Limit on production of Dark Photons from Dalitz Decay of Light Mesons in CLAS

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By believing passionately in something that still does not exist, we create it. The nonexistent is whatever we have not sufficiently desired.

Franz Kafka

The Dark Photon is highly desirable, but we have to find out if it does exist.

Outline

- Light Meson Decays in CLAS
- Dalitz Decay π^0 ->e+e-γ
- Dalitz Decay η ->e+e-γ
- Dalitz Decay ω ->e+e-π^0
- Expected upper limits for A' production

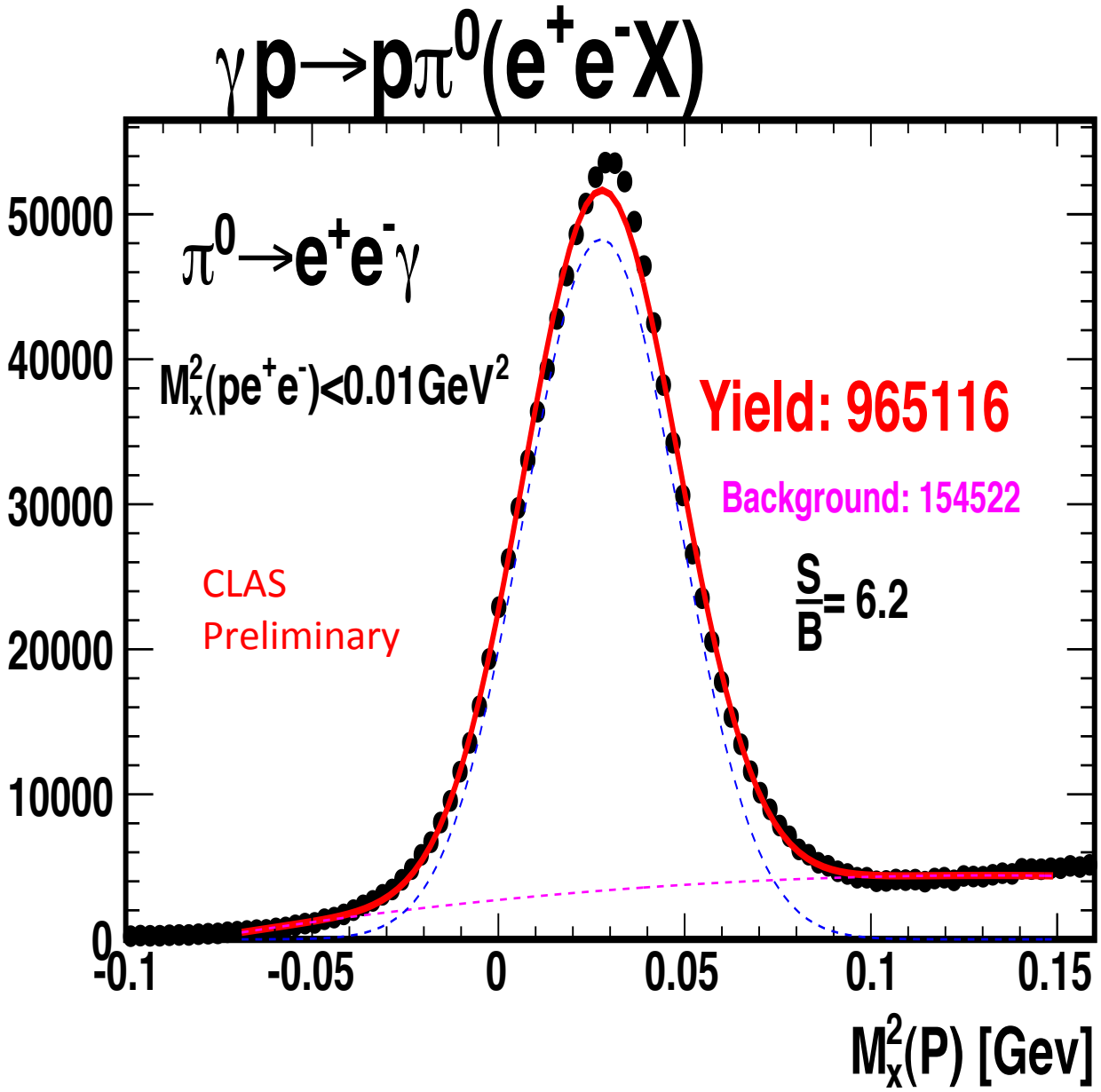
Light Meson Decays. CLAS Approved Analysis.

Decay Channels

π^0	$e^+e^-\gamma$			
η	$e^+e^-\gamma$	$\pi^+\pi^-\gamma$	$\pi^+\pi^-\pi^0$ $\pi^+\pi^-$	$\pi^+\pi^-e^+e^-$
η'	$e^+e^-\gamma$	$\pi^+\pi^-\gamma$	$\pi^+\pi^-\pi^0$ $\pi^+\pi^-$	$\pi^+\pi^-\eta$ $\pi^+\pi^-e^+e^-$
ρ		$\pi^+\pi^-\gamma$		
ω	$e^+e^-\pi^0$	$\pi^+\pi^-\gamma$	$\pi^+\pi^-\pi^0$	
φ			$\pi^+\pi^-\pi^0$	$\pi^+\pi^-\eta$
f1(1285)				$\boldsymbol{\pi^+\pi^-\eta}$

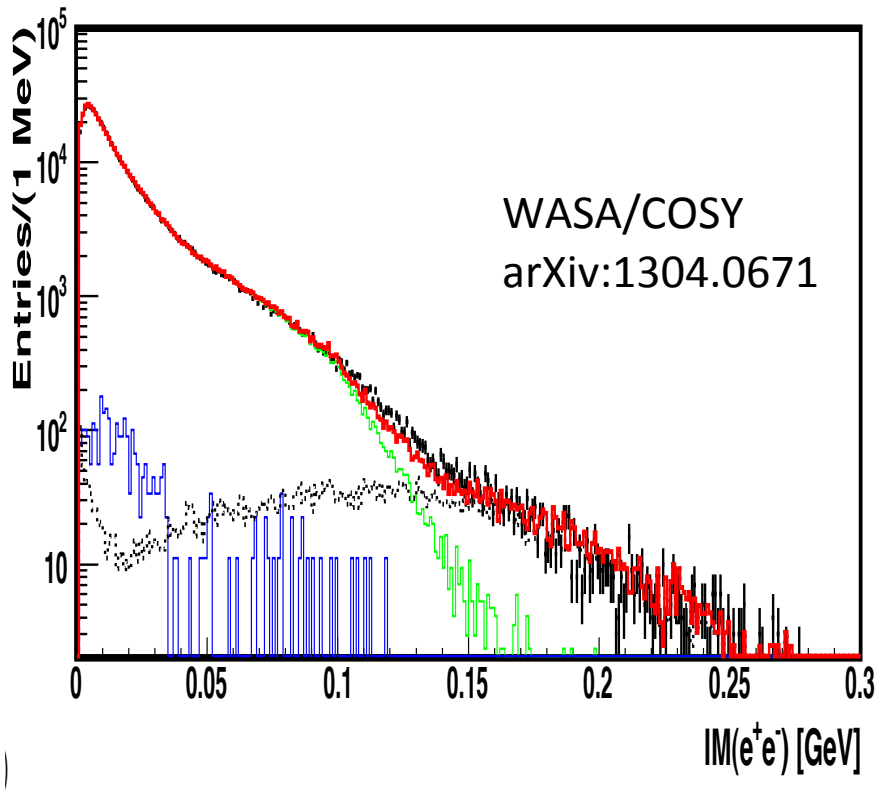
Decays to e+e- can be used for A' search

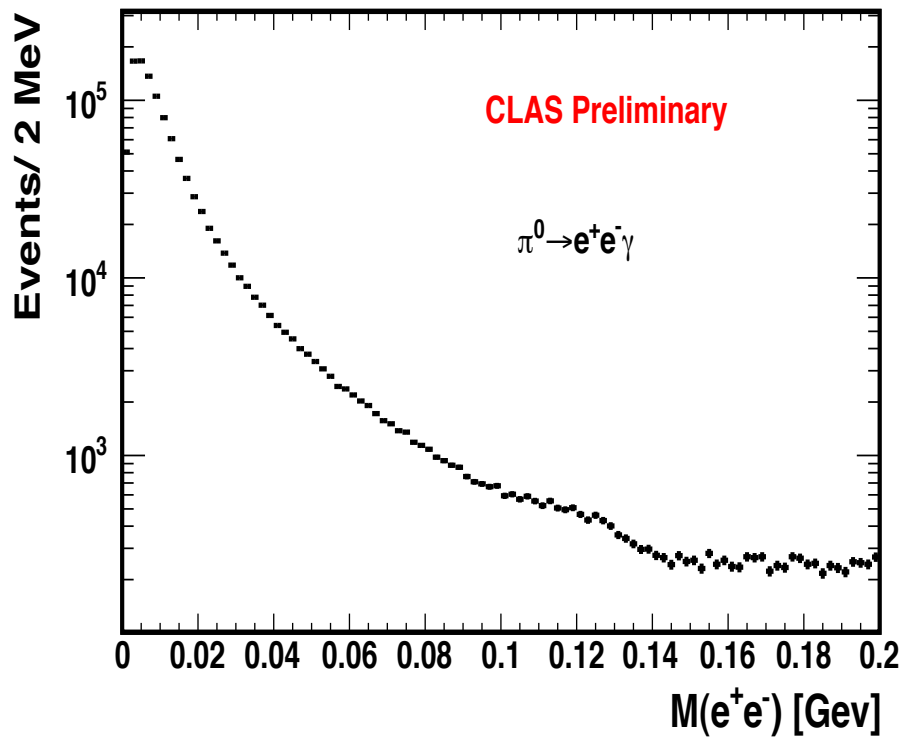
Dalitz Decay of π^0 in CLAS



Highest statistics in the world ~1M events

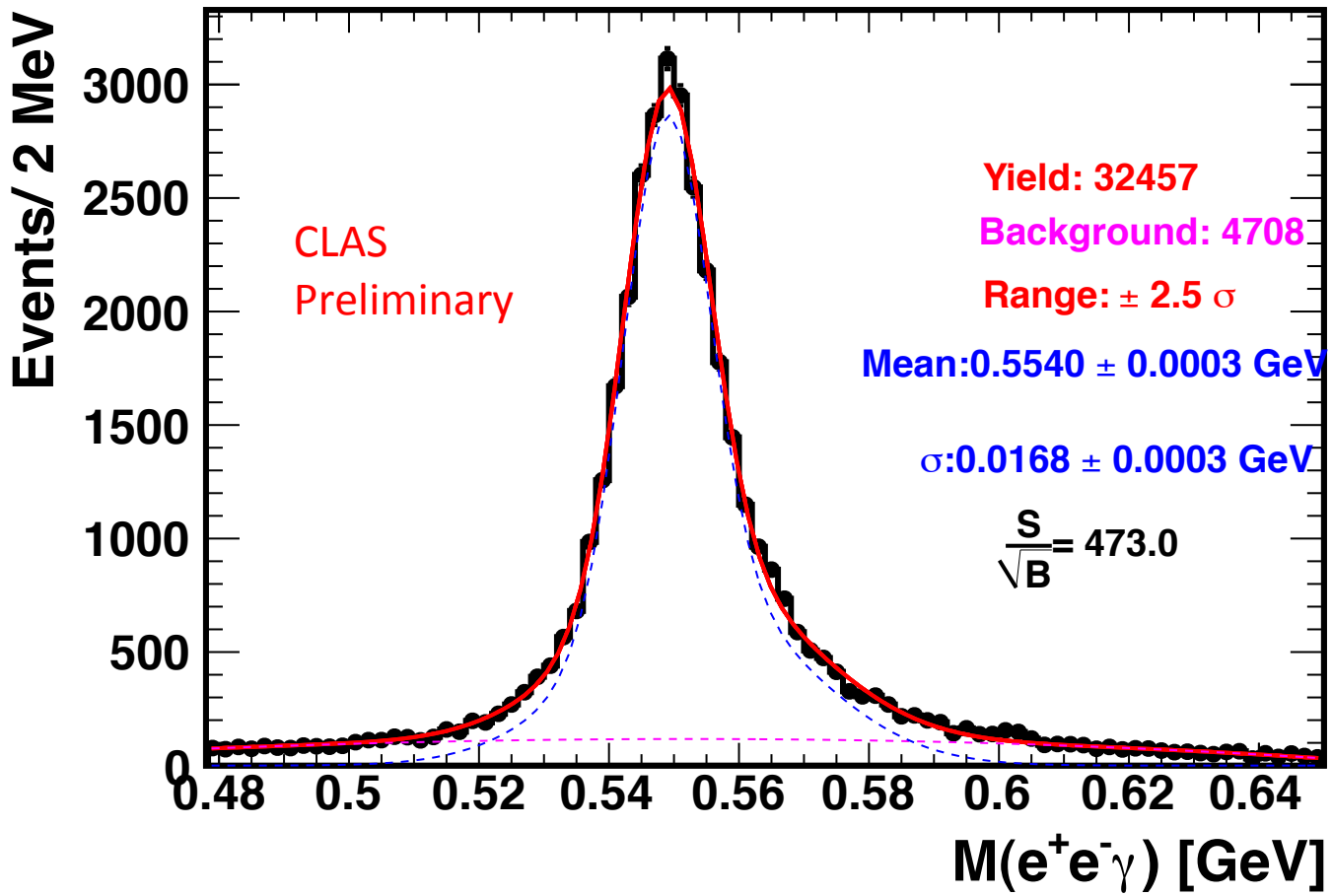
Invariant Mass of e+e- under π^0 peak



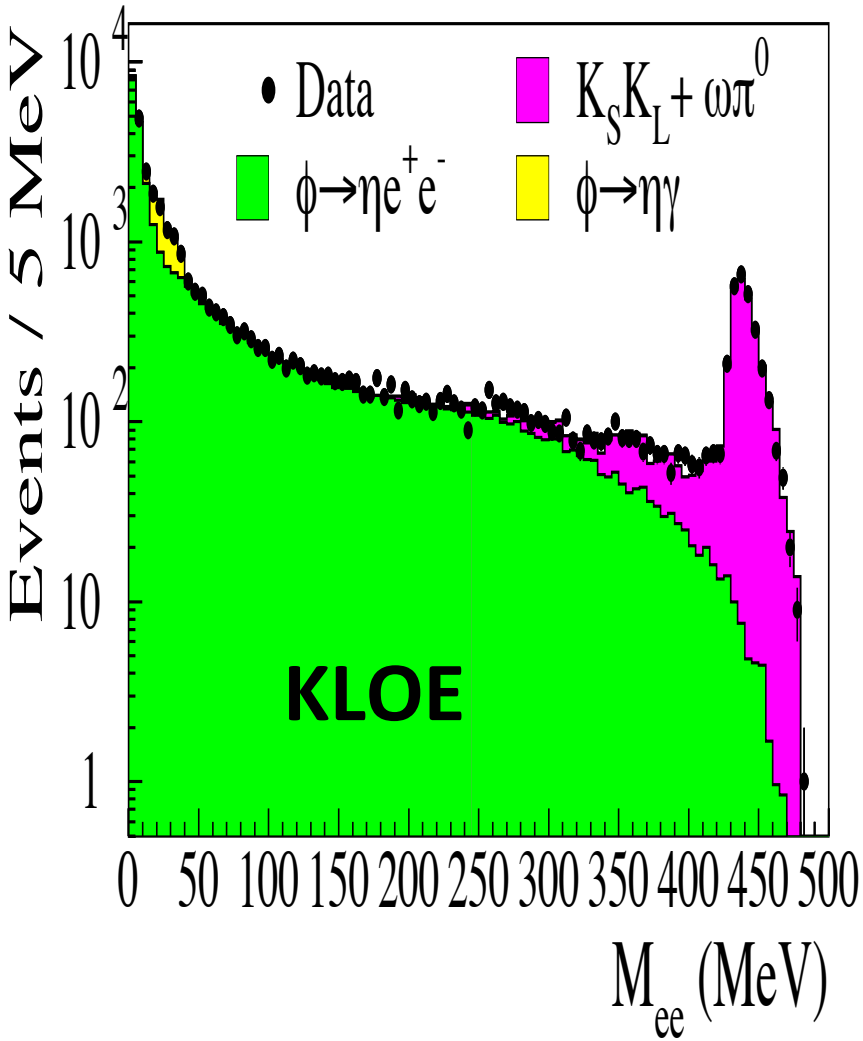


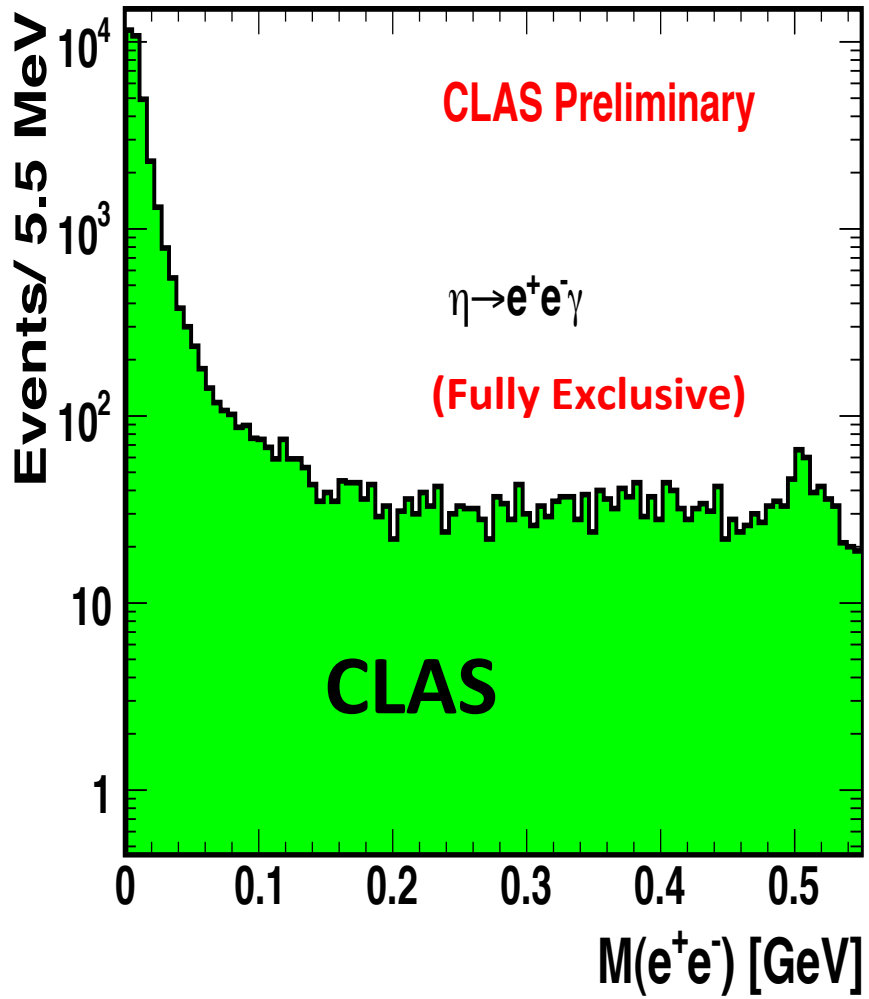
CLAS effectively has collected factor of 3 times more events

Dalitz Decay of η in CLAS



Invariant mass $M(e^+e^-)$





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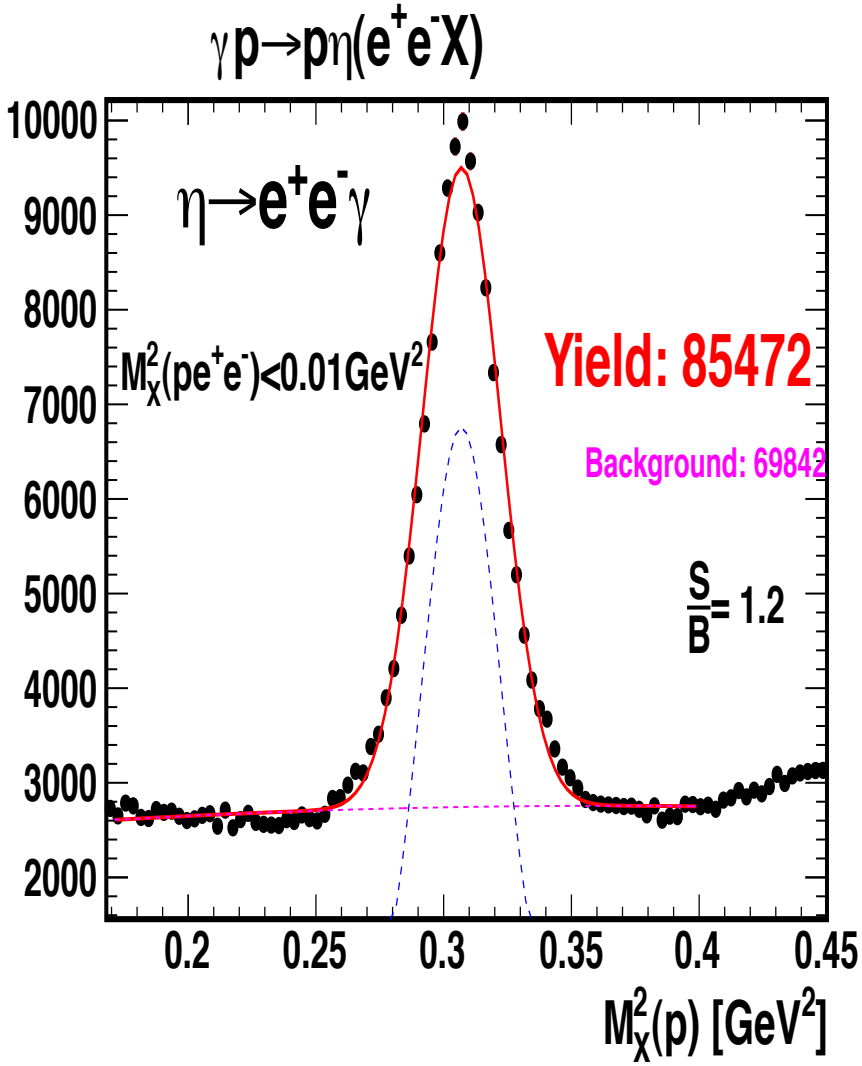
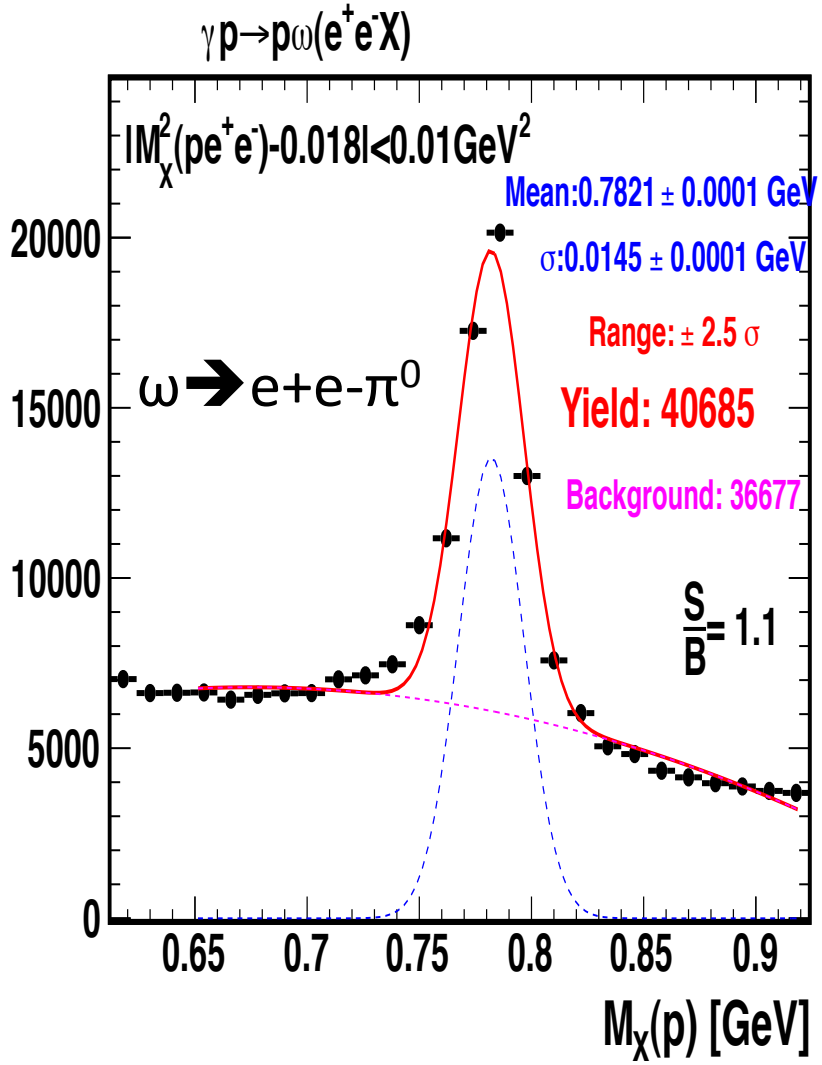
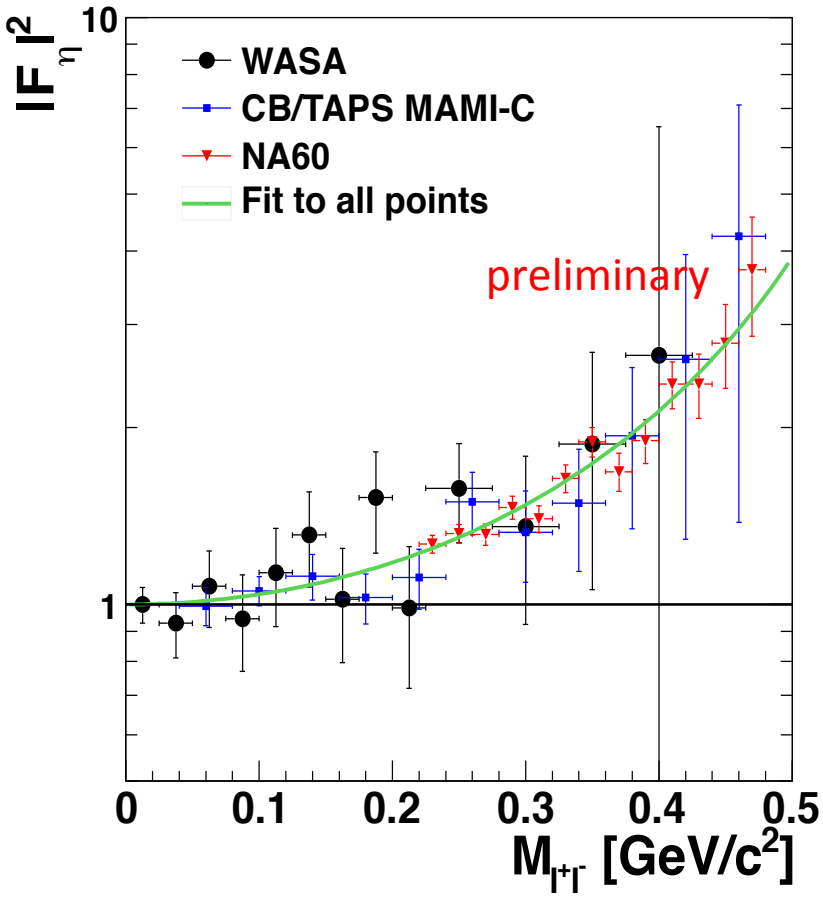
Missing Mass of Proton



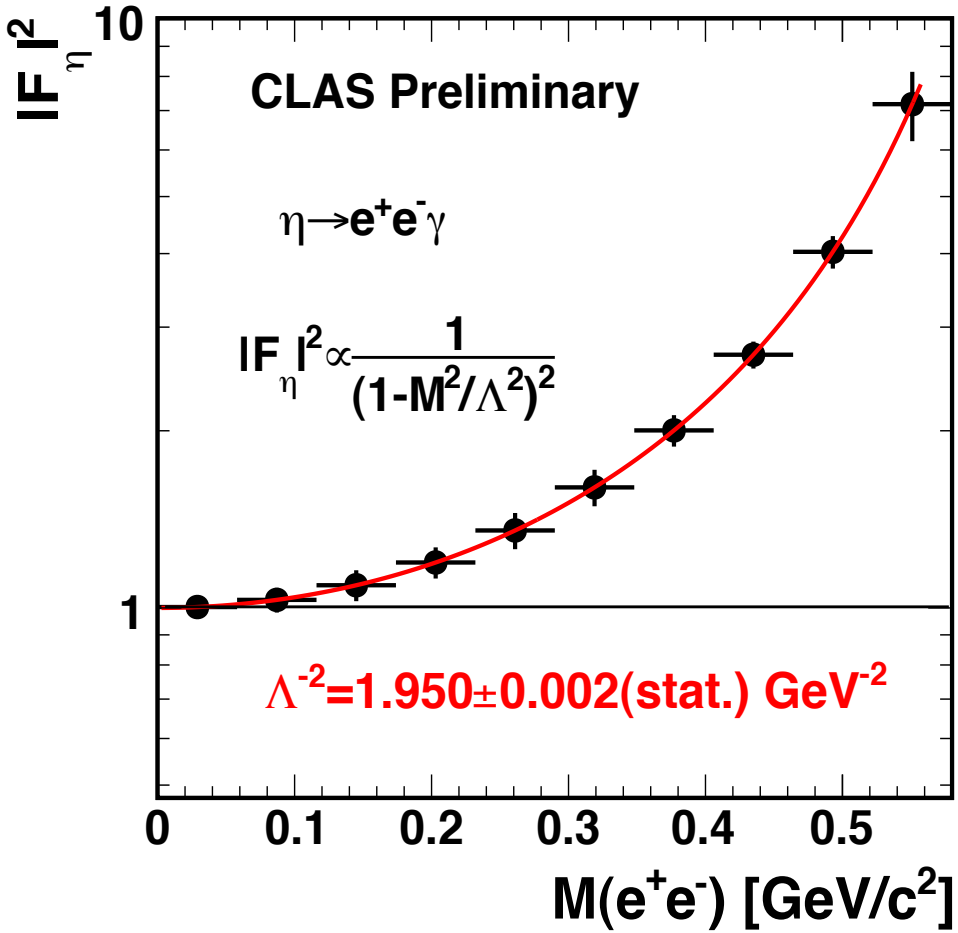


Statistics of η increases ~3 times with no γ

World Data



CLAS g12 Data



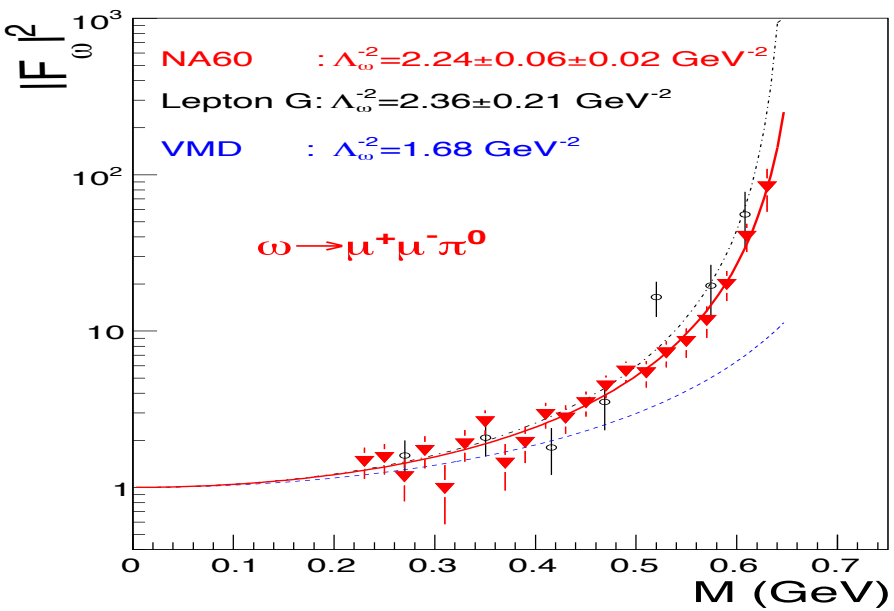
CB/TAPS $\Lambda^{-2} = 1.92 \pm 0.35(stat.) \pm 0.13(syst.) \quad GeV^{-2}$

NA60 $\Lambda^{-2} = 1.95 \pm 0.17(stat.) \pm 0.05(syst.) \quad GeV^{-2}$

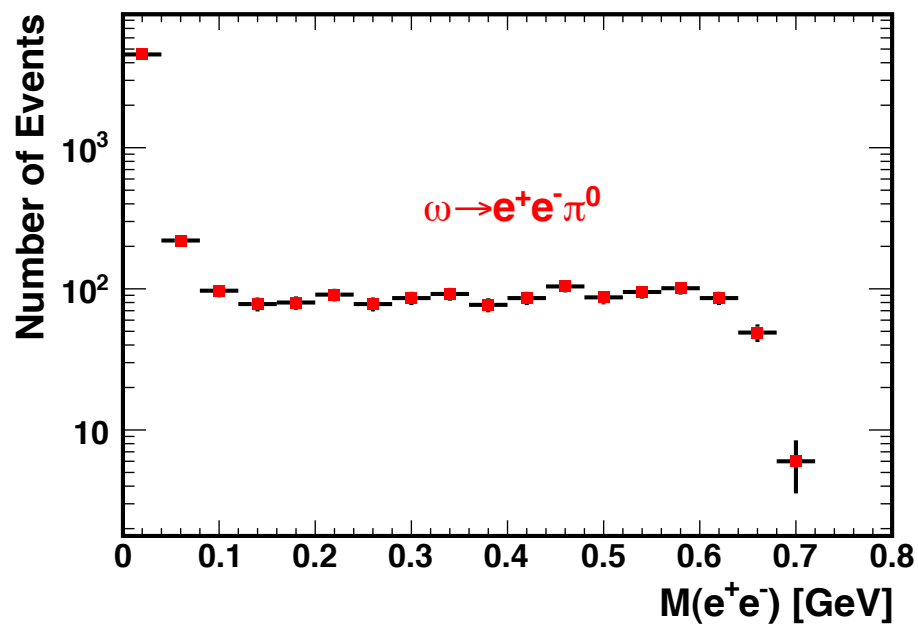
CLAS syst. err. ~ 0.05 (preliminary)

Transition Form Factor $\omega \rightarrow e^+e^-\pi^0$

World data



CLAS g12 Data



Significant improvement in stat. error with CLAS Data

Expected Upper Limits from CLAS

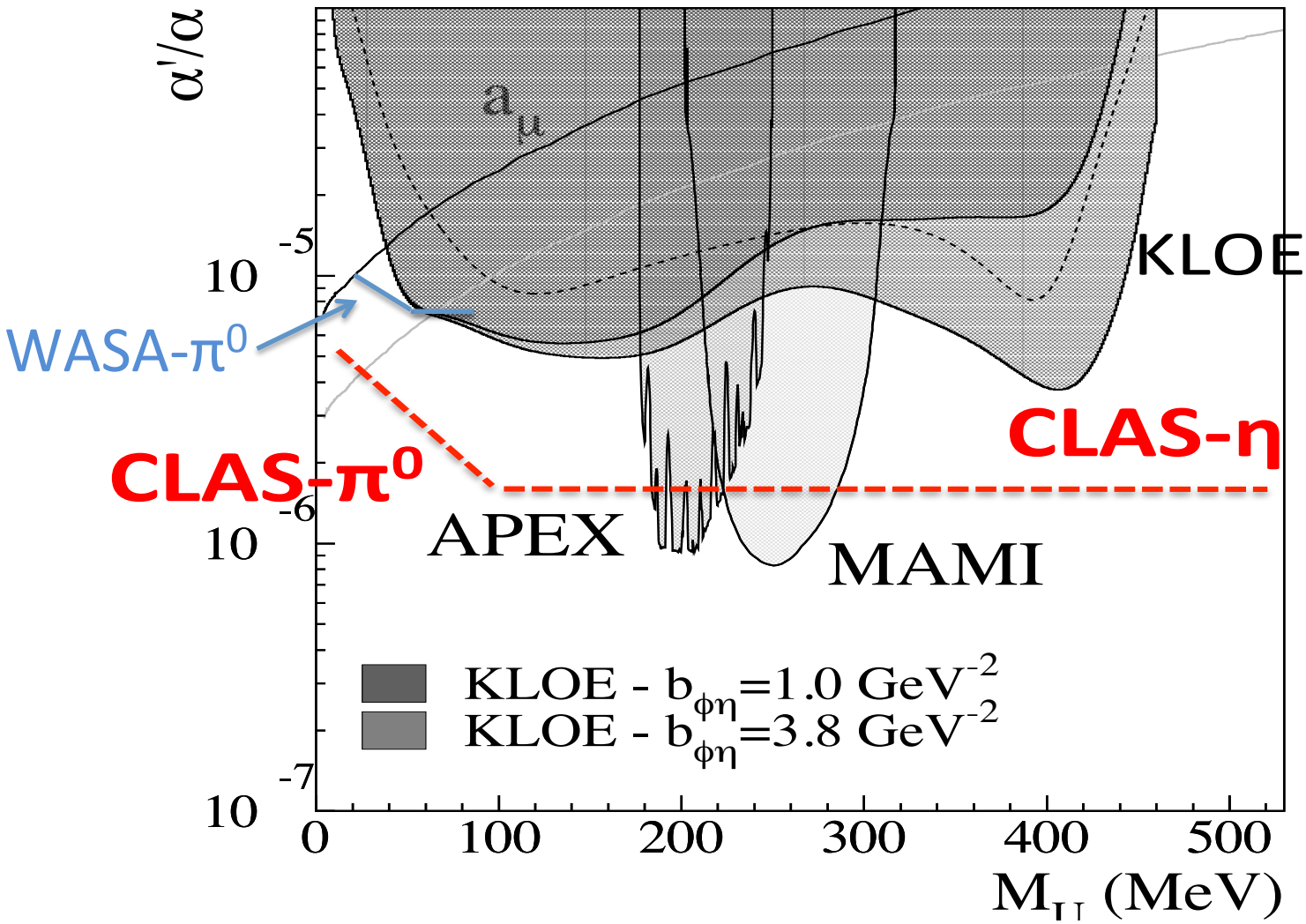


Figure from arXiv:1210.3927

SUMMARY

Dalitz Decay of Light Mesons in CLAS is a powerful source of e+e- pairs

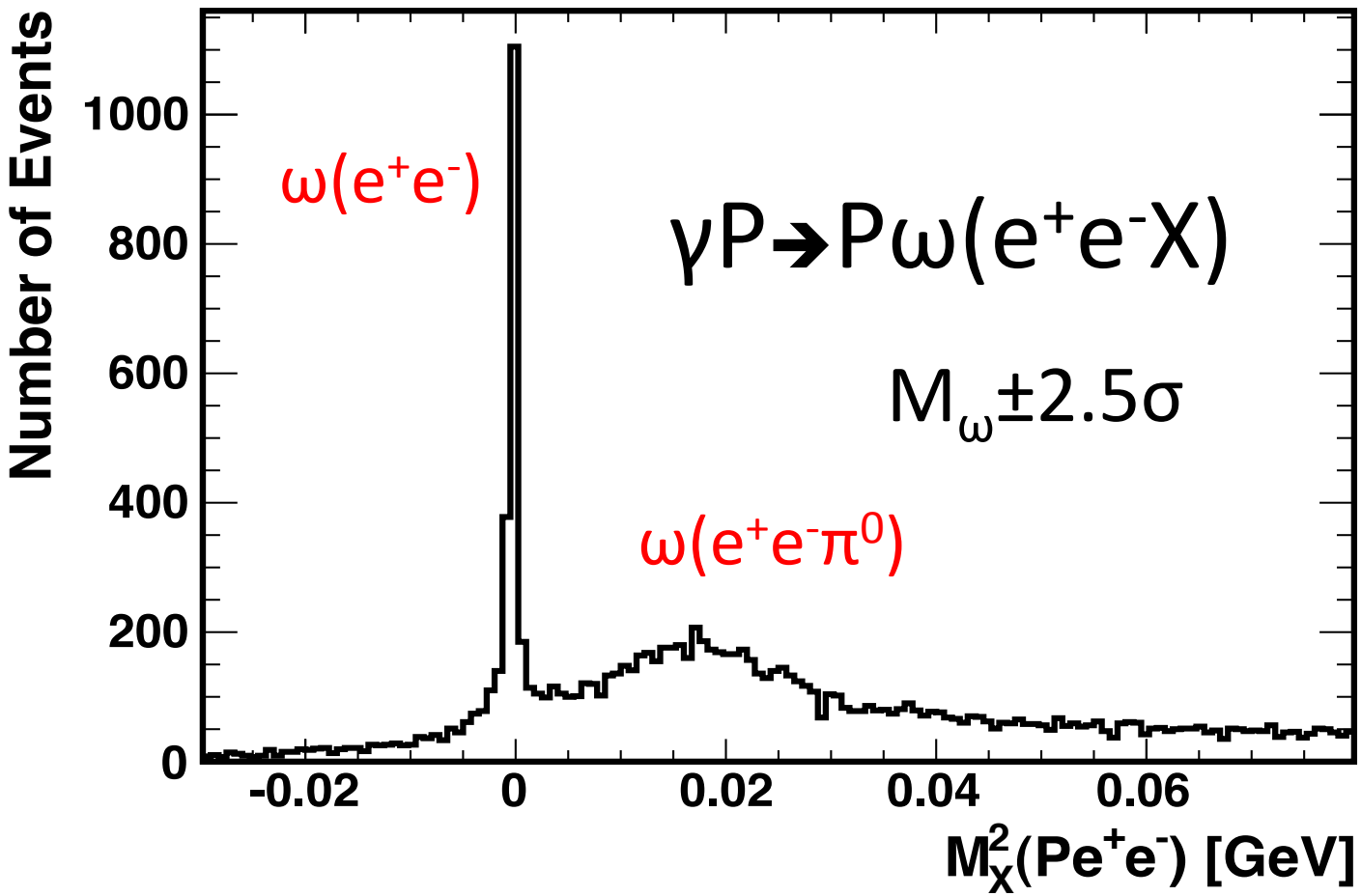
Preliminary studies of π^0 and η decays show expected upper limit from CLAS to be below world data in a wide range up to η (and possibly ω mass)

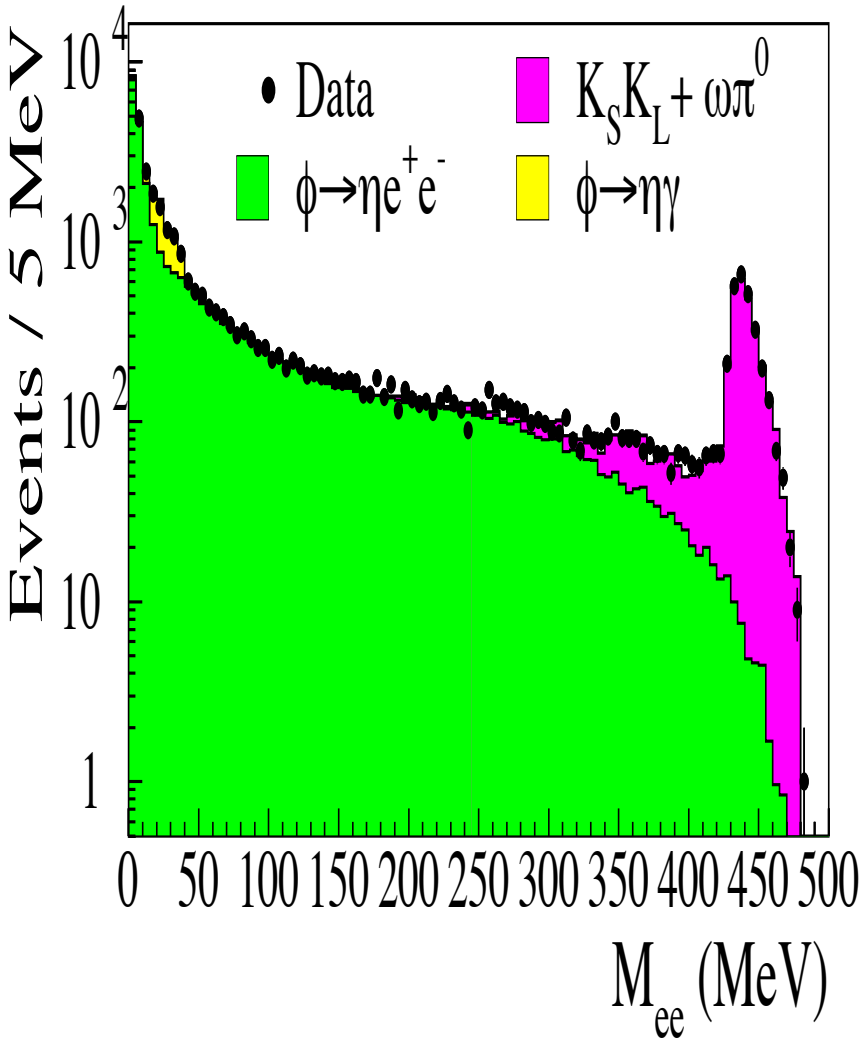
Data analysis of all Dalitz Decay channels is in progress

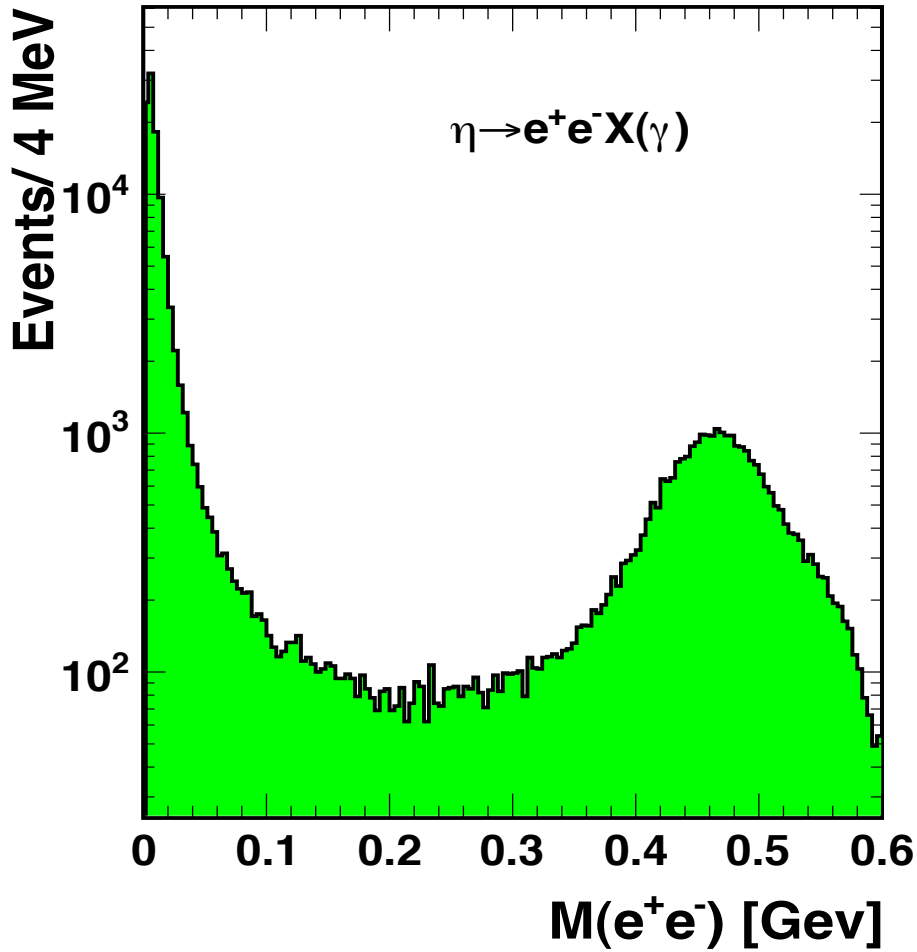
Additional efforts are needed to extend Light Meson Decay Program to 12GeV era at JLAB with CLAS12 and GlueX

Backup Slides

Missing Mass of Pe^+e^-




Events / 5 MeV
Data
$K_S K_L + \omega\pi^0$
$\phi \to \eta e^+ e^-$
$\phi \to \eta\gamma$
M_{ee} (MeV)


Events/ 4 MeV
$\eta \to e^+ e^- X(\gamma)$
$M(e^+e^-)$ [Gev]