An update of γp -> pω Differential Cross Section From g12 and g8b

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CLAS COLLABORATION MEETING
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Outline

- Motivation
- CLAS-g12 and CLAS-g8b Experiment
- An Update of Omega Cross Section from g12
- What We Can learn From g12-Omega Cross Section
- An Update of Omega Cross Section from g8b
- Summary and Outlook

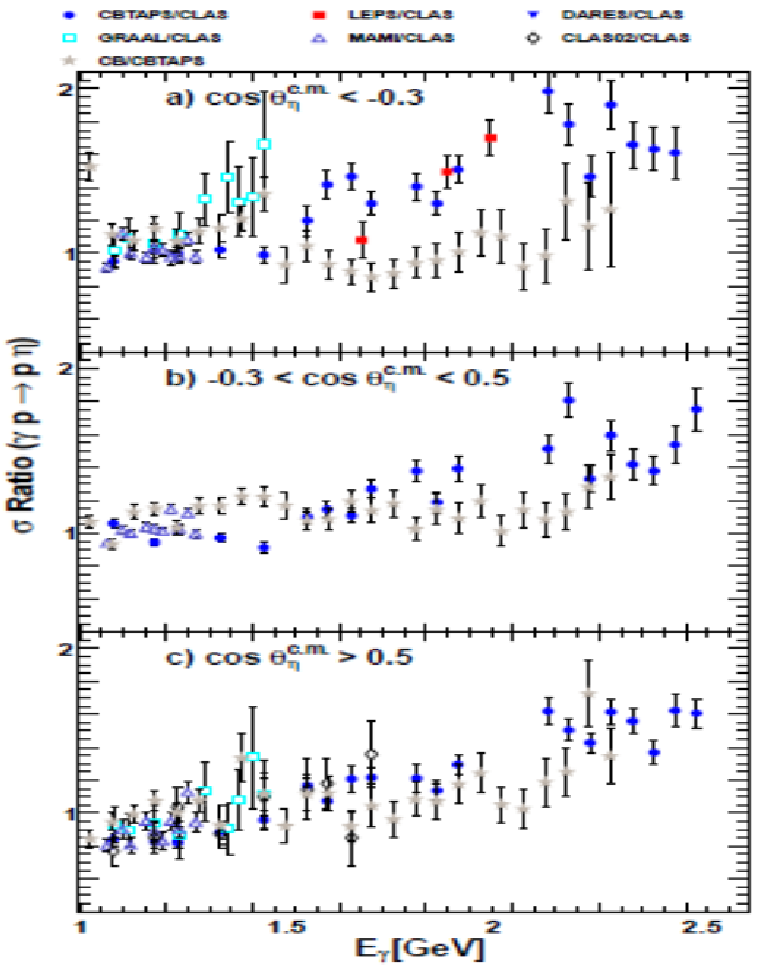
Motivation

Motivation

- A lot of baryon resonances that are predicted by Constituent Quark Model (CQM) and Lattice QCD have not been observed yet.
- A lot of effort has been put to study *N** resonances through pseudoscalar meson channel.
- We need to complete those effort by studying *N** through vector meson production channel (pω, p*ρ*, pφ).
- Omega meson acts as Isospin filter and still under explored (PDG 2014)

		Status			Status as seen in —						
Particle	J^P	overall	πN	γN	$N\eta$	$N\sigma$	$N\omega$	ΛK	ΣK	$N\rho$	$\Delta\pi$
N	$1/2^+$	****									
$N(1440)$	$1/2^+$	****	****	****		***				*	***
$N(1520)$	$3/2^-$	****	****	****	***					***	***
$N(1535)$	$1/2^-$	****	****	****	****					**	*
$N(1650)$	$1/2^-$	****	****	***	***			***	**	**	***
$N(1675)$	$5/2^-$	****	****	***	*			*		*	***
$N(1680)$	$5/2^+$	****	****	****	*	**				***	***
$N(1685)$	$?^?$	*									
$N(1700)$	$3/2^-$	***	***	**	*			*	*	*	***
$N(1710)$	$1/2^+$	***	***	***	***		**	***	**	*	**
$N(1720)$	$3/2^+$	****	****	***	***			**	**	**	*
$N(1860)$	$5/2^+$	**	**							*	*
$N(1875)$	$3/2^-$	***	*	***			**	***	**		***
$N(1880)$	$1/2^+$	**	*	*		**		*			
$N(1895)$	$1/2^-$	**	*	**	**			**	*		
$N(1900)$	$3/2^+$	***	**	***	**		**	***	**	*	**
$N(1990)$	$7/2^+$	**	**	**					*		
$N(2000)$	$5/2^+$	**	*	**	**			**	*	**	
$N(2040)$	$3/2^+$	*									
$N(2060)$	$5/2^-$	**	**	**	*				**		
$N(2100)$	$1/2^+$	*									
$N(2150)$	$3/2^-$	**	**	**				**			**
$N(2190)$	$7/2^-$	****	****	***			*	**		*	
$N(2220)$	$9/2^+$	****	****								
$N(2250)$	$9/2^-$	****	****								
$N(2600)$	$11/2^-$	***	***								
$N(2700)$	$13/2^+$	**	**								

- There are discrepancies on some photo production reactions.
- Therefore, measuring γp -> pω from two different dataset (g12 and g8b) may help us to understand the discrepancies issue.
- CLAS-g12 experiment has higher energy compare to previous CLAS experiment.



Clas g12 and g8b Experiment

CLAS-g12 and g8b Experiment

	G12	G8b
Date	Completed in June 2008	July – September 2005
Electron Energy	5.71 GeV	4.55 GeV
Photon Beam	Circular	Linearly polarized
Target	LH2 Unpolarized Z = -90	LH2 Unpolarized Z = -20
Trigger	Require at least two charger track hit in two different sector	Require one charged track

Some issue in our previous talk :

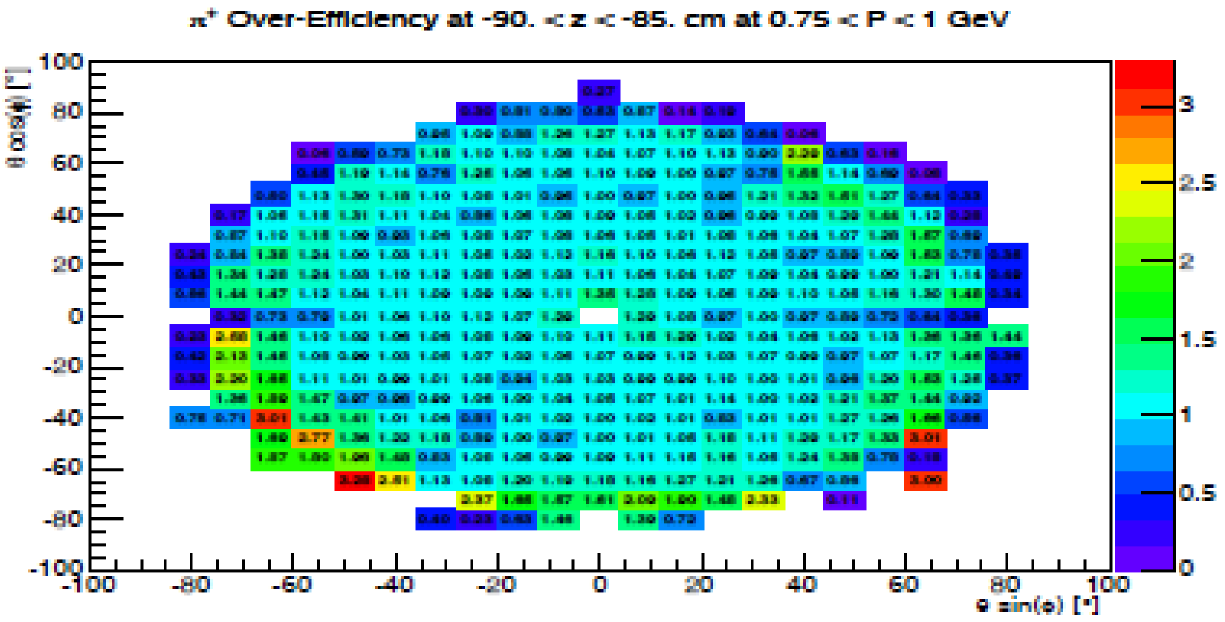
1. 15% global inefficiency correction that I apply -> resolve by inefficiency track correction, derived by Michael Kunkel.

2. Incorrect angular distribution of omega cross section from g8b.

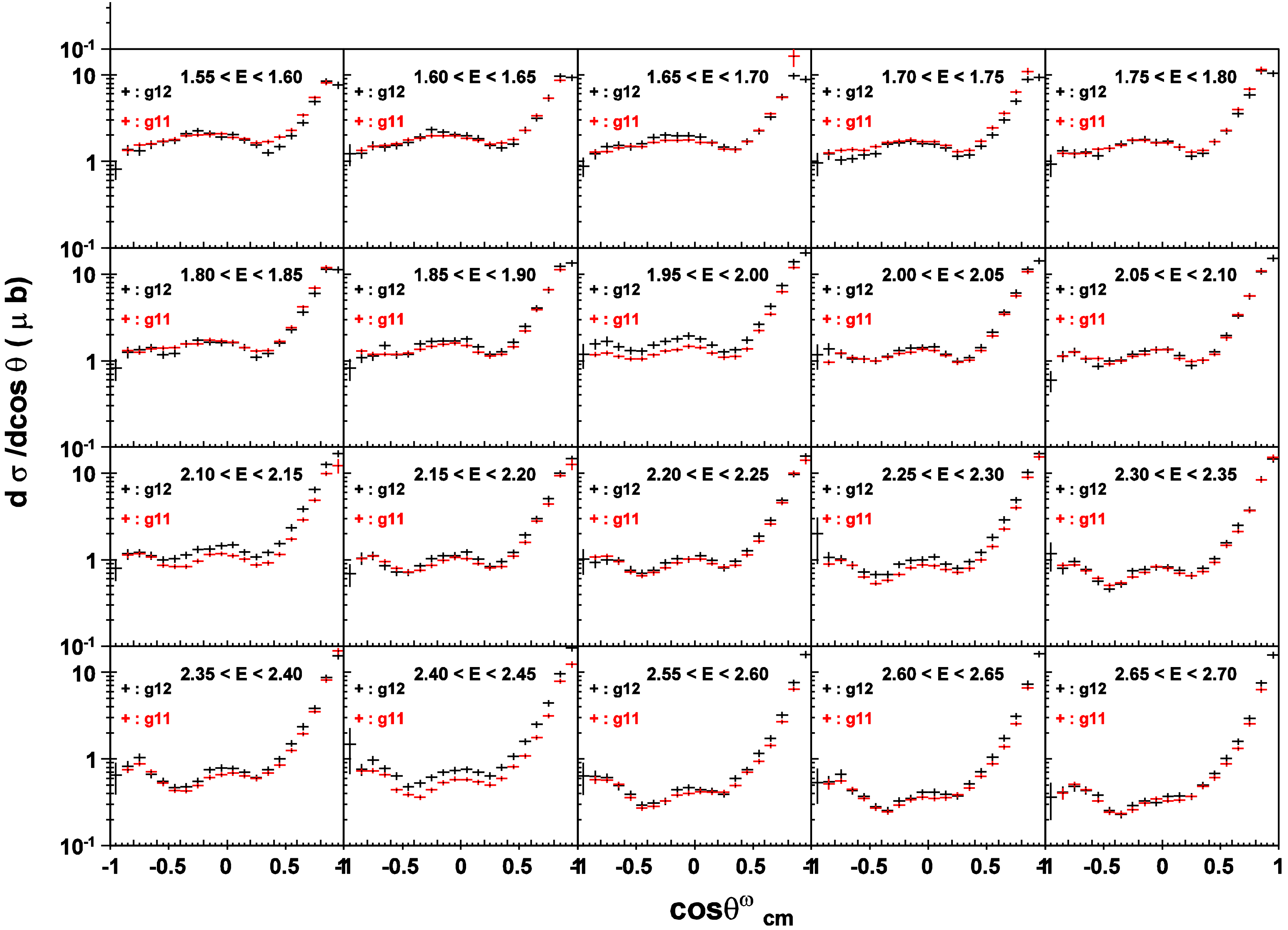
An Update of Omega Cross Section fro CLAS-g12

Track Inefficiency Correction

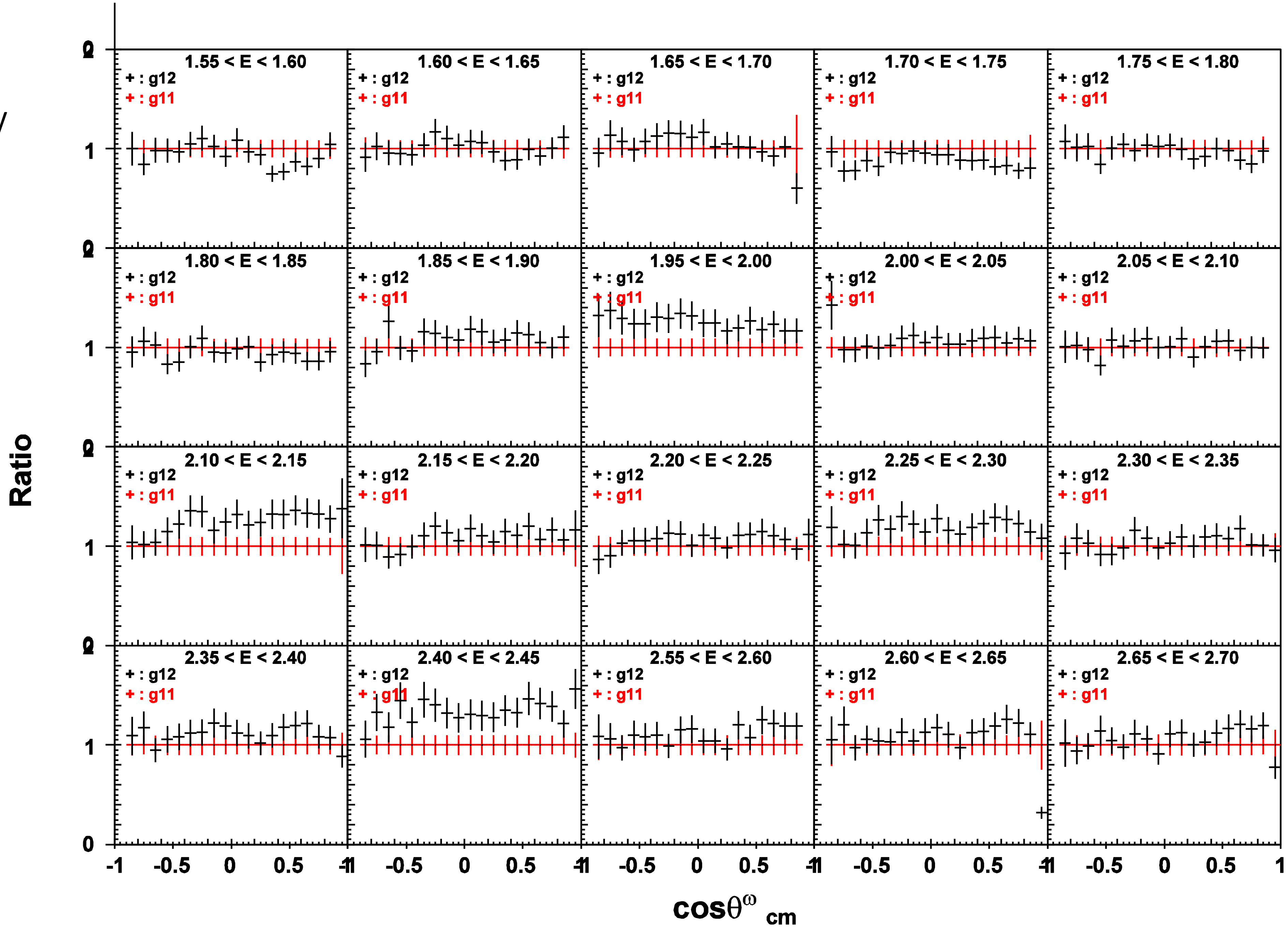
- We apply charge inefficiency track correction instead of 15% global correction.
- This efficiency correction is based on the study of $\gamma p \to (p)\pi^+\pi^-$, $\gamma p \to p(\pi^+)\pi^-$, $\gamma p \to p\pi^+(\pi^-)$ topology.
- Michael Kunkel use those topologies to determine detection efficiency for both data and monte carlo.
- Ideally, both data and monte carlo should result in the same detection efficiency.
- This procedure result in the maps of monte carlo over efficiency compare to the data as a function of vertex, momentum and angle.
- The overall inefficiency correction is 13% in average.



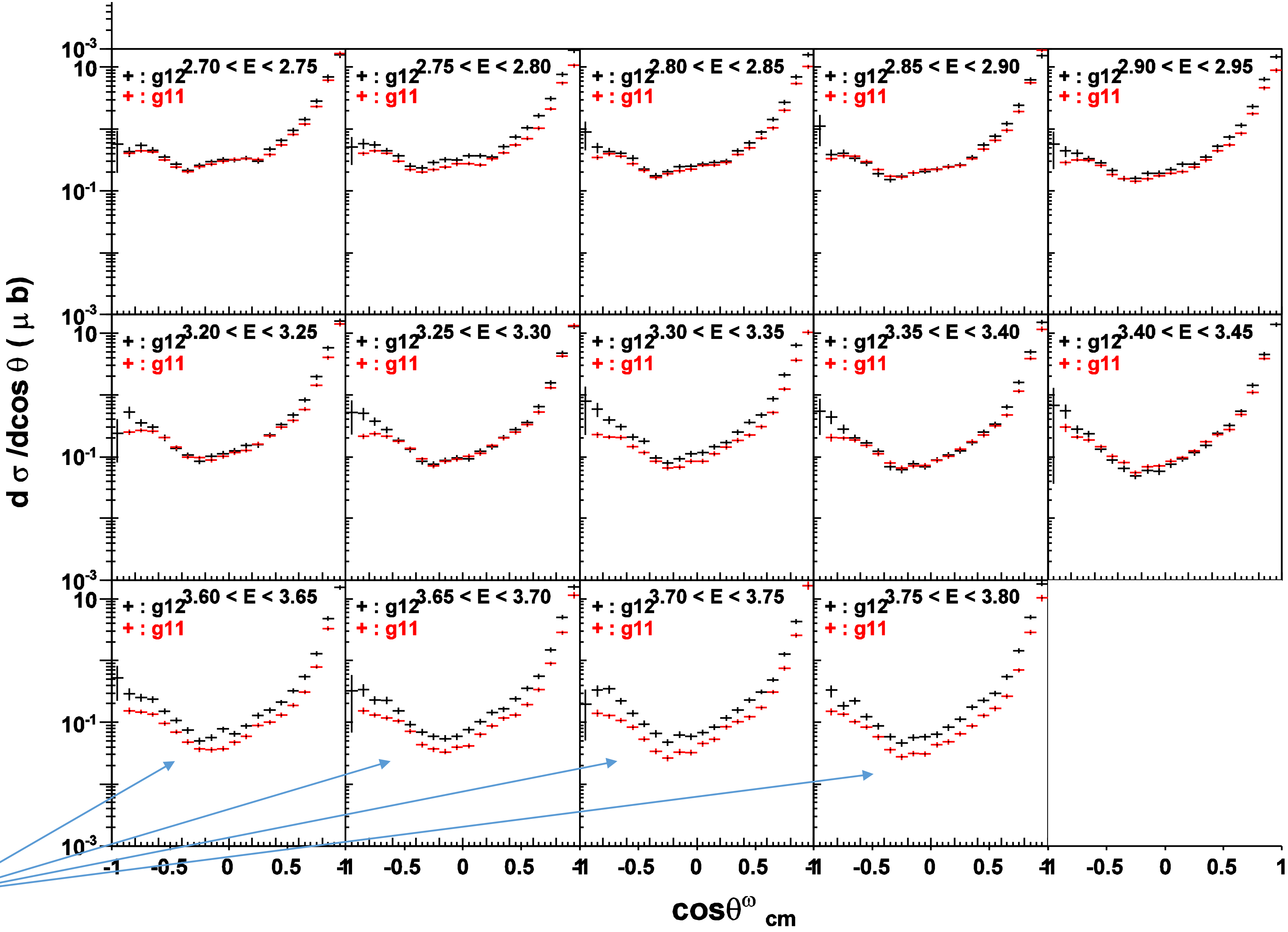
Preliminary result of the Differential Cross Section from 1.55 to 2.70 GeV in comparison with g11 results.



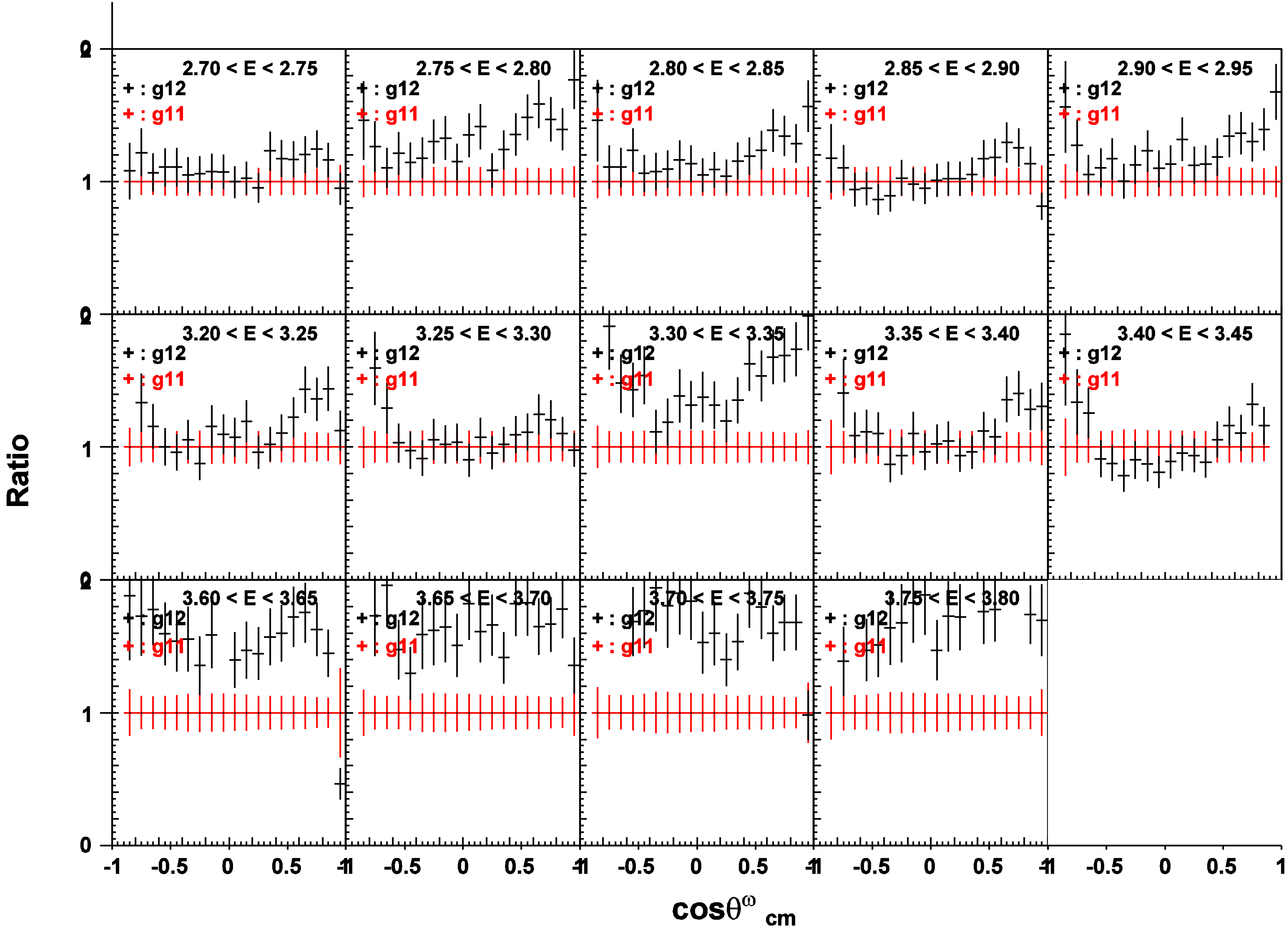
The Ratio of g12/g11 from 1.55 to 2.70 GeV



The Differential Cross Section from 2.70 to 3.80 GeV, In Comparison with g11 results.

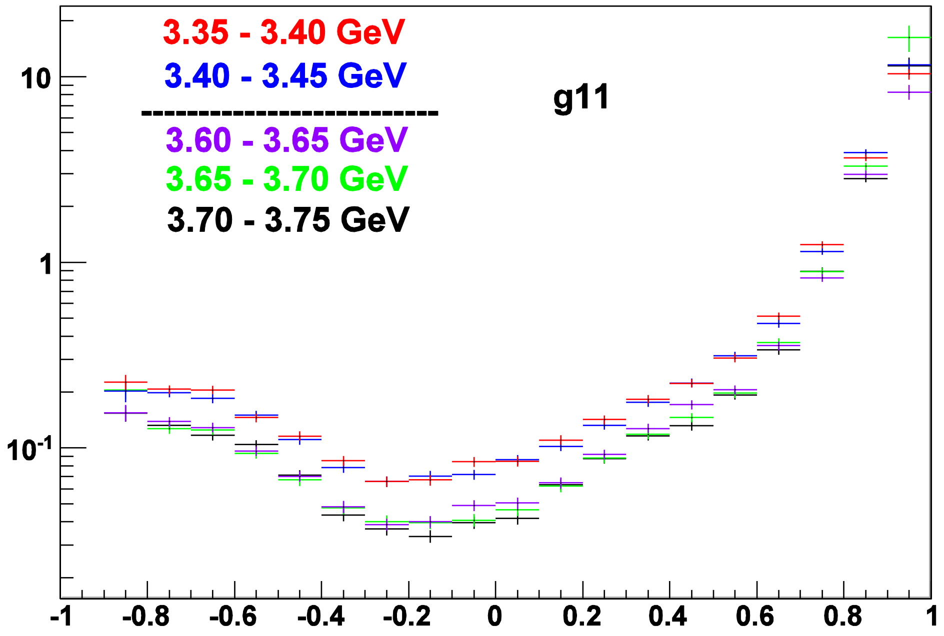


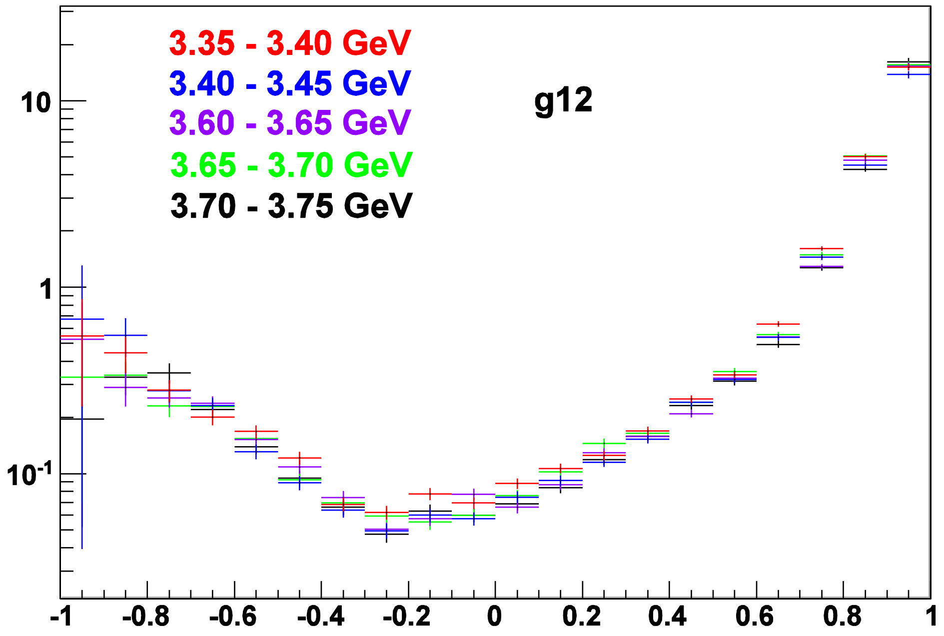
There are visible discrepancies start from 3.6 GeV



Ratio
2.70 < E < 2.75
2.75 < E < 2.80
2.80 < E < 2.85
2.85 < E < 2.90
2.90 < E < 2.95
3.20 < E < 3.25
3.25 < E < 3.30
3.30 < E < 3.35
3.35 < E < 3.40
3.40 < E < 3.45
3.60 < E < 3.65
3.65 < E < 3.70
3.70 < E < 3.75
3.75 < E < 3.80
+ : g12
+ : g11
$\cos\theta^{\omega}_{cm}$

Sudden drop in g11 Cross Section at 3.6 GeV

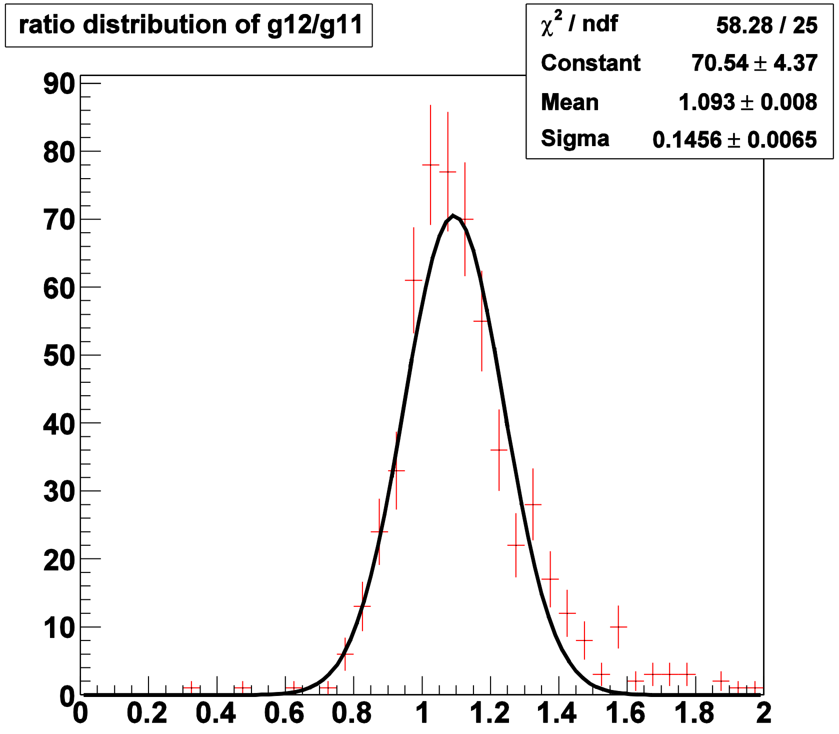




To study the discrepancy issue, I plot the cross section for both data from 3.35 – 3.75 GeV in one plot. Here we see that g11 has a sudden drop at 3.6 GeV.

Ratio of Cross Section and g12 Systematic Uncertainty

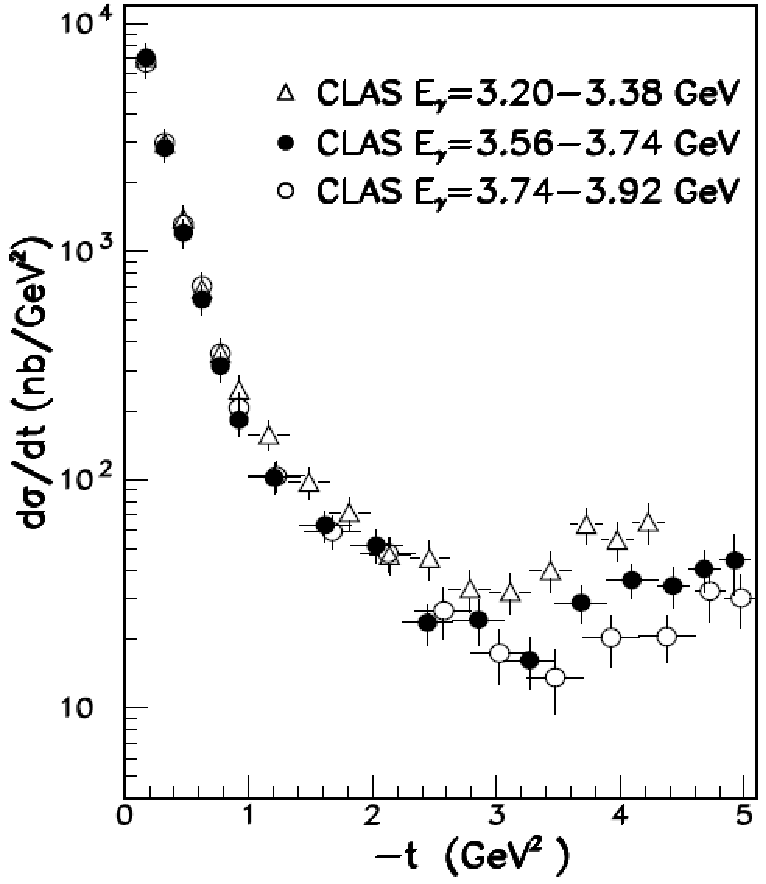
Ratio of g12/g11

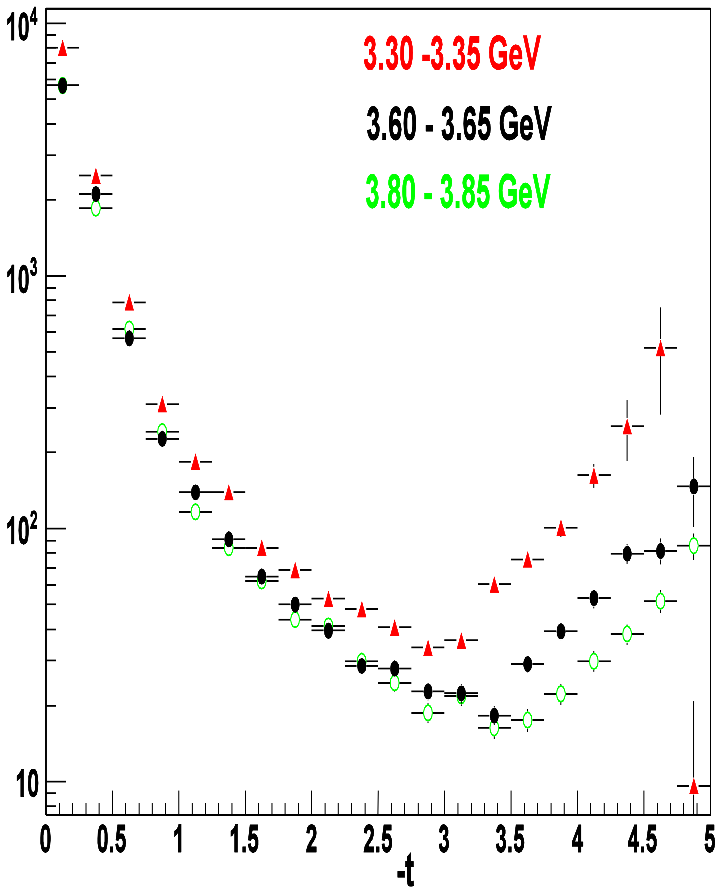


g12 Systematics Uncertainty

Source	% Uncertainty
Sector by Sector	5.9
Flux	1.7
Per-Track Inefficiency	3.0
Beam Polarization	3.3
Target	0.5
z-vertex	0.4
Fiducial Selection	~2.4
Normalization Uncertainty	1.8

Comparison with previous CLAS measurement by M. Battagliery *et al*

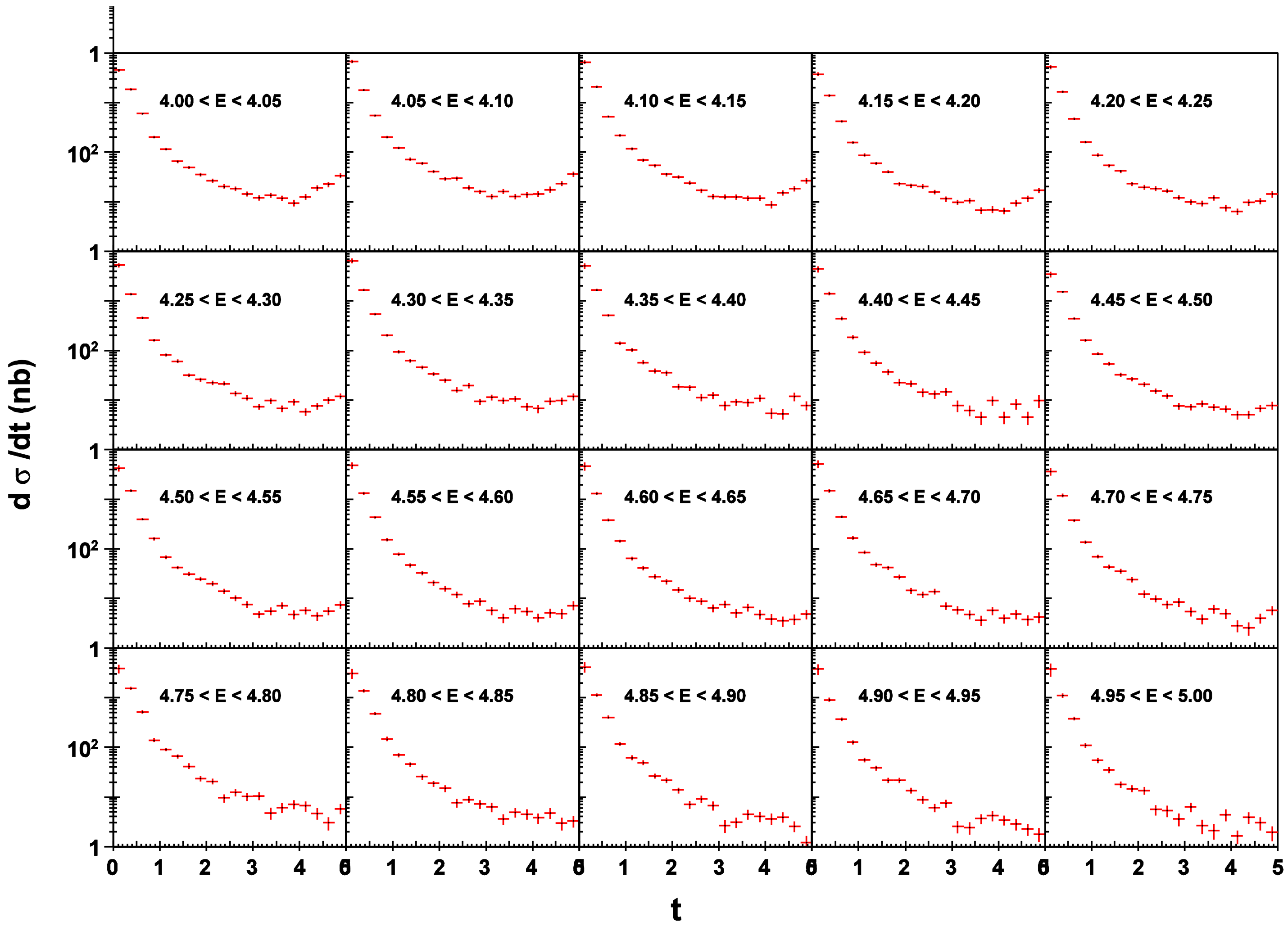




What We can Learn From g12 Omega Cross Section

Omega Cross Section in Higher Energy

Personal note : I will replace this picture with the picture that include additional fitting of pomeran exchange mechanism. It fit nicely at low t as expected.



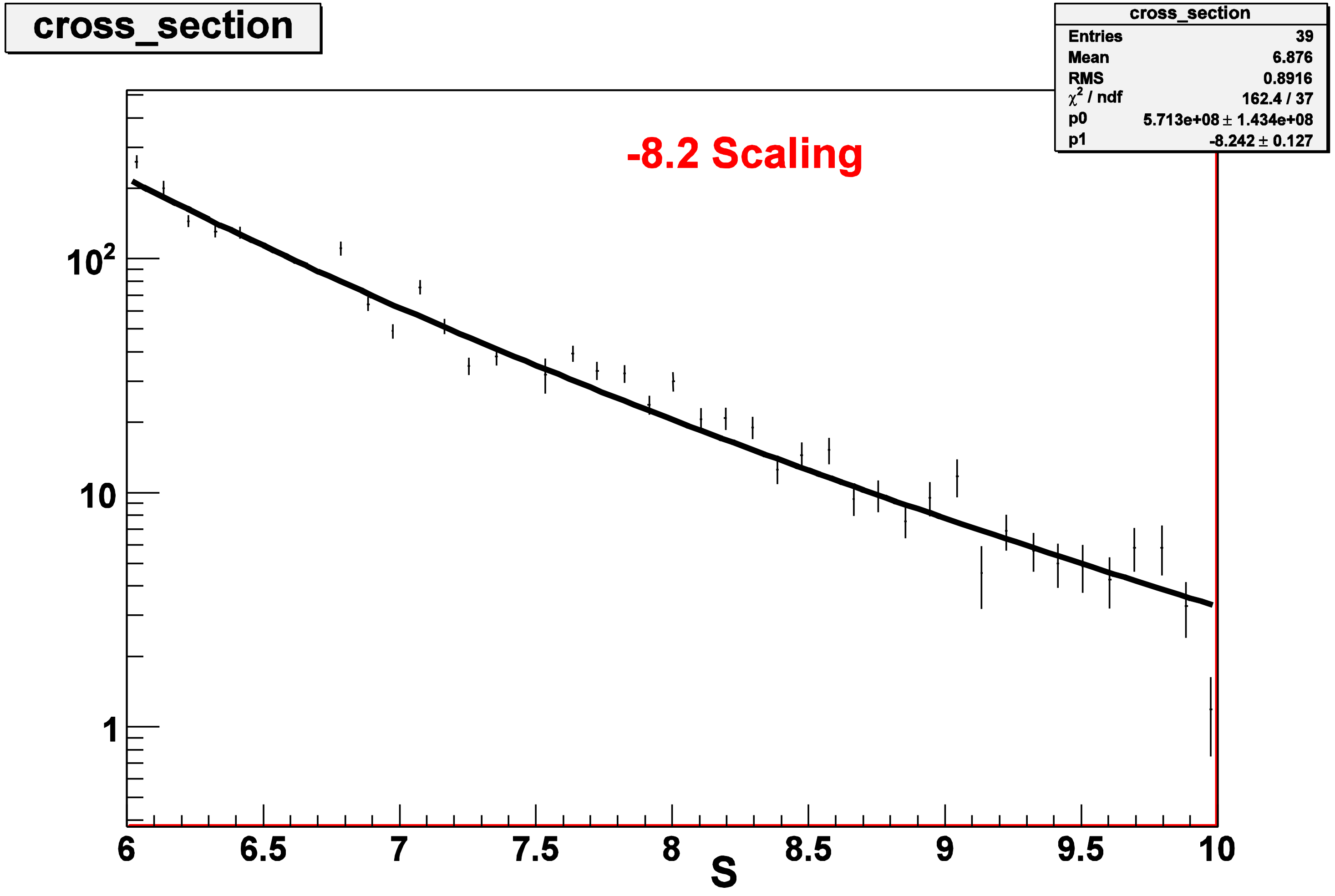
Scaling Behavior in Omega Cross Section

Perturbative QCD predict that the cross section at high energy follow the scaling behavior :

$$(d\sigma/dt)_{AB\to CD} \sim s^{-n+2} f(t/s)$$

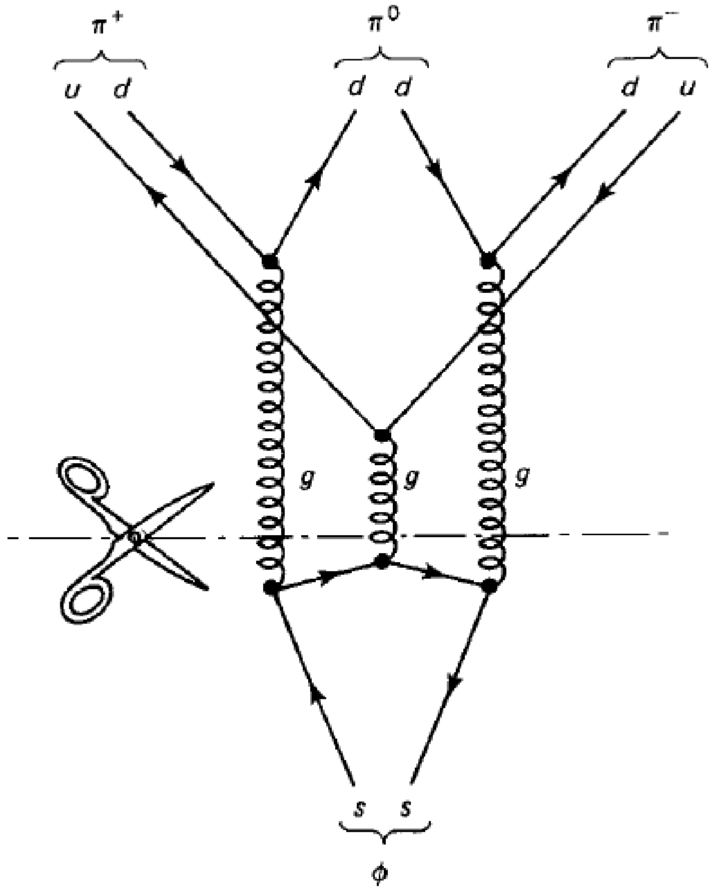
n is the total number of elementary field (constituent) that involved in initial and final state reactions.

Here we see the our cross section has scaling behavior from 6 < s < 10 GeV^2 and s/t = 2.



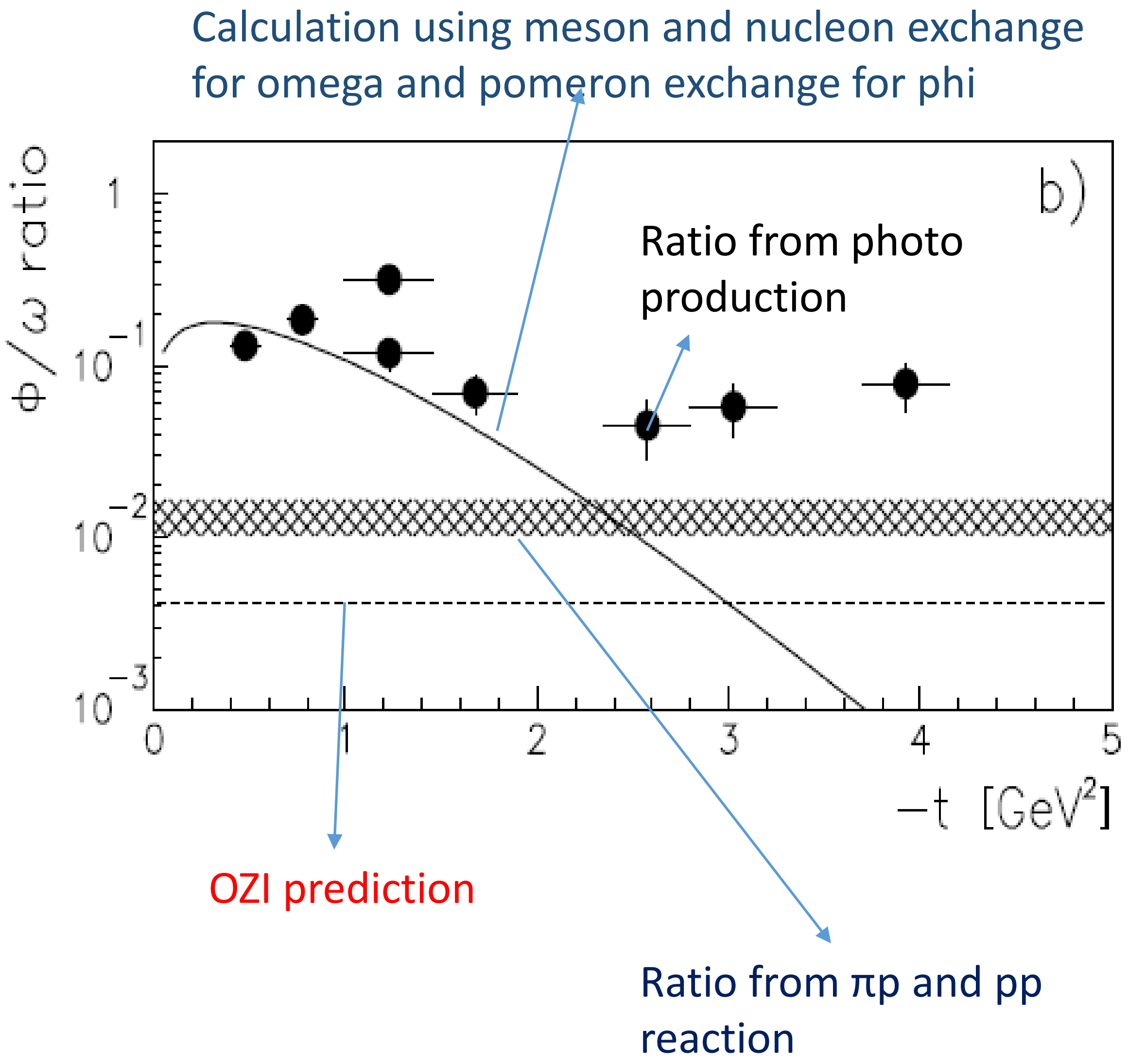
Study of OZI Rule Violation

- The fact that φ meson decays more often to Kaon rather than pion, stimulates Okubo, Zweig, and Iizuka (OZI) to make hypothesis that the diagram which can be cut by slicing gluon lines are suppressed.
- SU(3) mixing between omega and phi predict that the ratio of cross section between omega and phi is : 4.2×10^{-3}
- Such deviation from the ratio is called OZI rule violation.
- The study of OZI rule Violation help us to understand the production mechanism of phi and omega meson.



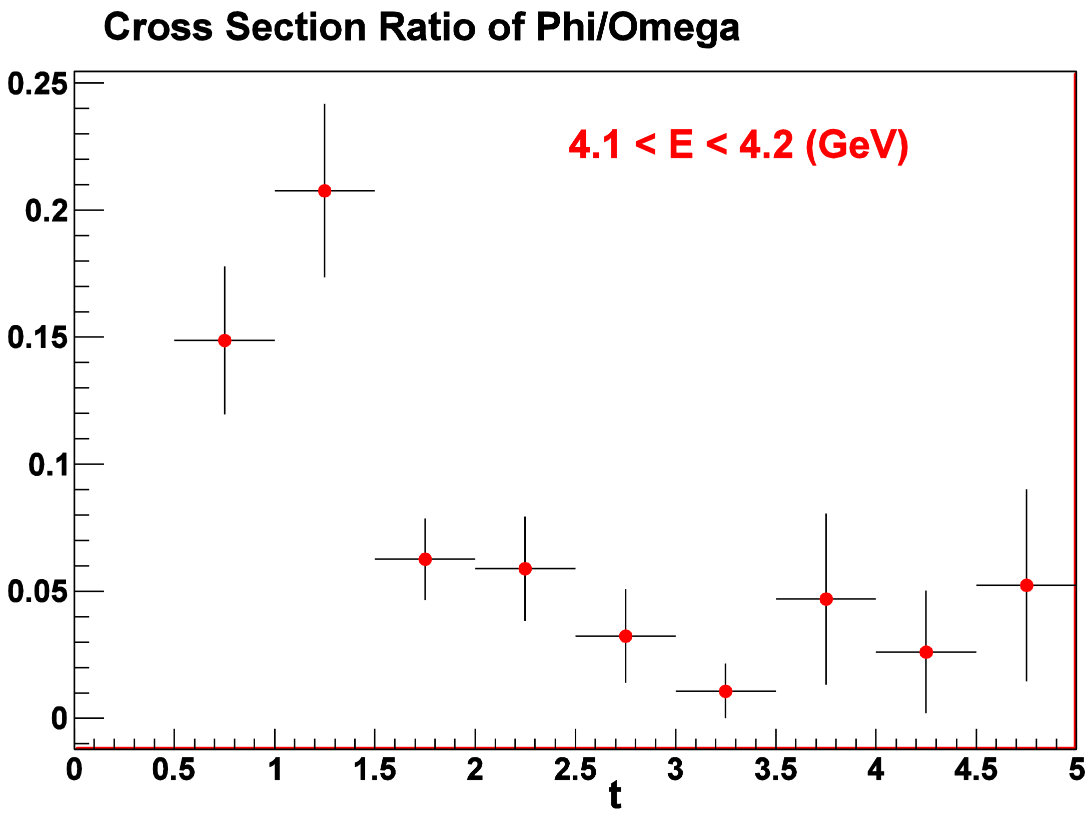
Study of OZI Rule Violation

- Recent study by A. Sibirtsev *et al* reveals that photo production has very strong OZI violation.
- The production mechanism of phi and omega meson also not well understood.
- Currently, γp -> pφ cross section through double charge kaon decay mode from g12 is being studied by Andrew Hurley at FSU.
- Along with the γp -> pω cross section from g12, we can extend the previous OZI Violation study to higher energy or higher momentum transfer.



Study of OZI Rule Violation

- This picture shows a (very) preliminary ratio of both cross section from g12. It is consistent with the previous study.
- It shows that the ratio at low momentum transfer is 0.15, can be understood in terms of the dominance of pomeron or two gluon exchange in φ photo production at low energy. (A. Sibirtsev *et al).*



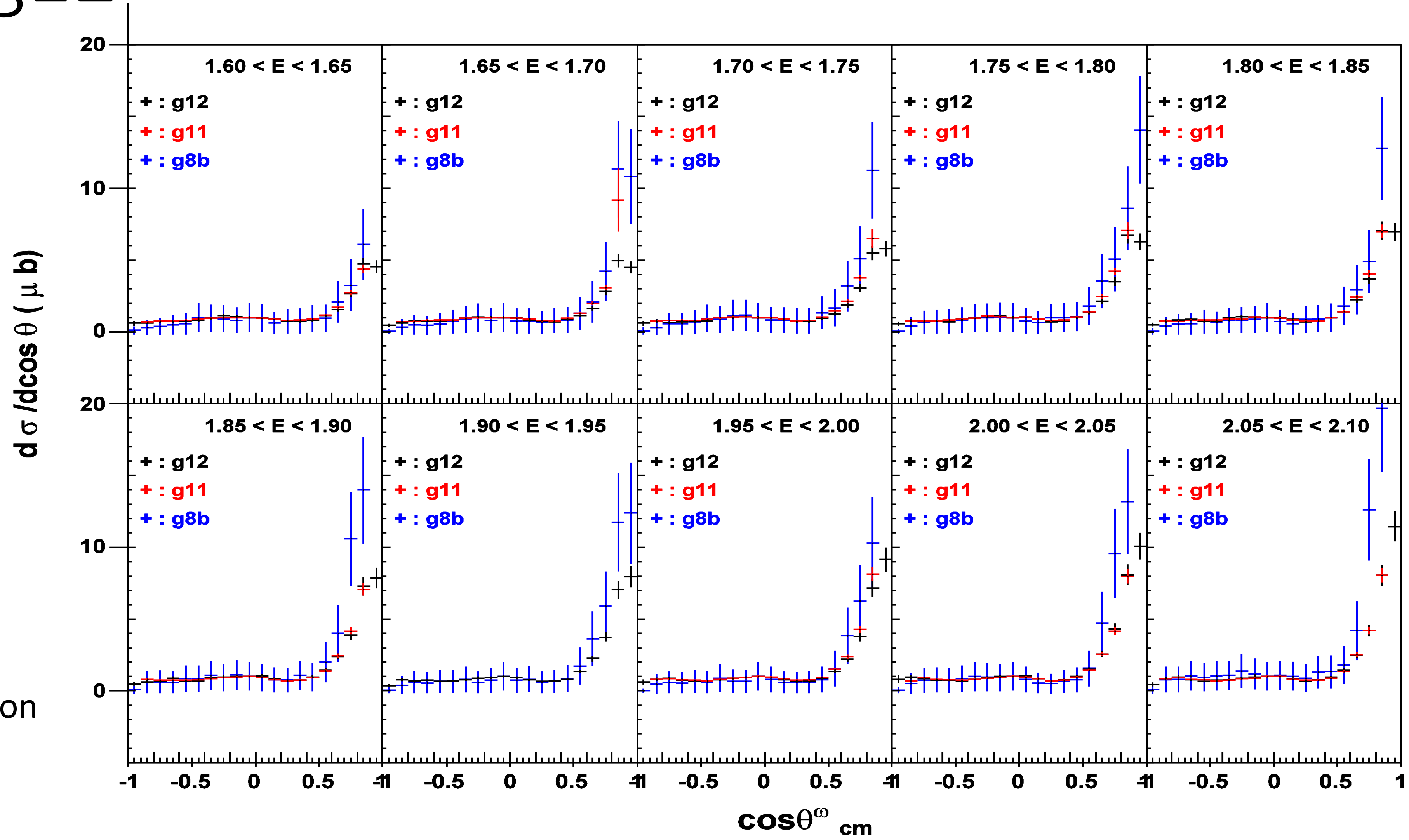
An Update of Omega Cross Section from CLAS-g8b

Normalized Omega Cross Section from g8b, g11 and g12

This picture shows the omega cross section, normalized to the central bin from g8b, g11 and g12.

The error bar for g8b is very large due to the limited number of monte carlo produced.

The photon flux determination for g8b is the next step.



Summary & Outlook

- We almost finalize the γp -> pω Cross section from g12, covering the energy from 1.55 Gev – 5.05 GeV.
- The average discrepancy with g11 measurement is 9.3 %, still on the same order with the error from both measurement.
- We have sent the g12 omega cross section at higher energy to Vincent (JPAC) for further study.
- We will study photon flux for g8b to obtain the absolute γp -> pω cross section.

Thank You