

$\eta \rightarrow \pi^0 \gamma \gamma$ with FCAL(2)

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Table of contents

- 1 Introduction
- 2 2017 “Winter” data set
- 3 η simulation samples
- 4 TMVA

Introduction

Reaction filter: $\gamma p \rightarrow \gamma\gamma\gamma\gamma p$

Events with two photon pairs with invariant masses, $m_{\gamma\gamma}$, with

- $m_{\pi^0} - 3\sigma \leq m_{\gamma\gamma}^{a/b} \leq m_{\pi^0} + 3\sigma$ ($2\pi^0$ events)
- $m_{\pi^0} - 3\sigma \leq m_{\gamma\gamma}^a \leq m_{\pi^0} + 3\sigma$ and $m_{\eta} - 3\sigma \leq m_{\gamma\gamma}^b \leq m_{\eta} + 3\sigma$ ($\pi^0\eta$ events)
- $m_{\eta} - 3\sigma \leq m_{\gamma\gamma}^{a/b} \leq m_{\eta} + 3\sigma$ (2η events)

are discarded

Events with

- $m_{\pi^0} - 3\sigma \leq m_{\gamma\gamma}^a \leq m_{\pi^0} + 3\sigma$
- $m_{\pi^0} - 5\sigma \geq m_{\gamma\gamma}^b$ or $m_{\gamma\gamma}^b \geq m_{\pi^0} + 5\sigma$ ($2\pi^0$ veto)

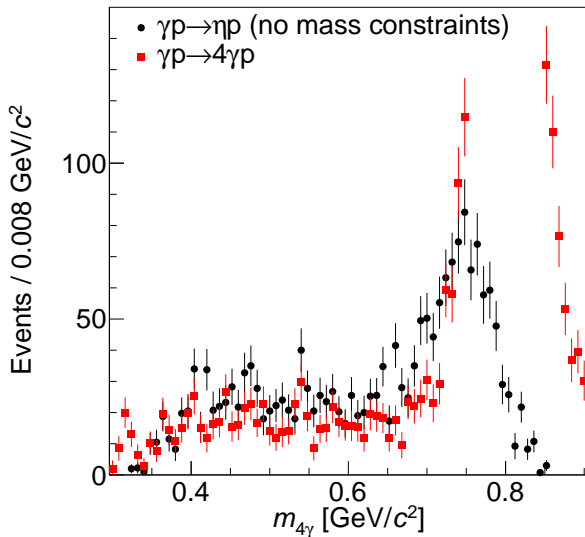
are selected. Best surviving combination is selected by a χ^2 test (solely based on final state photons)

Addition (loose) selection criteria

- Extra energy
- Extra tracks
- Kinematic fit χ^2
- Coplanarity
- Missing mass squared
- Elasticity

2017 “Winter” data set

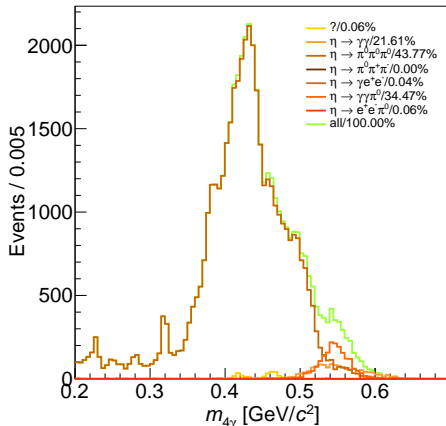
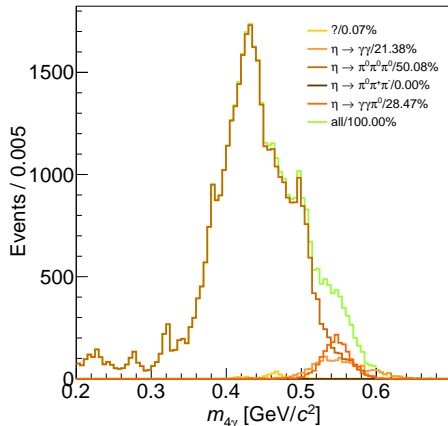
All photons are in FCAL



η simulation samples

EtaRegge + post processing via evtgen

- 50M w/o $2\gamma\pi^0$ and $e^+e^-\pi^0$ decays (background training sample)
- 1M $2\gamma\pi^0$ decay (signal training sample)
- 50M with all decays (testing sample), figure below, left-GlueX and right-JEF

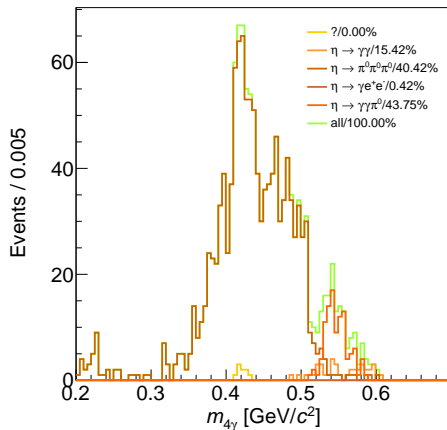
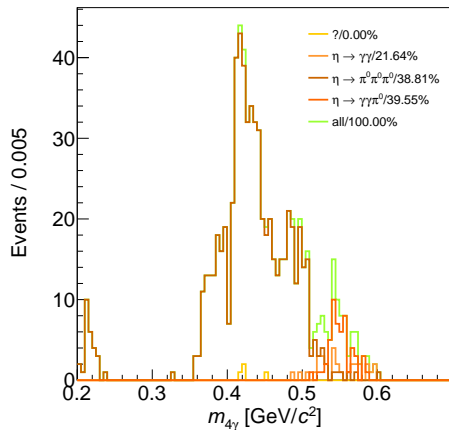


Percentage calculated between 510 and 590 MeV/c²

TMVA, GlueX

All photons in FCAL + 3 or more photons in insert

- Left, Fisher
- Right, BDT



TMVA, JEF

All photons in FCAL + 3 or more photons in insert

- Left, Fisher
- Right, BDT

