Light Meson Decays

status of LMD group

Susan Schadmand, IKP
hadron spectroscopy session
CLAS collaboration meeting
June, 2017

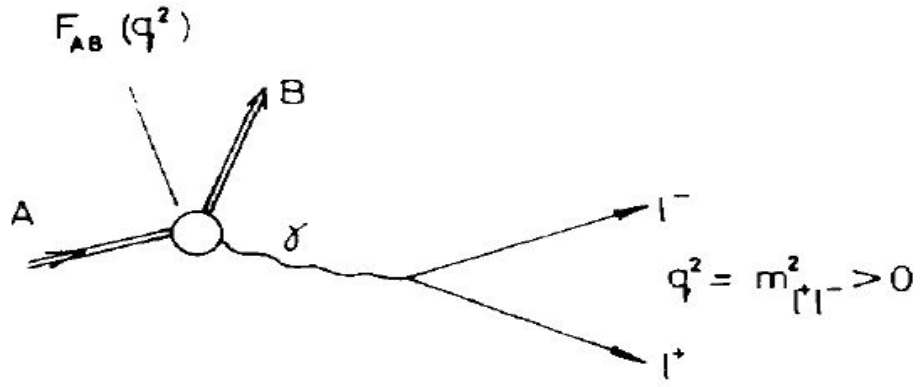
List of Meson Decays

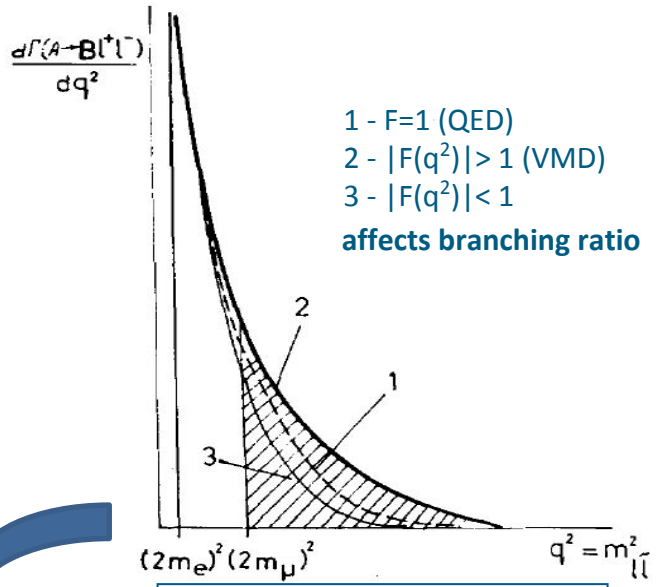
From Lmdwiki

meson decay	physics	people	data	status	publication
$\pi \to \gamma e^+e^-$	transition form factor, Me+e- (dark photon)	Michael Kunkel	g12	PhD 2014, ODU	pi0 cross section in preparation
$\eta' \to \gamma e^+e^-$	transition form factor	Michaela Schever	g12	Master 2015, RWTH Aachen	----------→ CLAS12
$\eta \to \gamma e^+e^-$	transition form factor				
$\omega \to \pi^0 e^+e^-$	transition form factor	Susan Schadmand	g12	this talk	
$\eta \to \pi^0 e^+e^-$	C violation				
$\eta' \to \pi^+\pi^-\gamma$	box anomaly upper limit branching ratio	Georgie Mbianda Njencheu	g11	PhD 2017, ODU	analysis report in preparation
		Daniel Lersch	g12		
$\eta \to \pi^+\pi^-\gamma$	box anomaly	Torri Roark	g11		
		Daniel Lersch	g12		
$\varrho \to \pi^+\pi^-\gamma$		Tyler Viducic	g11 ?		
$\eta, \omega, \phi \to \pi^0\pi^+\pi^-$	Dalitz plot analysis η ω ϕ	Daniel Lersch, (Diane Schott) Carlos Salgado + , Chris Pederson	g11/g12	DL: see talk this meeting	
$\eta' \to \pi^+\pi^-\eta$	Dalitz plot analysis pi+ pi- correlation	Sudeep Ghosh	g12, (g11)		analysis report in preparation

transition form factor

L.G. Landsberg, Electromagnetic decays of light mesons





$$\frac{d\Gamma(A \to B\, l^+l^-)}{dq^2 \cdot \Gamma(A \to B\gamma)} = \left|F_{A\to B}(q^2)\right|^2 \cdot |\mathrm{QED}|$$

form factor: divide experimental q^2 distribution by QED

$F_{AB}(q^2) = [1 - q^2/\Lambda^2]^{-1}$ (single) pole approximation

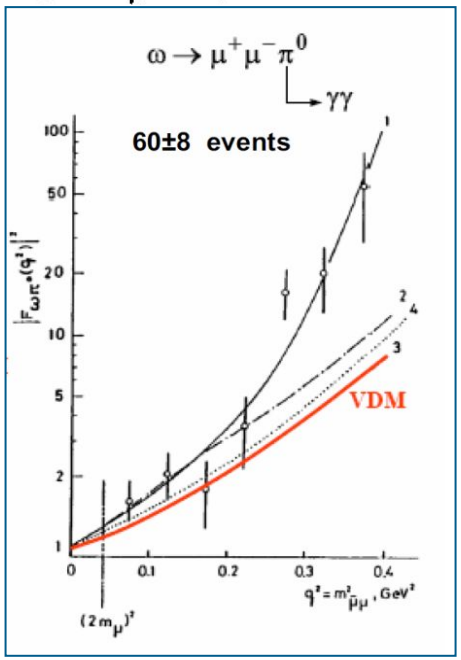
$$F_{AB}(q^2) \simeq 1 + q^2[\mathrm{d}F_{AB}/\mathrm{d}q^2]|_{q^2\simeq 0} = 1 + q^2 b_{AB} = 1 + \tfrac{1}{6}q^2\langle r^2_{AB}\rangle$$

$\Lambda \simeq m_\rho$ $(\Lambda^{-2} = b_{AB})$

'standard' VMD

slope parameter

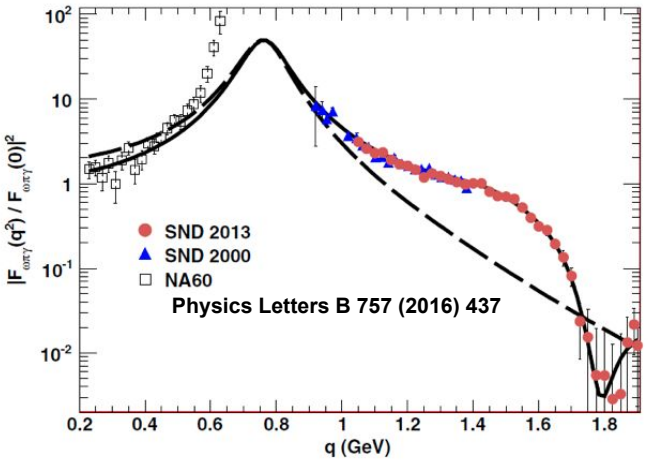
size (transition region)



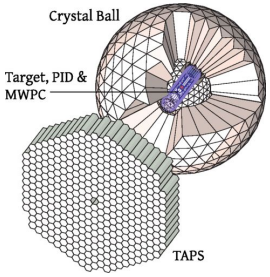
status of the ω-π transition form factor

Phys.Rev. D88 (2013) 054013

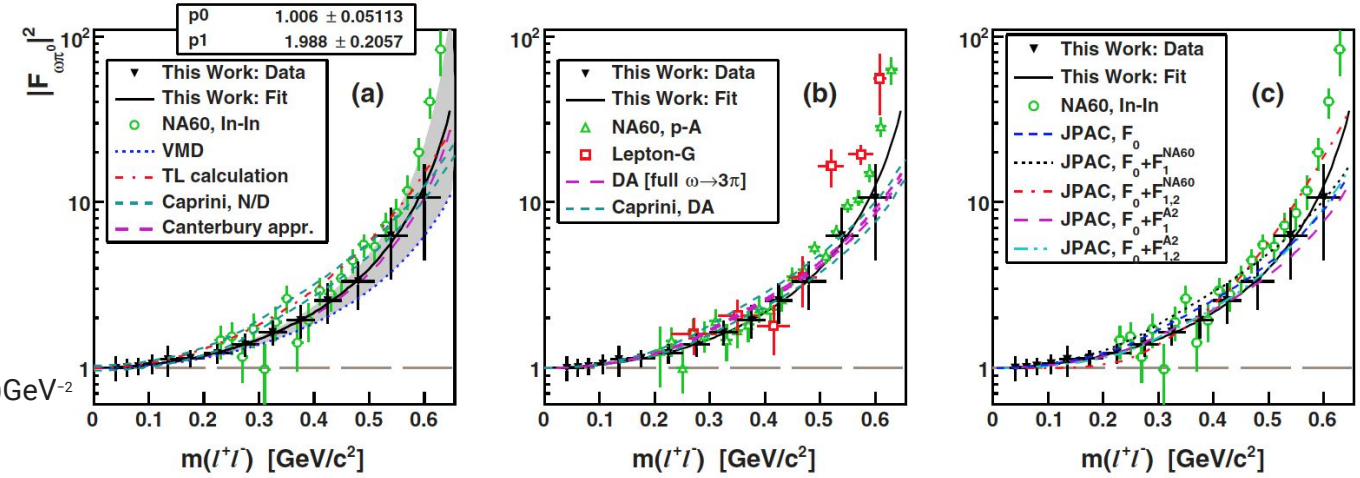
Study of $e^+e^- \to \omega\pi^0 \to \pi^0\pi^0\gamma$ in the energy range 1.05–2.00 GeV with SND



S. Prakhov (A2 Collaboration at MAMI)
Phys. Rev. C 95, 035208



$\Lambda^{-2}=(1.99\pm0.21_{tot})\text{GeV}^{-2}$

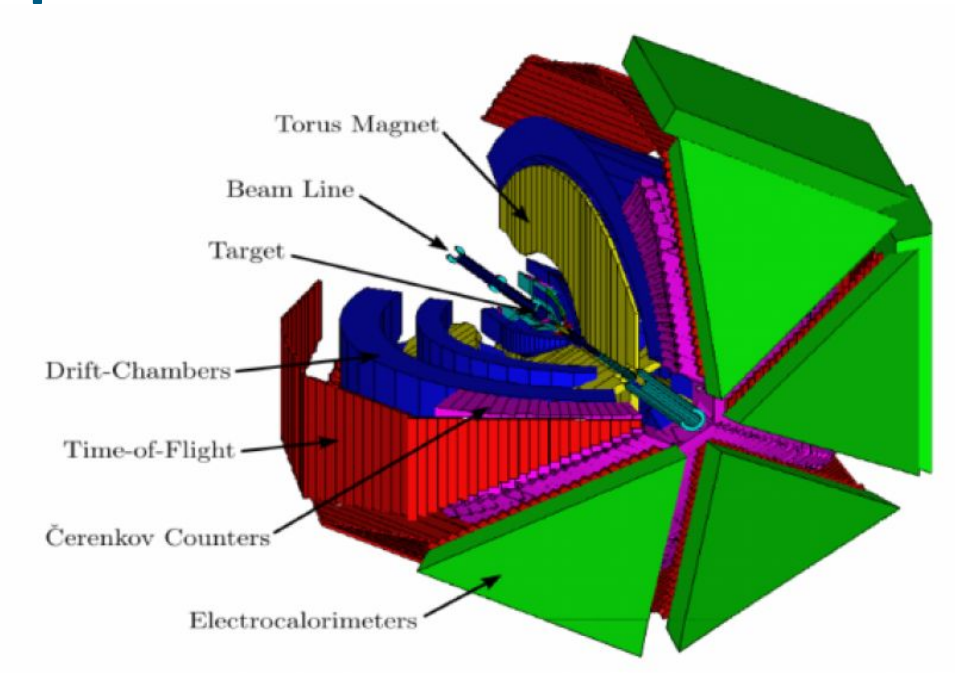


conclusion:

* A2 results are in better agreement with theoretical calculations, compared to earlier experiments
* statistical accuracy of the present data points at large m (ee) masses does not allow a final conclusion

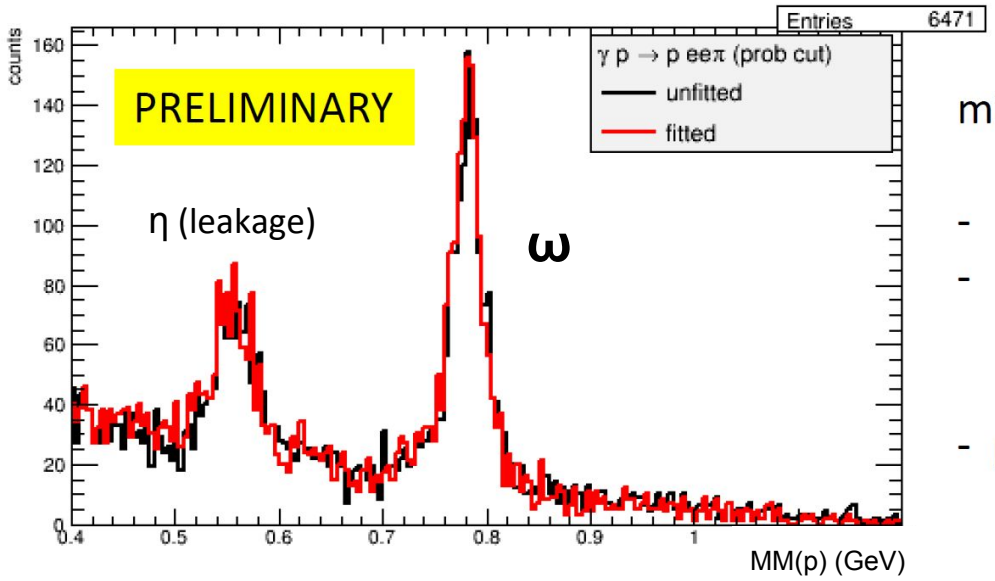
→ study ω decay with CLAS

CLAS g12 experiment



CLAS g12 setup	
LH_2 target	main source for *external γ conversion*
Cerenkov Counters	excellent *dilepton identification*
EM calorimeter	particle identification photon detection

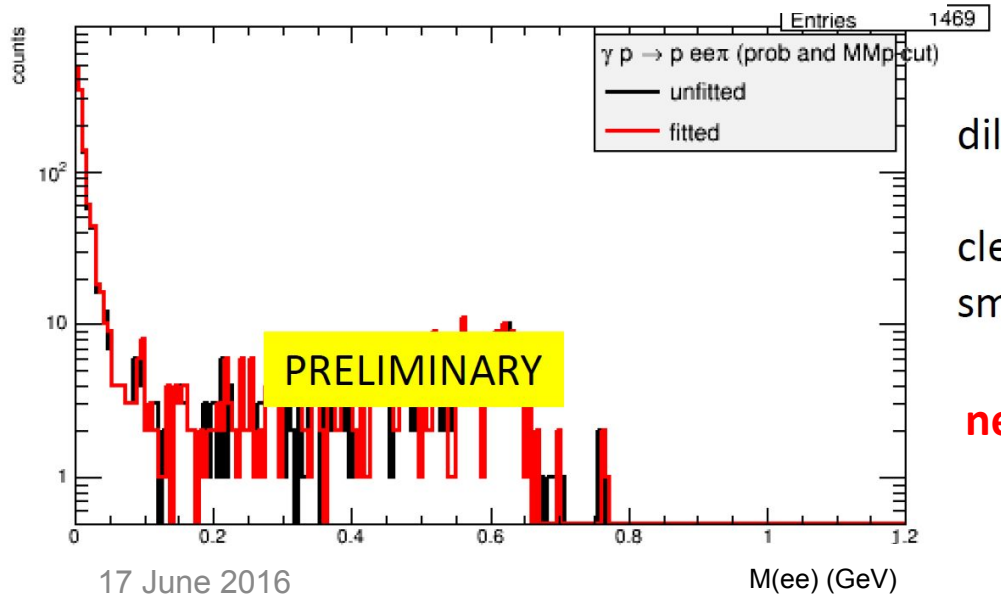
CLAS g12 dileptons



missing mass (p)

- smooth background
- in-peak background:
  competing decays
  photon external conversion
- peaking background?

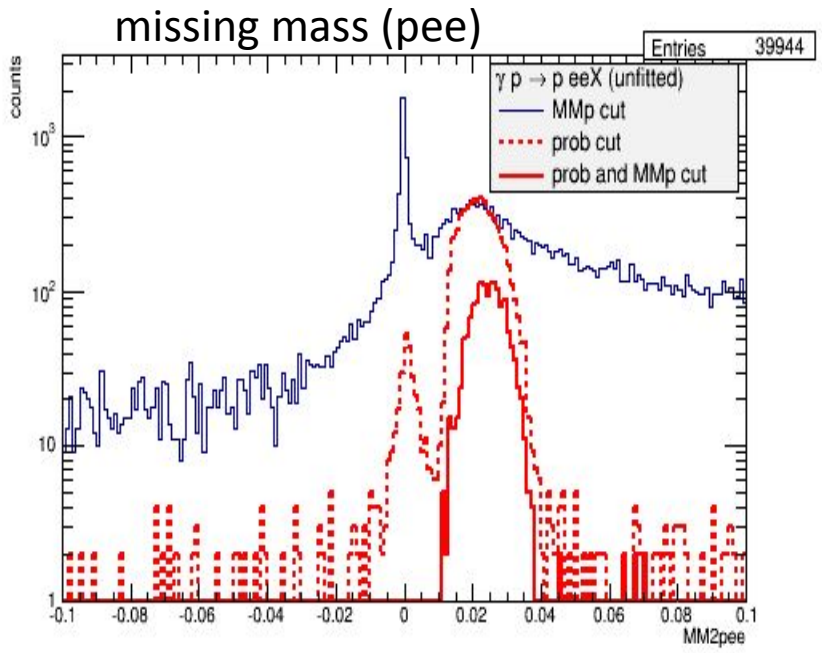
not background subtracted
not acceptance corrected

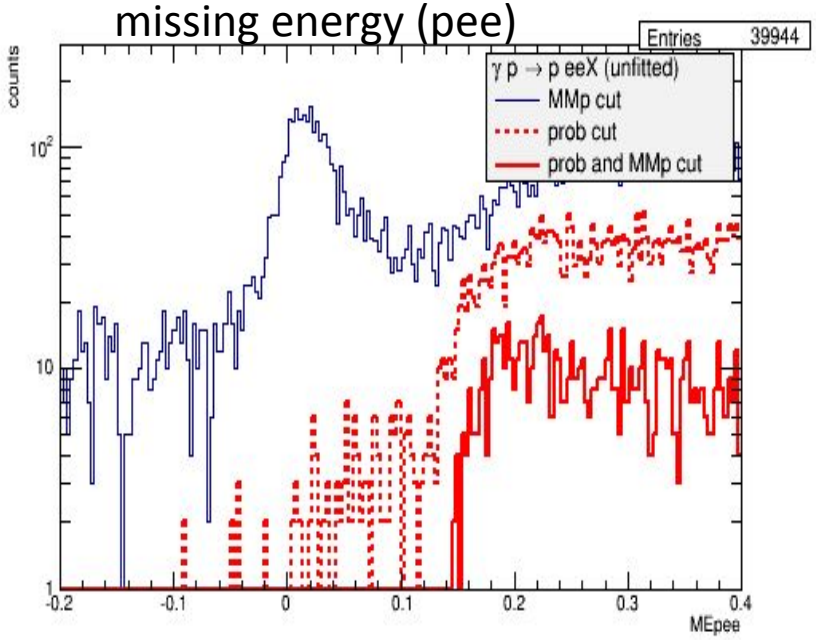


dilepton mass

clearly dominated by background
small masses: external conversion

next step: background study





CLAS g12 dileptons kinematics

analysis strategy:
e+e- detection
and missing particle

missing pion: **ω→πee**
- missing mass is pion mass
- missing energy

missing photon: **η(′)→γee**
- missing mass zero
- missing energy

missing nothing: **ρ/ω→ee**
- missing mass and nergy zero

dilepton analysis of g12 data / simulations

1. dilepton skim (=1 ptoton and =1 charged particle pair) ..... final state

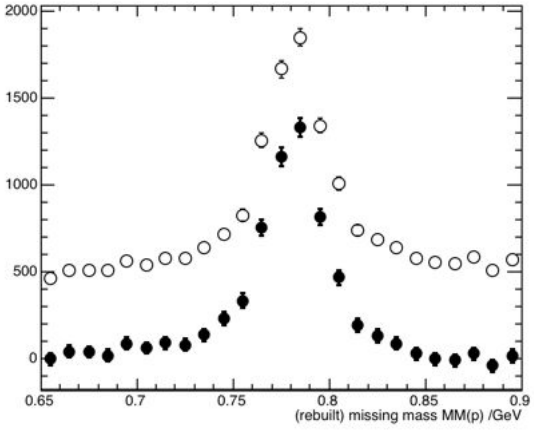
2. beam corrections (only data)
3. momentum corrections (only data)
4. Fiducial cuts, TOF and EC knockouts
5. eventtrackeff (only data)

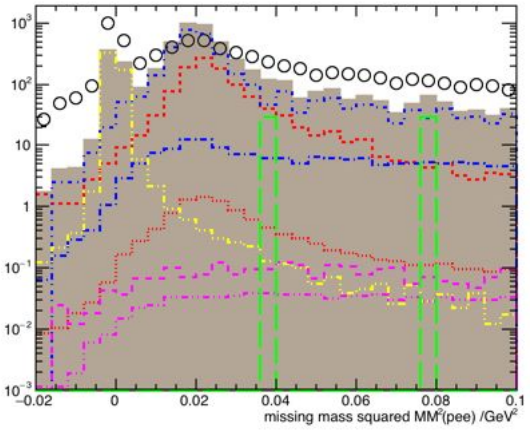
6. g7 leptons …….. *CC&EC cut*
   beta cut ……..... *ToF electron candidates*
   vertex cut

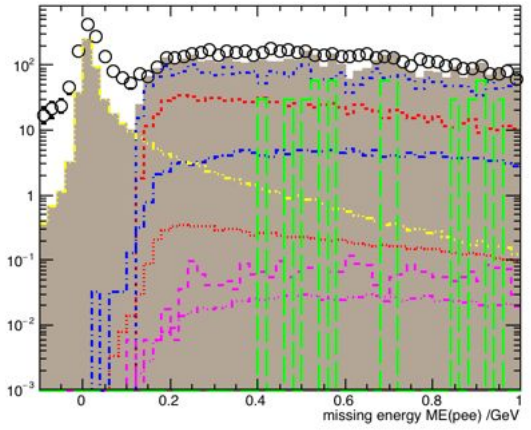
7. MM2PEpEm>0.01 && MM2PEpEm<0.035 ..... *MMpee : massless or no missing particle*
   MEPEpEm>0.075 ..... *MEpee : missing particle (has energy)*

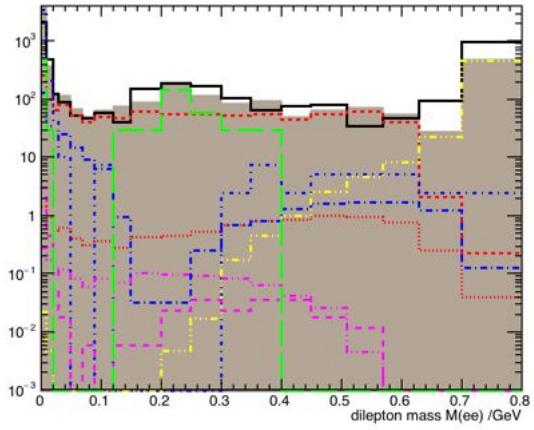
dilepton analysis of g12 data / simulations

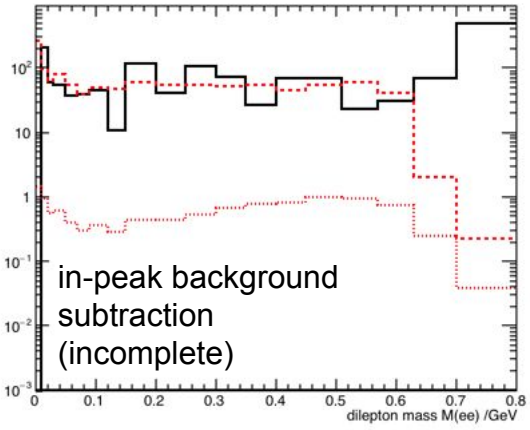
after cuts (6)

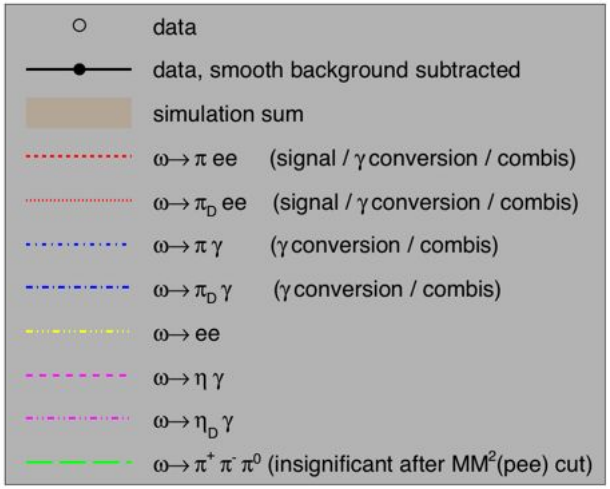








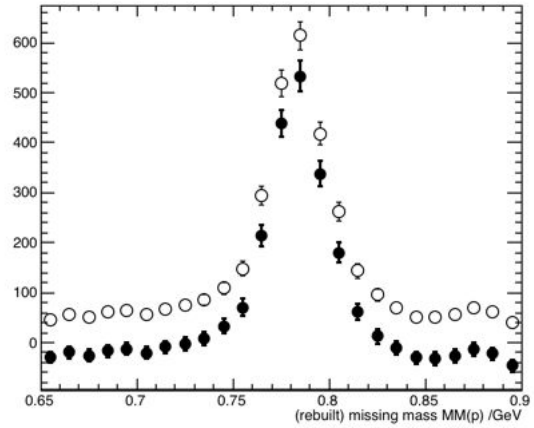


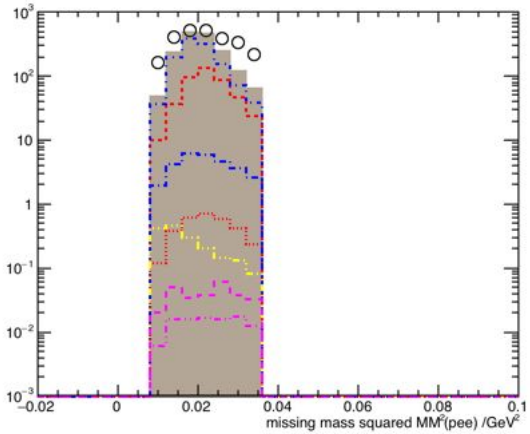


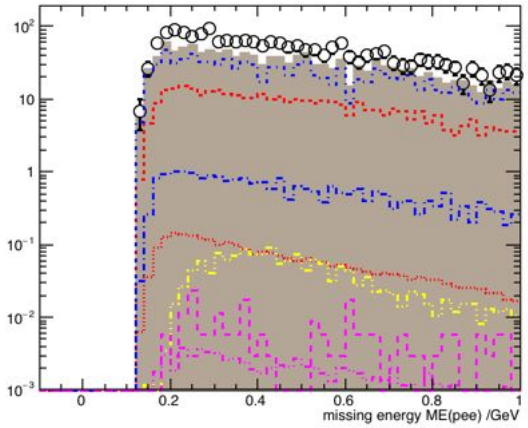
- bin-wise subtraction of smooth background (in Mee bins)
- charged pions (and muons) suppressed, rest can be discriminated via missing mass/energy
- omega/rho decays are important
- combinatorics from photon conversion

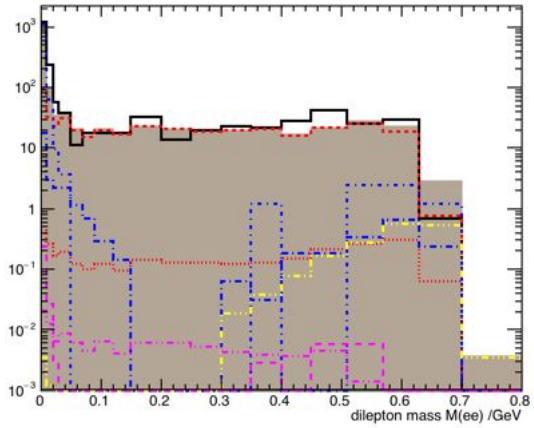
dilepton analysis of g12 data / simulations

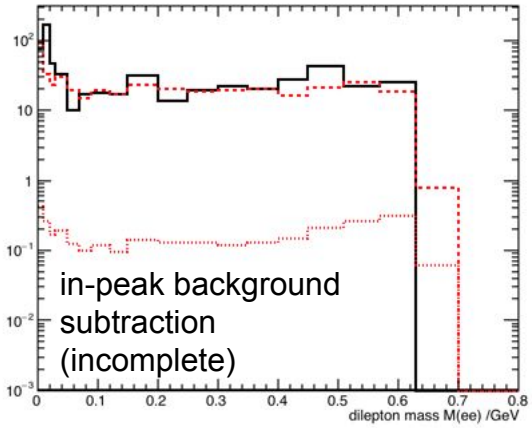
after cut (7)

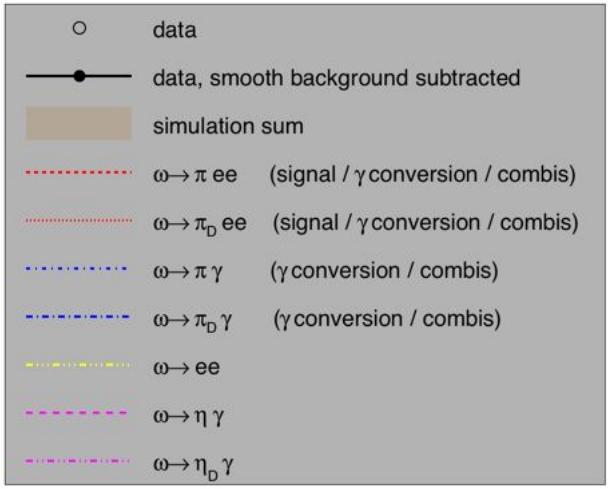












- bin-wise subtraction of smooth background (in Mee bins)
- charged pions (and muons) suppressed, via missing mass/energy
- omega/rho decays are important
- combinatorics from photon conversion

next steps

- more simulations for background
- different methods:
  - cut based analysis
  - kinematic fit
  - qfactor background subtraction 
- compare/combine methods (⇨ systematic errors)
- acceptance correction
- extract transition form factor

further outlook:

looking at statistics, continue study with CLAS12.