

Reconstruction of $\omega \rightarrow \pi^0 \gamma$ with light ECAL in p+C at SIS100

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Motivation

basic properties of the light vector mesons can be modified in the presence of the medium

modifications can be studied by comparison of meson properties measured in leptonic and hadronic decay modes

PDG: $m_\omega = 782$, $\Gamma_\omega = 8.5$ MeV

$\omega \rightarrow \pi^0 \pi^+ \pi^-$ (Br=89.1%)

$\omega \rightarrow \pi^0 \gamma$ (Br=8.9%)

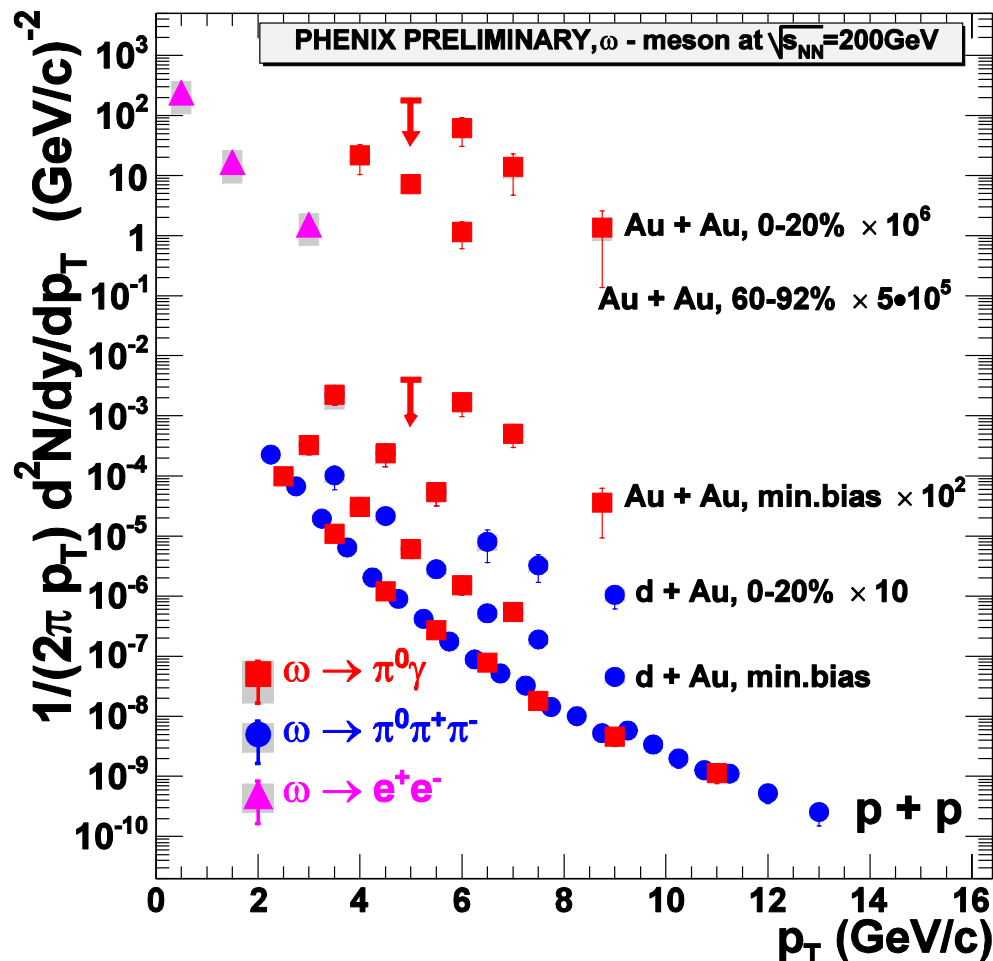
$\omega \rightarrow \pi^+ \pi^-$ (Br=1.7%)

$\omega \rightarrow e^+ e^-$ (Br= $7 \cdot 10^{-5}$)

not all $\omega \rightarrow h\dots$ can be reconstructed due to h secondary interactions

$$\rightarrow N_{\omega \rightarrow ll} \geq N_{\omega \rightarrow 1h} \geq N_{\omega \rightarrow 2h} \geq N_{\omega \rightarrow 3h}$$

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Input info

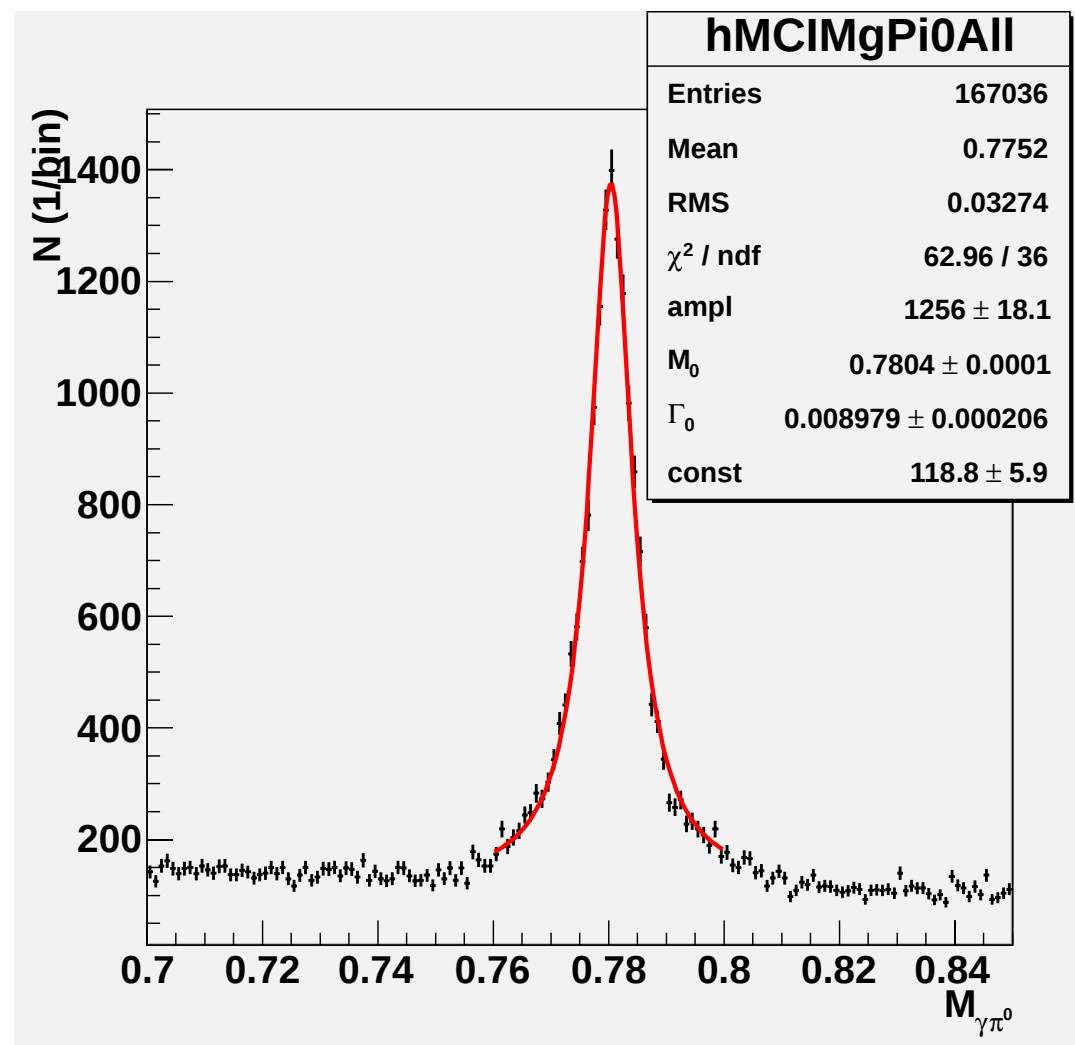
- CbmRoot package (trunk Sep2010), Geant3
- 10^6 UrQMD p+C ($b=0$ fm) events at 30 GeV, simulated and reconstructed in the light ECAL by Misha Prokudin
- STS + Light ECAL (LECAL)
- LECAL wall at 6 m from a target
 - Size: $X \times Y = 5.28 \times 4.32 \text{ m}^2$, beam hole $0.24 \times 0.24 \text{ m}^2$
 - Central part ($\rho < 1 \text{ m}$): $3 \times 3 \text{ cm}^2$ cells
 - Peripheral part ($\rho > 1 \text{ m}$): $6 \times 6 \text{ cm}^2$ cells
- p_γ cut: $p_\gamma > 0.5 \text{ GeV}/c$
- ECAL cluster cut: $\chi^2 < 25$

“Primary” ω

In the UrQMD output
there are no ω

However, in the invariant
mass spectrum of MC
primary γ and π^0 tracks
there is a peak at m_ω

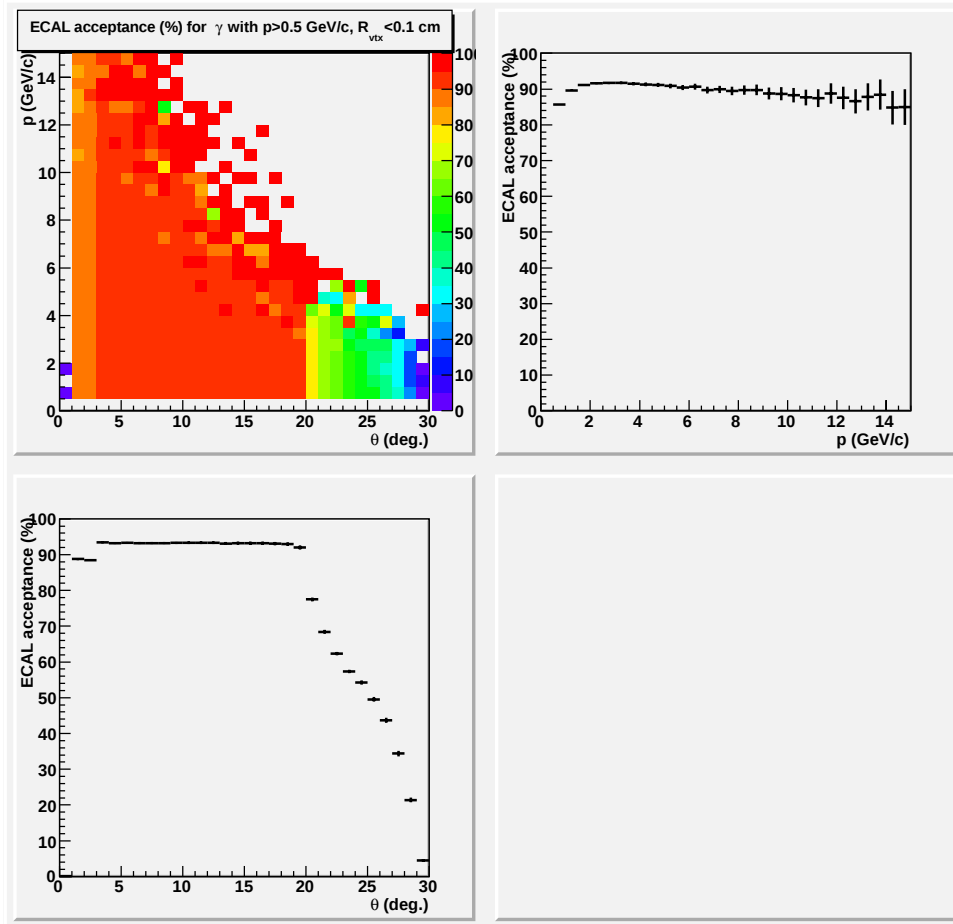
assumption:
primary γ and π^0 tracks with
 $0.77 < M_{\gamma\pi} < 0.79$
are from “primary” ω



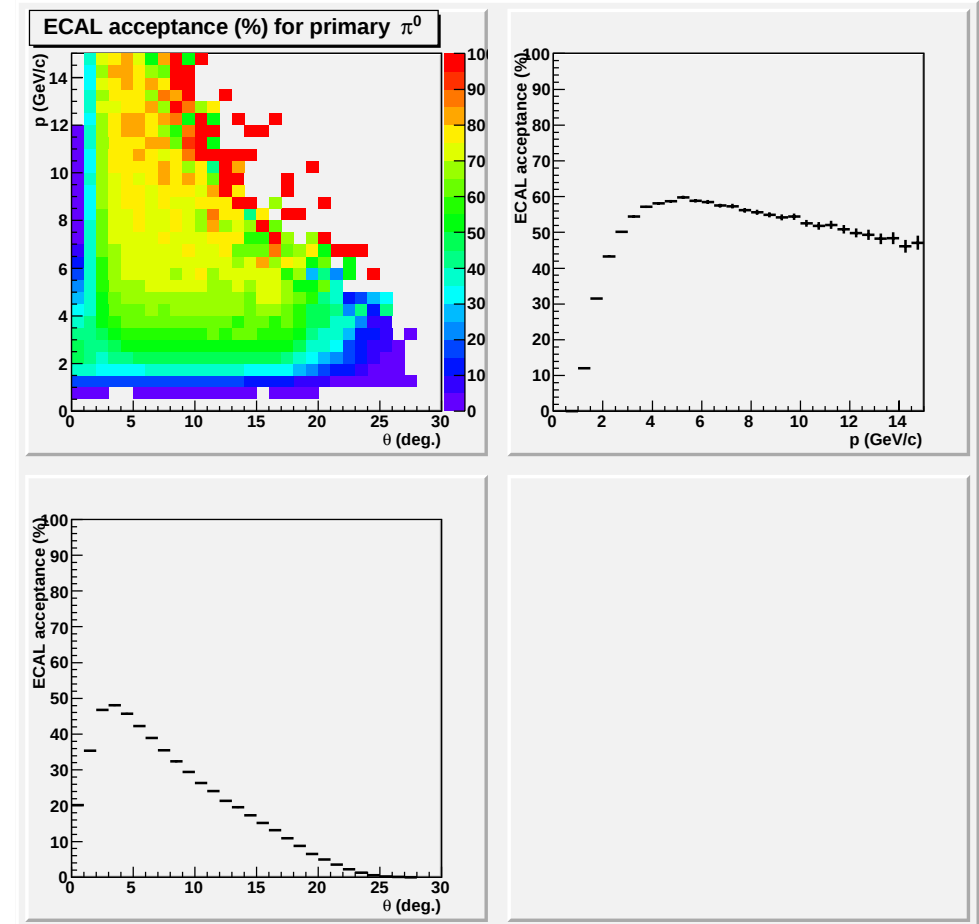
Reminder: γ and π^0 acceptance

(17th CBM meeting, 04.04.2011, Dresden)

γ acceptance



π^0 acceptance

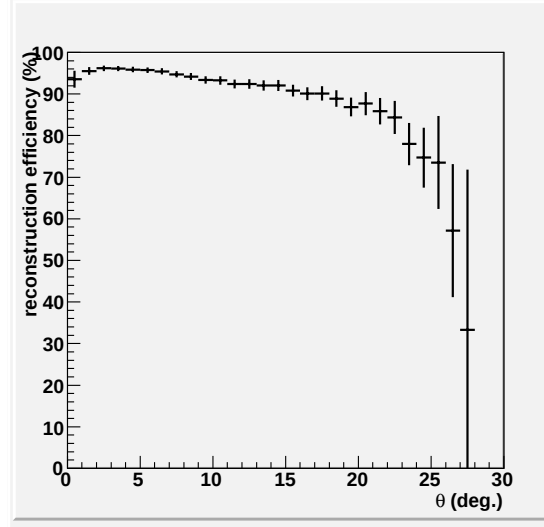
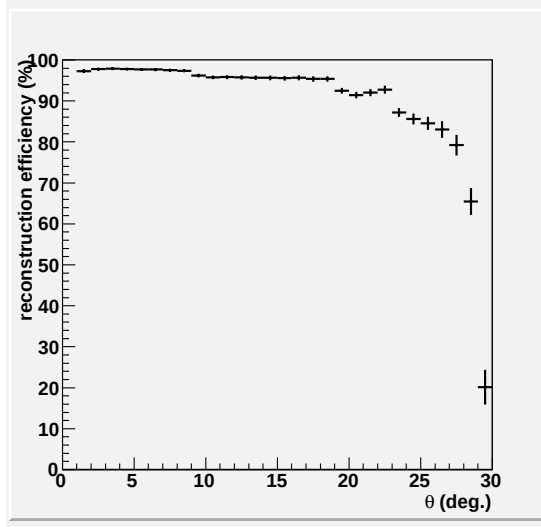
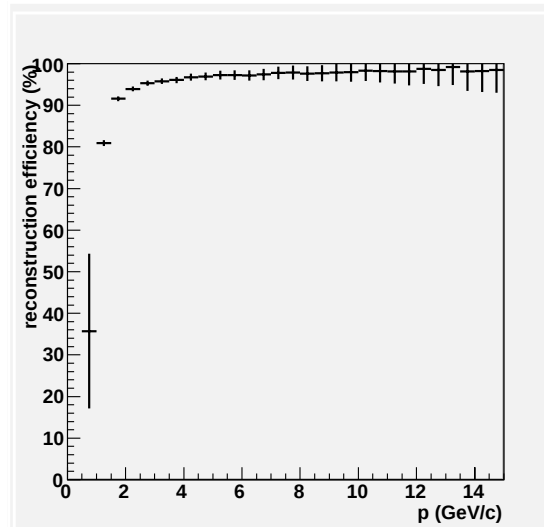
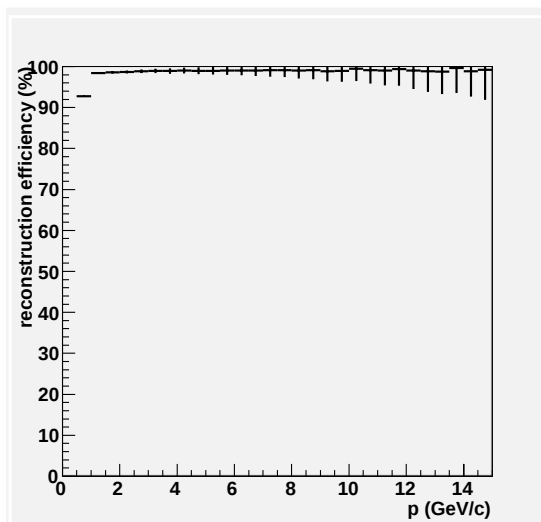


$\sim 2 - 3$ times higher than with large ECAL

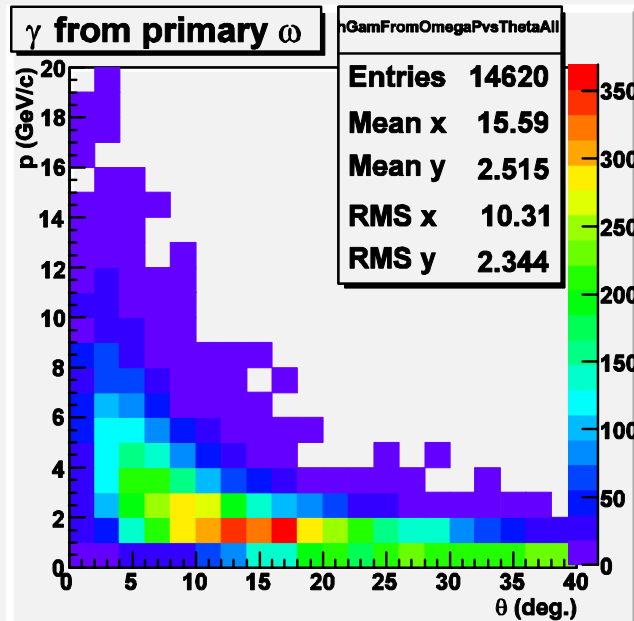
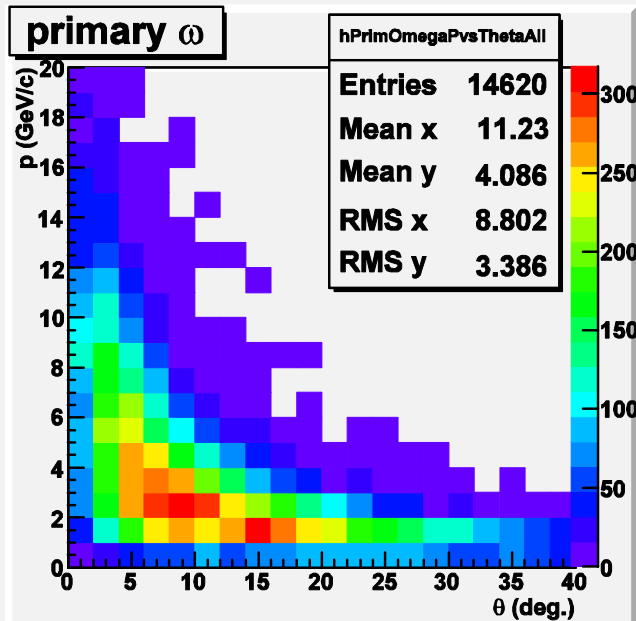
Reminder: γ and π^0 reconstruction efficiency

(17th CBM meeting, 04.04.2011, Dresden)

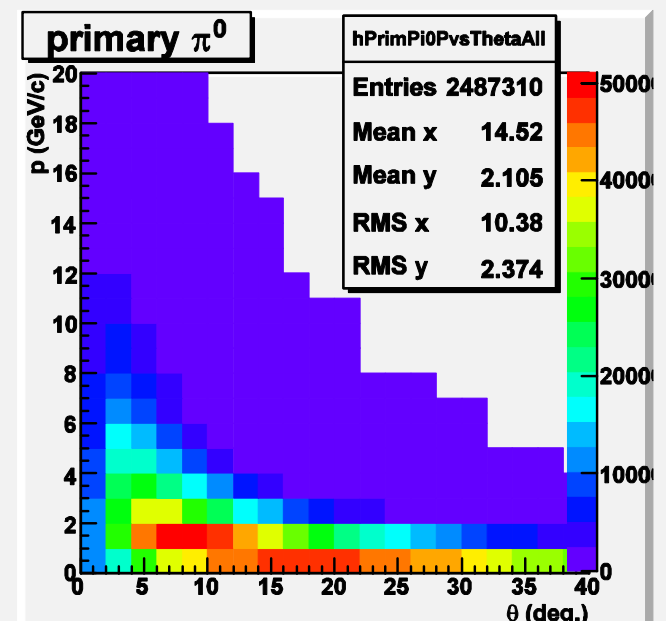
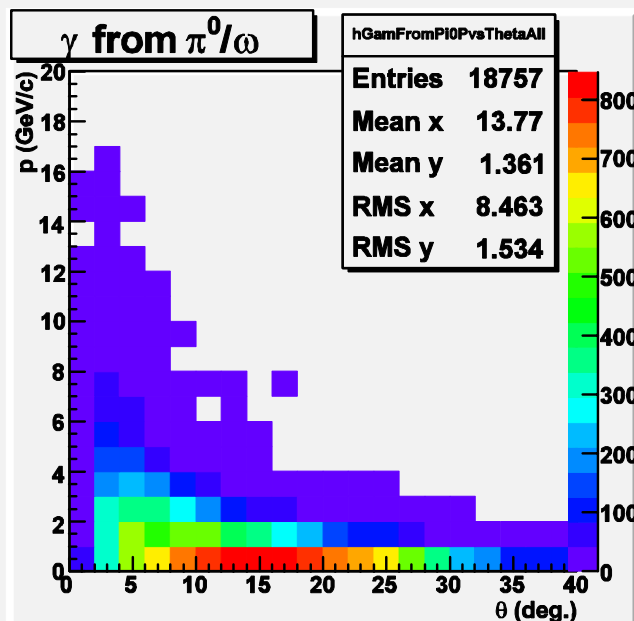
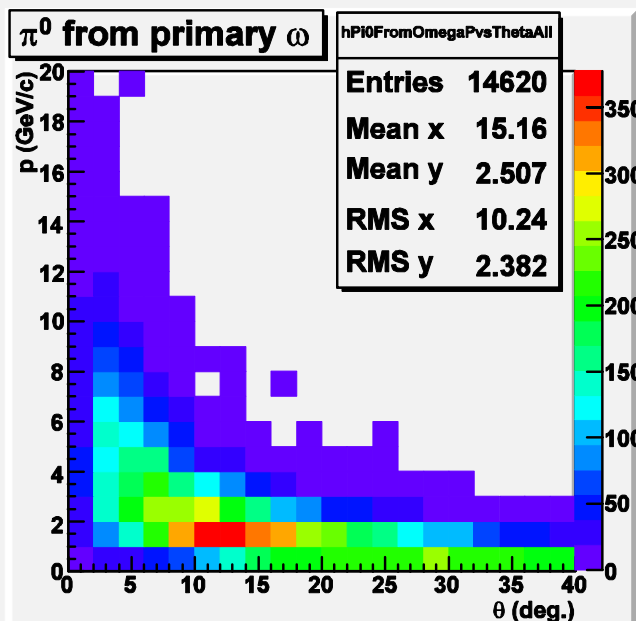
γ reco efficiency π^0 reco efficiency



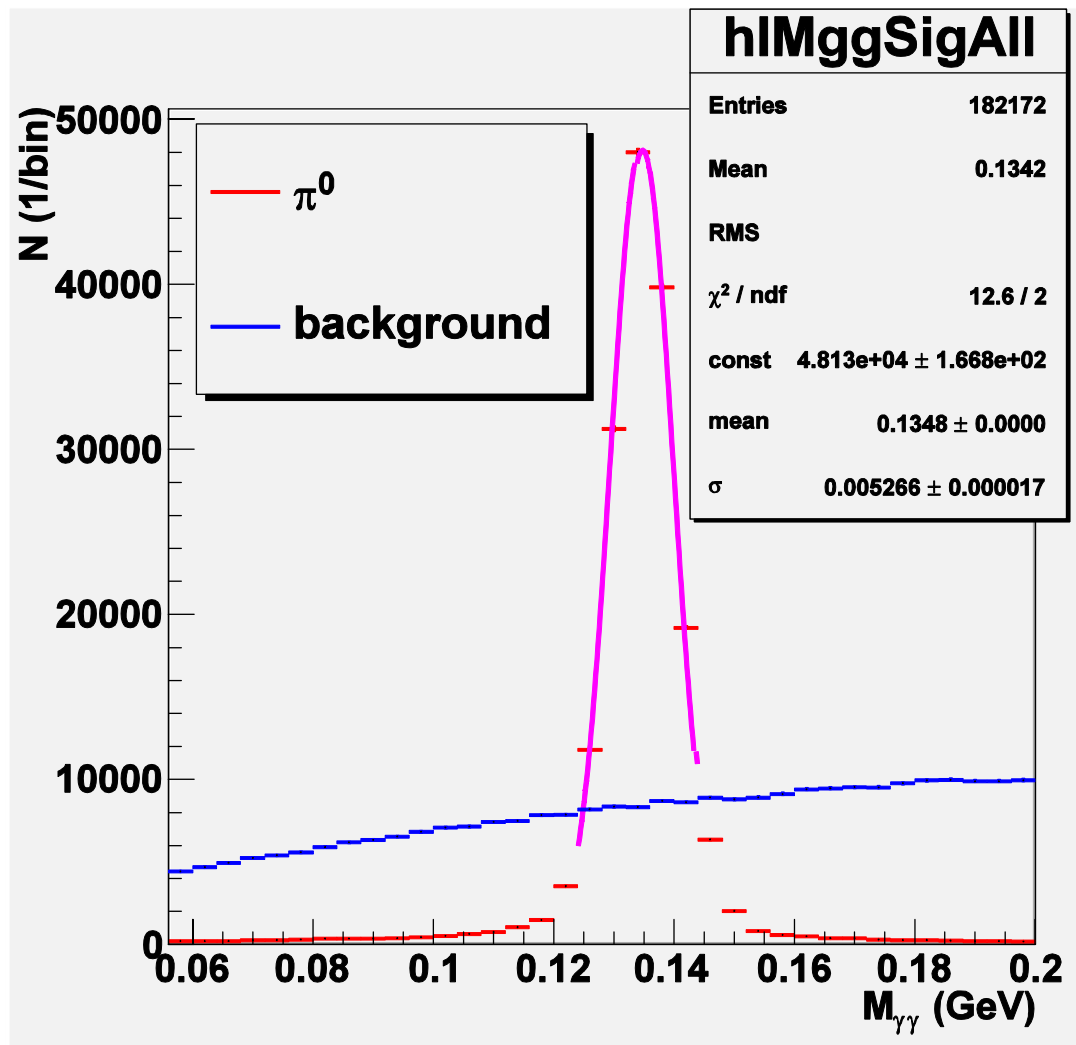
A bit larger than
with large ECAL



$\omega \rightarrow \pi^0 \gamma$:
spectra



$\omega \rightarrow \pi^0 \gamma$: π^0 and γ candidates



$$p_\gamma > 1.0 \text{ GeV}/c$$

$$\sigma = 5.3 \text{ MeV}$$

$$S/B_{2\sigma} = 3.06$$

$$\text{Significance} = 343$$

π^0 candidate:

$$m_{\gamma\gamma}: m_\pi \pm 2\sigma$$

Background:

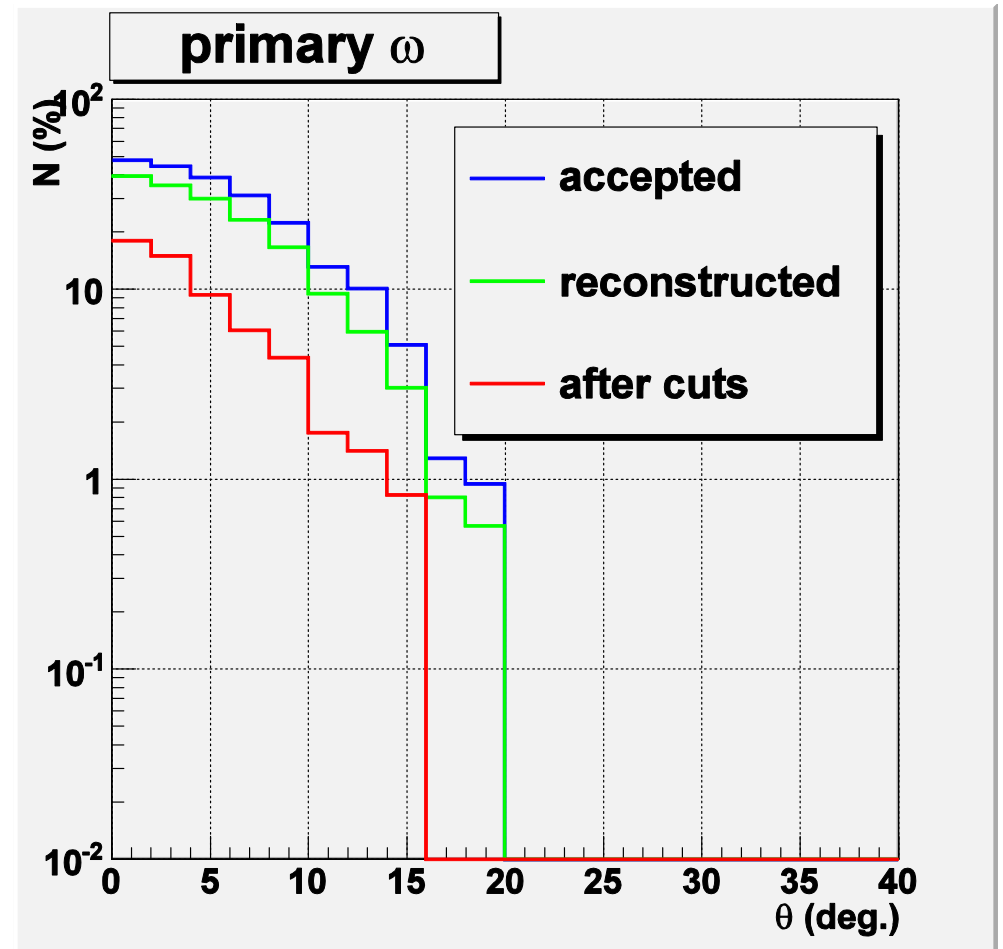
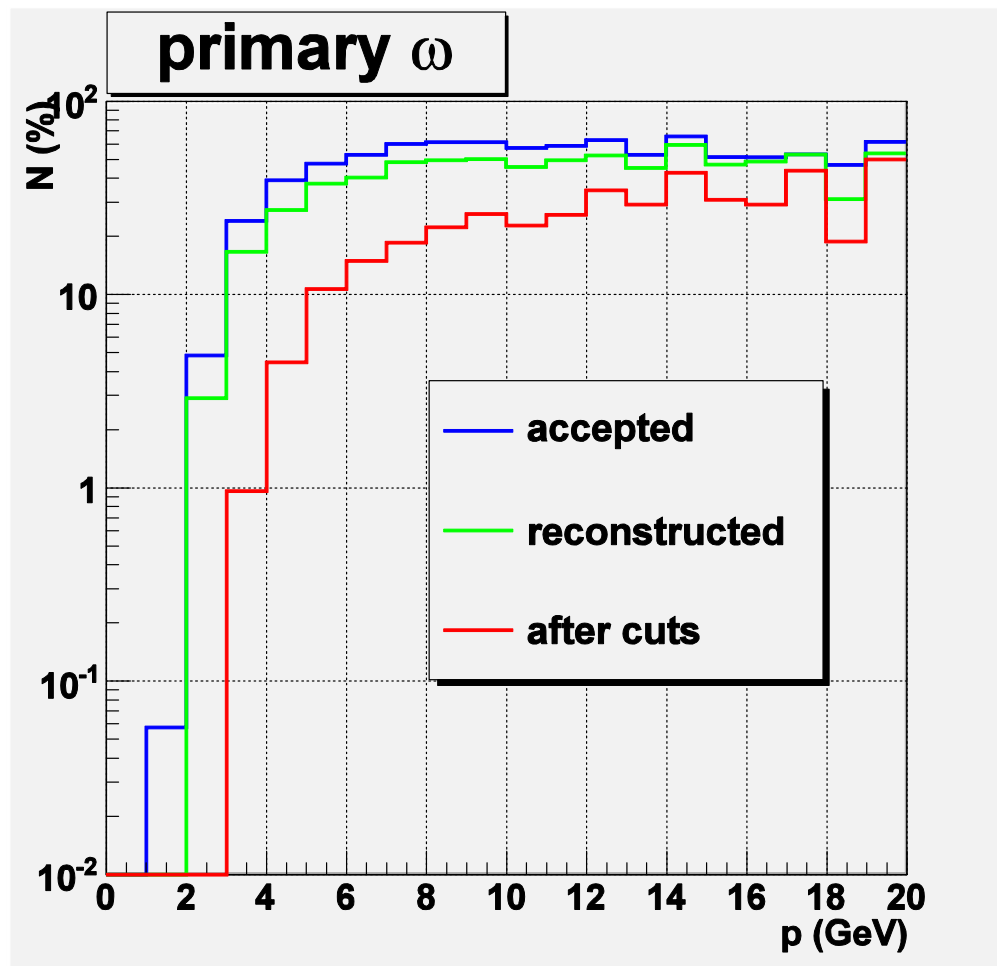
primary π^0

$\sim 2\text{-}3 \pi^0$ per event

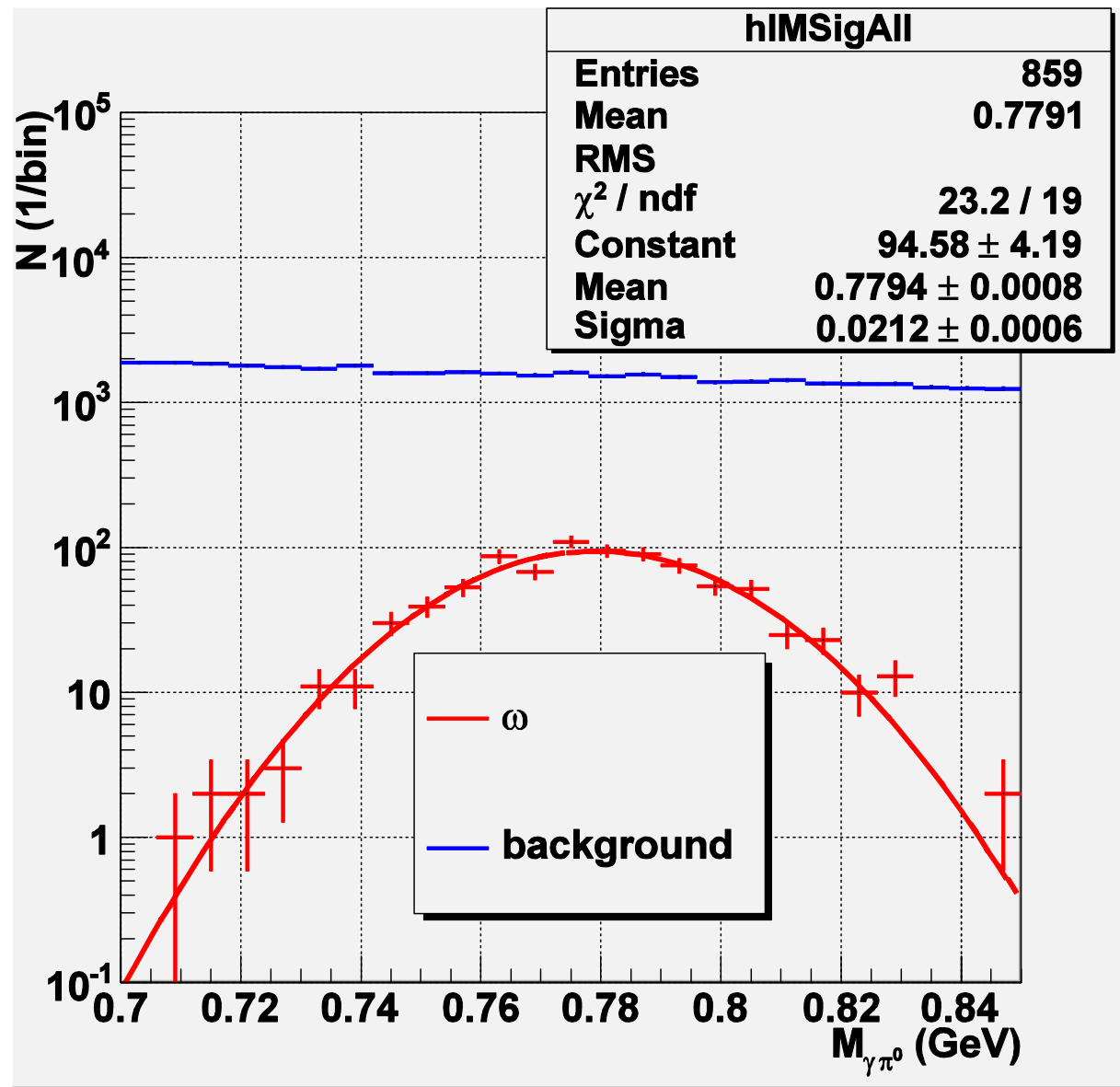
γ candidate:

$\omega \rightarrow \pi^0 \gamma$: signal

acceptance, reconstruction, cuts efficiencies



$\omega \rightarrow \pi^0 \gamma$: Signal/Background



	$\omega \rightarrow \gamma \pi^0$
Statistics (events)	10^6
Yield/event	0.015
Acceptance eff.	22 %
Reconstruction eff.	77%
Cut eff.	35%
Total eff.	6%
σ (MeV)	21
$S/B_{2\sigma}$	3.7%
Significance	5.4

light ECAL vs. large ECAL

light ECAL

	$\omega \rightarrow \gamma \pi^0$
Statistics (events)	10^6
Yield/event	0.015
Acceptance eff.	22 %
Reconstruction eff.	77%
Cut eff.	35%
Total eff.	6%
σ (MeV)	21
$S/B_{2\sigma}$	3.7%
Significance	5.4

large ECAL

	$\omega \rightarrow \gamma \pi^0$
Statistics (events)	10^6
Yield/event	0.015
Acceptance eff.	4 %
Reconstruction eff.	74%
Cut eff.	30%
Total eff.	0.9%
σ (MeV)	22
$S/B_{2\sigma}$	0.7%
Significance	0.9

Summary

10^6 UrQMD p+C (b=0 fm) events at 30 GeV

reconstruction of $\omega \rightarrow \pi^0 \gamma$ with light ECAL

efficiency $\sim 6\%$

$\sigma_{\pi\gamma} = \sim 20 \text{ MeV}$

$S/B_{2\sigma} \sim 4\%$

significance ~ 5

One can hope for p+A @ SIS100 CBM will “see” hadron secondary interactions due to $N_{\omega \rightarrow 1l} \geq N_{\omega \rightarrow 1h} \geq N_{\omega \rightarrow 2h} \geq N_{\omega \rightarrow 3h}$