Status report on $a_0 \rightarrow \eta\pi^0$

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Data sample

- **2001 + 2002 data: 402 pb^{-1} (157 + 245)**
- **New ntuple production with correct energy and time resolutions:**

   $\sigma_E/E = 5.7\%/\sqrt{E}$ barrel

   $6.1\%/\sqrt{E}$ endcap

   $\sigma_t = 55$ ps$/\sqrt{E} \oplus 140$ ps   barrel

   60 ps$/\sqrt{E} \oplus 140$ ps   endcap

MC rad04

- **MC rad04 production used (L×5)**
- **Only data runs with corresponding MC runs have been analyzed**
- **Corrected energy and time resolutions (slightly different from data)**
- **Energy scale corrections applied**

	offset(MeV)	slope
Barrel	**-2.84±0.03**	**0.9868±0.0002**
EC-Central	**-2.25±0.09**	**1.0500±0.0005**
EC-Long	**-3.31±0.04**	**0.9817±0.0002**
EC-Short	**-4.3±0.2**	**0.935±0.001**

- **Correction for accidentals applied (according to Stefano and Matteo tables)**
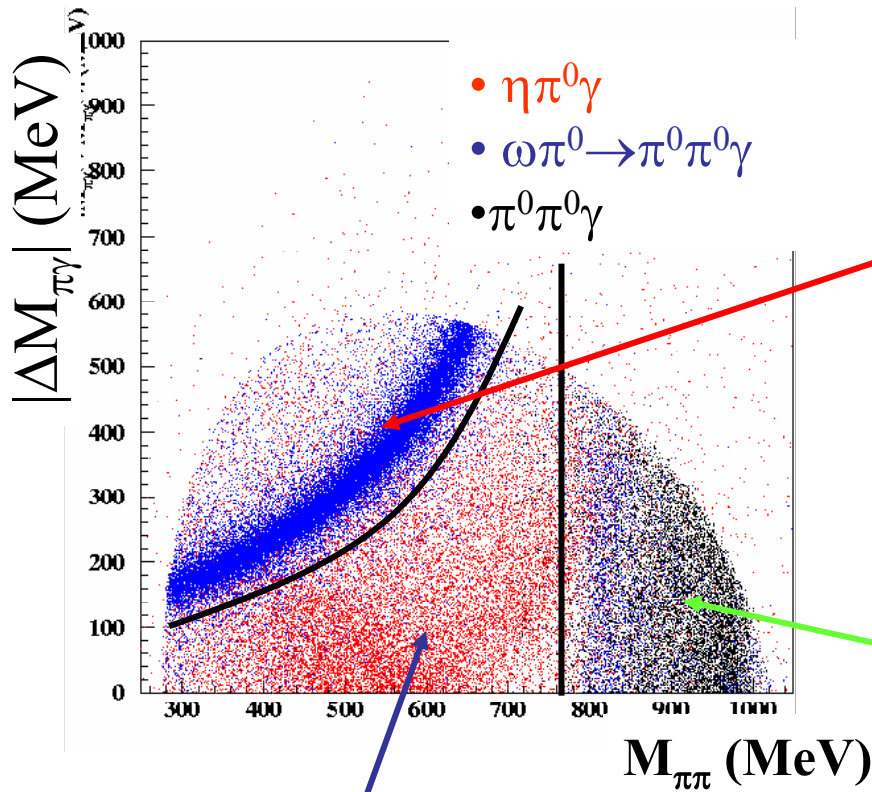
Background subtraction

- **Main problem of this analysis is that ~ 50% of the final sample is background**

- **Main background processes: $\eta\gamma$ ($\eta\rightarrow 3\pi^0$)**

$$\pi^0\pi^0\gamma \;\; (f_0 + \omega\pi^0)$$

- **MC cross sections (nb) from a sample of ~30 pb^{-1}:**

	MC	expected
$\omega\pi^0$	0.75	0.50
$f_0\gamma$	0.27	0.36 ?
$\eta\gamma$ ($\eta\rightarrow 3\pi^0$)	13.5	13.8
$\eta\gamma$ ($\eta\rightarrow\gamma\gamma$)	16.2	16.9
$\pi^0\gamma$	4.1	4.1
$\eta\gamma$ ($\eta\rightarrow\pi^0\gamma\gamma$)	0.03	~ 0.003

weights have to be determined

$\omega\pi^0$ and $f_0\gamma$

$\eta\pi^0\gamma$

$\omega\pi^0 \to \pi^0\pi^0\gamma$

$\pi^0\pi^0\gamma$

$|\Delta M_{\pi\gamma}|$ (MeV)

$M_{\pi\pi}$ (MeV)

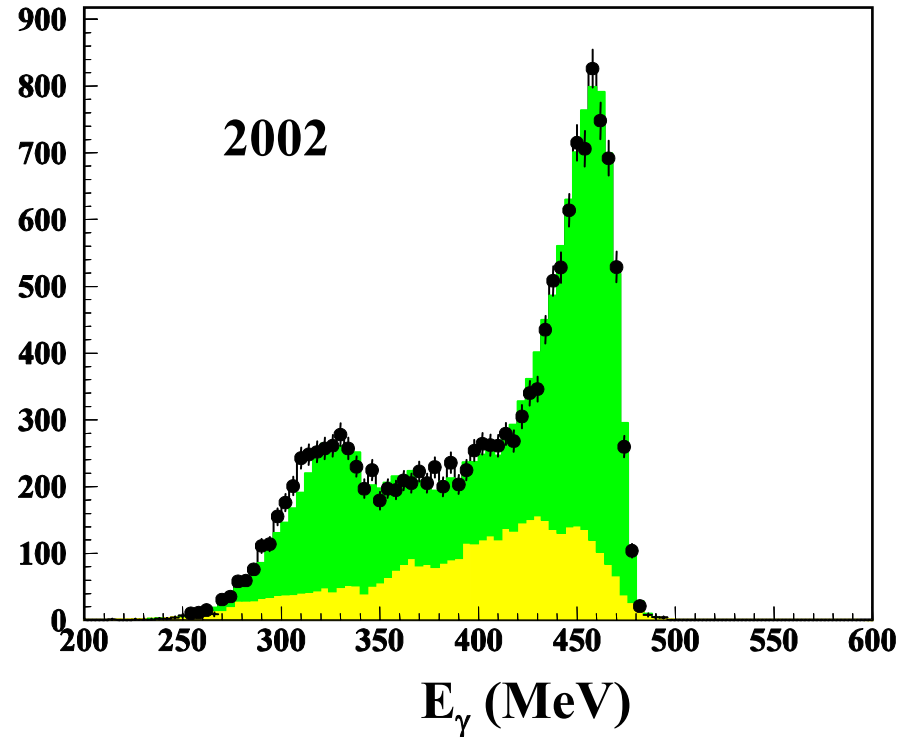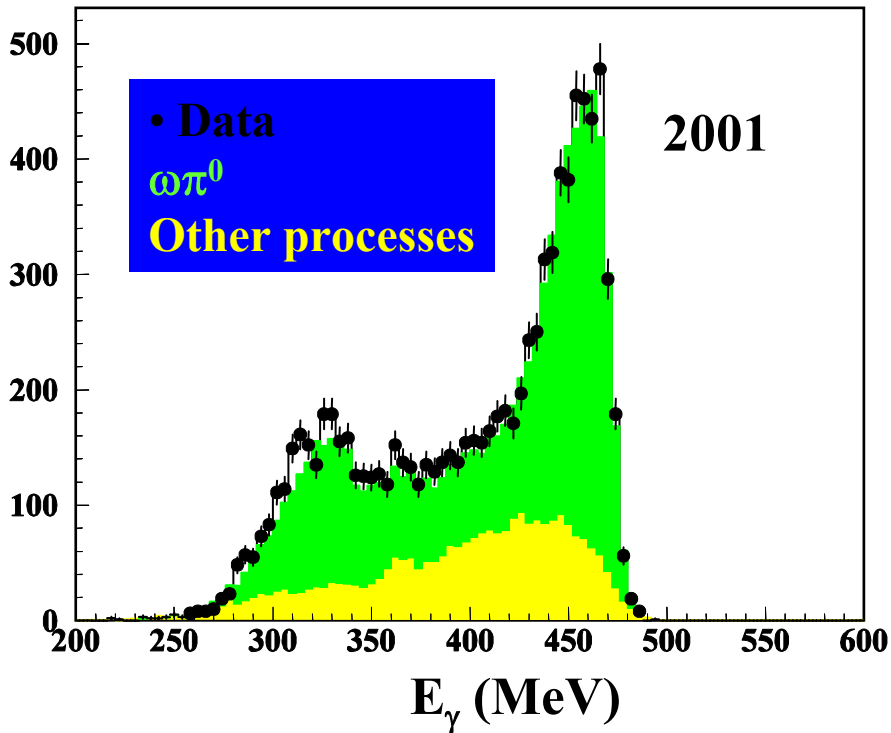**$\omega\pi^0$: select that region and fit the E_γ distribution (γ from $\omega \to \pi^0\gamma$)**

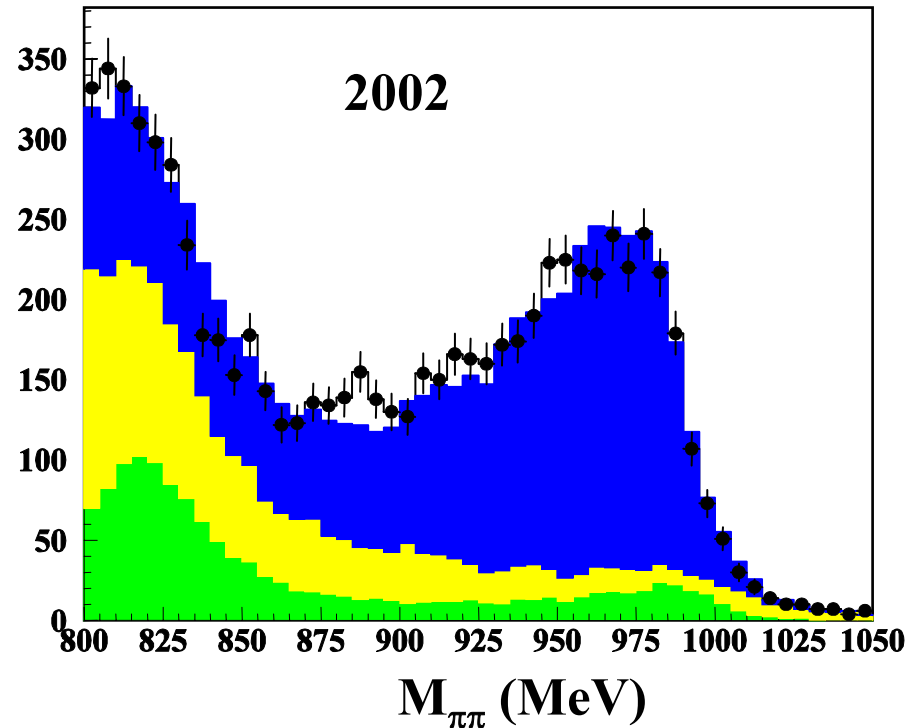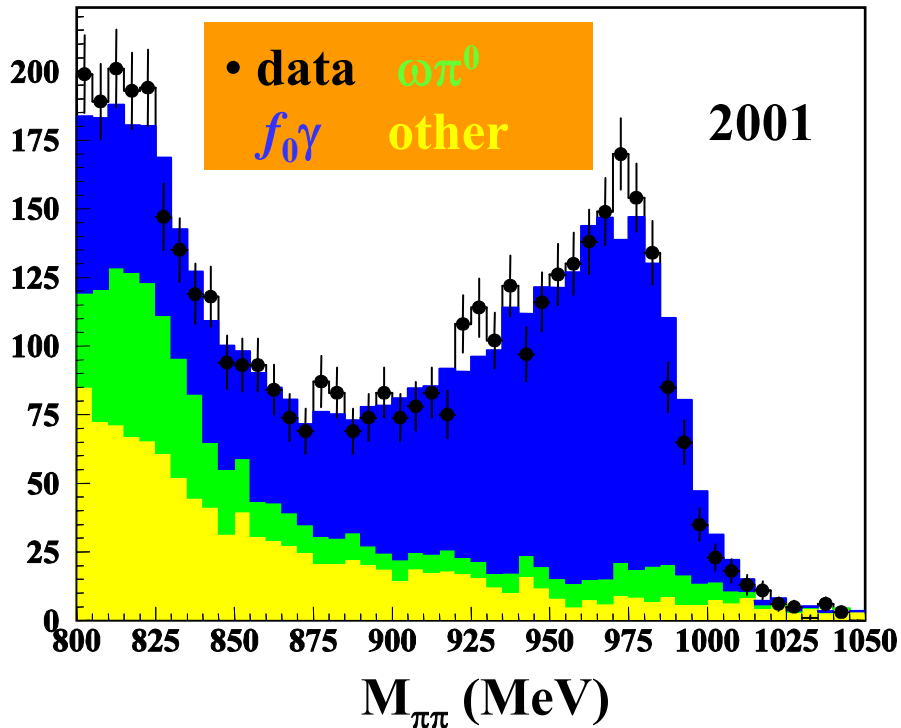**Region dominated by f_0: select events with $M_{\pi\pi} > 800$ MeV**

Signal region

$\omega\pi^0$

- **Fit results:**

	2001	2002
($\omega\pi^0$ %)	70.4 ± 2.0	71.8 ± 1.6

71.3% (average) $\Rightarrow$ **weight = 0.659 ± 0.011**

(0.5 nb /0.75 nb = 0.67 expected)

$f_0\gamma$

- **Fit results ($\omega\pi^0$ is fixed):**

		2001	2002
$f_0\gamma$ %		60.2 ± 2.2	59.6 ± 1.7

average = 59.8% $\Rightarrow$ weight = 1.394 $\pm$ 0.033
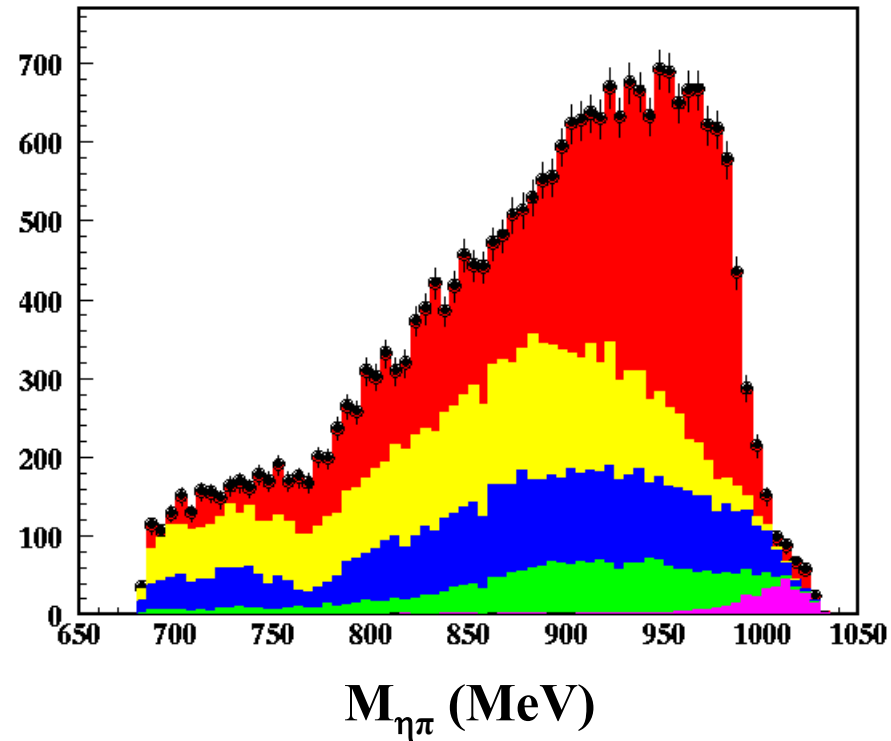
(0.36 nb/0.27nb = 1.38 expected)

Background subtraction

- We use the weights determined for $\omega\pi^0$ and $f_0\gamma$

- For the moment we use the number of expected events from MC for $\eta\gamma$ ($\eta\to3\pi^0$, $\gamma\gamma$)

- For $\eta\gamma$ ($\eta\to\pi^0\gamma\gamma$) we use a weight = 0.1 (very small contribution)

Final sample

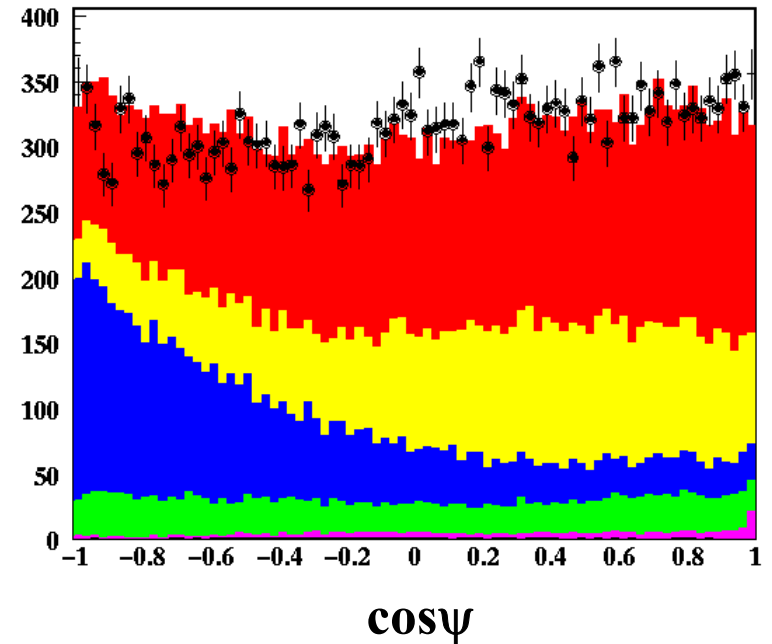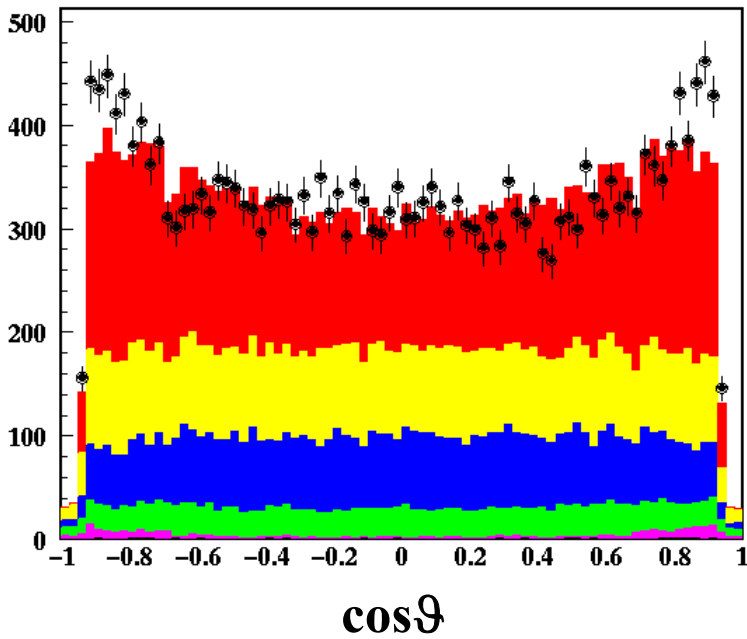|	2001+ 2002
Data	25351
$\omega\pi^0$	2072
$f_0\gamma$	5005
$\eta\gamma\ (\eta\to3\pi^0)$	6319
$\eta\gamma\ (\eta\to\gamma\gamma)$	306
$\eta\gamma\ (\eta\to\pi^0\gamma\gamma)$	78
Total Bckg.	13780
Signal	11531

$M_{\eta\pi}$ (MeV)

Final sample

- **Data**   MC $a_0\gamma$

  $\omega\pi^0$ $\eta\gamma$ ($\eta\rightarrow3\pi^0$)

  $f_0\gamma$ $\eta\gamma$ ($\eta\rightarrow\gamma\gamma$)

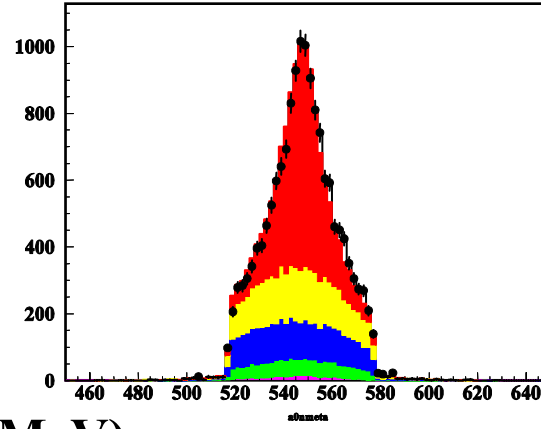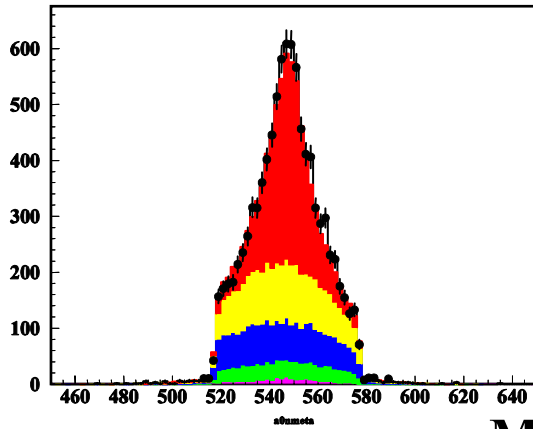$\cos\vartheta$

$\cos\psi$

- **Still some data-MC discrepancy: are we subtracting too much f_0 ?**

Data-MC comparison

2001

2002

M_η **(MeV)**
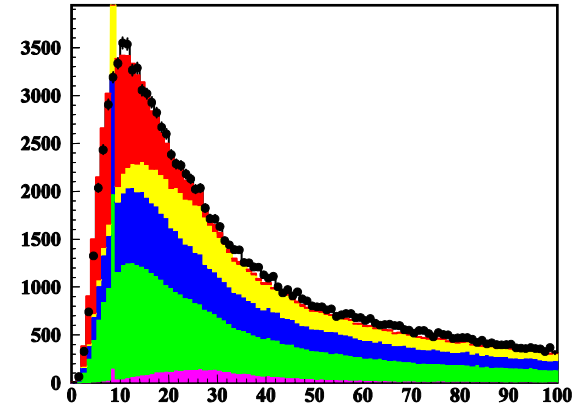
χ^2
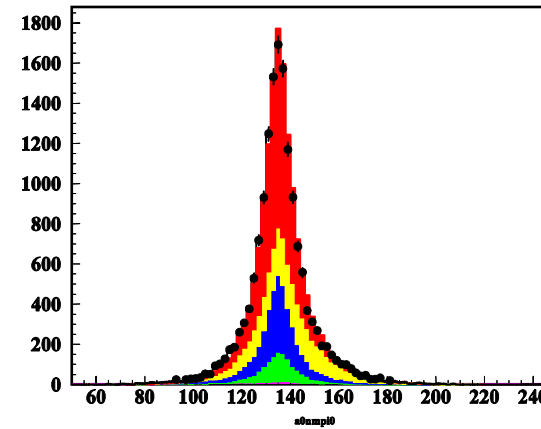
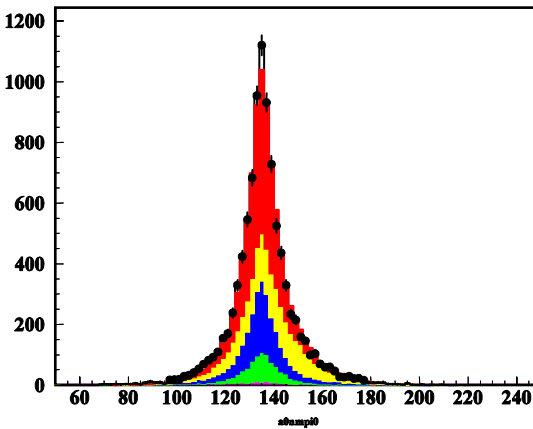$M_{\pi 0}$ **(MeV)**

- **Data**   **MC** $a_0\gamma$
                $\omega\pi^0$
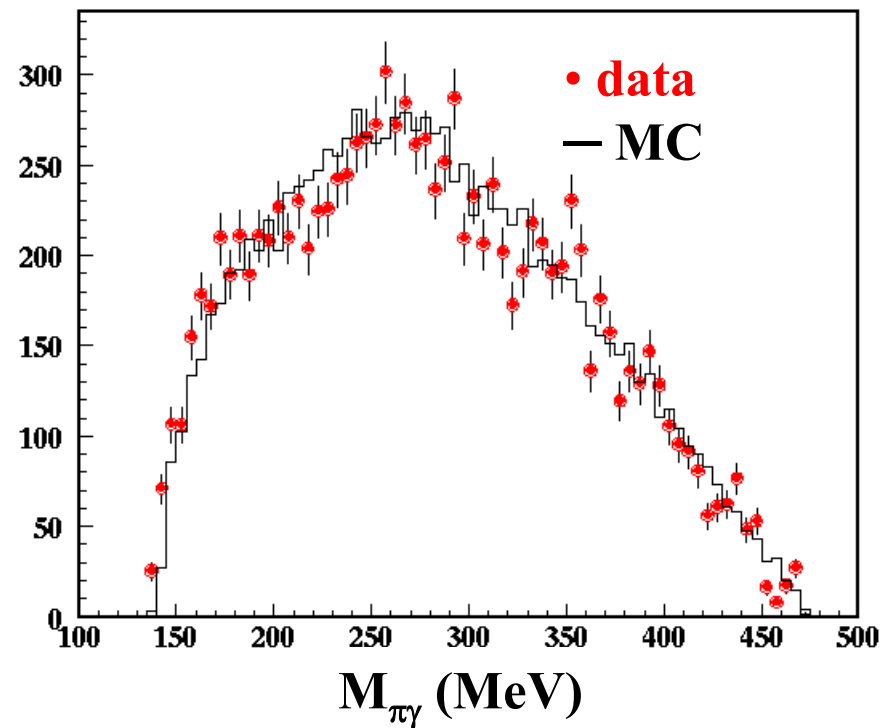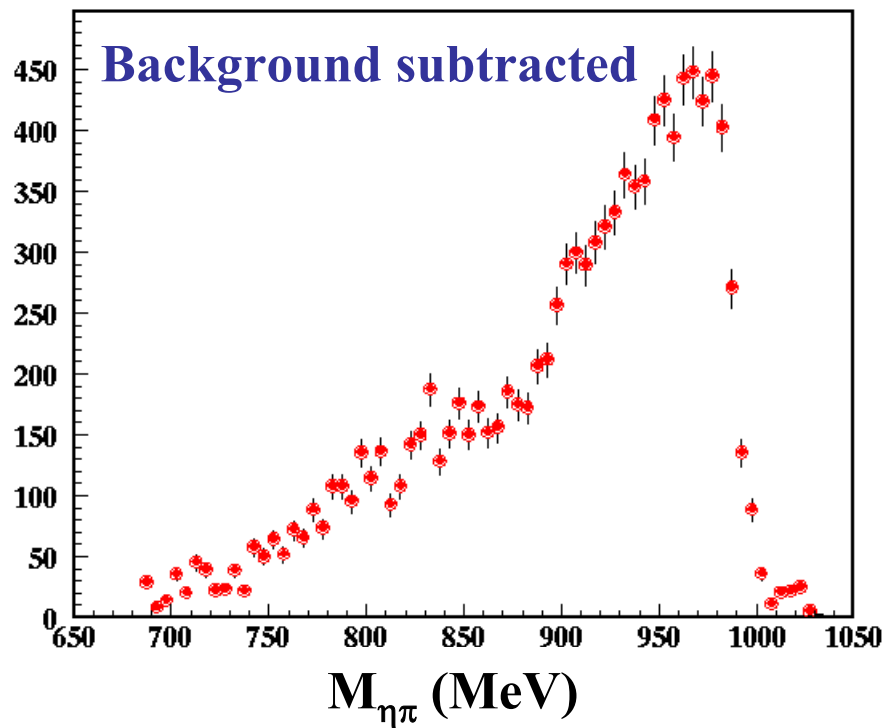 $f_0\gamma$
                $\eta\gamma$ ($\eta\rightarrow 3\pi^0$)
 $\eta\gamma$ ($\eta\rightarrow\gamma\gamma$)

Final sample

Br evaluation

- **To compare with our previous results**
- **Average efficiency = 29.5 % (not corrected for FILFO-EVCL) (Capri'03 ε=32%, with the old MC)**

- **Contamination in the final sample: 54 % (Capri'03 : 47%)**

- **Br($\phi \rightarrow \eta \pi^0 \gamma$) = (7.49 $\pm$ 0.10(stat+ bckg) $\pm$ …) $\times$ 10^{-5}**

- **Capri'03: Br($\phi \rightarrow \eta \pi^0 \gamma$) = (7.25 $\pm$ 0.15(stat+ bckg) $\pm$ …) $\times$ 10^{-5}**

- **PLB : Br($\phi \rightarrow \eta \pi^0 \gamma$)=(8.51$\pm$0.51$_{\text{stat+bckg}}\pm$0.57$_{\text{syst}}$) $\times 10^{-5}$**

- **Br depends on the σ_{peak} used. Try the normalization to $\eta \gamma$ ($\eta \rightarrow 3\pi^0$): selection in progress**

To conclude the analysis

- **Understand the data-MC discrepancies**
- **Check the $\eta\gamma$ contamination in the final sample**
- **Try to reduce the $\eta\gamma$ ($\eta\rightarrow 3\pi^0$) background (using the discriminant variable for merged clusters)**
- **Check the FILFO-EVCL efficiency with the "minimum bias" sample**
- **Build the new efficiency/smearing matrix**

- **And then fit the spectrum to the various models, in order to get the a_0 parameters**

Final sample

M?[cp]! (MeV)

$M_{\eta\pi}$ (MeV)

$M_{\eta\pi}$ (MeV)
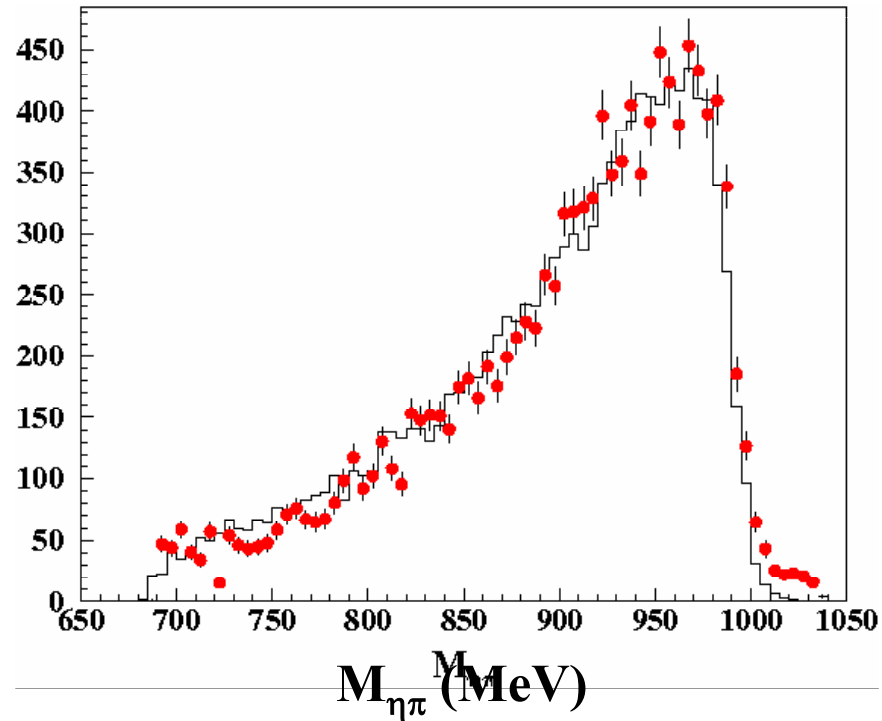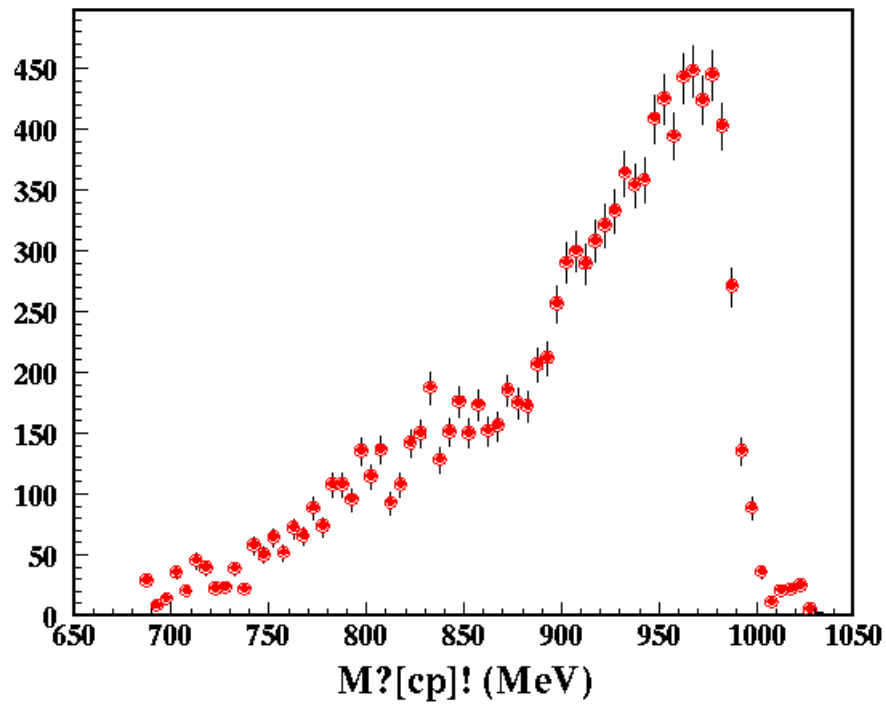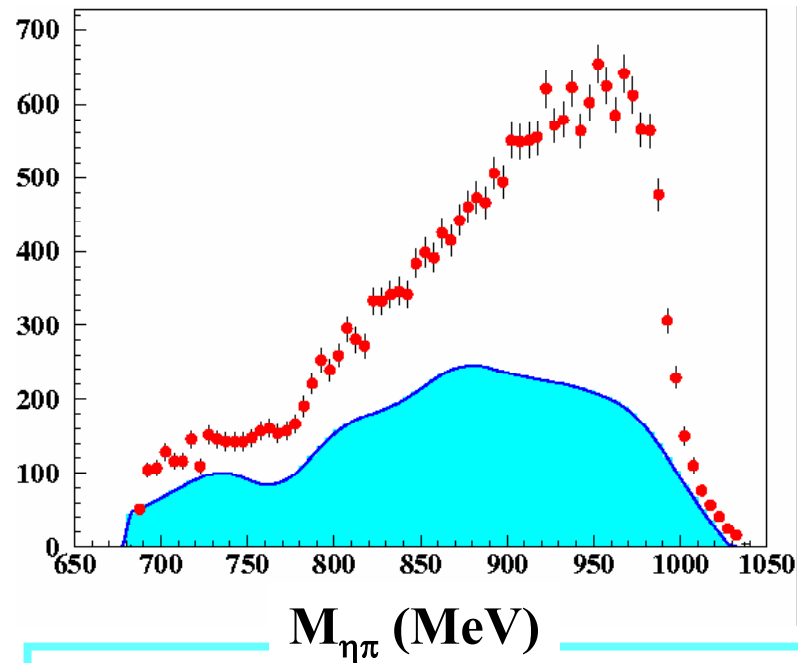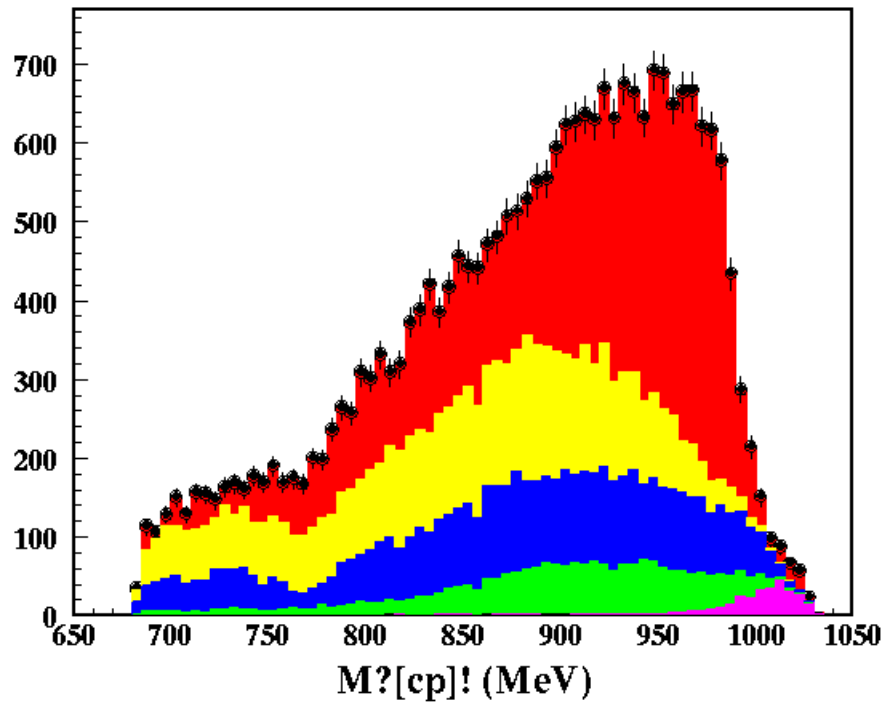
Eff. for Bckg	old MC	new MC
$f_0\gamma$	2.5%	3.7%
$\omega\pi^0$	0.7%	0.8%
$\eta\gamma\rightarrow 7\gamma$	6×10^{-4}	
$\eta\gamma\rightarrow 5\gamma$	7.7%	
$\eta\gamma\rightarrow 3\gamma$	6×10^{-6}	

Total bckg = 10508 evts.

ID		17
ENTRIES		20471
.000E+00	.000E+00	.000E+00
.000E+00	.205E+05	.000E+00
.000E+00	.000E+00	.000E+00

2001−02 data

$M^2_{\pi\gamma}$ vs $M^2_{\eta\pi}$