A first look at multi-photon final states from the Spring'16 data

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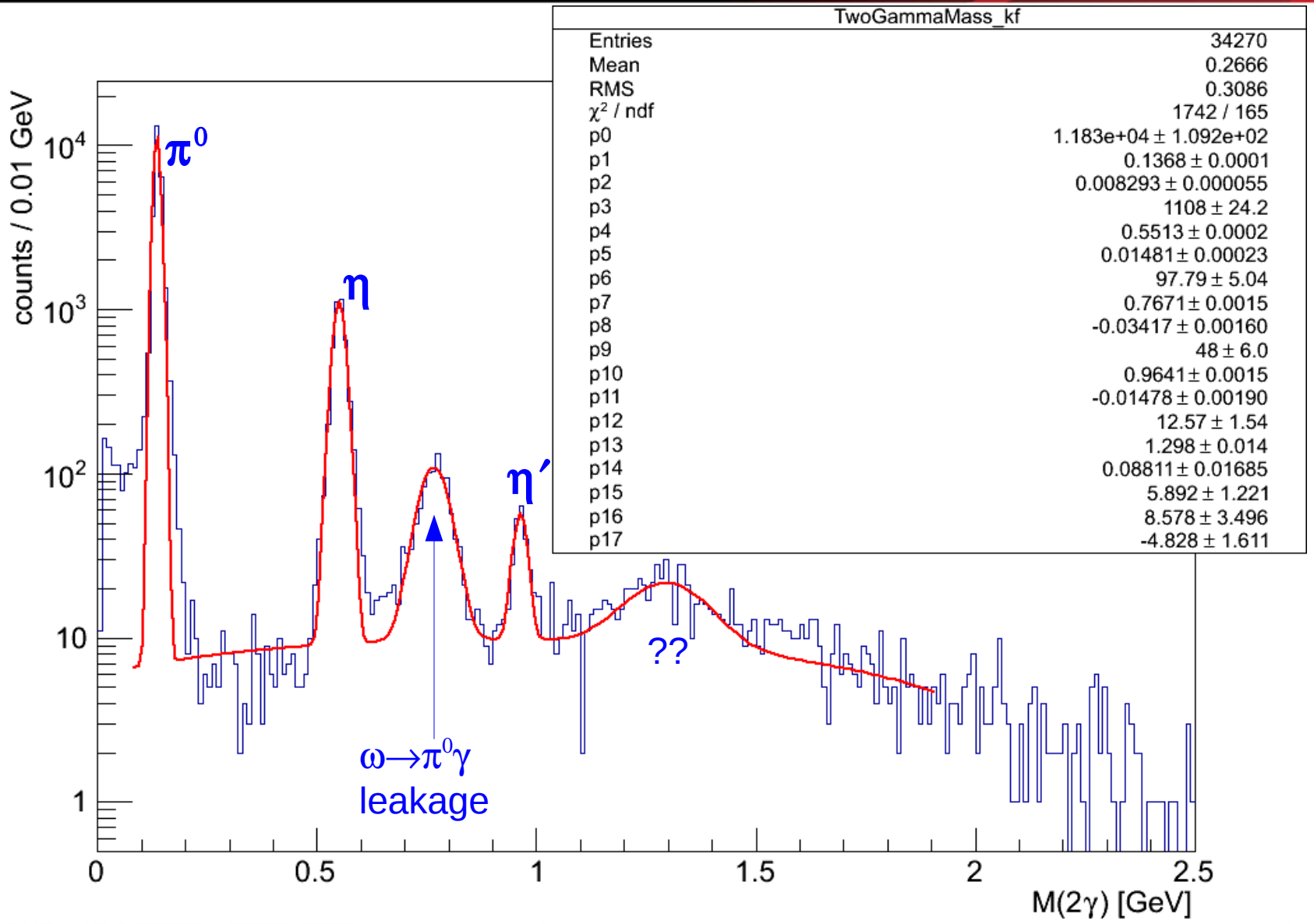
- Analyzed REST files from runs
10391,10392,10423,10436,10492,10493,10591,10595,10611,10707

  100 MeV minimum shower energy (FCAL and BCAL)

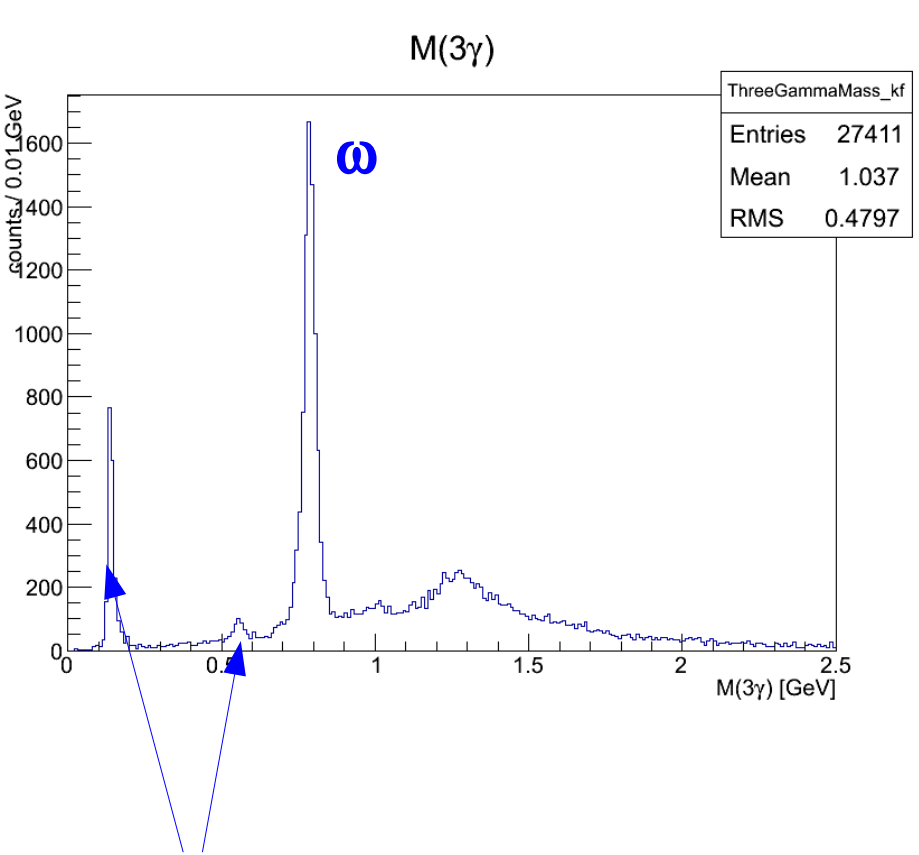
  Require proton and no other charged particle

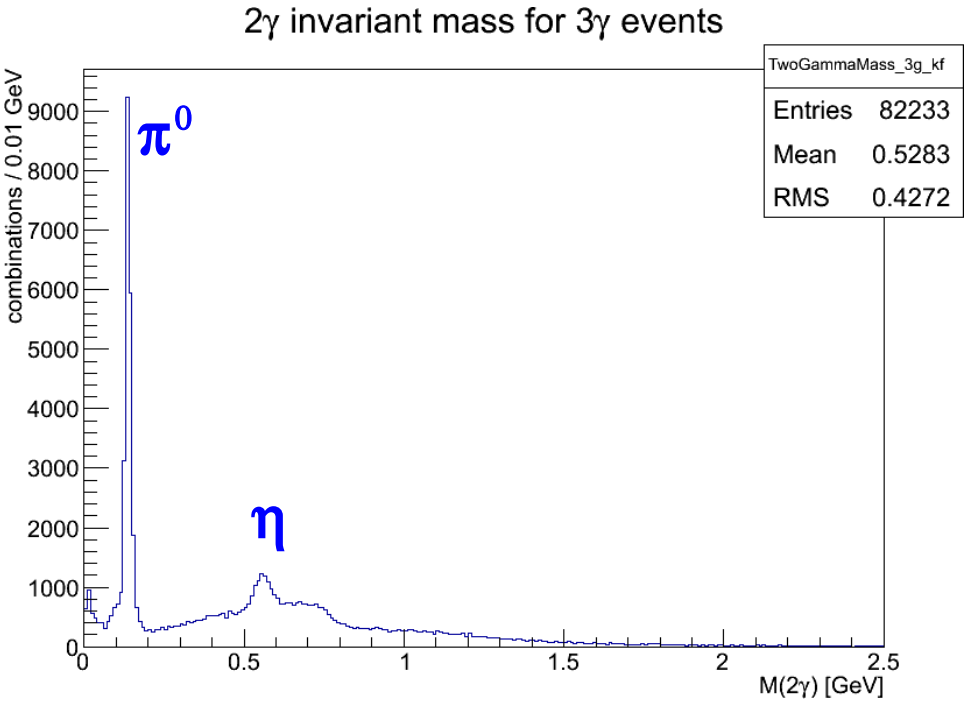
  Kinematic fit (energy and momentum), cut at CL=0.1

Two photons


TwoGammaMass_kf
Entries 34270
Mean 0.2666
RMS 0.3086
χ² / ndf 1742 / 165
p0 1.183e+04 ± 1.092e+02
p1 0.1368 ± 0.0001
p2 0.008293 ± 0.000055
p3 1108 ± 24.2
p4 0.5513 ± 0.0002
p5 0.01481 ± 0.00023
p6 97.79 ± 5.04
p7 0.7671 ± 0.0015
p8 -0.03417 ± 0.00160
p9 48 ± 6.0
p10 0.9641 ± 0.0015
p11 -0.01478 ± 0.00190
p12 12.57 ± 1.54
p13 1.298 ± 0.014
p14 0.08811 ± 0.01685
p15 5.892 ± 1.221
p16 8.578 ± 3.496
p17 -4.828 ± 1.611
counts / 0.01 GeV
π⁰
η
η′
??
ω→π⁰γ
leakage
M(2γ) [GeV]

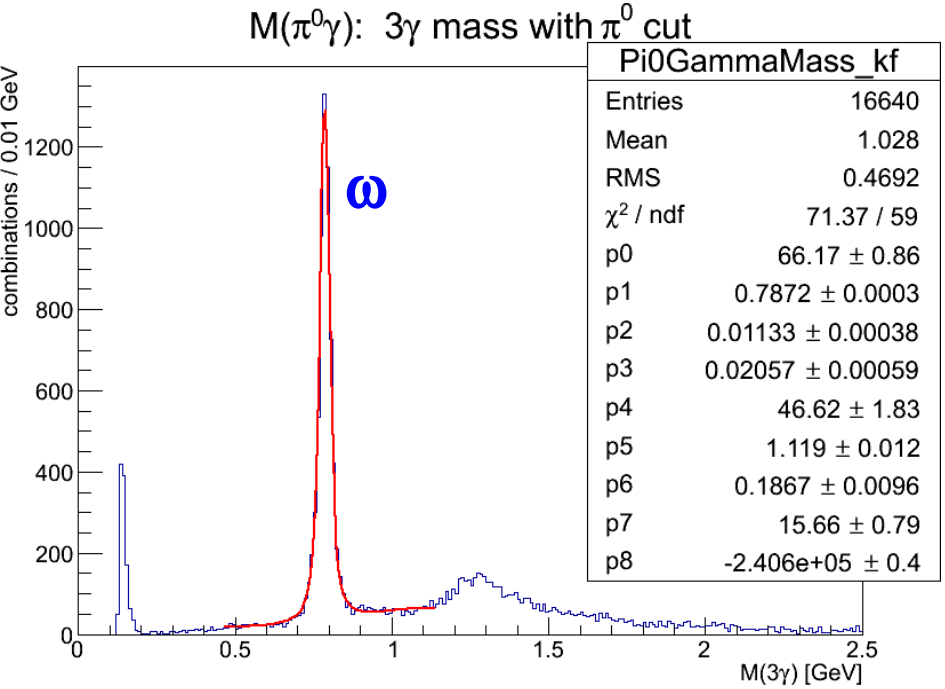
Three photons

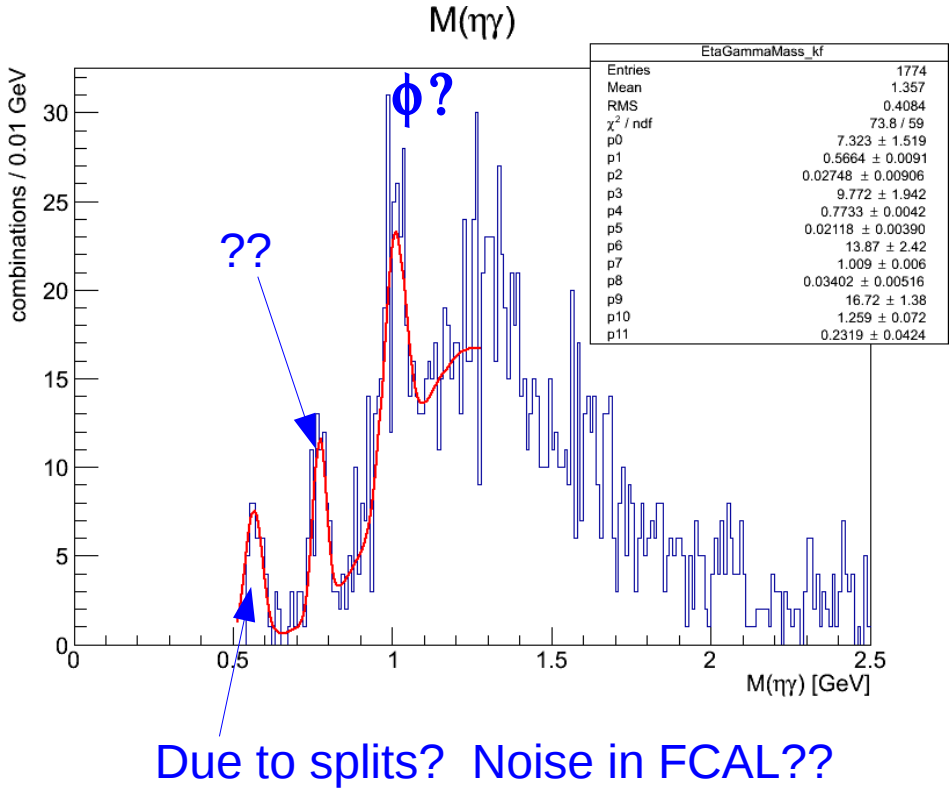




Due to splits? Noise in FCAL??

Three photons





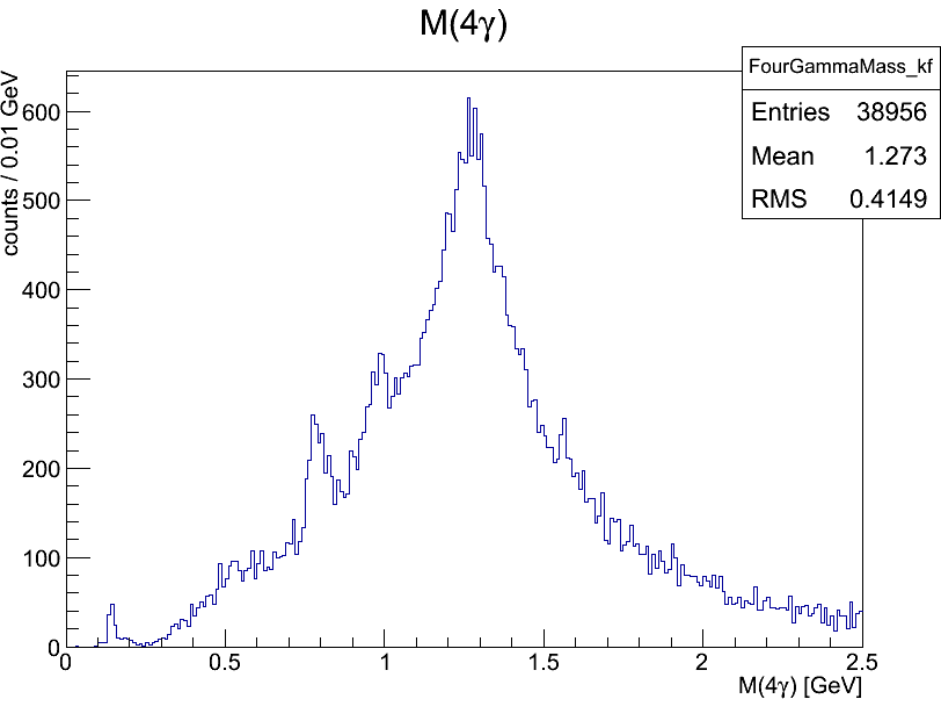
Due to splits? Noise in FCAL??

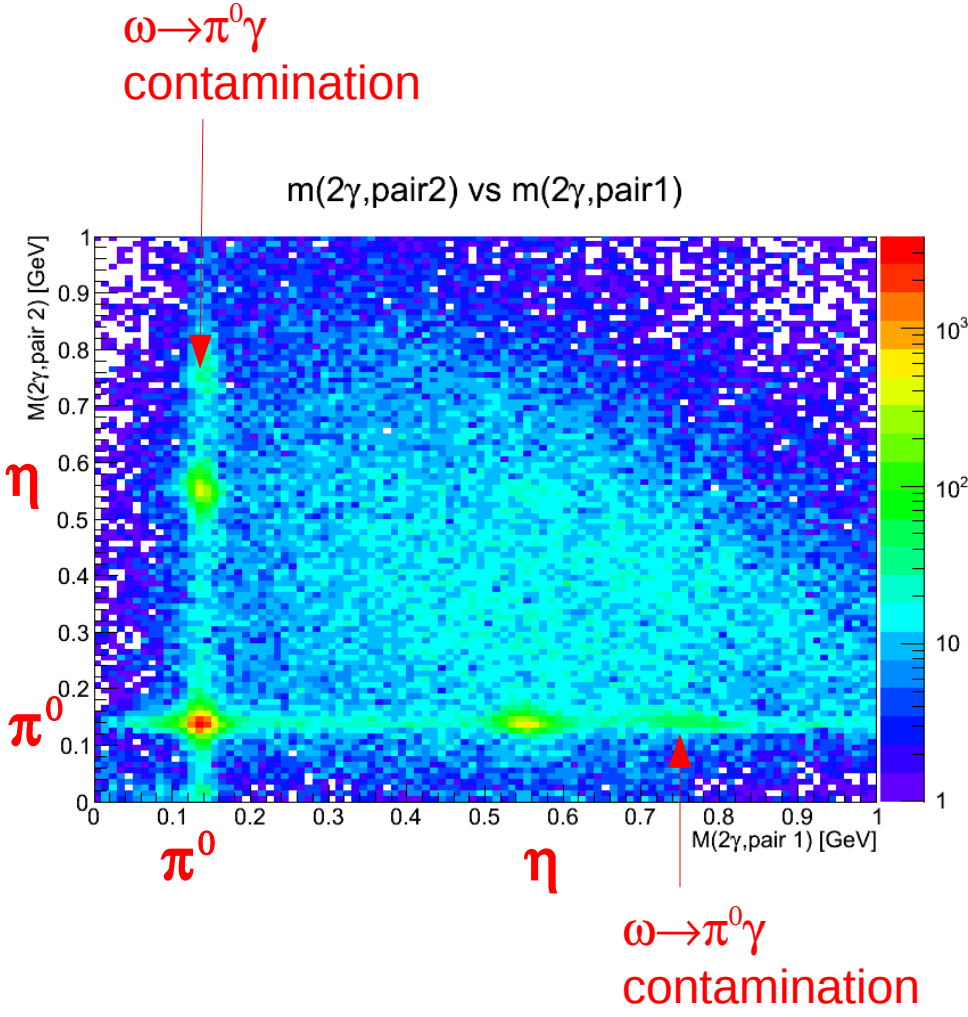
$\rho \rightarrow \eta\gamma$ branch is small: BR=3×10^{-4}

$\omega \rightarrow \eta\gamma$ branch is small: BR=4.6×10^{-4}

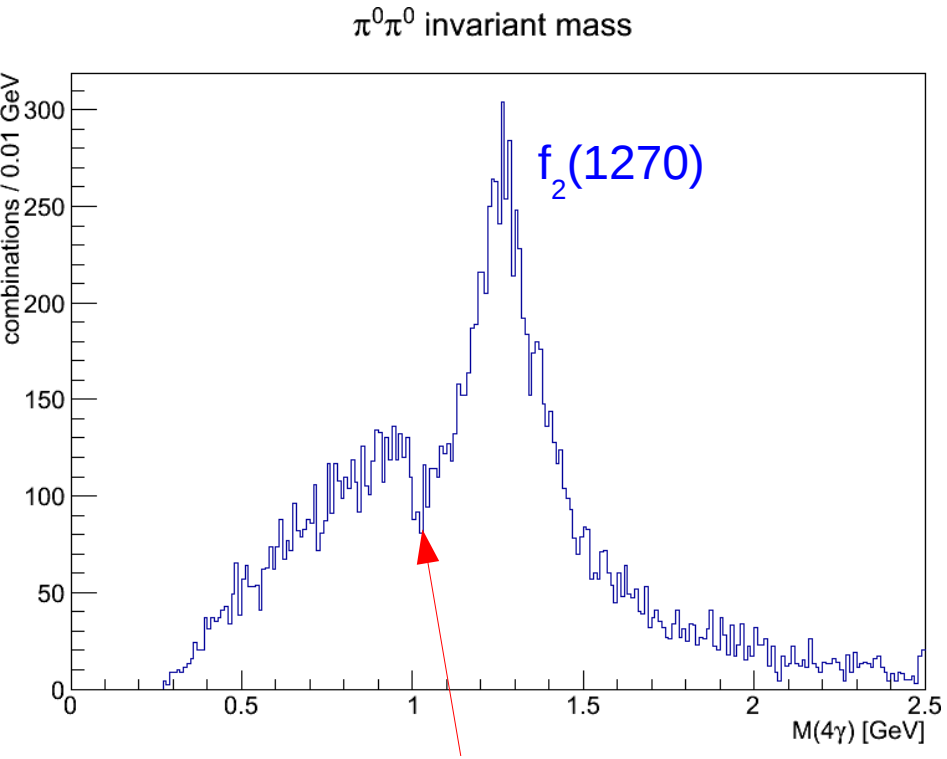
$\phi \rightarrow \eta\gamma$ branch: BR=1.3%

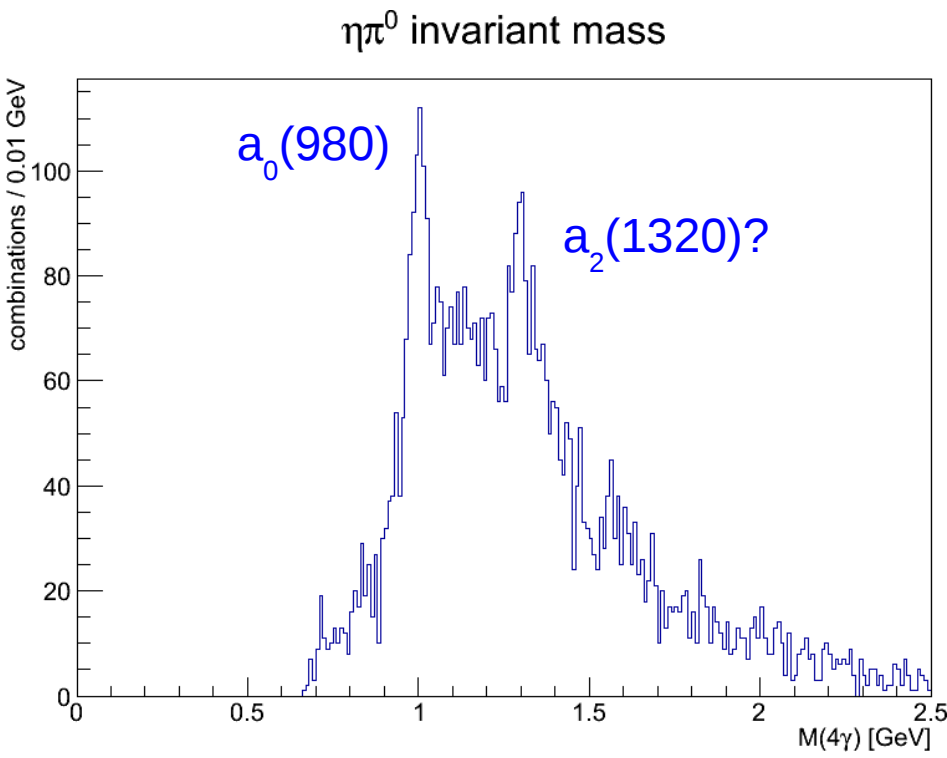
Four photons





Four photons

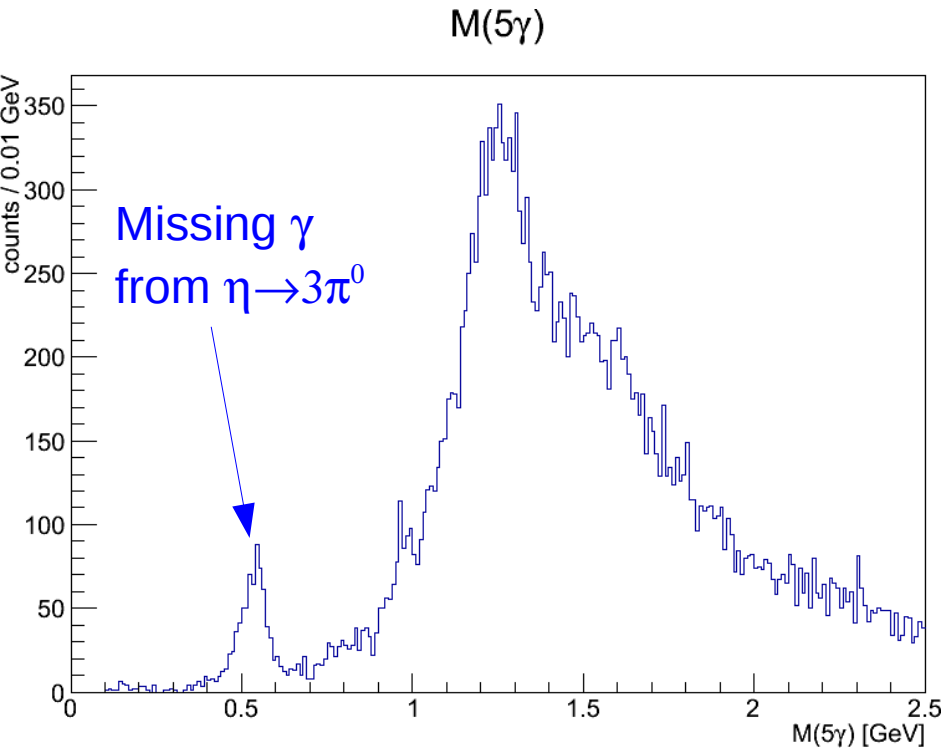


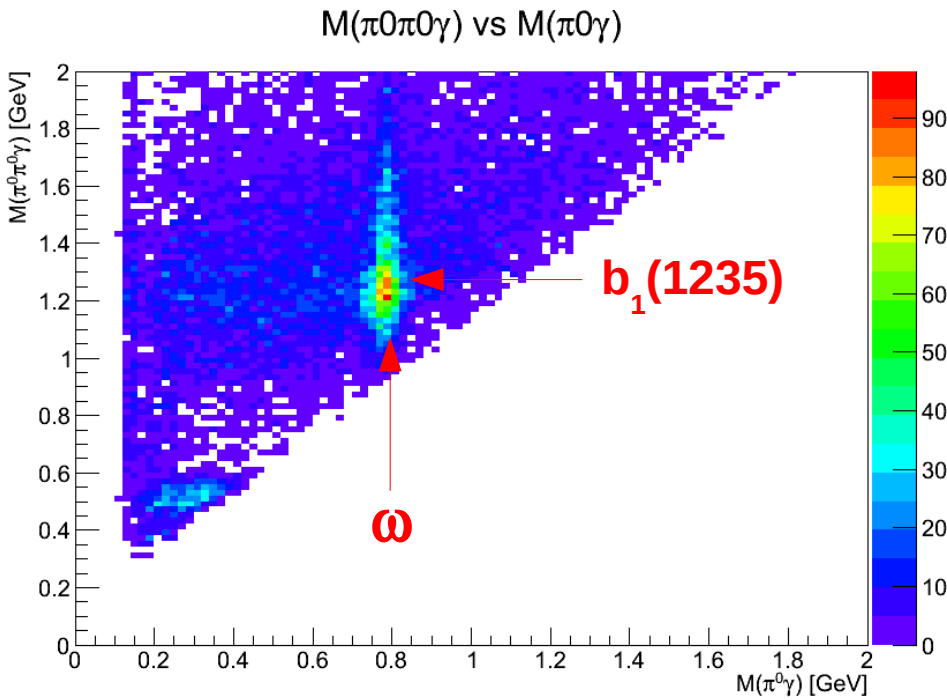


I saw this dip just above the $f_0(980)$ in the Spring'15 data...

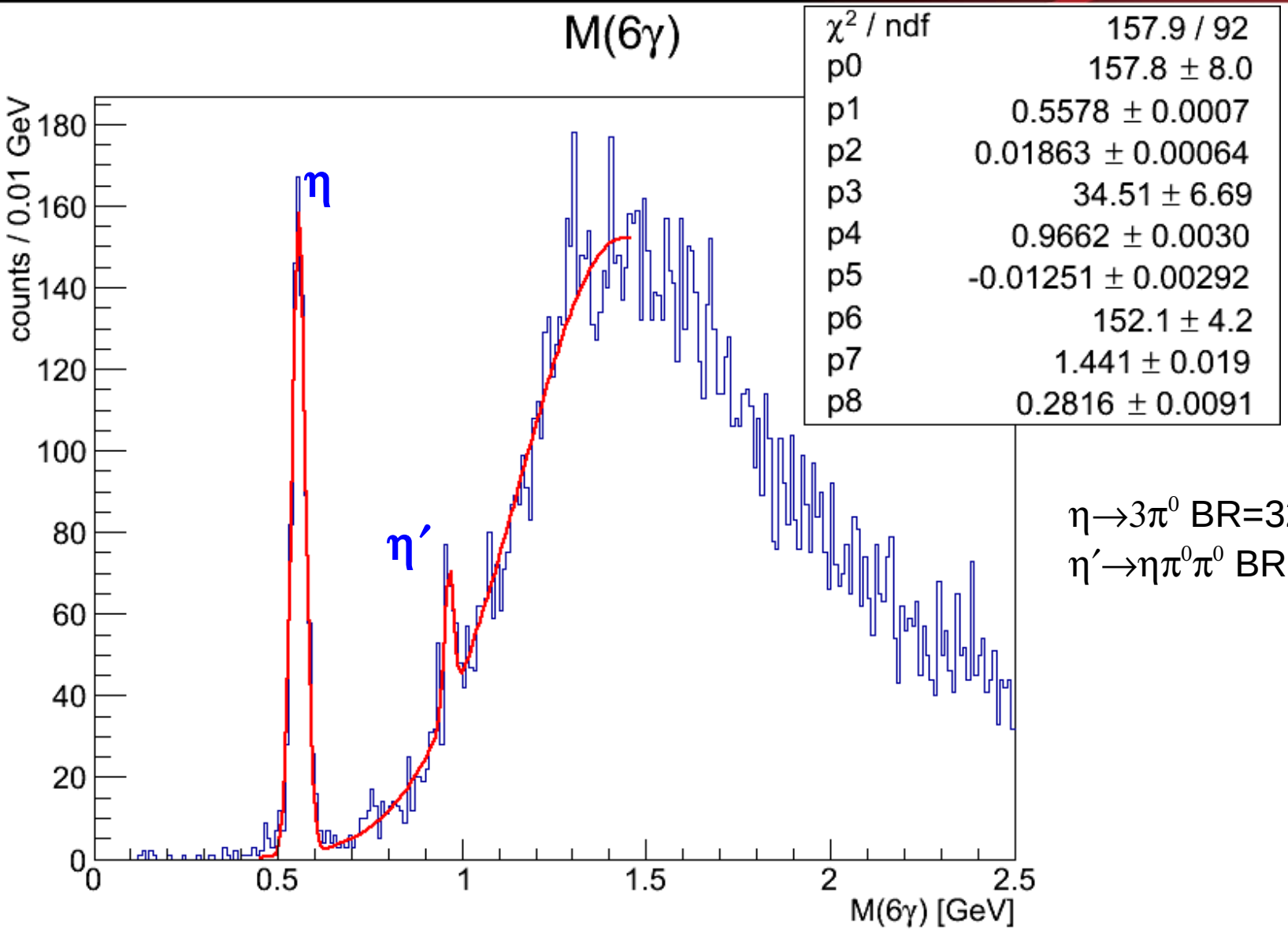
- $a_0(980)$: Γ=50-100 MeV, $\eta\pi$ channel dominant
- $f_0(980)$: Γ=40-100 MeV, $\pi\pi$ channel dominant
- $f_2(1270)$: M=1275 MeV, Γ=185 MeV, $\pi\pi$ BR=84.8%
- $a_2(1320)$: M=1318 MeV, Γ=111 MeV, $\eta\pi$ BR=14.5%

Five photons





Six photons



$\eta \rightarrow 3\pi^0$ BR=32.6%

$\eta' \rightarrow \eta\pi^0\pi^0$ BR=20.7%

Summary

- Already surpassed Spring'15 data set, but only looked at small fraction of the available data...
  - Features seen in Spring'15 also seen in this data set
  - Impact (and source!) of extra “photons” and missing photons needs to be studied carefully

These REST files were created before fixes to tracking in the forward direction...