Reconstruction of π^0 and η mesons with light ECAL

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- Invariant mass spectra $M_{\gamma\gamma}$
- Extracted signals
- True signals
- S/B
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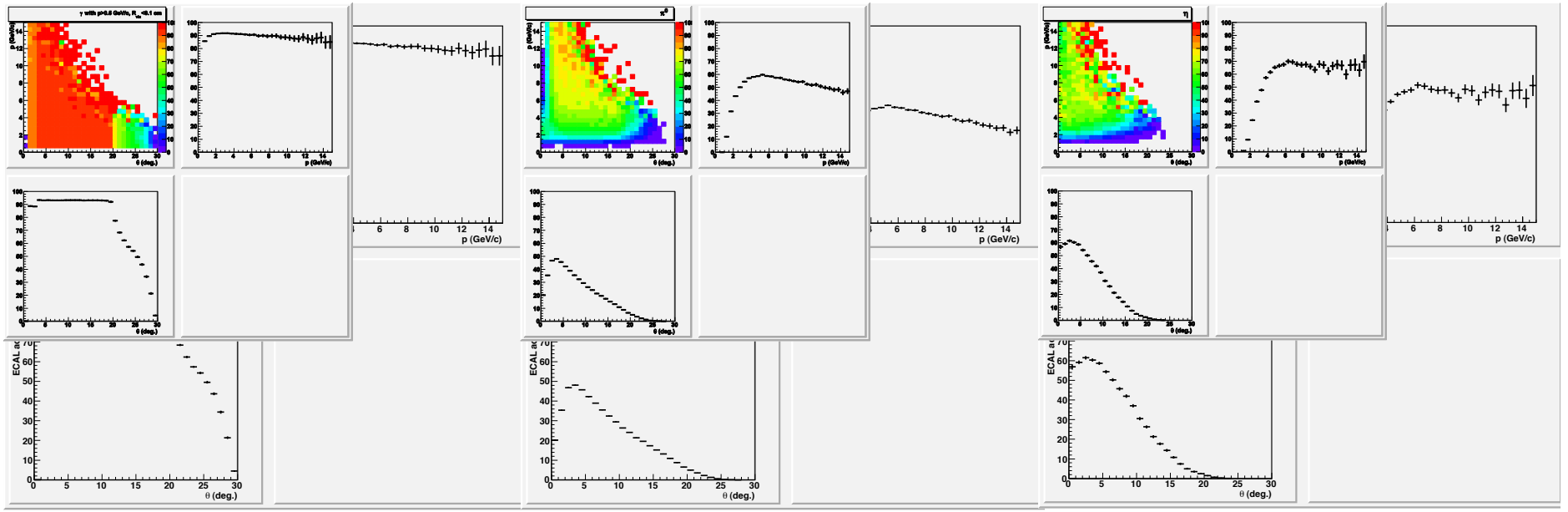
Input info

- CbmRoot package (trunk Sep2010), Geant3
- UrQMD (b=0 fm) events simulated and reconstructed in the light ECAL by Misha Prokudin:
  - 10^6 p+C 30 GeV
  - 10^5 C+C 25 AGeV
  - 10^4 Cu+Cu 25 AGeV
  - 10^4 Au+Au 25 AGeV
- STS + Light ECAL (LECAL)
- LECAL wall at 6 m from a target
  - Size: X x Y = 5.28 x 4.32 m^2 , beam hole 0.24 x 0.24 m^2
  - Central part ($\rho < 1$ m): 3 x 3 cm^2 cells
  - Peripheral part (($\rho > 1$ m): 6 x 6 cm^2 cells
- p_γ cut: $p_\gamma > 0.5$ GeV/c
- ECAL cluster cut: $\chi^2 < 25$

acceptance

γ (R_{vtx}<0.1cm) primary π^0 primary $\eta \rightarrow \gamma\gamma$



<accep.> : ~ 90 % ~20 % ~35%

$\gamma(R_{vtx}<0.1cm)$ reco efficiency: the example C+C

18.34 reco γ/event:

18.17 matched with MC tracks

16.45 of them R_{vtx} <0.1 cm

11.81 (72%) of them are photons

11.30 (96%) of them enter ECAL

0.51 (4%) "enter" ECAL by $e^{\pm}$ due to conversion

4.64 (28%) are n, $\pi^{\pm}$, p, …

42.65 MC tracks/event enter ECAL

13.53 of them are photons

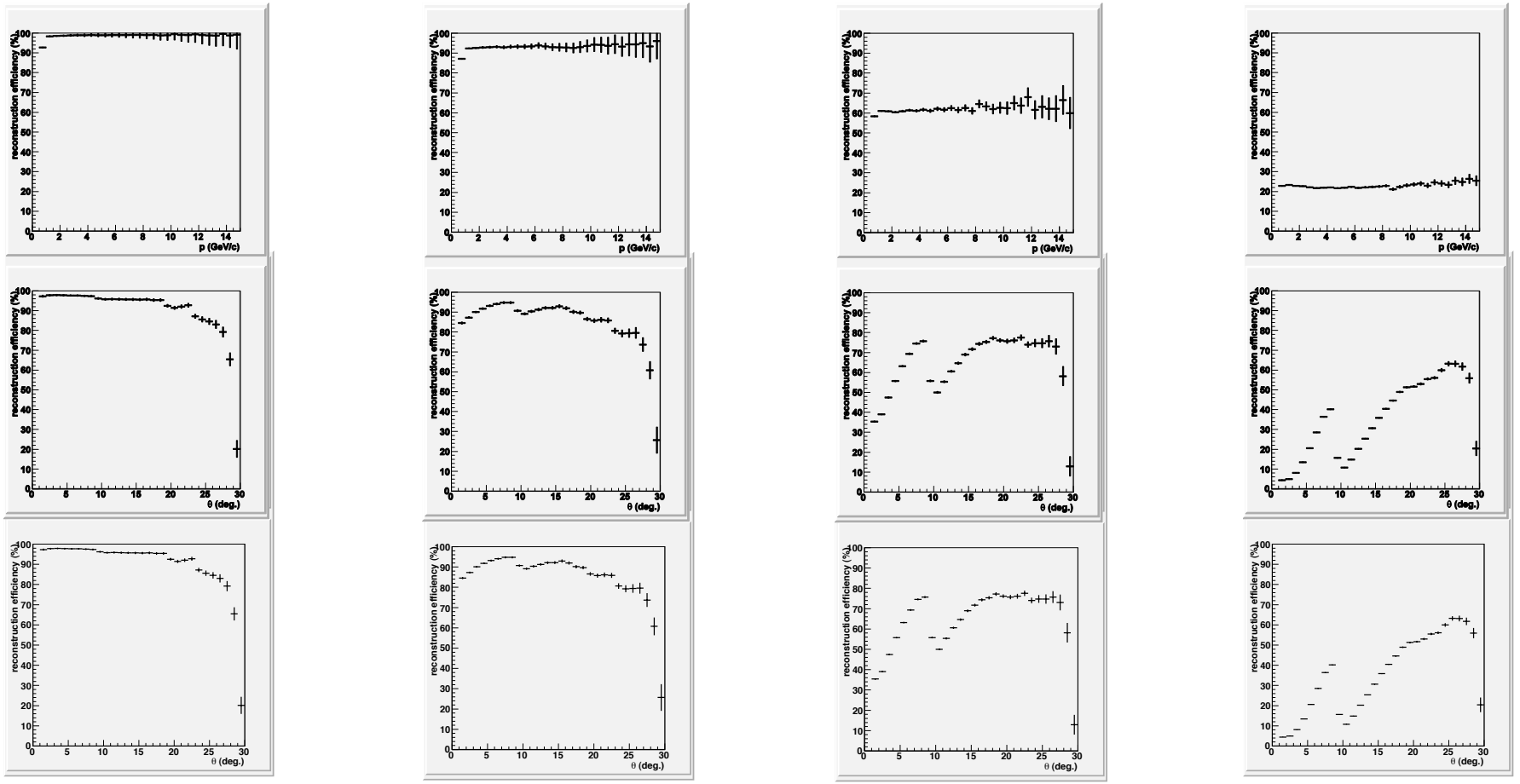
12.45 of them R_{vtx} <0.1 cm

γ reco efficiency = 11.30 / 12.45 = 91%

converting part = 0.51 / 11.81 = 4%

reco efficiency: $\gamma(R_{vtx}<0.1cm)$

p+C C+C Cu+Cu Au+Au



<reco> : ~ 96 % ~91 % ~60% ~23%

π^0 and η reco efficiency: the example Cu+Cu

π^0

9.0 reco primary/ev.:
- 8.0 (89%): 2γ enter ECAL
- 0.7 (8%): 1γ enter ECAL
- 0.3 (3%): 0γ enter ECAL

106.8 primary/ev.
- 22.8 enter ECAL

reco efficiency = 8.0/22.8
= 35 (%)
converting part: 11%

$\eta \rightarrow \gamma\gamma$

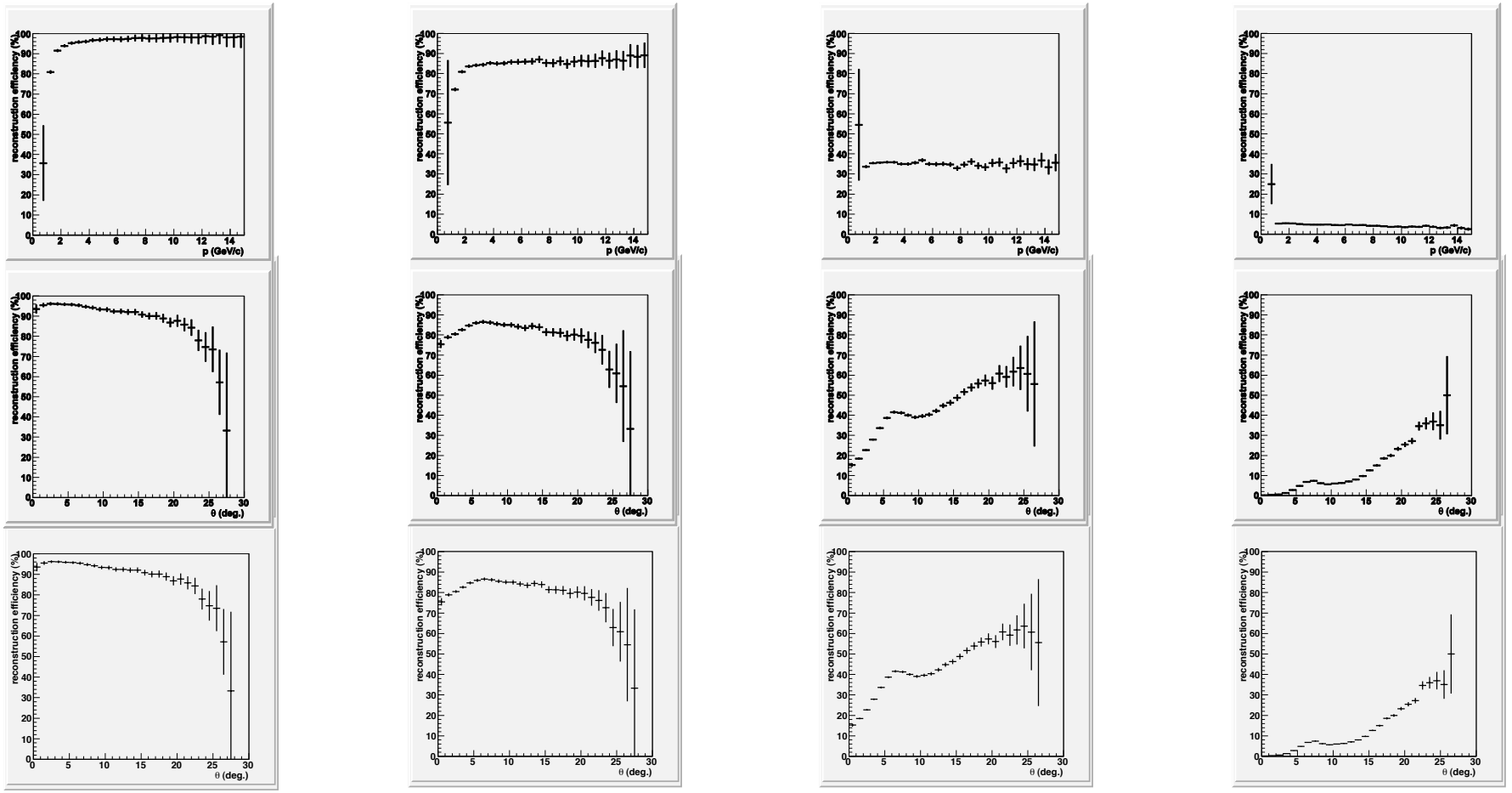
0.73 reco primary/ev.:
- 0.65 (87%): 2γ enter ECAL
- 0.06 (9%): 1γ enter ECAL
- 0.02 (4%): 0γ enter ECAL

4.22 primary/ev.
- 1.42 enter ECAL

reco efficiency = 0.65/1.42
= 46 (%)
converting part: 13%

reco efficiency: primary π^0

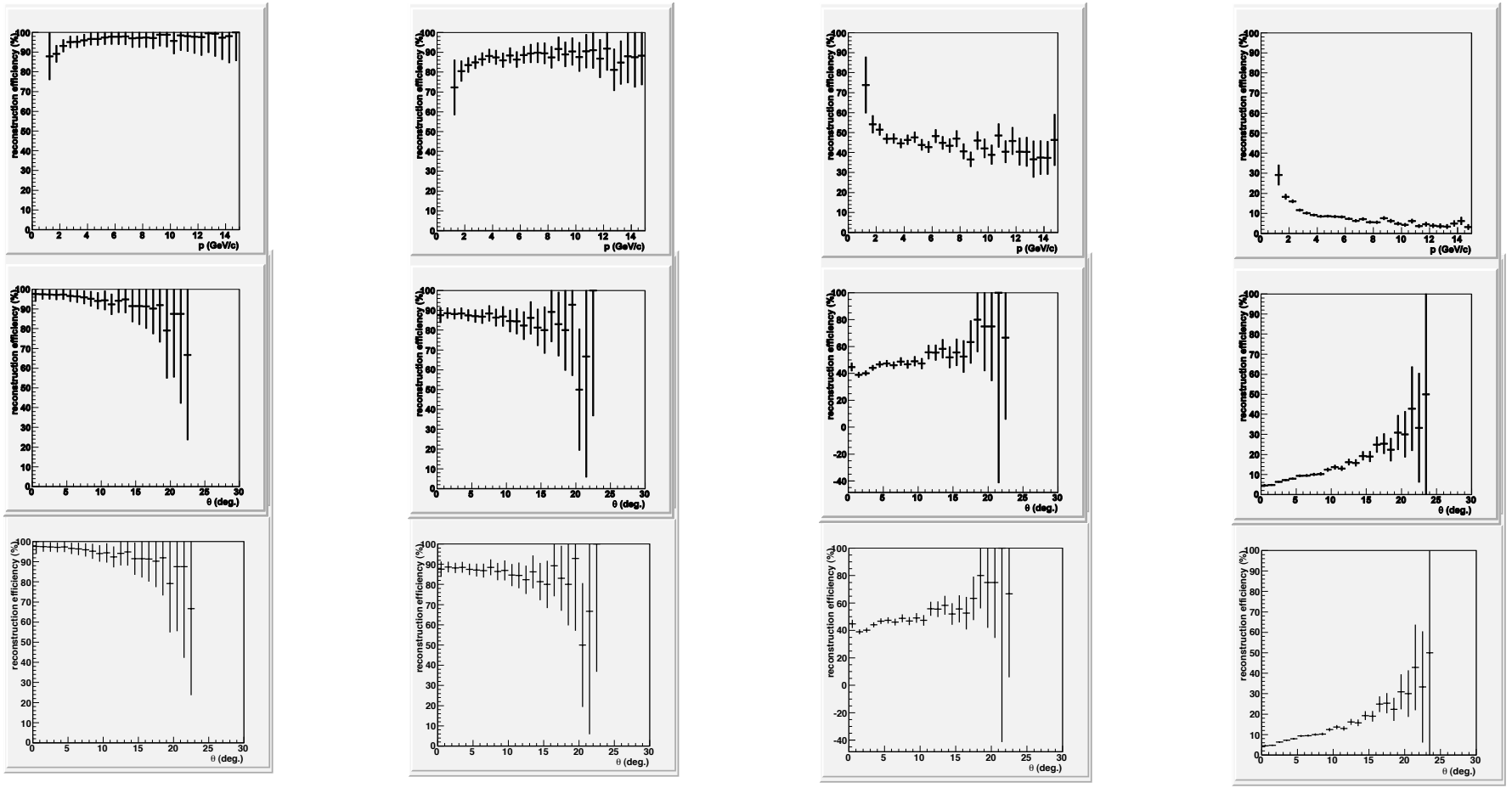
p+C C+C Cu+Cu Au+Au



<reco> : ~ 94 % ~84 % ~35% ~5%

reco efficiency: primary $\eta \rightarrow \gamma\gamma$

p+C C+C Cu+Cu Au+Au

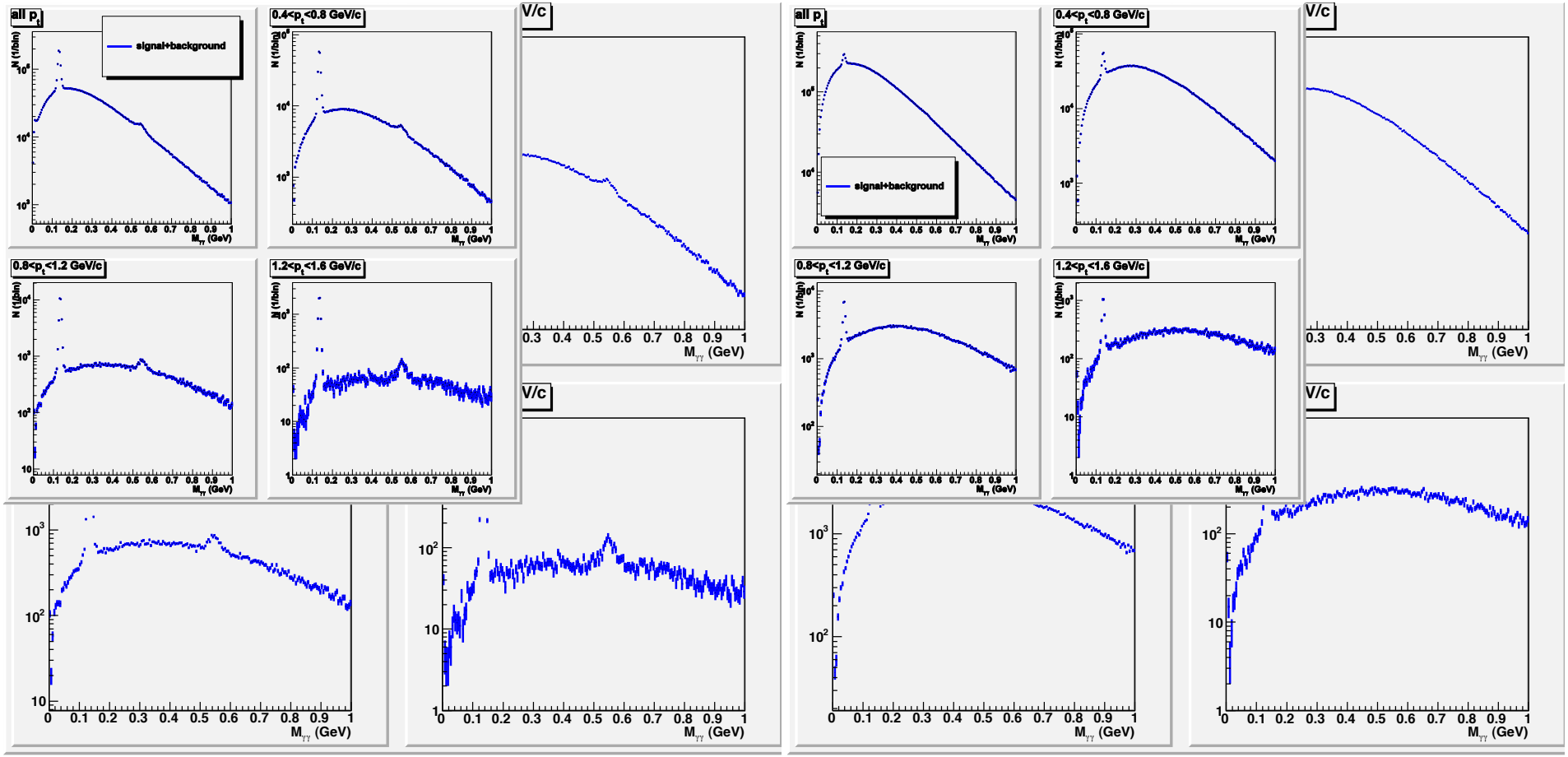


<reco> : ~ 96 % ~87 % ~46% ~9%

$M_{\gamma\gamma}$ spectra: p+C, C+C

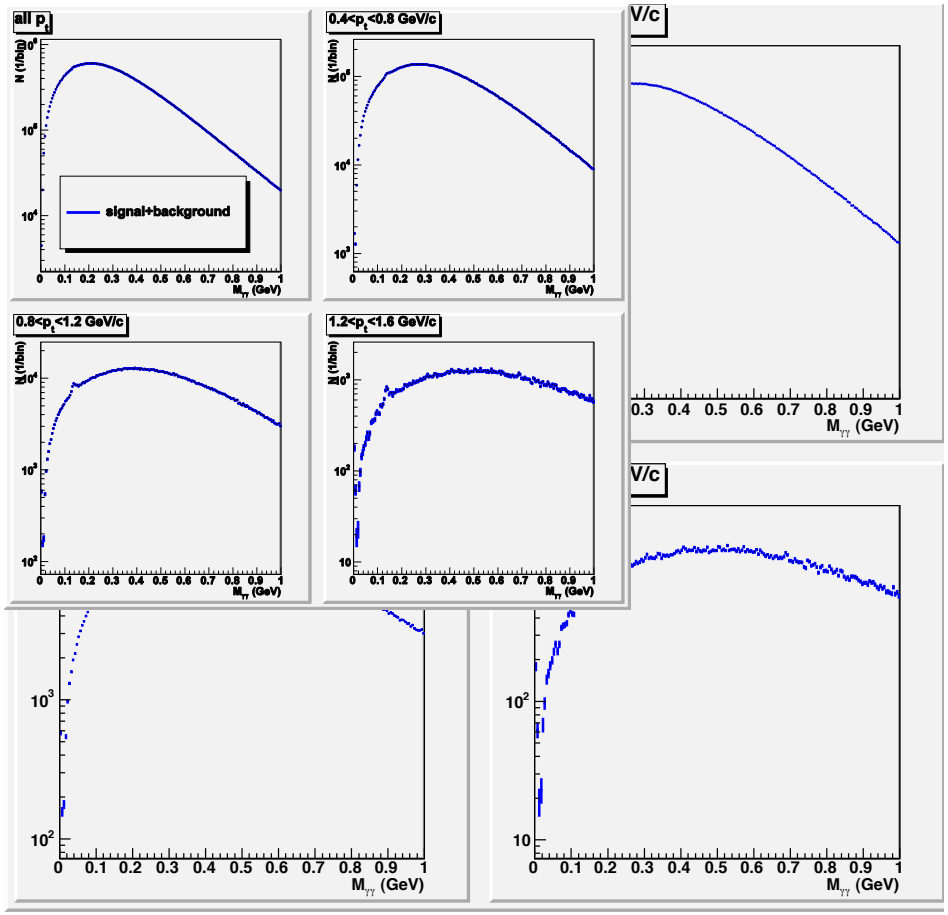
p+C

C+C

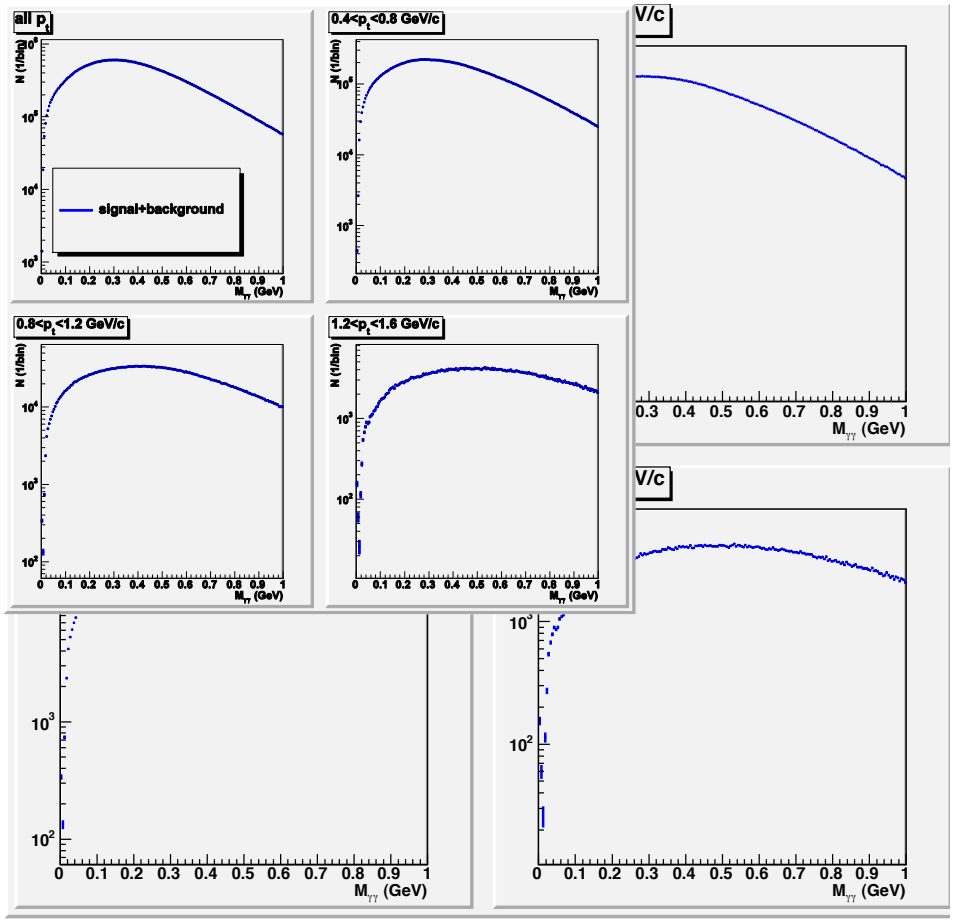


$M_{\gamma\gamma}$ spectra: Cu+Cu, Au+Au

Cu+Cu

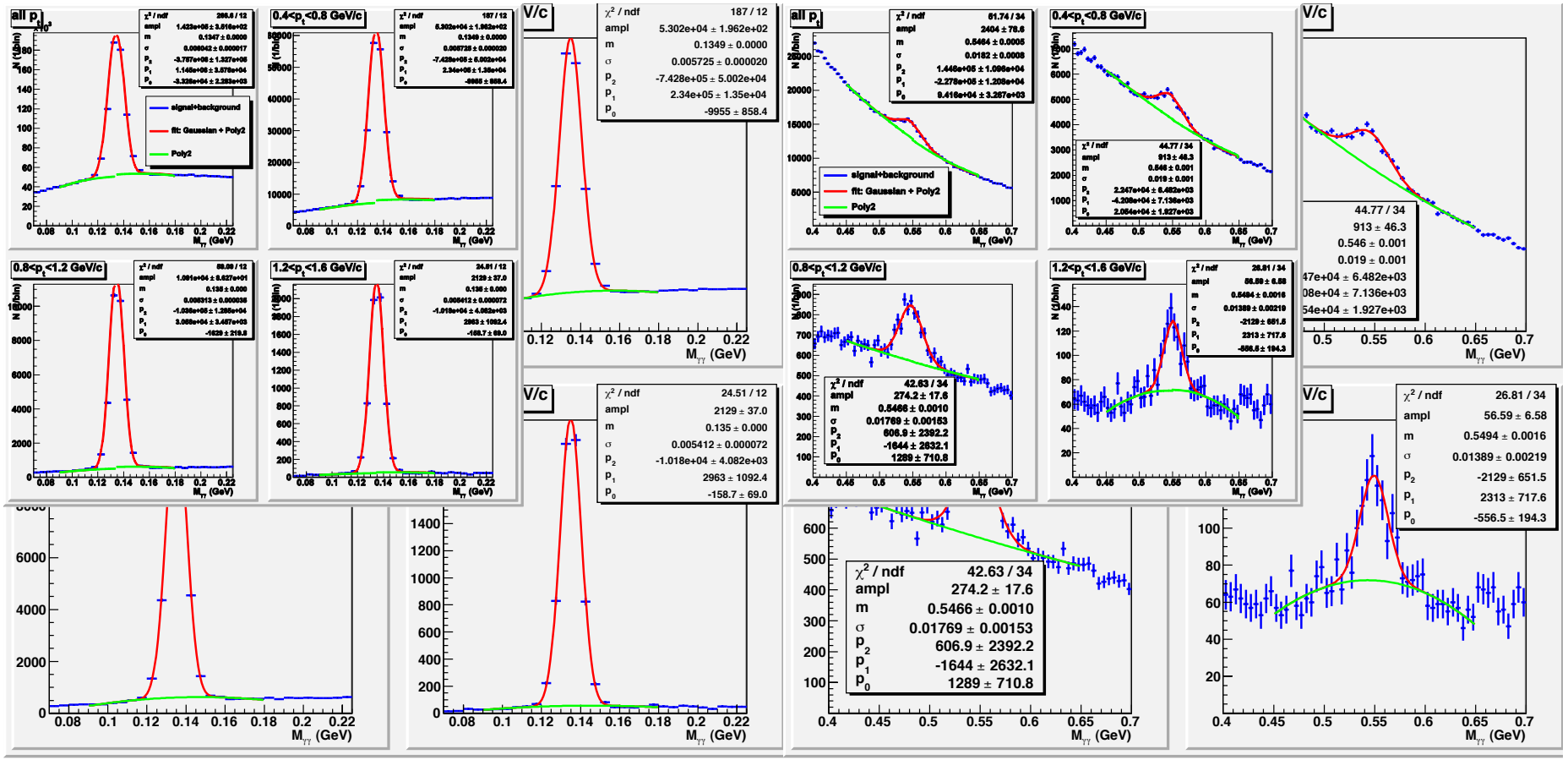


Au+Au



extracted signals: p+C

π^0 η



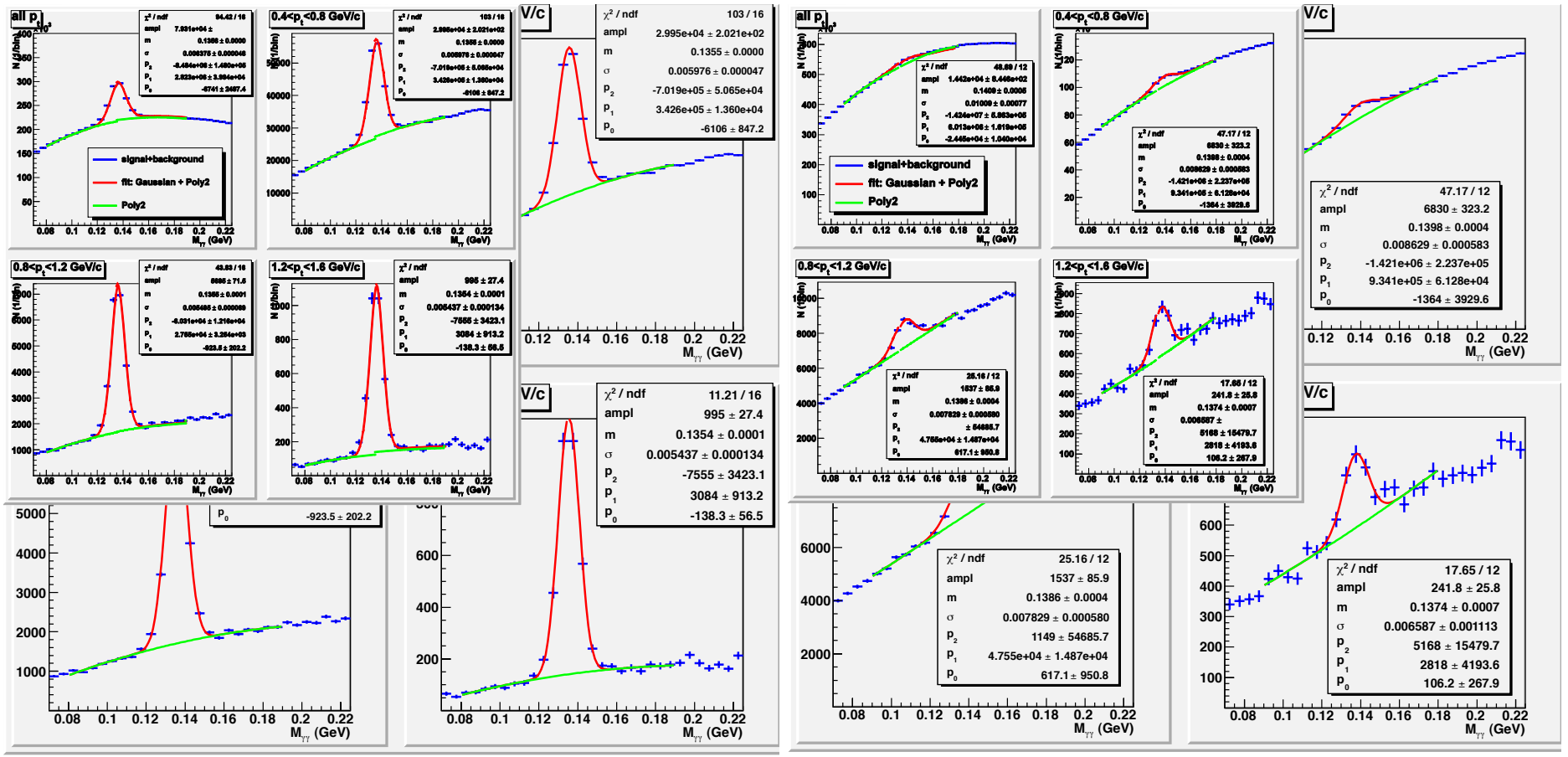
$\sigma_\pi \approx 6$ MeV

$\sigma_\eta \approx 18$ MeV

extracted signals: C+C, Cu+Cu

C+C: π^0

Cu+Cu: π^0

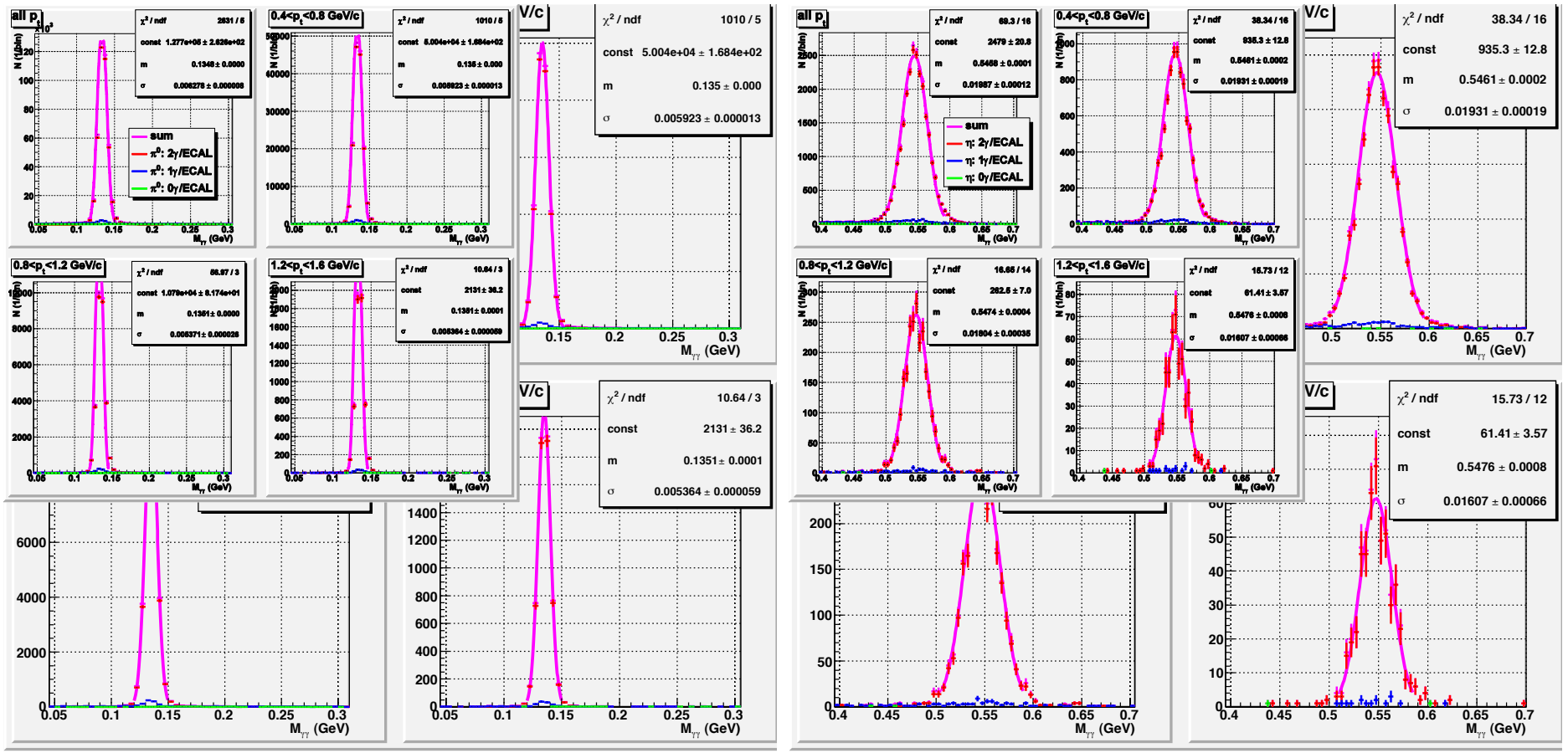


$\sigma_\pi \approx 6$ MeV

$\sigma_\pi \approx 10$ MeV

true signals: p+C

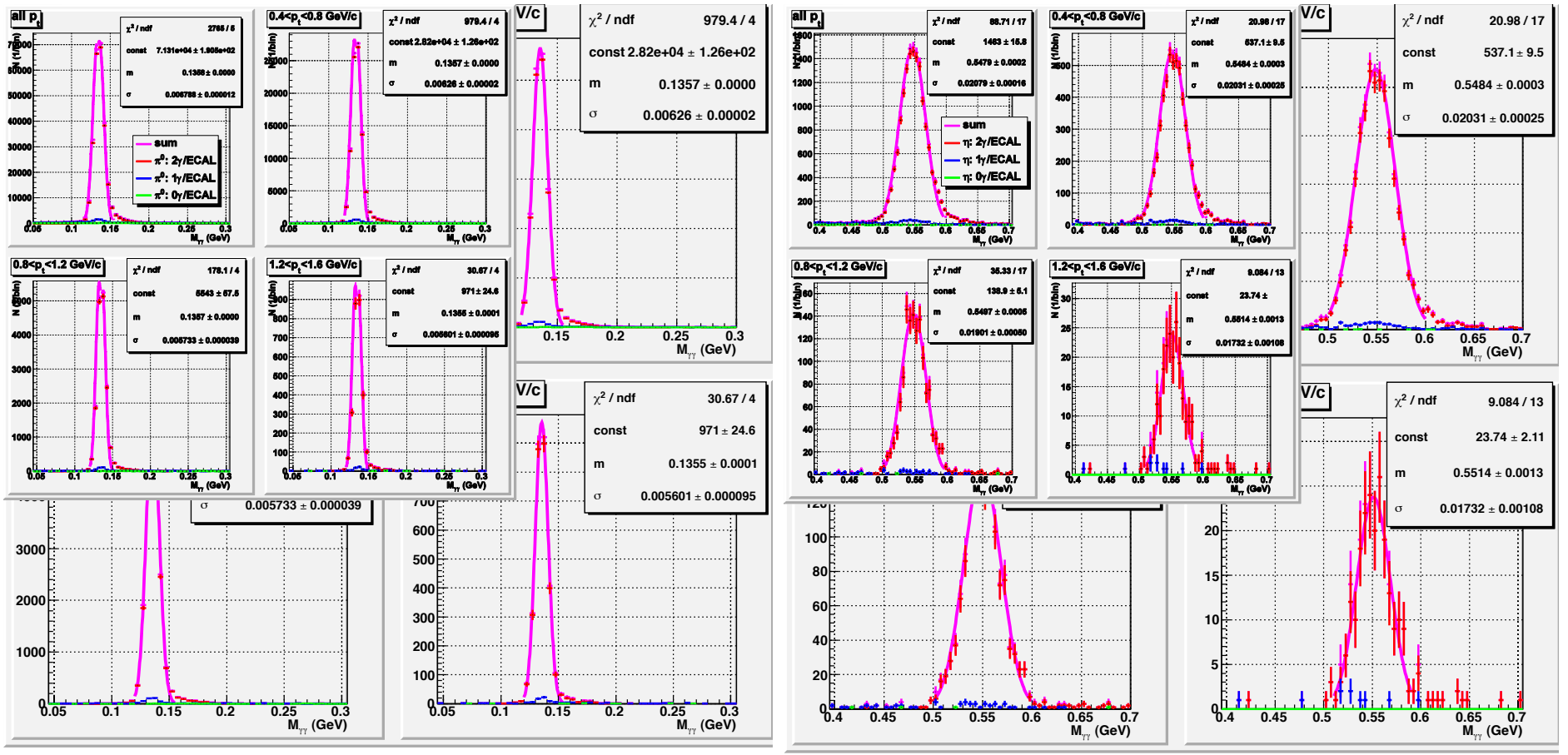
π^0 η



$\sigma_\pi \approx 6$ MeV $\sigma_\eta \approx 18$ MeV

true signals: C+C

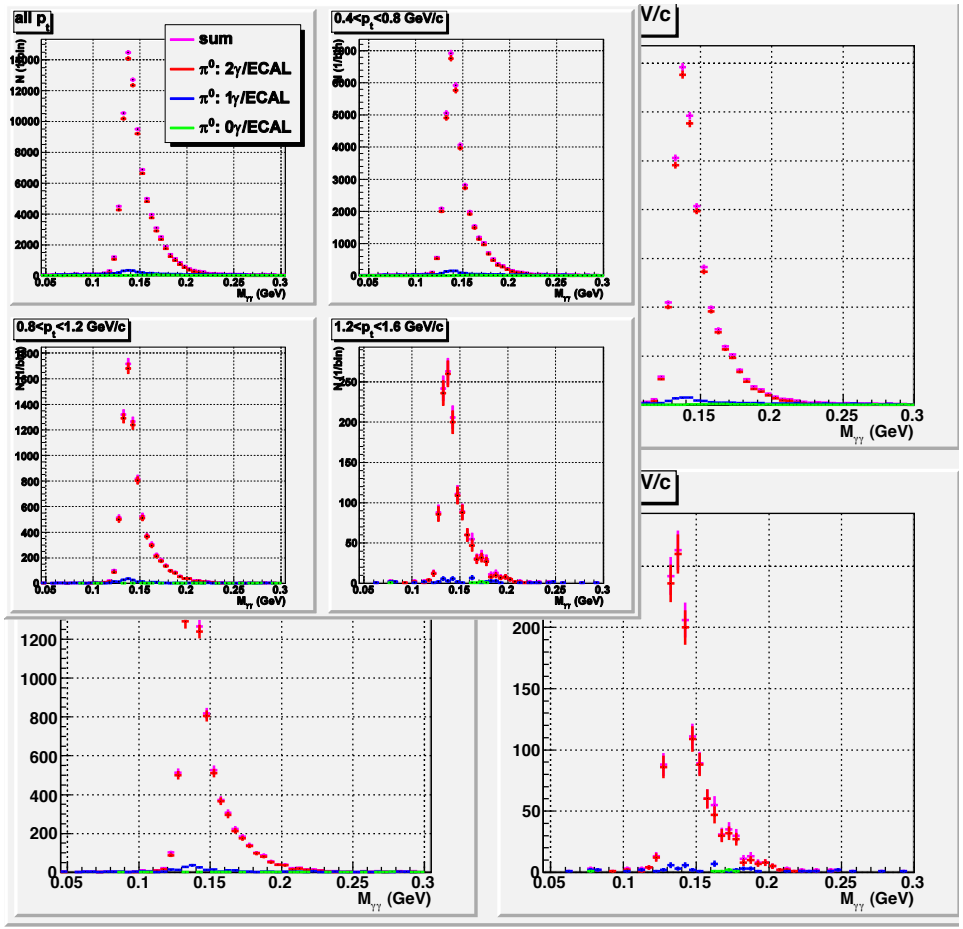
π^0 η

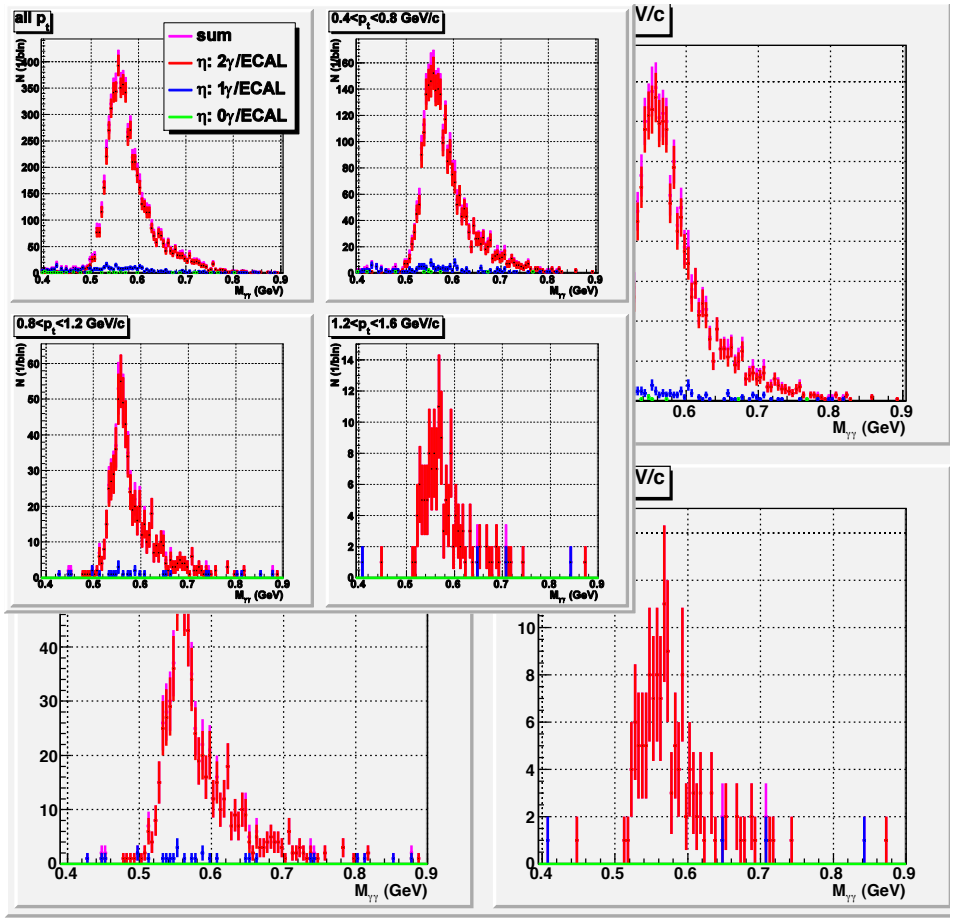


$\sigma_\pi \approx 7$ MeV $\sigma_\eta \approx 20$ MeV

true signals: Cu+Cu

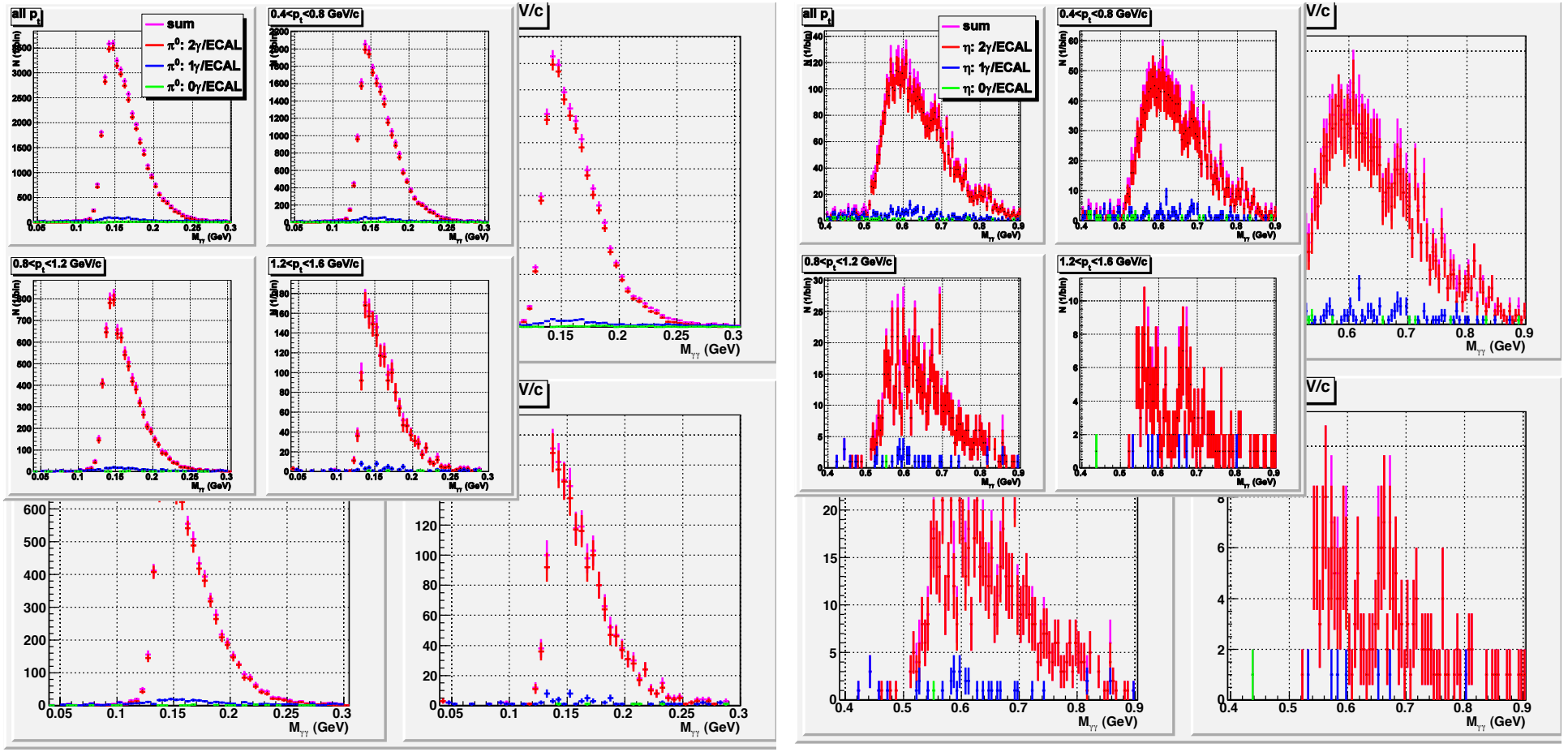
π^0 η





true signals: Au+Au

π^0 η



$S/B_{2\sigma}$ (signif.) for extracted signals

primary π^0

p_t (GeV/c)	0.4 – 0.8	0.8 – 1.2	1.2 – 1.6
p+C	4.06(343)	11.60(161)	24.89(73)
C+C	0.65(184)	2.00(100)	4.24(46)
Cu+Cu	0.04(33)	0.13(25)	0.24(12)

primary $\eta \rightarrow \gamma\gamma$

p_t (GeV/c)	0.4 – 0.8	0.8 – 1.2	1.2 – 1.6
p+C	0.13(31)	0.29(23)	0.47(11)

Estimation of S/B(%) (signif.) from true signals

primary π^0

p_t (GeV/c)	0.4 – 0.8	0.8 – 1.2	1.2 – 1.6
Au+Au	0.27(8)	0.79(7)	1.55(5)

primary $\eta \rightarrow \gamma\gamma$

p_t (GeV/c)	0.4 – 0.8	0.8 – 1.2	1.2 – 1.6
C+C	1.67(9)	3.16(6)	4.77(3)
Cu+Cu	0.12(1.7)	0.18(1.1)	0.31(0.6)
Au+Au	0.014(0.5)	0.022(0.4)	0.037(0.3)

Summary

	primary π^0				primary $\eta \rightarrow \gamma\gamma$			
	p+C	**C+C**	**Cu+Cu**	**Au+Au**	**p+C**	**C+C**	**Cu+Cu**	**Au+Au**
Statistics (events)	10^6	10^5	10^4	10^4	10^6	10^5	10^4	10^4
Yield/event	2.5	13.5	107	365	0.10	0.53	4.22	14.2
Acceptance eff.	17 %	22 %	21 %	21 %	26 %	34 %	34 %	34 %
Reconstruction eff.	94%	84%	35%	4.9%	96%	87%	46%	8.8%
Total eff.	16%	18%	7%	1%	25%	30%	16%	3%
σ (MeV)	6.1	6.4	10.1	-	18.2	20.8	-	-
S/B	1.65	0.22	0.016	0.0019	0.11	0.016	0.0011	0.00014
Significance	509	207	33	8	46	15	2.6	0.8