Update on the inclusive π^0 analysis for online polarimetry on the ECAL endcaps

Katherin Shtejer Díaz

SPD Physics Weekly Meeting
02.07.2024

### Generation

- ❑ SpdRoot version 4.1.6
- ❑ pp @ $\sqrt{s} = 27$ GeV
- ❑ Particle generator: Pythia 8 (number of events: $\sim 1\ million$)
- ❑ Minimum Bias
- ❑ Vertex assumed at (0, 0, 0) → Gaussian smeared: $\sigma_z = 30\ cm$ and $\sigma_{x,y} = 0.1\ cm$

Realistic reconstruction

- ❑ Focus on the "ECAL" reconstructed particle
- ❑ Identified the cluster to which the particle belongs
- ❑ Position and energy taken from cluster
- ❑ Selected clusters that belong to the ECAL endcaps

Analysis

- ❑ Cuts: $E_\gamma > 400$ MeV, $p_T > 0.5$ GeV/c
- ❑ Candidates to π^0 selected from $\gamma\gamma$ combinations (invariant mass)
- ❑ To select photon candidates:
  - ✓ Initially no checking pdg code = 22
- ❑ Different scenarios to analyze the combinatorial background
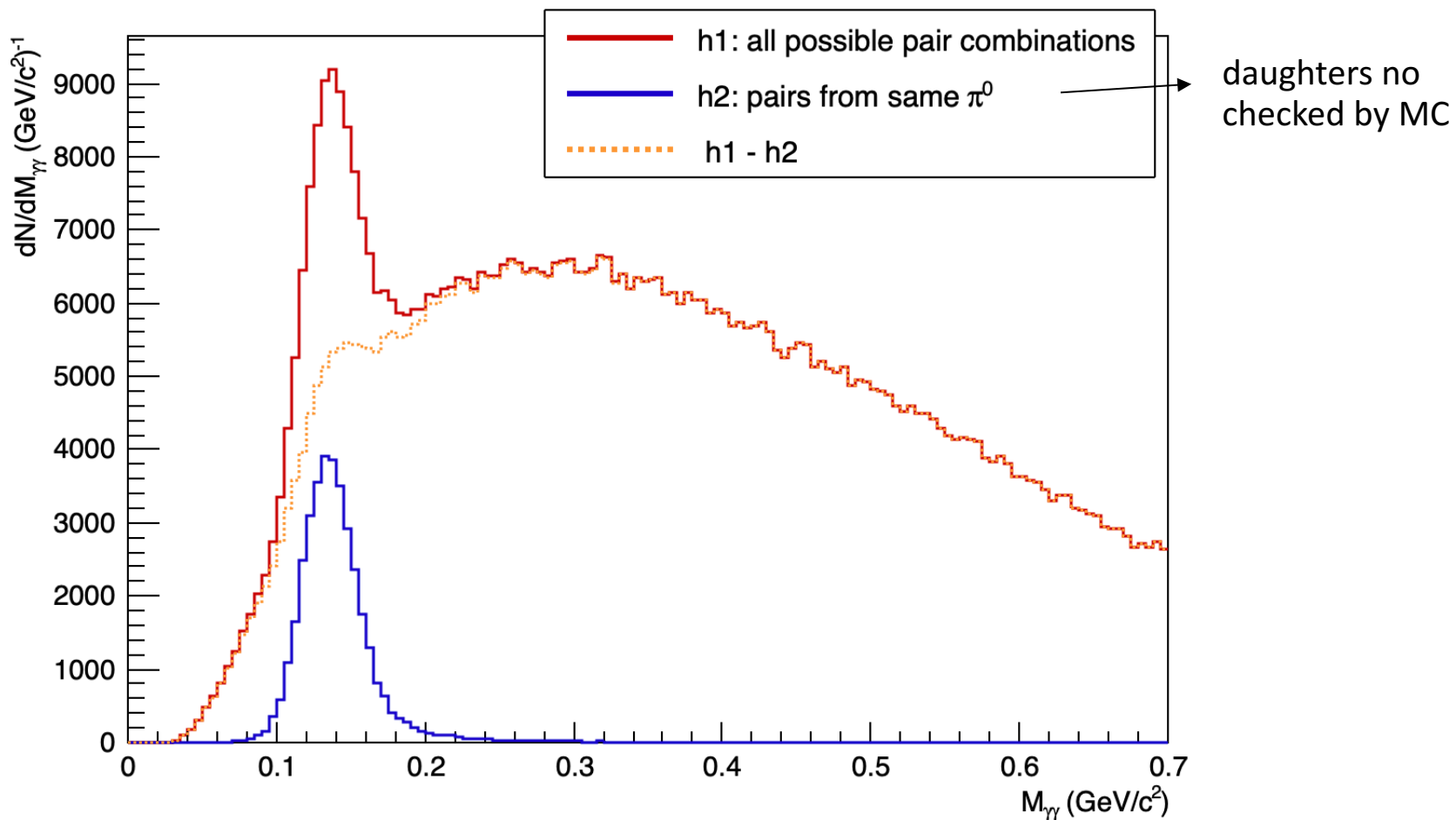
The background consists of particles randomly combined, most of them coming from different mothers.

We want to understand the background, in particular the
structure that mimics a peak around the nominal mass of the π^0
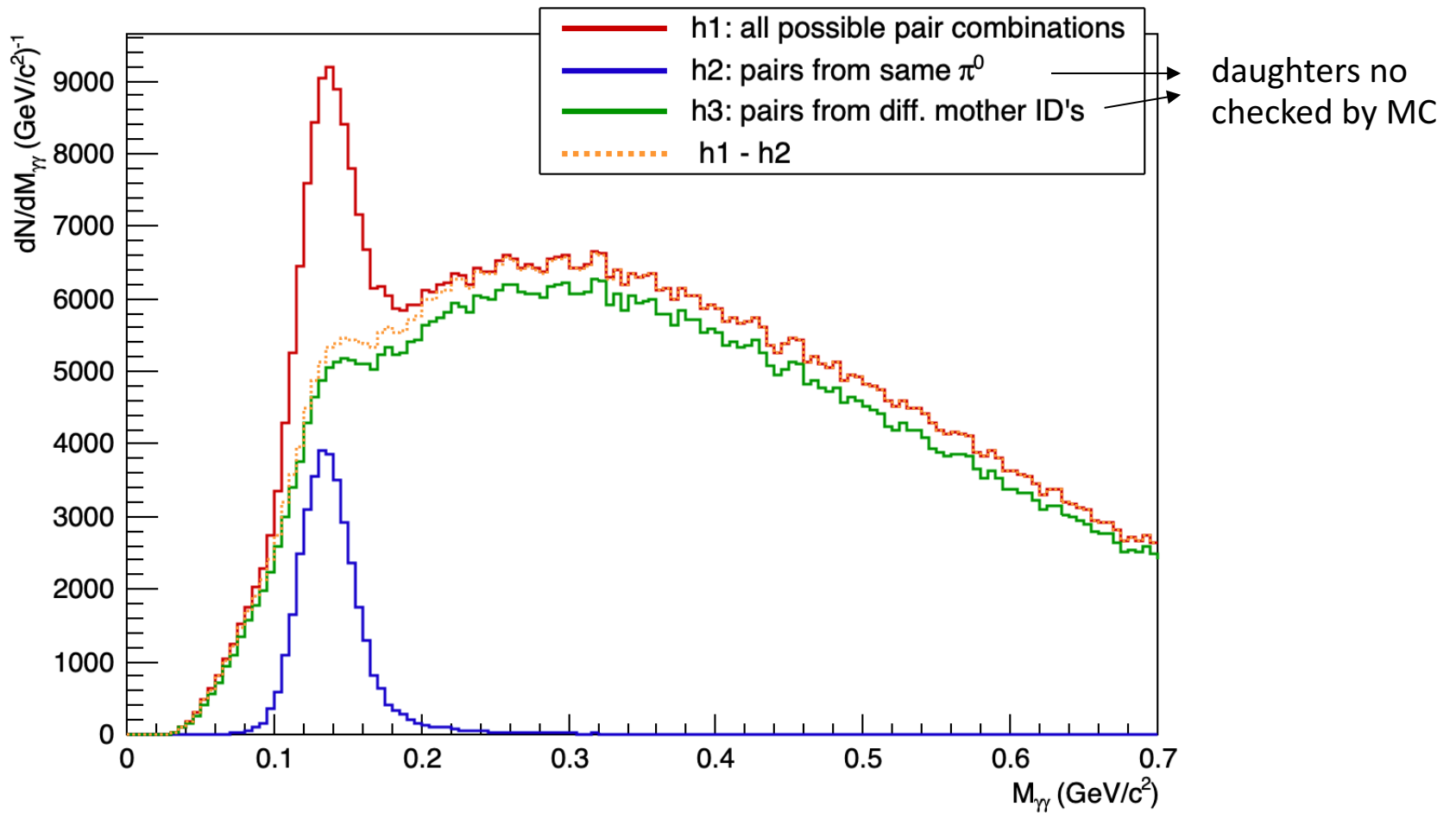
The background consists of particles randomly combined most of them coming from different mothers.

… Are those daughter particles all photons?
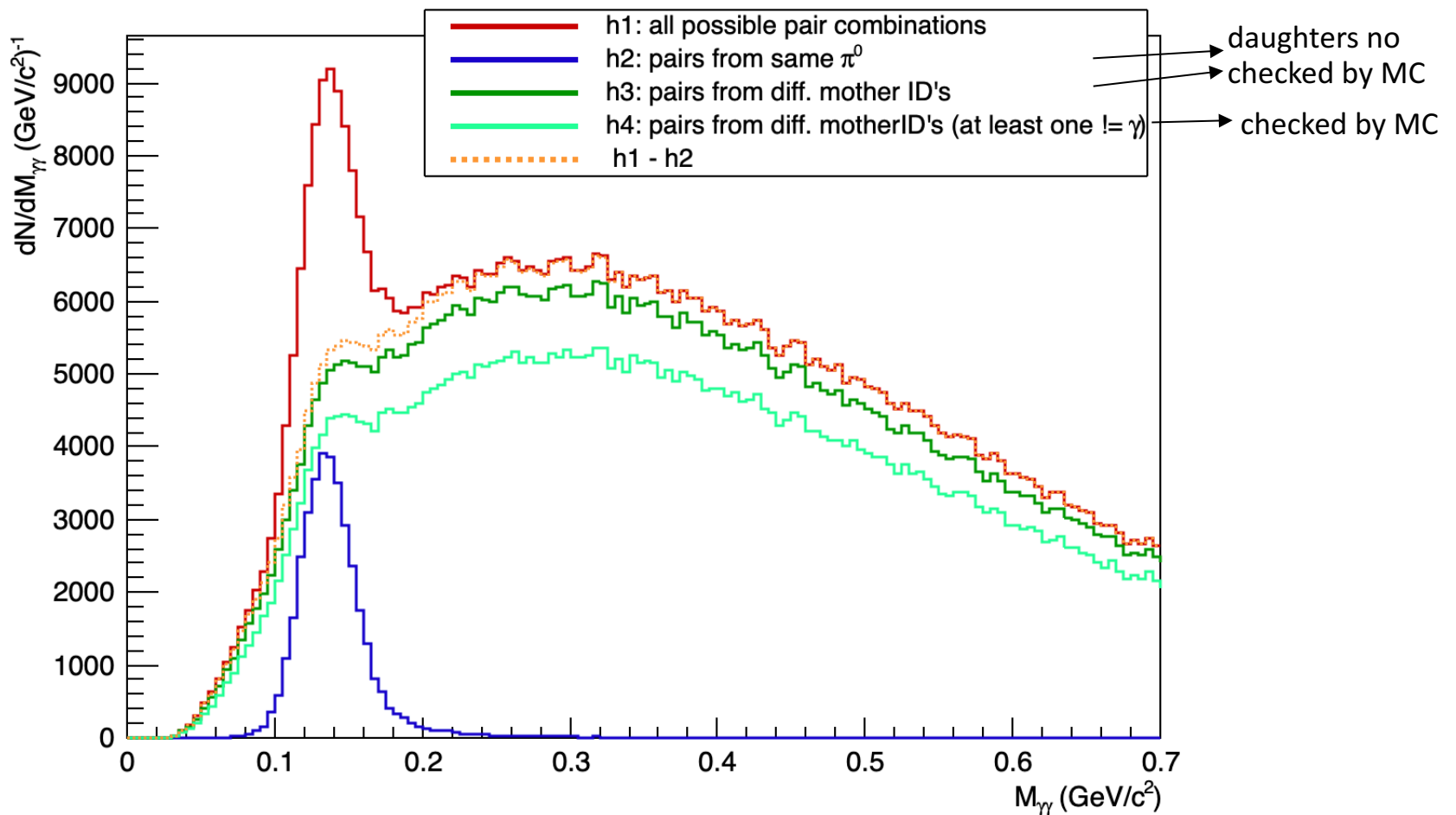
The background, mainly consists of photons randomly combined *between them and with other particles*, most of them coming from different mothers.

… How much the two-photon pairs from different mother particles contribute to the background?
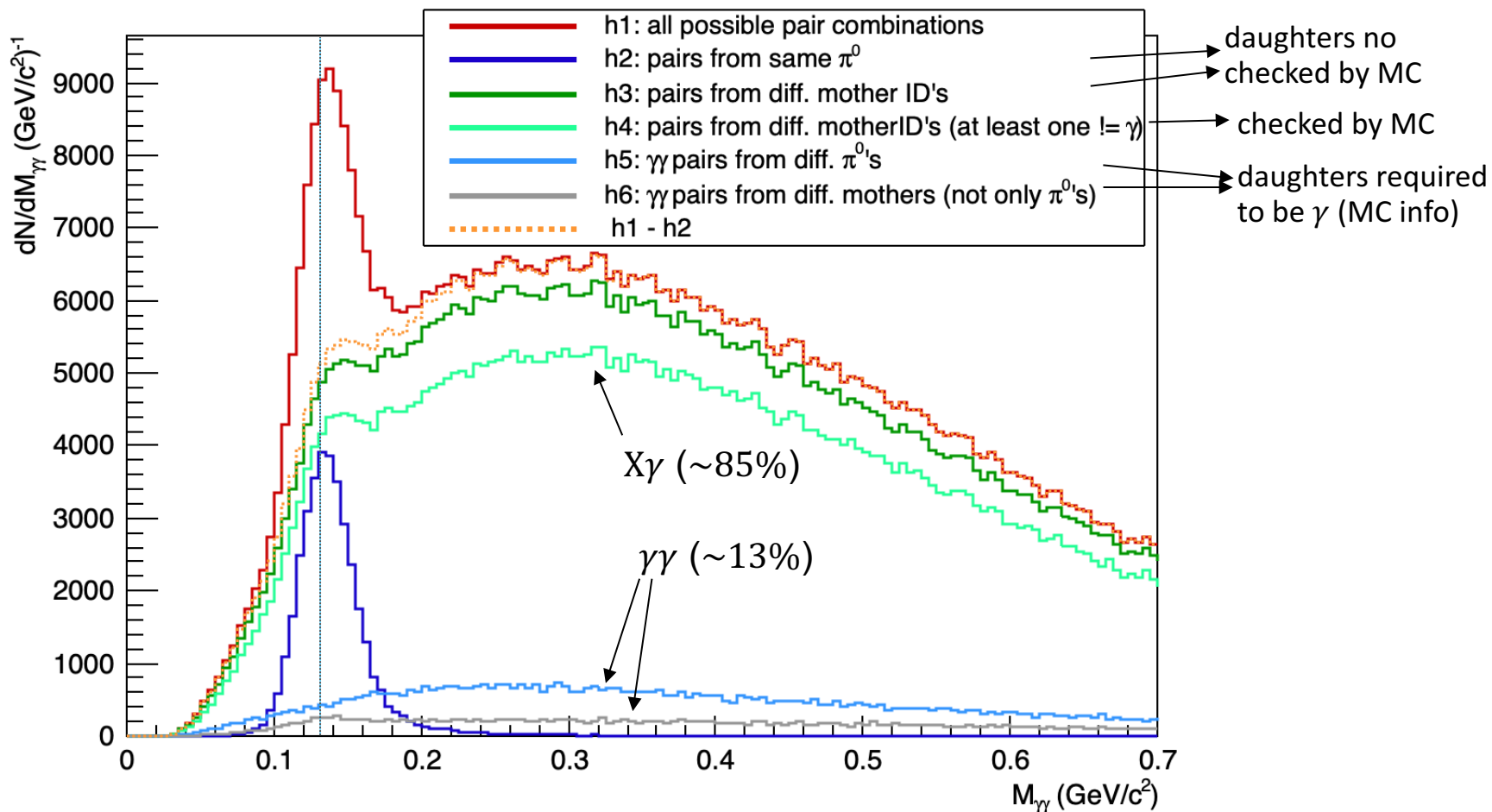
The pairs of two photons with different mothers represent 14% of the overall background made of random combination of particles with different mother ID's.

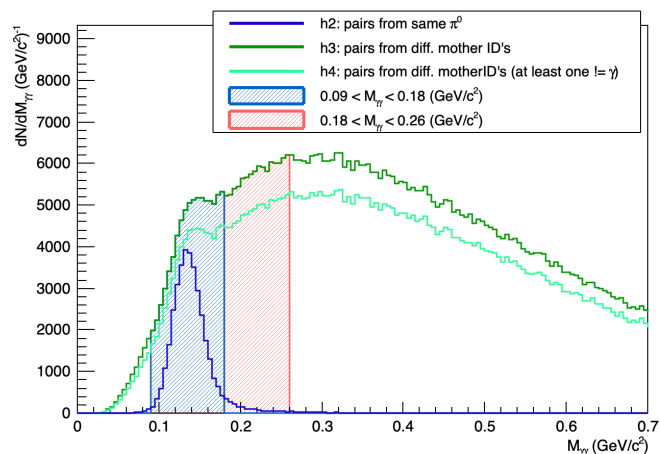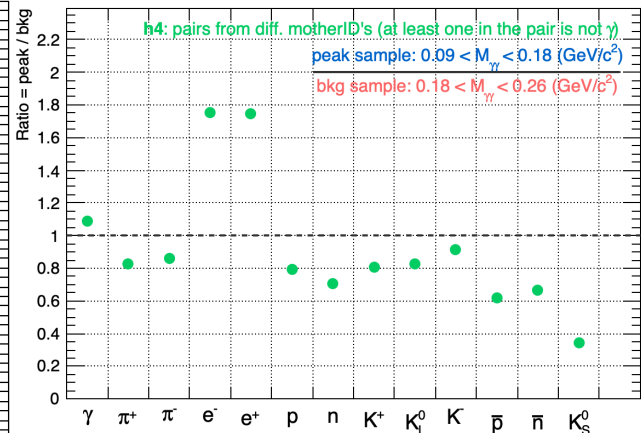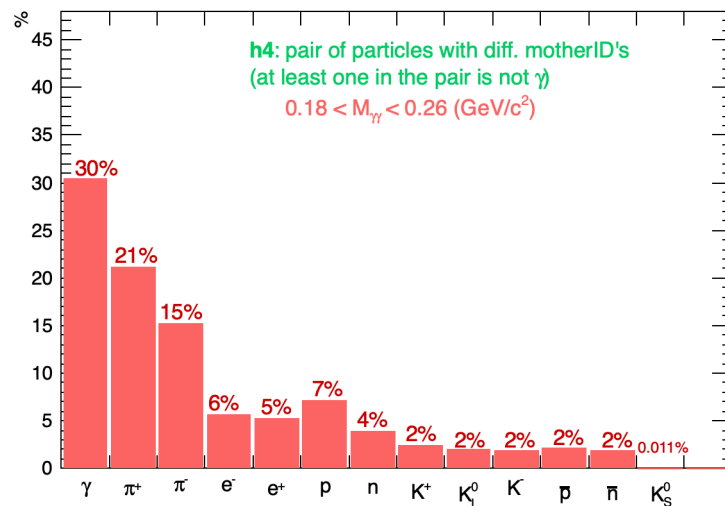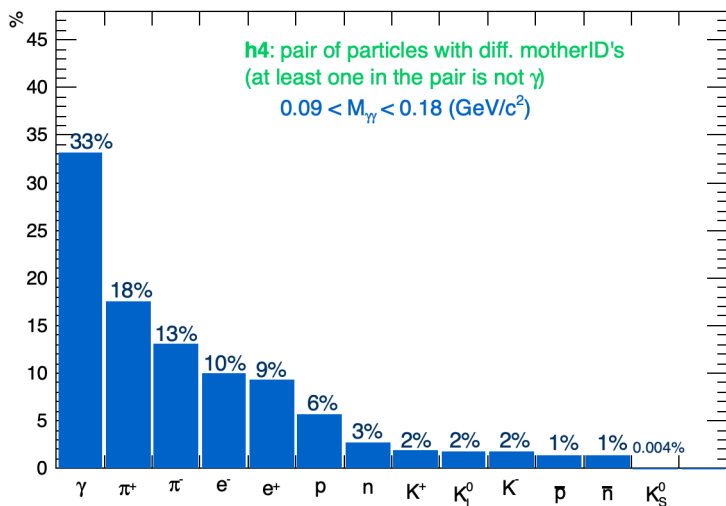In the 85% there is the contribution of particles that are not photons.
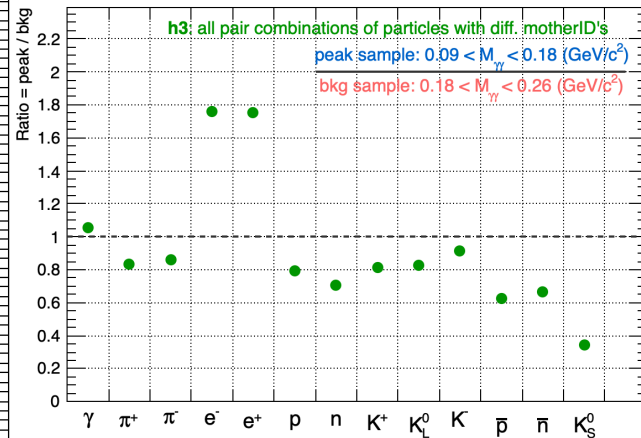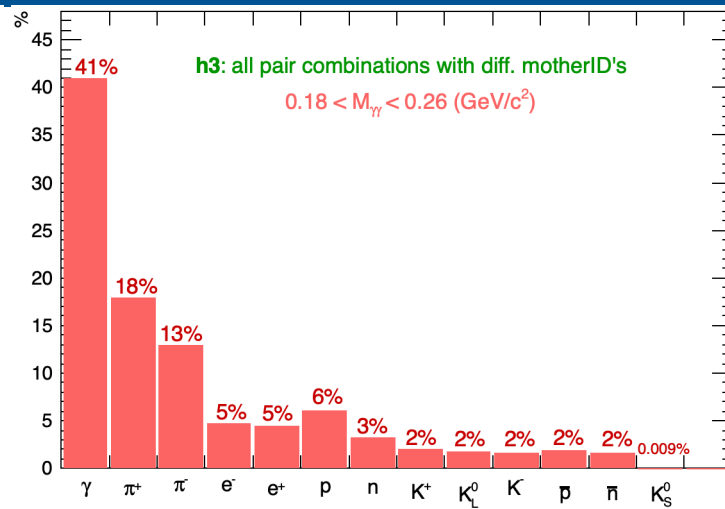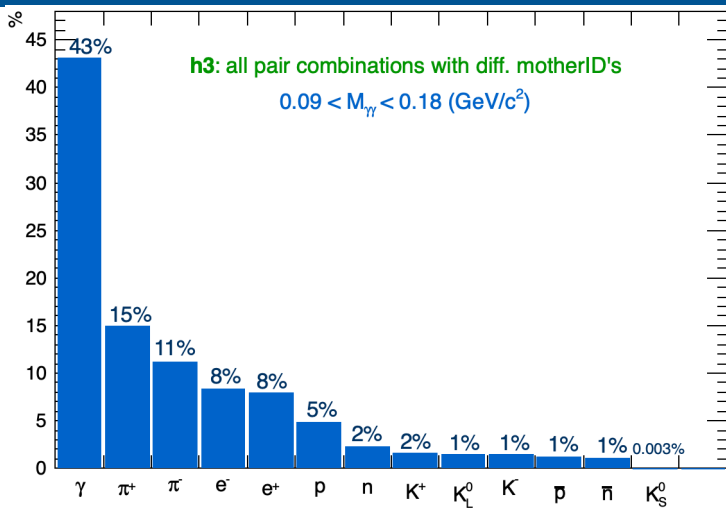
The peak of the background around the nominal π^0 mass seems to be triggered by the combination of particles which are not photons.

… What particles is this background composed of?
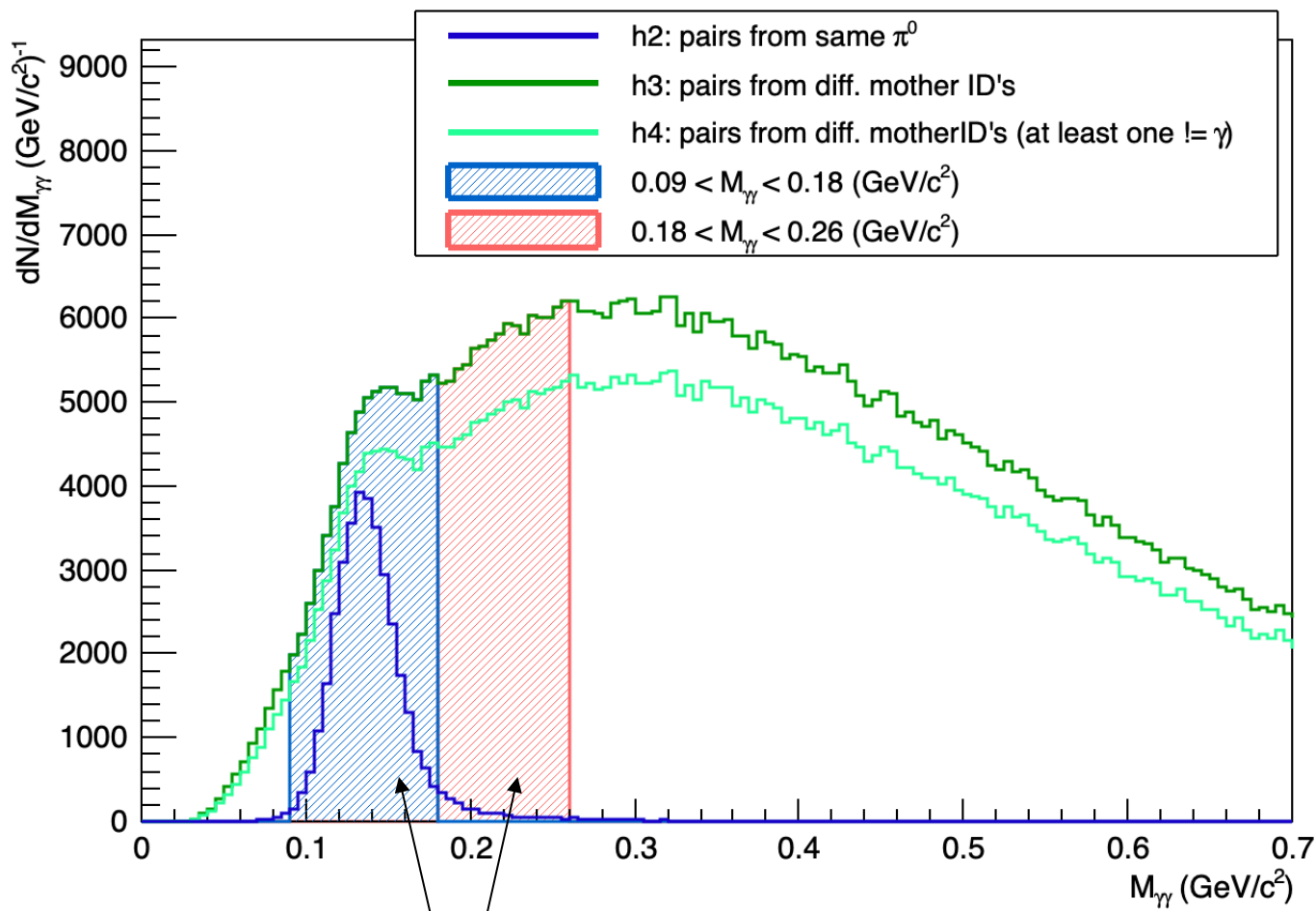
The particle composition giving rise to these invariant regions is examined

Either in XX or $X\gamma$ pair of daughters, the fraction of e^-, e^+ is ≈ 1.8 higher in the peak mass region than in the bkg.

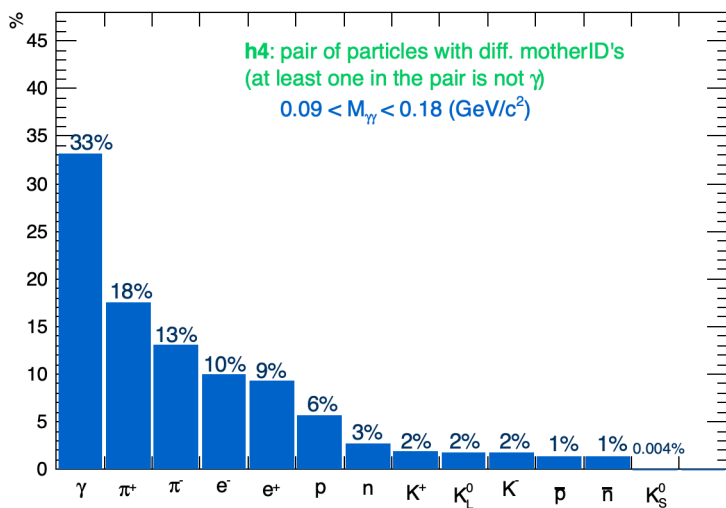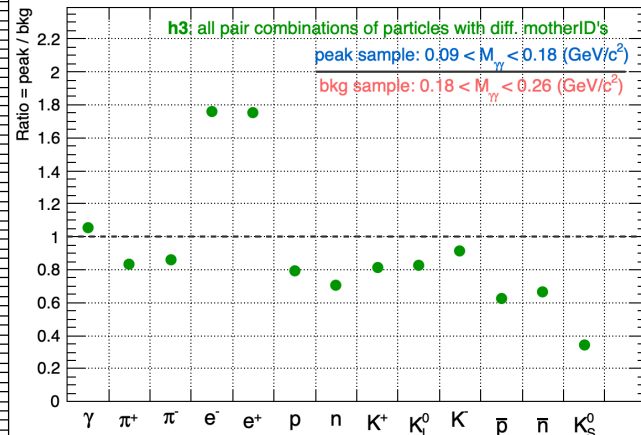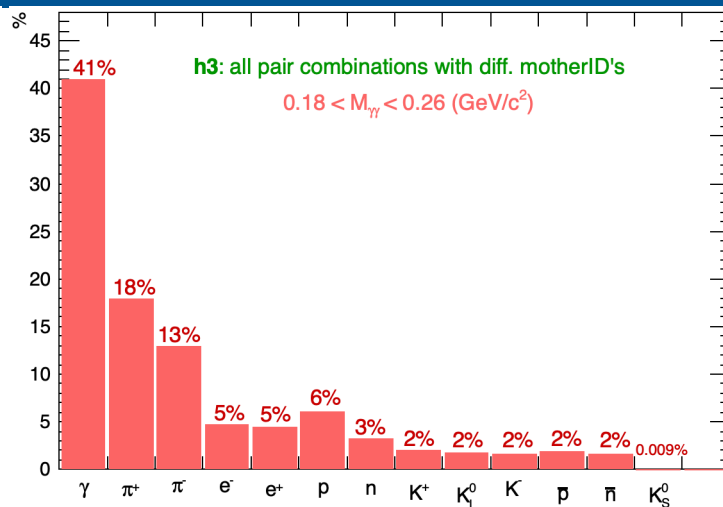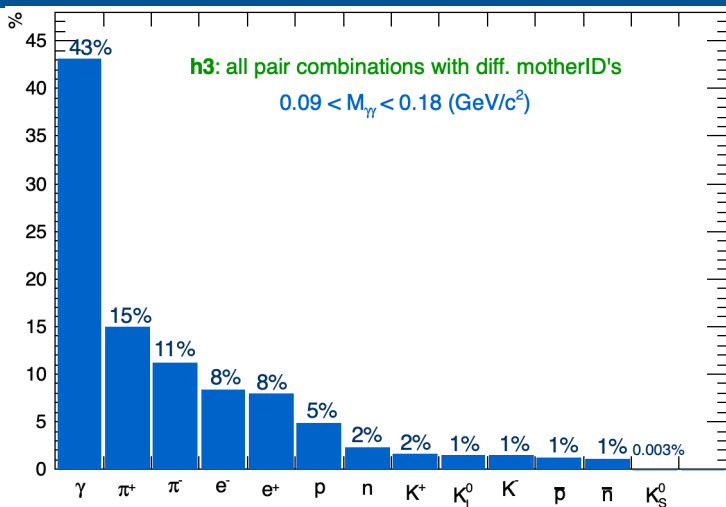The γ contribution is only 1.1 times higher in the peak over the background region.

The π^-, π^+ is the second highest contribution after photons, in both: peak and bkg.

h3: XX: any particle – any particle
h4: $X\gamma$: any particle – photon

Particle composition
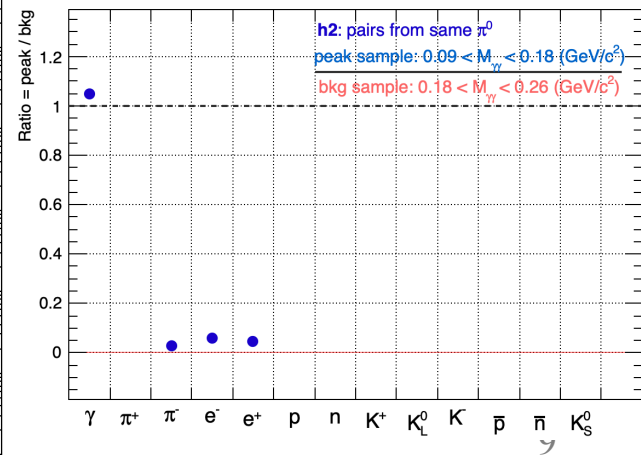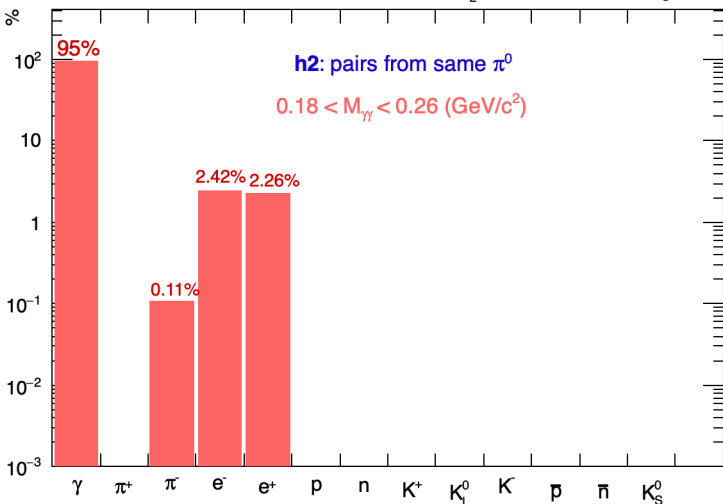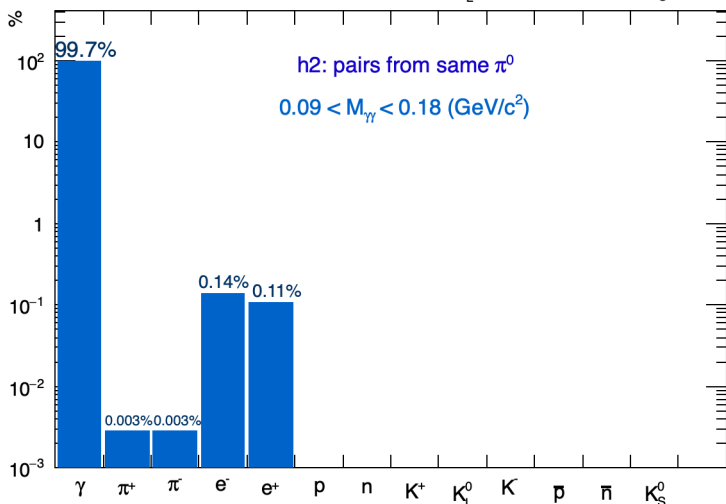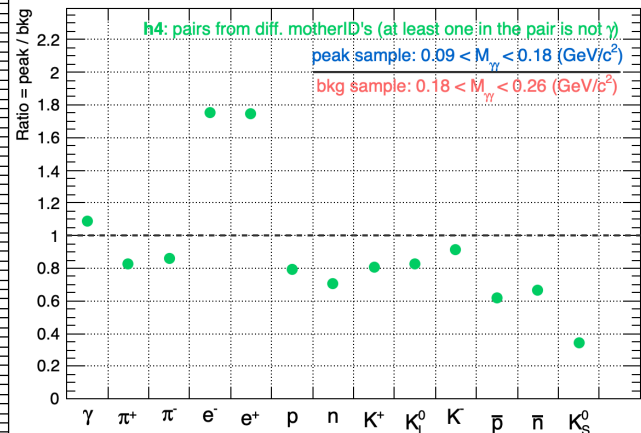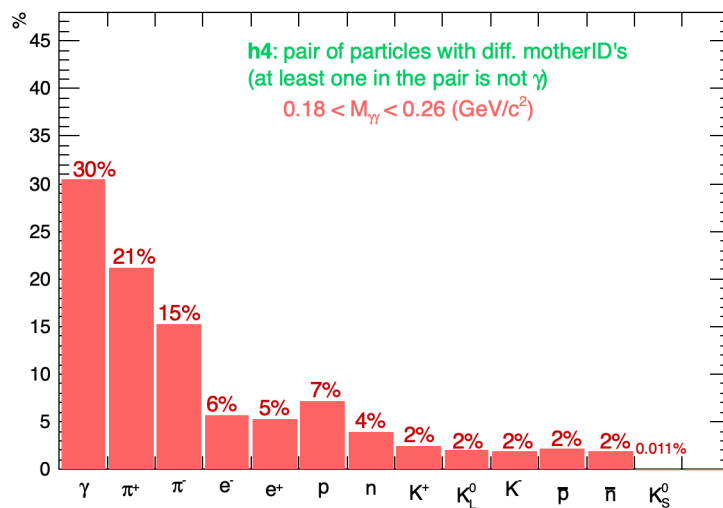
… Adding the e^+, e^- combinations

Legend:
- h1: all possible pair combinations
- h2: pairs from same π^0
- h3: pairs from diff. mother ID's
- h4: pairs from diff. motherID's (at least one $!= \gamma$)
- h5: $\gamma\gamma$ pairs from diff. π^0's
- h6: $\gamma\gamma$ pairs from diff. mothers (not only π^0's)
- h7: e^-e^+ pairs
- h1 - h2
- h4 + h5 + h6 + h7

$X\gamma \quad \gamma\gamma \quad \gamma\gamma \quad e^-e^+$
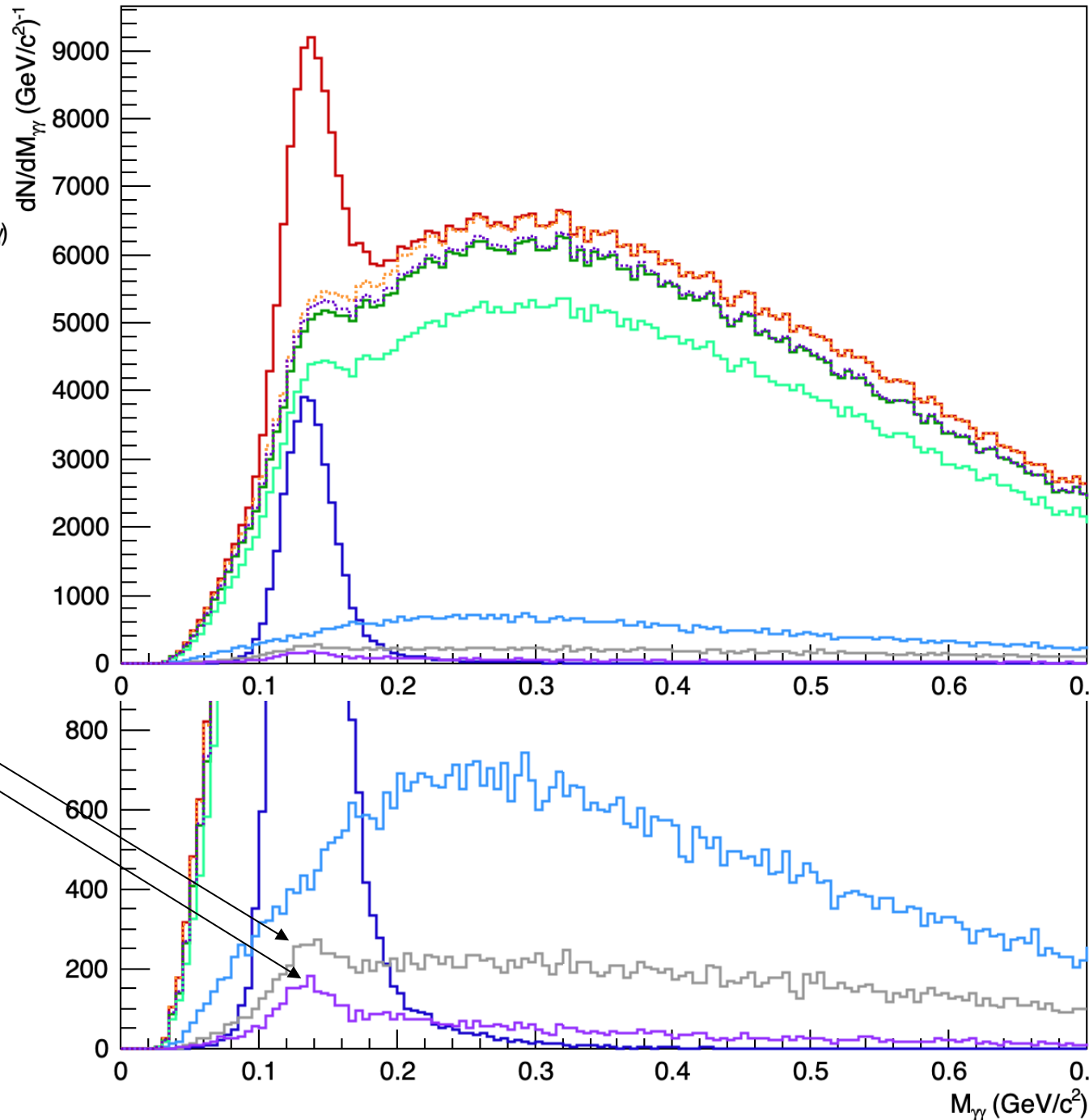
Structure that mimics a peak around the nominal mass of the π^0

Photon candidates might result from a misidentified photon conversions.

Dalitz decay should not be ruled out:
$$\pi^0 \rightarrow e^+ e^- \gamma$$