}{1 + \alpha} + \beta BW_{\rho'}}{1 + \beta}$$

FZK

$$M_\rho = 768.5 \text{ MeV}$$

$$\Gamma_\rho = 150.7 \text{ MeV}$$

$$\alpha = 1.85 \times 10^{-3}$$

$$\beta = -0.145$$

LNF

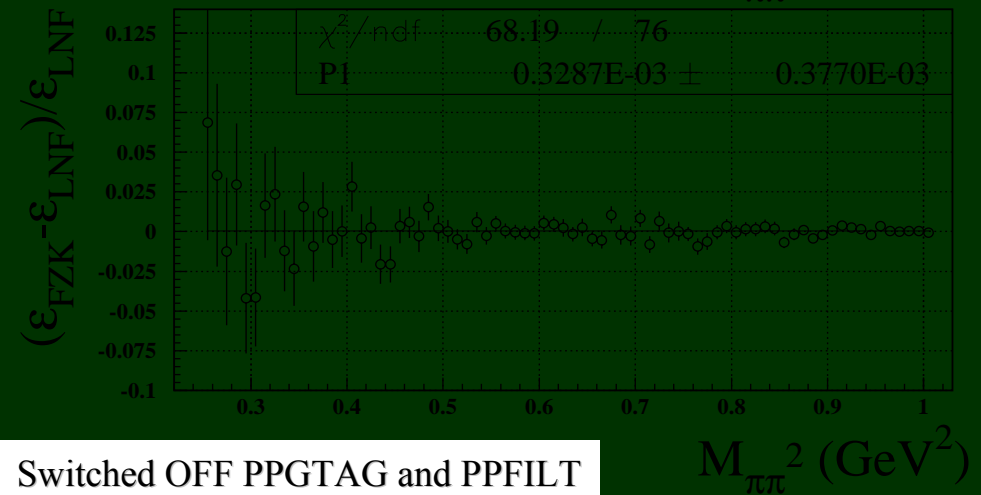
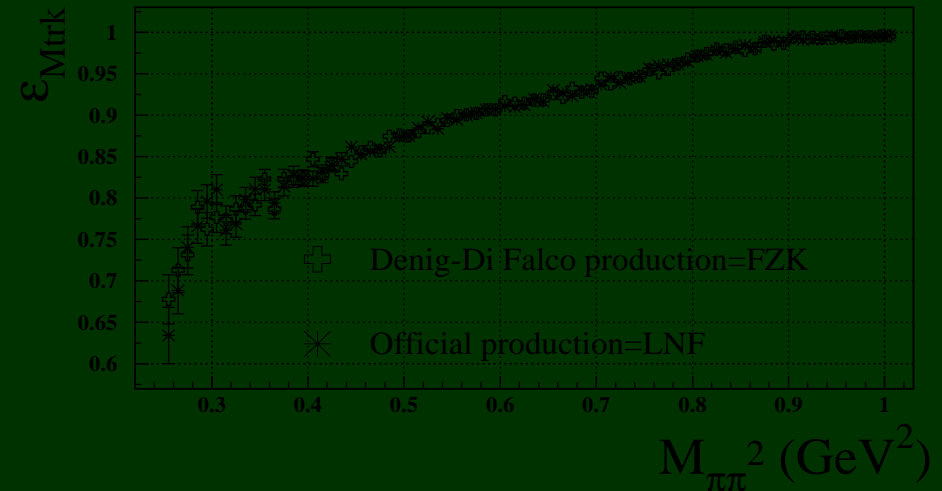
$$M_\rho = 772.6 \text{ MeV}$$

$$\Gamma_\rho = 143.7 \text{ MeV}$$

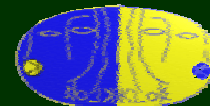
$$\alpha = 1.48 \times 10^{-3}$$

$$\beta = -0.1473$$

$\varepsilon_{\text{FZK}}(M_{\pi\pi}) \approx \varepsilon_{\text{LNF}}(M_{\pi\pi})$
at the level $\leq 2\%$



Switched OFF PPGTAG and PPFILT



Geometrical Cuts Systematics (I)

we studied acceptance
cuts dependence on \mathbf{F}_π
parameters by generating
stand alone $\pi\pi\gamma$ MC samples
($\mathbf{N}_{\text{TOT}}=10^6$ events) with
different \mathbf{M}_ρ or $\mathbf{\Gamma}_\rho$ values
covering the
whole phase space

our acceptance selection:

$$40^\circ < \theta_{\pi^+}, \theta_{\pi^-} < 140^\circ \text{ and}$$

$$(p_t > 160 \text{ MeV or } |p_z| > 90 \text{ MeV})$$

$$0^\circ < \theta_\Sigma < 15^\circ \text{ or } 165^\circ < \theta_\Sigma < 180^\circ$$

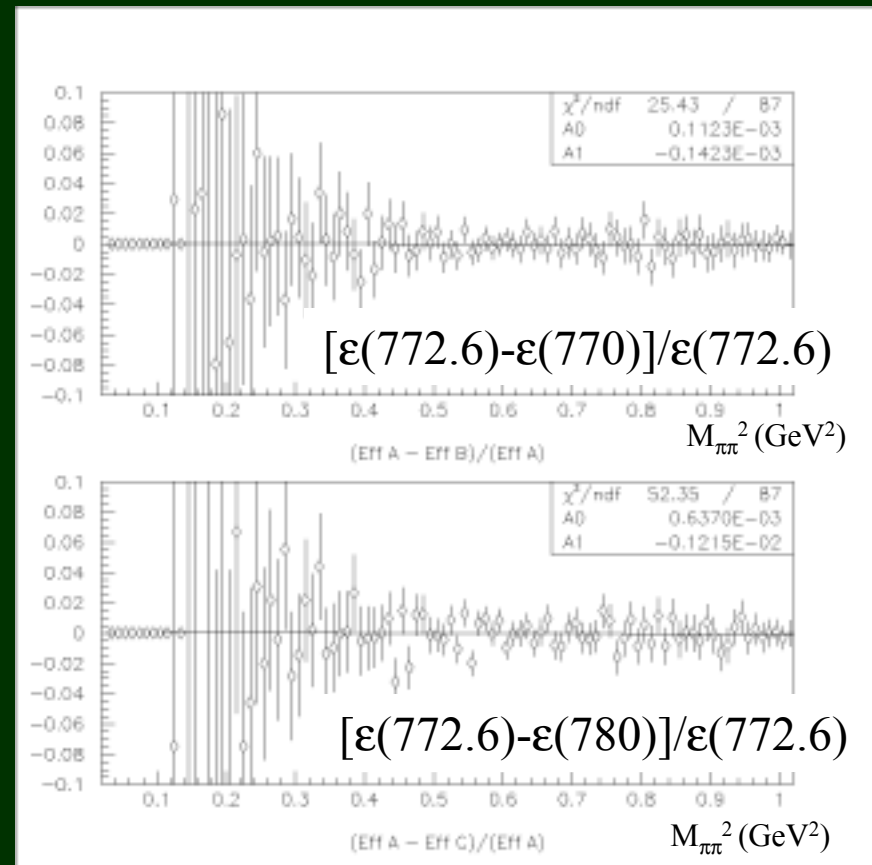
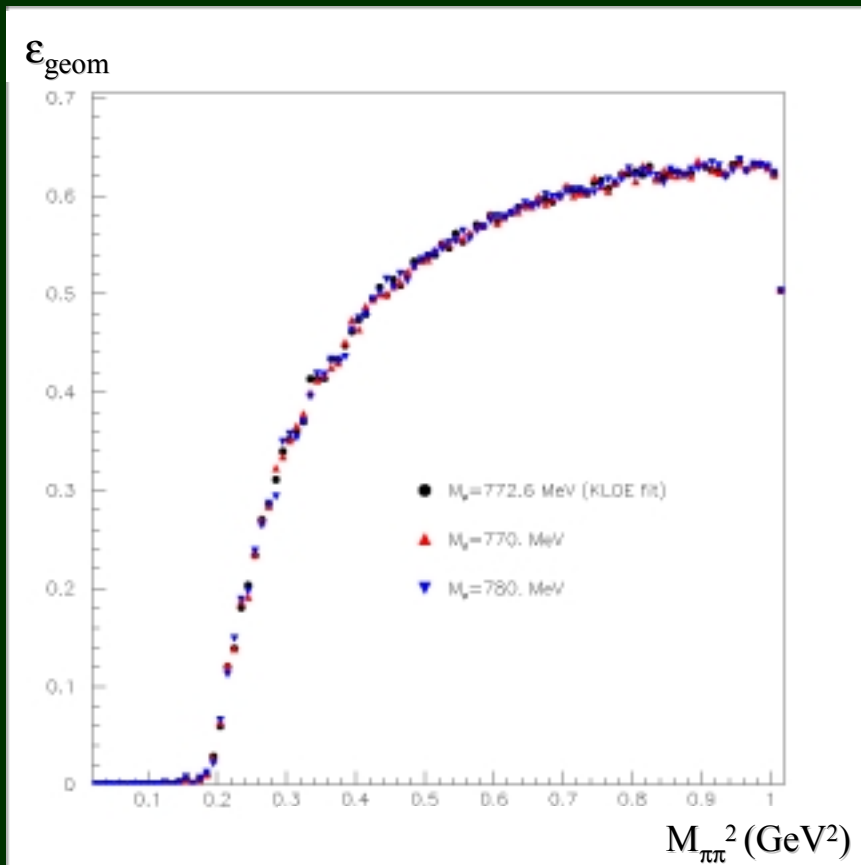
$$E_\Sigma > 10 \text{ MeV}$$

there is no significant dependence on \mathbf{F}_π
parameters in acceptance studies



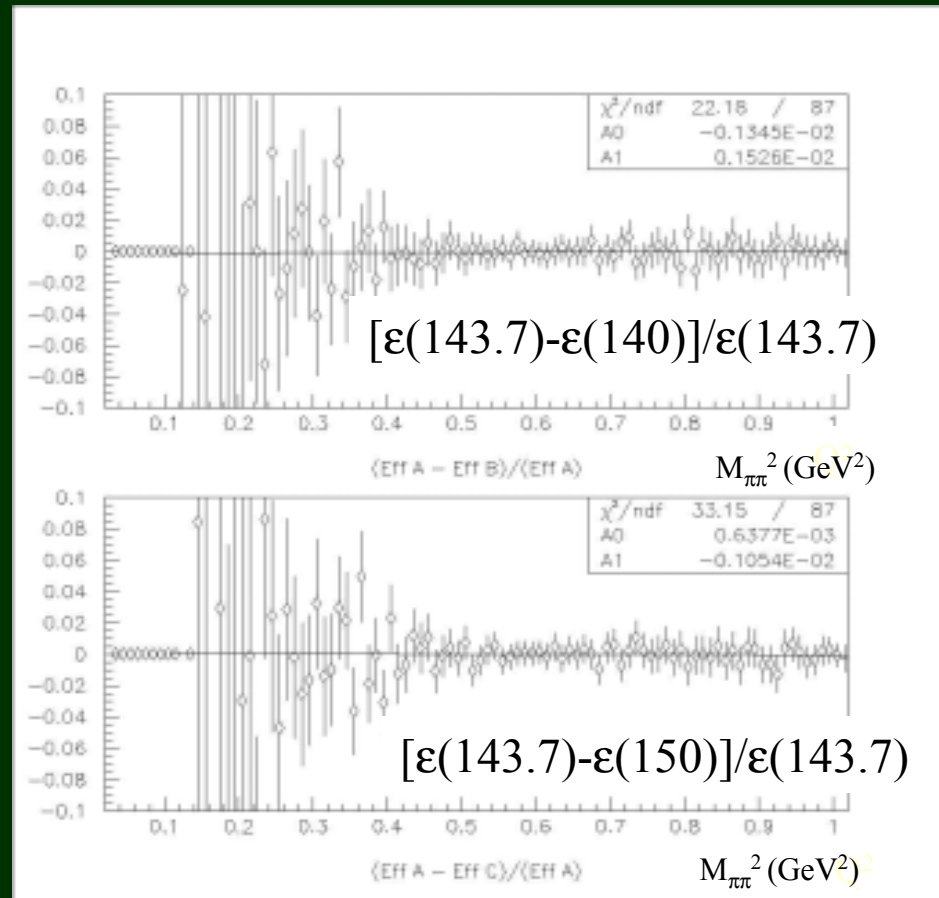
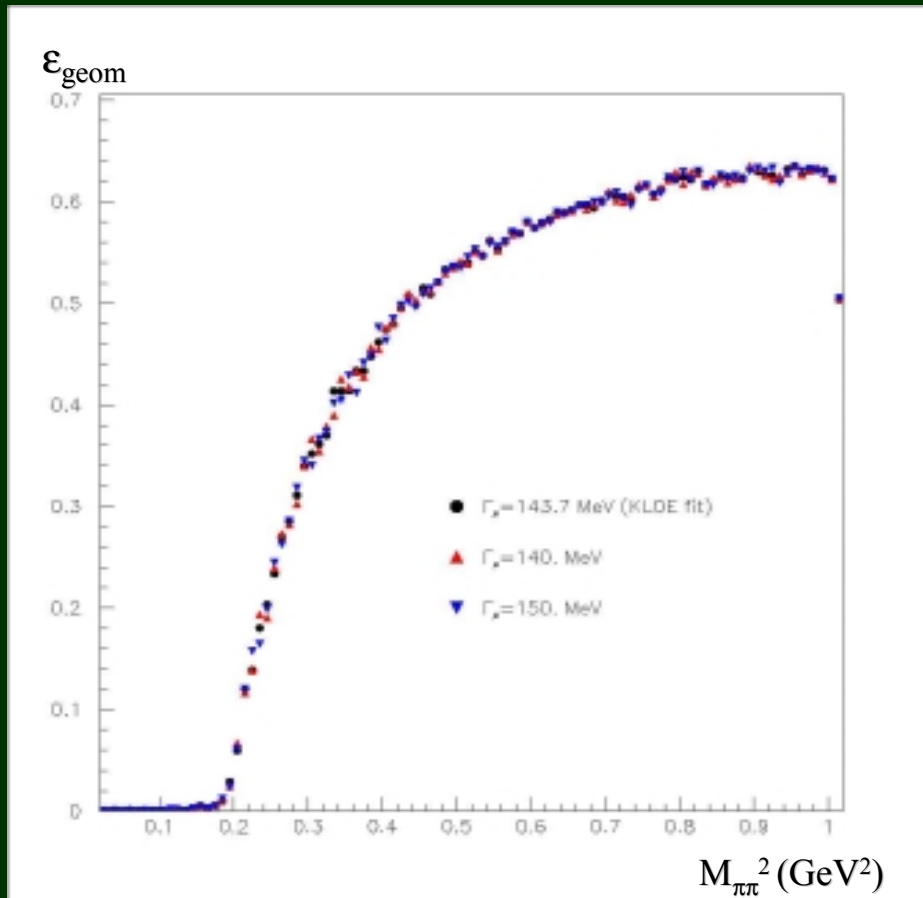
Geometrical Cuts Systematics (II)

dependence on M_p - we fixed the other parameters



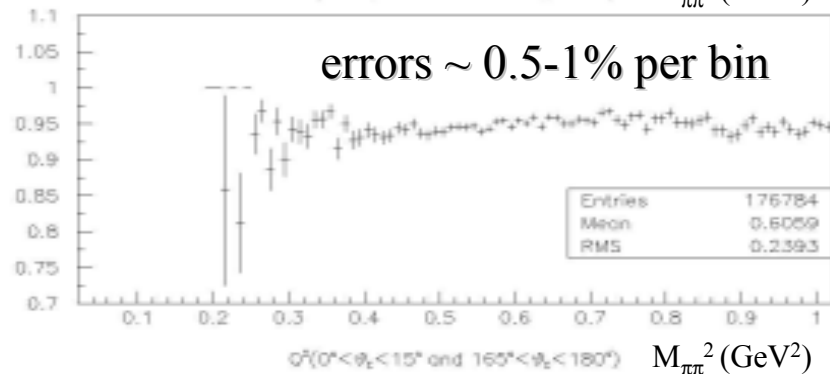
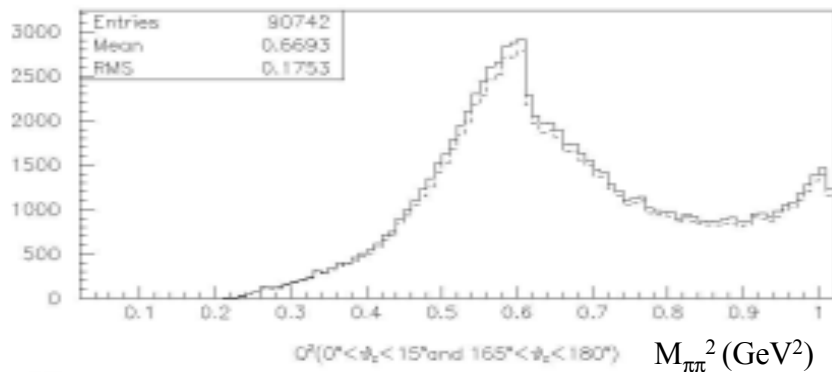
Geometrical Cuts Systematics (III)

dependence on Γ_ρ - we fixed the other parameters



Filfo Systematics (I)

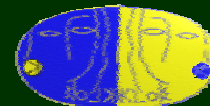
FILFO/par=5: ~ 2000 refiltered files \approx 6 pb-1
from different periods of 2001 DATA taking



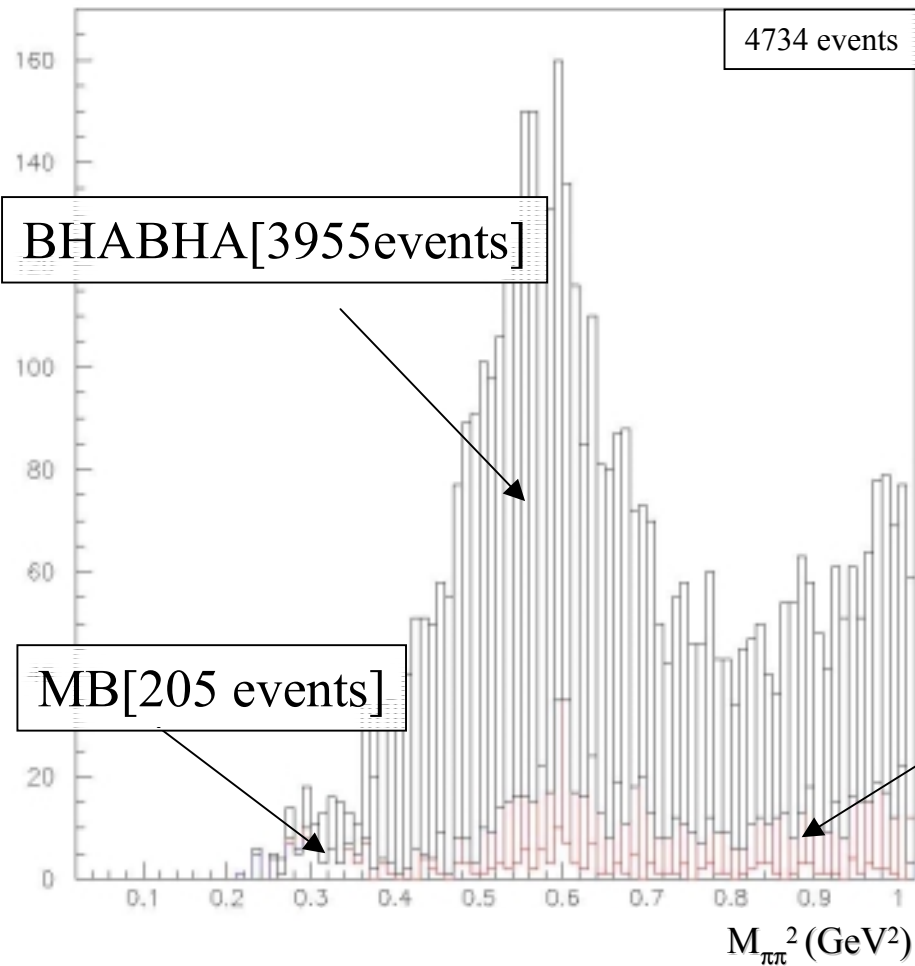
Overall efficiency:

$$\epsilon_{\text{DATA}}^{\text{FILFO, SMA}} = (94.82 \pm 0.07) \%$$

- o Filfo efficiency is evaluated from DATA by reprocessing RAW without using Filfo as a filter
- o to overcome the long reconstruction time, a prefilter, based on CALORIMETER and PATTERN RECOGNITION, is used, then TRACK, VERTEX modules are called...

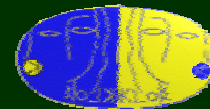


Filfo Systematics (II)



signal events vetoed by FILFO/par=5
by the following:

- Bhabha-filter (83.5%)
- Cosmic-filter (13.9%)
- Machine Background filter (4.3%)

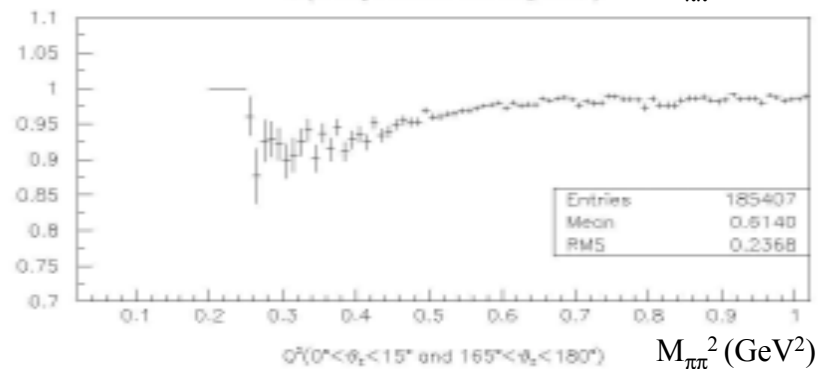
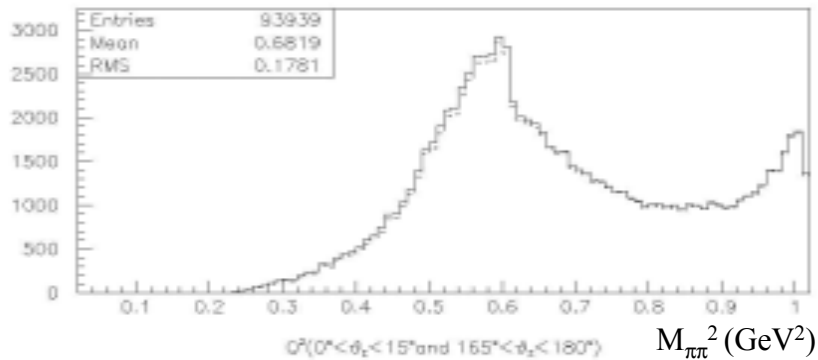


Filfo Systematics (III)

FILFO/par=5: 2×10^5 stand alone MC events

Overall efficiency (Filfo at first):

$$\epsilon_{\text{FILFO, SMA}}^{\text{MC}} = (96.66 \pm 0.07) \%$$



Overall efficiency (Filfo at the end):

$$\epsilon_{\text{FILFO, SMA}}^{\text{MC}} = (97.37 \pm 0.07) \%$$

- o we wanted to know the difference in applying Filfo at the beginning or at the end of our analysis chain
- o resulting systematic correction:

$$\Delta\epsilon = (-0.71 \pm 0.07) \%$$

systematic Filfo checks have been performed
we plan to study Filfo changes in different periods of DATA taking





GENERAL

MEETING

$\phi \rightarrow \eta \gamma, \eta \rightarrow \pi^+ \pi^- \pi^0$: resolution,
fit procedure and results

Dalitz Plot Parameters: Definition

$$X = \sqrt{3} \frac{T_+ - T_-}{Q} \quad X \in [-1; 1]$$
$$Y = \frac{3T_0}{Q} - 1 \quad Y \in [-1; 0.895]$$

$T_i \equiv$ kinetic energy of the π^i

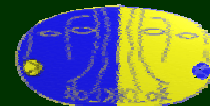
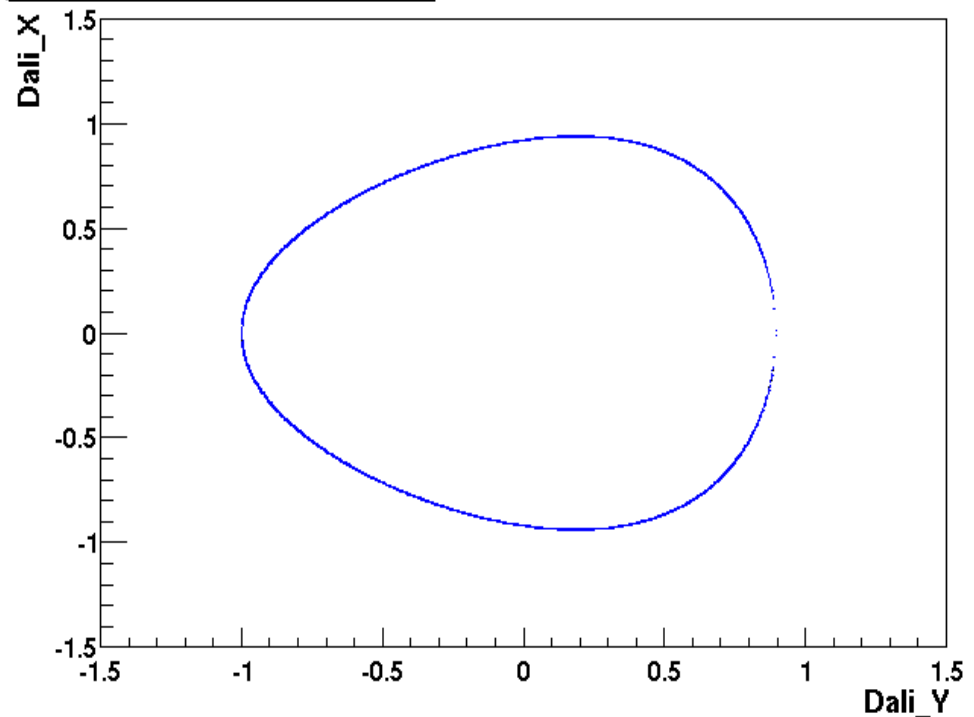
$Q \equiv m_\eta - 2m_{\pi^+} - m_{\pi^0}$

usual decay rate in terms of slope parameters:

$$\Gamma(\eta \rightarrow \pi^+ \pi^- \pi^0) \propto |\mathbf{M}(X, Y)|^2$$

$$|\mathbf{M}(X, Y)|^2 \approx 1 + aY + bY^2 + cX^2$$

Kinematics Boundary

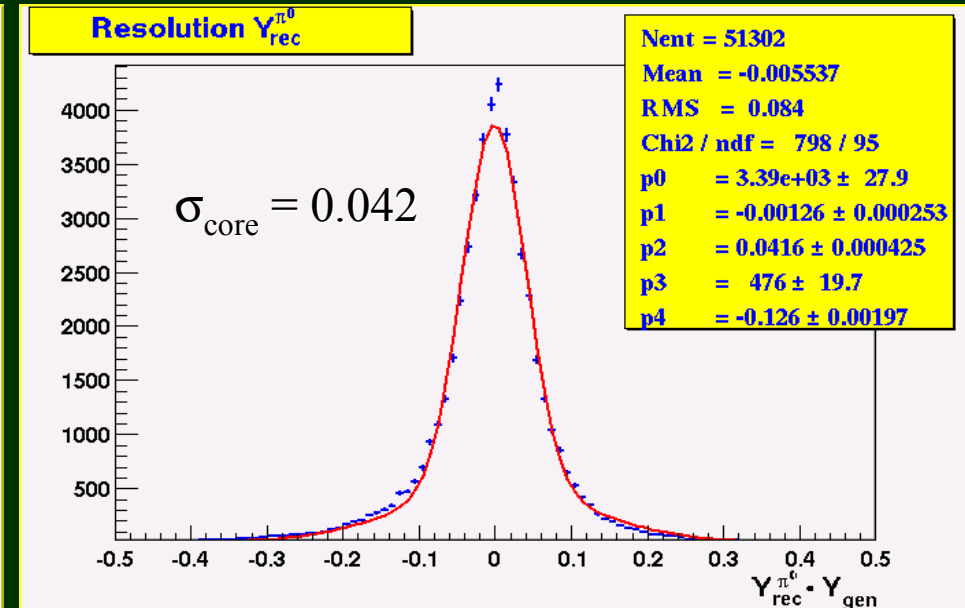
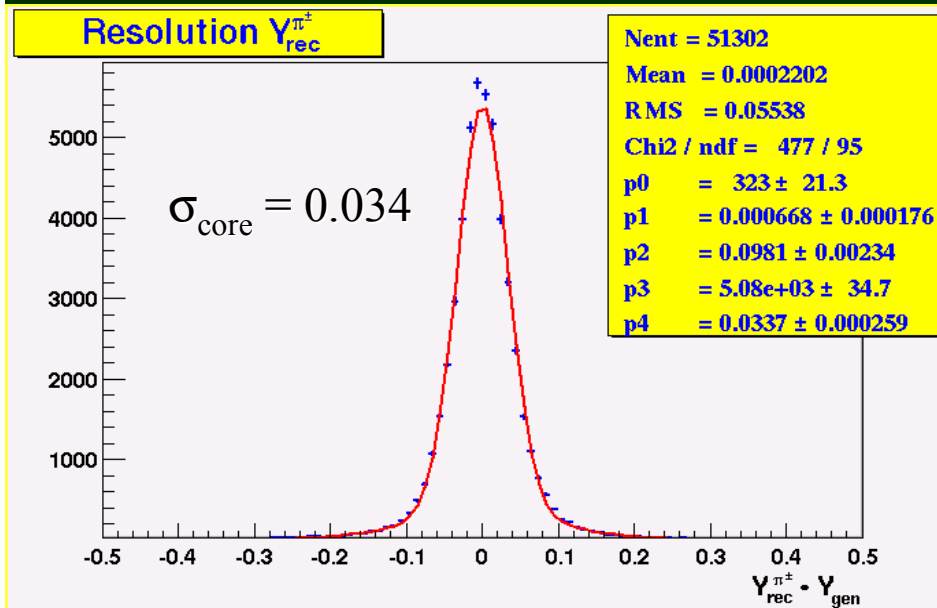


Dalitz Plot Parameters: Resolution (I)

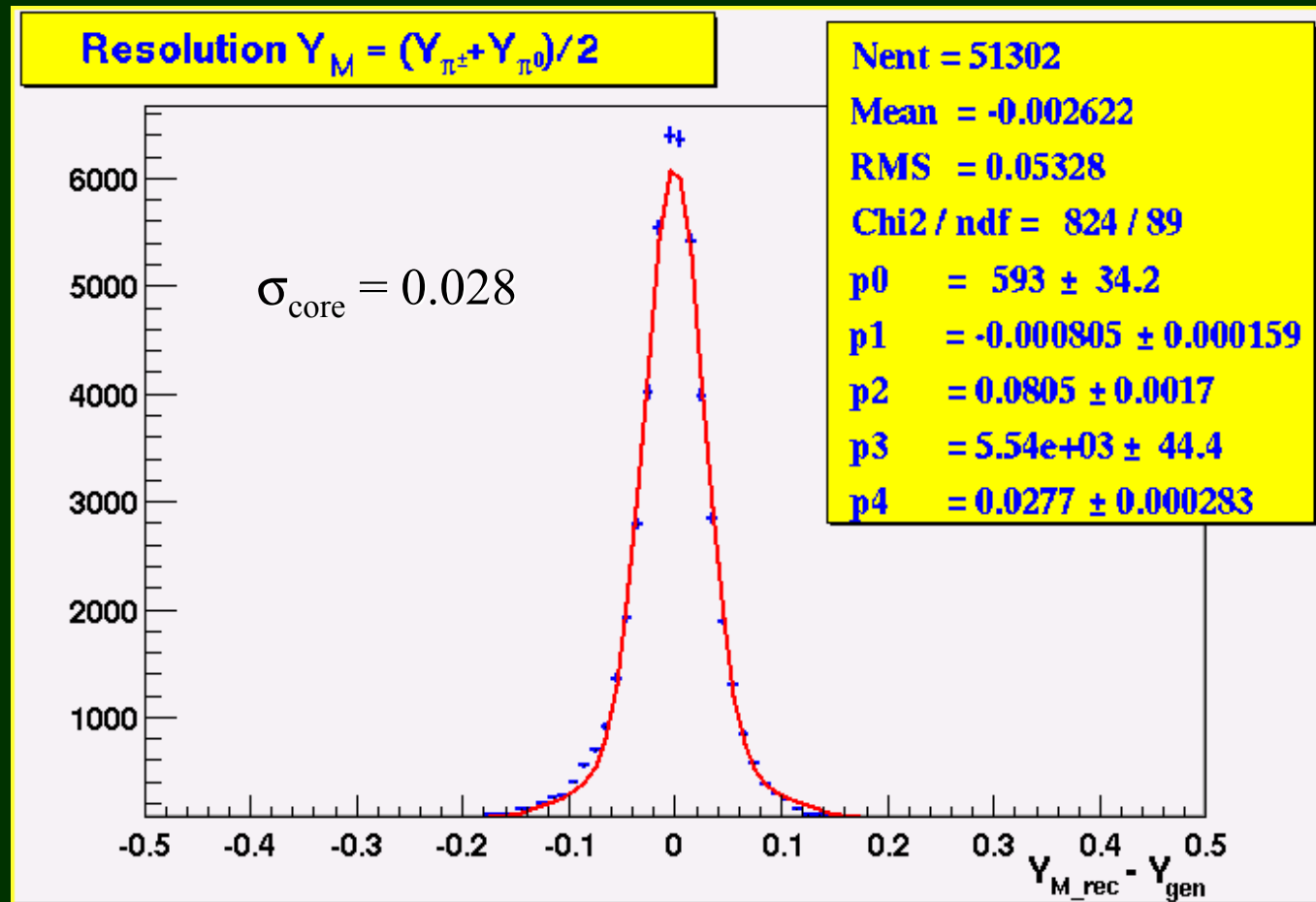
Υ resolution has been obtained by using 1.3×10^5 MC events
it can be estimated either from π^\pm or from $\gamma\gamma$ (from π^0)

$$T_0^{\pi^\pm} = m_\eta - E_{\pi^+} - E_{\pi^-} - m_{\pi^0}$$

$$T_0^{\pi^0} = E_{\gamma\gamma} - m_{\pi^0}$$



Dalitz Plot Parameters: Resolution (II)



Fit Procedure and Results (I)

as a 1st approximation $\mathbf{b} \sim \mathbf{c} \sim \mathbf{0}$, $|M^{the}(Y)|^2 = 1 + aY$, that has

to be fitted on:

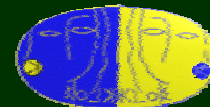
$$|M^{obs}(Y)|^2 = \sum_X \frac{N(X, Y)}{\epsilon(X, Y)} / \int_{PS(Y)} dX$$

where:

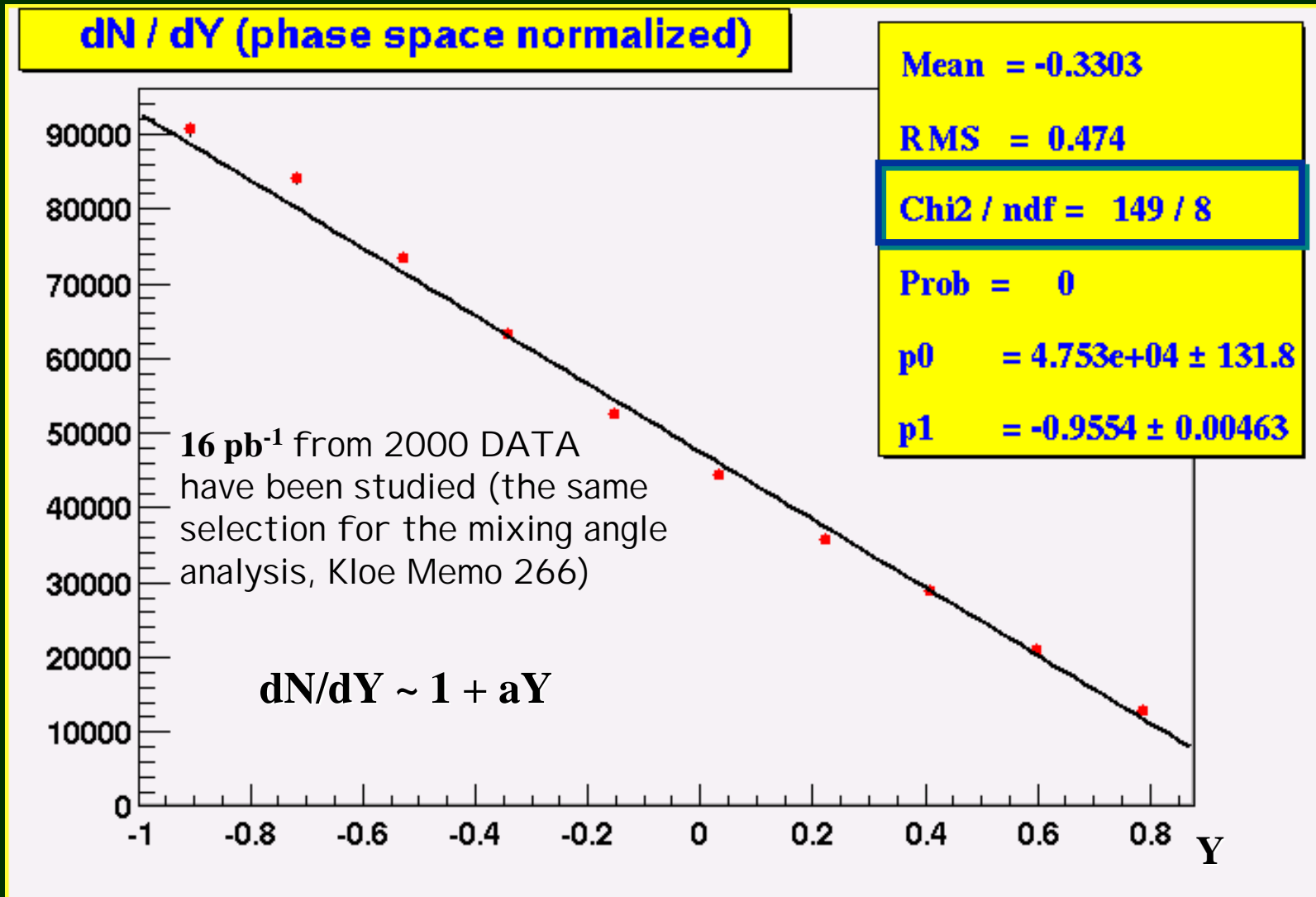
$N(X, Y)$ = # of events in the Dalitz plot

$\epsilon(X, Y)$ = efficiency (from an independent MC sample)

$PS(Y)$ = phase space as a function of Y bins

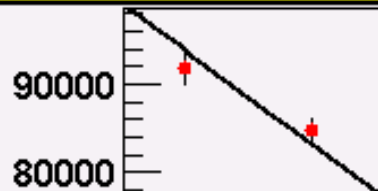


Fit Procedure and Results (II)



Fit Procedure and Results (III)

dN/dY Data (Phase space normalized)



resolution studies have been optimized,
1st glance at DATA shows sensitivity to the quadratic slope parameter

Mean = -0.3306

RMS = 0.4749

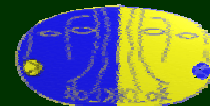
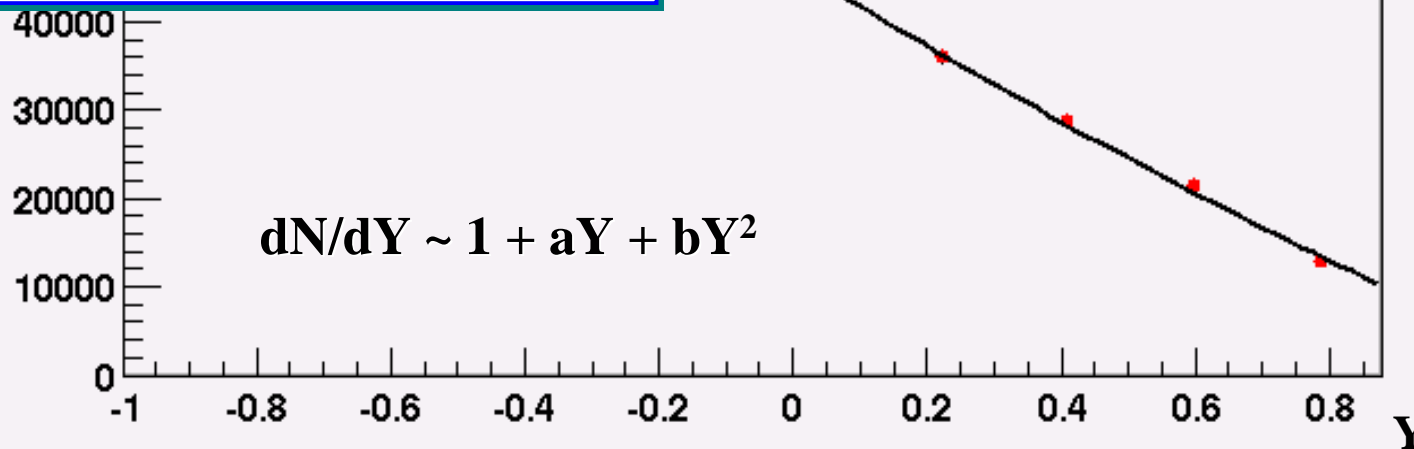
Chi2 / ndf = 7.631 / 7

Prob = 0.3662

p0 = 4.638e+04 ± 394.2

p1 = -1.008 ± 0.01528

p2 = 0.1335 ± 0.02695





GENERAL

MEETING

$\phi \rightarrow \eta \gamma, \eta \rightarrow \gamma \gamma \gamma$: selection cuts,
possible background and
preliminary limit

Analysis Requirements

Pre-selection:

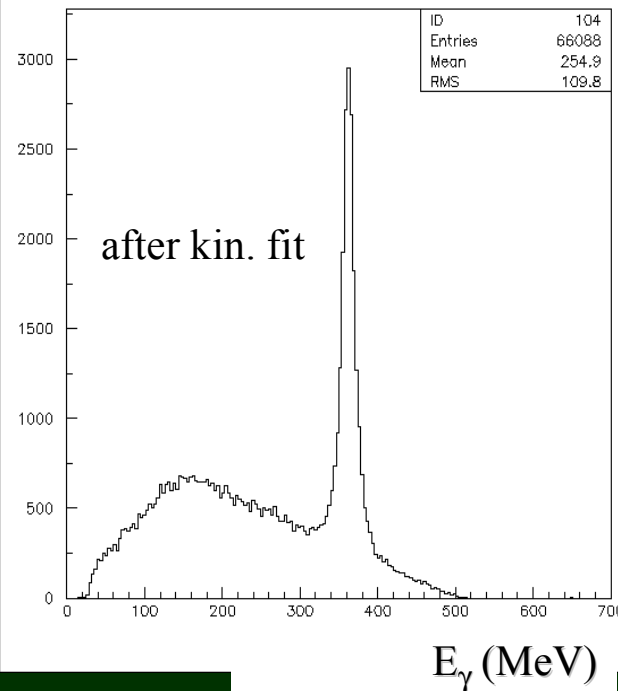
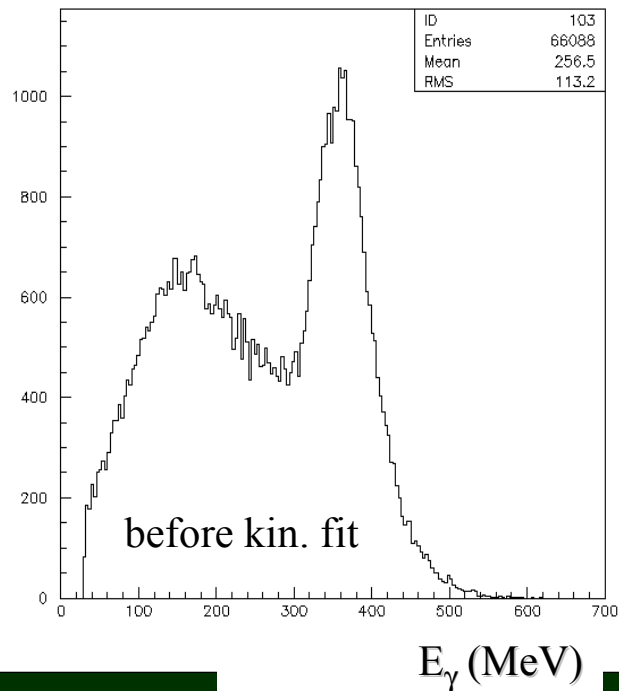
4 prompt clusters

Angle between two clusters $> 15^\circ$

$E_{\text{tot}}(\text{clusters}) > 900 \text{ MeV}$; $P_{\text{tot}} < 110 \text{ MeV}$

Final Selection:

- $P_{\text{kin-fit}}(\chi^2 > \chi^2_0) > 0.01$
- $|M_{\gamma\gamma} - 140| > 30 \text{ MeV}$
- **E vs. $\cos\theta$ plane cut**
- $|M_{\gamma\gamma} - 550| < 45 \text{ MeV}$



kinematic fit has been studied on MC

($N_{\text{tot}} = 3 \times 10^4$ events)



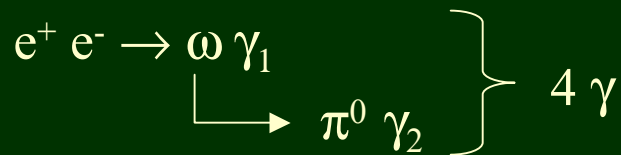
Background Problem

Data₂₀₀₁ (59.933 pb⁻¹)

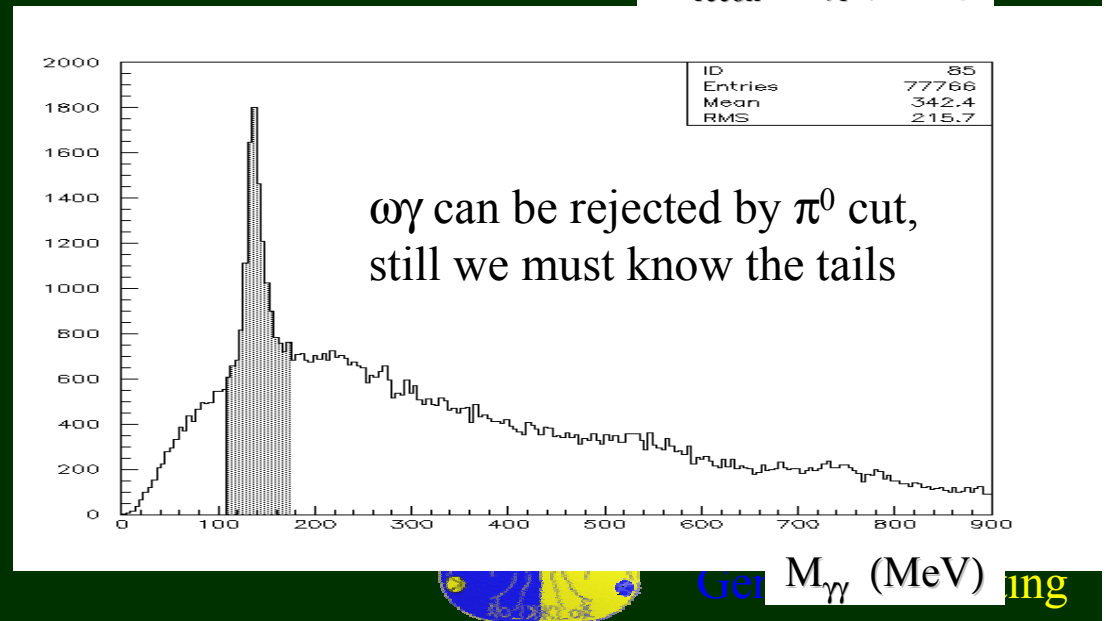
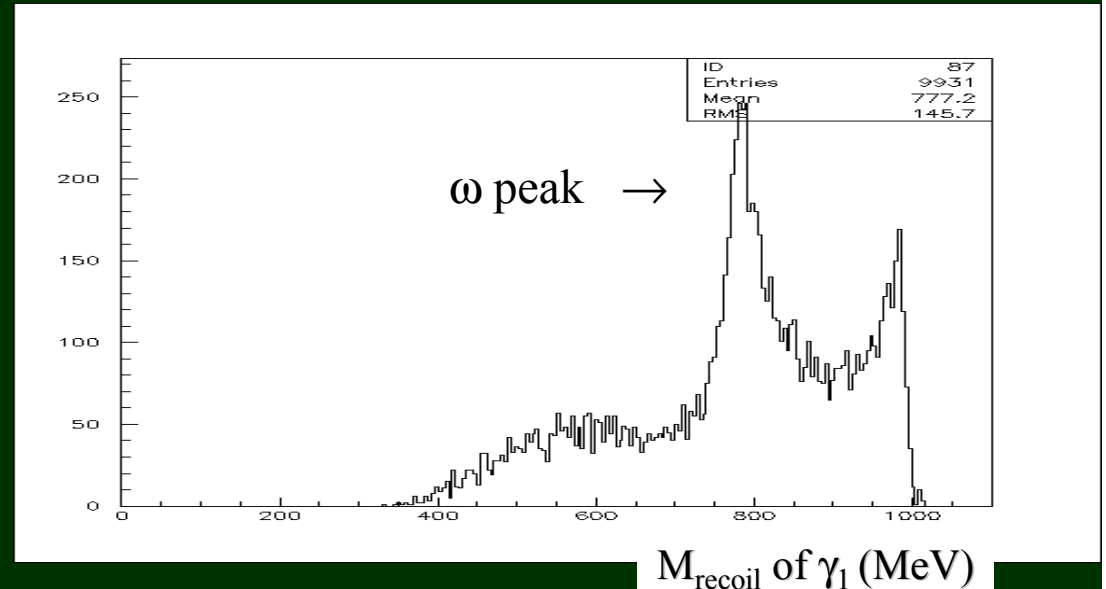
Cut Type	N _{tot} (ε)
Pre-cuts	1345779
Pre-selection	4499 (0.3%)
Final Selection	179 (4 %)
All.	179 (0.013%)

inconsistent with MC estimated background ⇒ 59 events

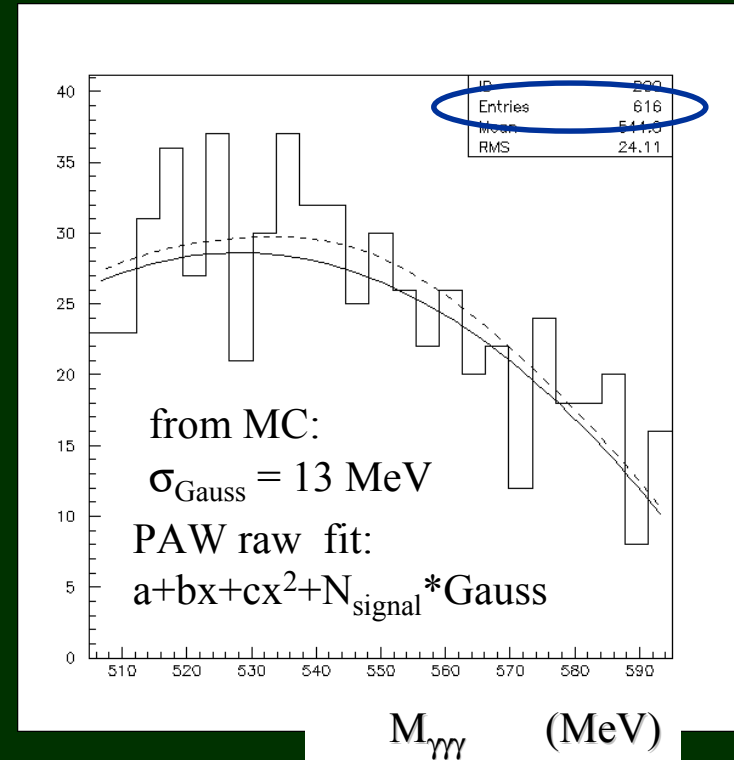
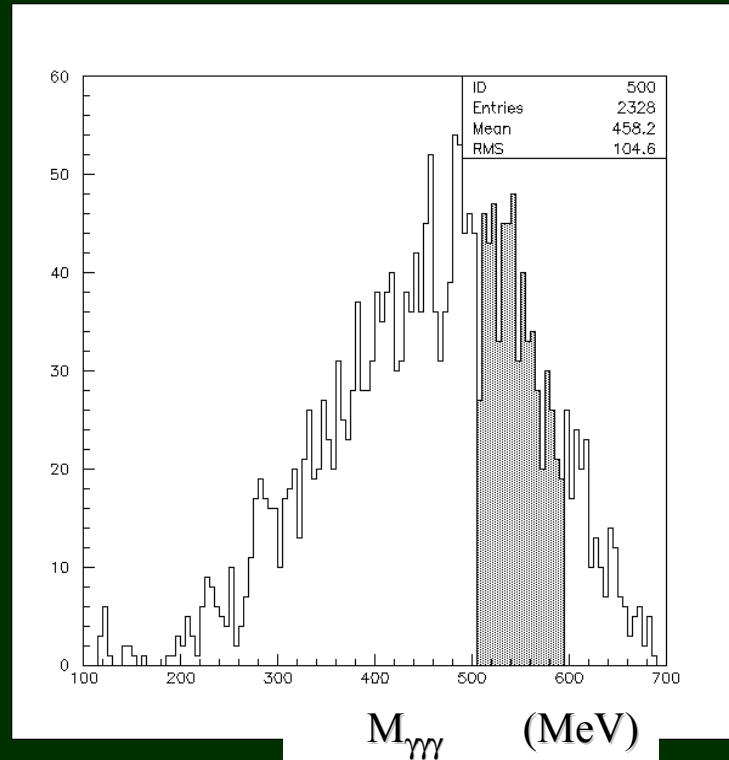
perhaps a missing background:



$\gamma_1 \equiv$ non π^0 least energetic γ



Preliminary Results on 2001 DATA



$N_{\text{signal}} = 9 \pm 26$, corresponding to 616 events out of 142 pb^{-1}

$N_{\text{upper}} \text{ (90\% C.L.)} = N_{\text{signal}} + 1.28 * \sigma_{N_{\text{signal}}} = 42$, $\epsilon_{\text{TOT}} = 21\%$

$\text{BR}(\eta \rightarrow \gamma\gamma) < N_{\text{upper}} / (L * \sigma_{\phi} * \text{BR}(\phi \rightarrow \eta\gamma) * \epsilon_{\text{TOT}}) = 3.5 \times 10^{-5}$



Summary and Outlook

σ_{had} :

NO significant F_{π} parameters dependence both in acceptance and trackmass, filfo efficiency has been studied, we started evaluating trackmass efficiency from DATA.

$\eta \rightarrow \pi^+ \pi^- \pi^0$:

resolution and fit procedure have been checked, work ahead: genuine 2D fit, 2001-2002 DATA analysis.

$\eta \rightarrow \gamma \gamma \gamma$:

$\omega\gamma$ background has been studied, but a MC code is needed, reachable limit ($\sim 500 \text{ pb}^{-1}$): $\text{BR}(\eta \rightarrow \gamma \gamma \gamma) < 2 \times 10^{-5}$.

