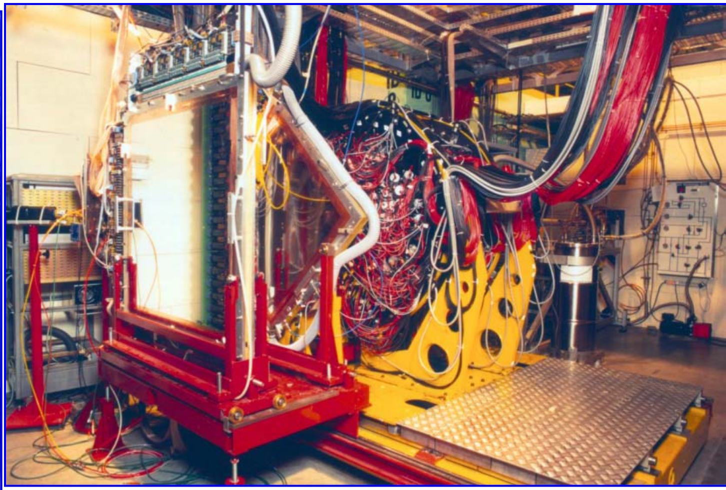
Updates on N*(1685).
New (preliminary) results on Compton scattering off the proton from GRAAL





Viacheslav Kuznetsov,
In collaboration with Nuclear Physics Group of Catania University
(V. Bellini, F. Mammoliti et al.,) and
Maxim Polyakov

HEPD seminar, PNPI, April 15 2014.

$N(1685)$ $?^?$

$I(J^P) = \frac{1}{2}(?^?)$ Status: $*$

OMITTED FROM SUMMARY TABLE

There is a small literature (which we do not try to cover) on this possible narrow state. See KUZNETSOV 11A, MART 11, and the other papers for further references. This state does not gain status by being a sought-after member of a baryon anti-decuplet.

$N(1685)$ MASS

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
~ 1670	JAEGLE	11	CBTP	$\gamma d \rightarrow \eta n (p)$
~ 1685	KUZNETSOV	11	GRAL	$\gamma d \rightarrow \gamma n (p)$
~ 1680	KUZNETSOV	07	GRAL	$\gamma d \rightarrow \eta n (p)$

$N(1685)$ WIDTH

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
~ 25	JAEGLE	11	CBTP	$\gamma d \rightarrow \eta n (p)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<30	KUZNETSOV	11	GRAL	$\gamma d \rightarrow \gamma n (p)$
<30	KUZNETSOV	07	GRAL	$\gamma d \rightarrow \eta n (p)$

$N(1685)$ REFERENCES

JAEGLE	11	EPJ A47 89	I. Jaegle *et al.*	(CBELSA/TAPS Collab.)
Also		PRL 100 252002	I. Jaegle *et al.*	(CBELSA/TAPS Collab.)
KUZNETSOV	11	PR C83 022201	V. Kuznetsov *et al.*	(GRAAL Collab.)
KUZNETSOV	11A	JETPL 94 503	V. Kuznetsov, M.V. Polyakov, M. Thurmann	(INRM+)
MART	11	PR D83 094015	T. Mart	(U. Indonesia)
KUZNETSOV	07	PL B647 23	V. Kuznetsov *et al.*	(GRAAL Collab.)

Outline:

- Introduction. Problem of ``missing resonances";
- Updates on N*(1685);

Some preliminaries from GRAAL:

- Width estimates
- Single pion photoproduction on the neutron;
- $\gamma n \to K\Lambda$, $\gamma n \to K\Sigma$
- Compton scattering on the proton at GRAAL: First outcome.

Resonant structure at 1.72 GeV

- $\gamma n \to K\Lambda$, $\gamma n \to K\Sigma$ from GRAAL, STAR and CLAS
- SAID PWA
- Updates from EPECUR

Problem of "Missing" Resonances

The models based on the idea of three constituent quarks predict rich spectrum of baryons resonances.

Baryon Summary Table

This short table gives the name, the quantum numbers (where known), and the status of baryons in the Review. Only the baryons with 3- or 4-star status are included in the main Baryon Summary Table. Due to insufficient data or uncertain interpretation, the other entries in the short table are not established as baryons. The names with masses are of baryons that decay strongly. For N, Δ, and Ξ resonances, the partial wave is indicated by the symbol $L_{2I,2J}$, where L is the orbital angular momuntum (S, P, D, ...), I is the isospin, and J is the total angular momentum. For Λ and Σ resonances, the symbol is $L_{I,2J}$.

p	P_{11}	****	$\Delta(1232)$	P_{33}	****	Λ	P_{01}	****	Σ^+	P_{11}	****	Ξ^0, Ξ^-	P_{11}	****
n	P_{11}	****	$\Delta(1600)$	P_{33}	***	$\Lambda(1405)$	S_{01}	****	Σ^0	P_{11}	****	$\Xi(1530)$	P_{13}	****
$N(1440)$	P_{11}	****	$\Delta(1620)$	S_{31}	****	$\Lambda(1520)$	D_{03}	****	Σ^-	P_{11}	****	$\Xi(1620)$		*
$N(1520)$	D_{13}	****	$\Delta(1700)$	D_{33}	****	$\Lambda(1600)$	P_{01}	***	$\Sigma(1385)$	P_{13}	****	$\Xi(1690)$		***
$N(1535)$	S_{11}	****	$\Delta(1750)$	P_{31}	*	$\Lambda(1670)$	S_{01}	****	$\Sigma(1480)$		*	$\Xi(1820)$	D_{13}	***
$N(1650)$	S_{11}	****	$\Delta(1900)$	S_{31}	**	$\Lambda(1690)$	D_{03}	****	$\Sigma(1560)$		**	$\Xi(1950)$		***
$N(1675)$	D_{15}	****	$\Delta(1905)$	F_{35}	****	$\Lambda(1800)$	S_{01}	***	$\Sigma(1580)$	D_{13}	**	$\Xi(2030)$		***
$N(1680)$	F_{15}	****	$\Delta(1910)$	P_{31}	****	$\Lambda(1810)$	P_{01}	***	$\Sigma(1620)$	S_{11}	**	$\Xi(2120)$		*
$N(1700)$	D_{13}	***	$\Delta(1920)$	P_{33}	***	$\Lambda(1820)$	F_{05}	****	$\Sigma(1660)$	P_{11}	***	$\Xi(2250)$		**
$N(1710)$	P_{11}	***	$\Delta(1930)$	D_{35}	***	$\Lambda(1830)$	D_{05}	****	$\Sigma(1670)$	D_{13}	****	$\Xi(2370)$		**
$N(1720)$	P_{13}	****	$\Delta(1940)$	D_{33}	*	$\Lambda(1890)$	P_{03}	****	$\Sigma(1690)$		**	$\Xi(2500)$		*
$N(1900)$	P_{13}	**	$\Delta(1950)$	F_{37}	****	$\Lambda(2000)$		*	$\Sigma(1750)$	S_{11}	***			
$N(1990)$	F_{17}	**	$\Delta(2000)$	F_{35}	**	$\Lambda(2020)$	F_{07}	*	$\Sigma(1770)$	P_{11}	*	Ω^-		****
$N(2000)$	F_{15}	**	$\Delta(2150)$	S_{31}	*	$\Lambda(2100)$	G_{07}	****	$\Sigma(1775)$	D_{15}	****	$\Omega(2250)^-$		***
$N(2080)$	D_{13}	**	$\Delta(2200)$	G_{37}	*	$\Lambda(2110)$	F_{05}	***	$\Sigma(1840)$	P_{13}	*	$\Omega(2380)^-$		**
$N(2090)$	S_{11}	*	$\Delta(2300)$	H_{39}	**	$\Lambda(2325)$	D_{03}	*	$\Sigma(1880)$	P_{11}	**	$\Omega(2470)^-$		**
$N(2100)$	P_{11}	*	$\Delta(2350)$	D_{35}	*	$\Lambda(2350)$	H_{09}	***	$\Sigma(1915)$	F_{15}	****			
$N(2190)$	G_{17}	****	$\Delta(2390)$	F_{37}	*	$\Lambda(2585)$		**	$\Sigma(1940)$	D_{13}	***	Λ_c^+		****
$N(2200)$	D_{15}	**	$\Delta(2400)$	G_{39}	**				$\Sigma(2000)$	S_{11}	*	$\Lambda_c(2593)^+$		***
$N(2220)$	H_{19}	****	$\Delta(2420)$	$H_{3,11}$	****				$\Sigma(2030)$	F_{17}	****	$\Lambda_c(2625)^+$		***
$N(2250)$	G_{19}	****	$\Delta(2750)$	$I_{3,13}$	**				$\Sigma(2070)$	F_{15}	*	$\Lambda_c(2765)^+$		*
$N(2600)$	$I_{1,11}$	***	$\Delta(2950)$	$K_{3,15}$	**				$\Sigma(2080)$	P_{13}	**	$\Lambda_c(2880)^+$		**
$N(2700)$	$K_{1,13}$	**							$\Sigma(2100)$	G_{17}	*	$\Sigma_c(2455)$		****
									$\Sigma(2250)$		***	$\Sigma_c(2520)$		***
									$\Sigma(2455)$		**	Ξ_c^+, Ξ_c^0		***
									$\Sigma(2620)$		**	$\Xi_c'^+, \Xi_c'^0$		***
									$\Sigma(3000)$		*	$\Xi_c(2645)$		***
									$\Sigma(3170)$		*	$\Xi_c(2790)$		***
												$\Xi_c(2815)$		***
												Ω_c^0		***
												Λ_b^0		***
												Ξ_b^0, Ξ_b^-		*

**** Existence is certain, and properties are at least fairly well explored.

*** Existence ranges from very likely to certain, but further confirmation is desirable and/or quantum numbers, branching fractions, etc. are not well determined.

** Evidence of existence is only fair.

* Evidence of existence is poor.

Despite of the availability of modern precise polarized data, many resonances predicted by quark models are not found in experiment.

Maybe it is timely to assume that the ``missing" resonances may not exist while the revision of theoretical predictions is needed?

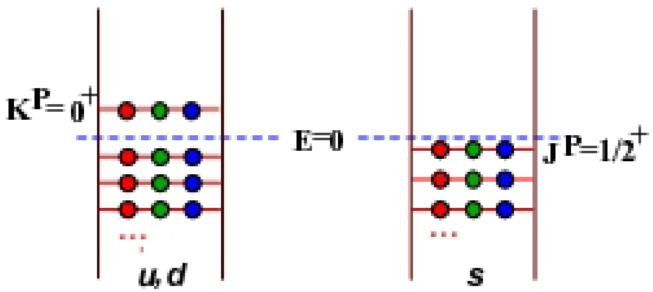
Mean-Field Approach (MFA)

Based on the papers

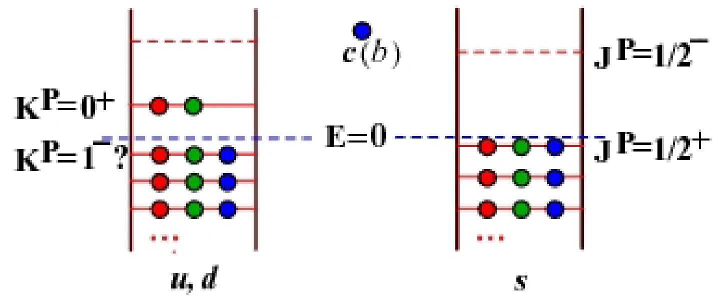
- D. Diakonov, `` Baryons resonances in the mean-field approach and the simple explanation of Θ+ pentaquark", Arxiv :0812.3418
- D.Diakonov, ``Prediction of New charmed and bottom exotics pentaquarks", Arxiv: 1003.2157
- **D. Diakonov, V. Petrov, and A.Vladimirov, ``Baryon resonances at large N_c, or Quark Nuclear Physics", Arxiv:1207.3679**

Baryons are multiquark systems stored in the mean field

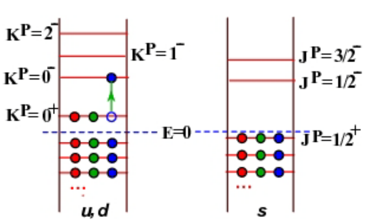
Proton and Neutron

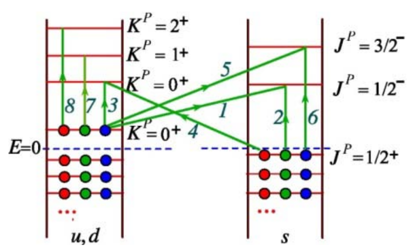


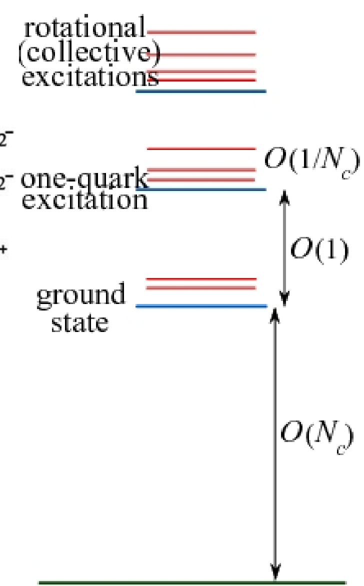
Charmed or bottom baryons



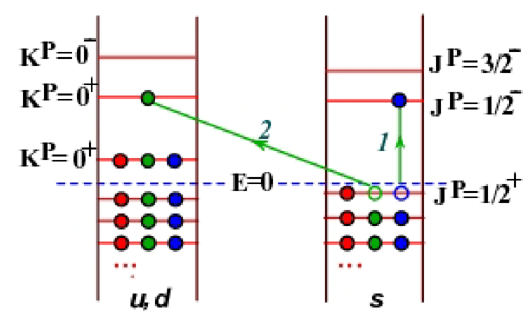
Baryon Resonances





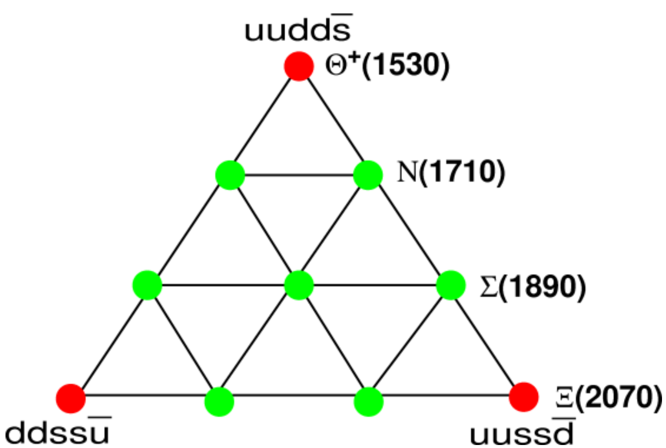


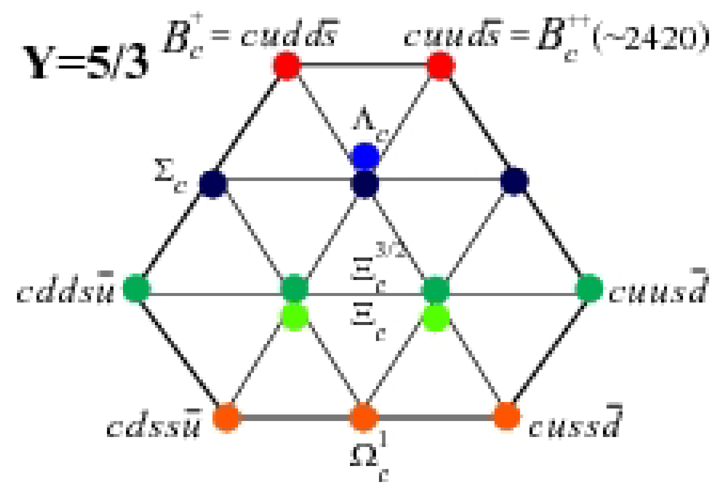
\`\`Pentaquarks" – specific transitions



MFA predicts the same **octet and decuplet of known baryons**. It ``..also predicts baryons resonances from the PDG Tables. **Neither of resonances below 2 GeV remain unaccounted for, and no additional resonances is predicted** except only one Δ(3/2+)" (citation from ***D. Diakonov, V. Petrov, and A. Vladimirov, ``Baryon resonances at large N_c, or Quark Nuclear Physics", Arxiv:1207.3679***)

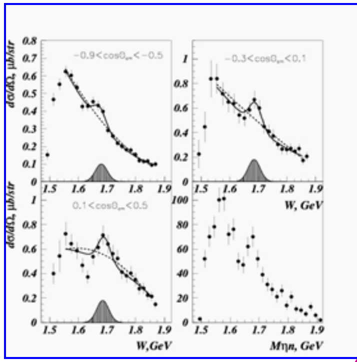
As byproduct, long-lived narrow exotic states (``pentaquarks") are predicted.



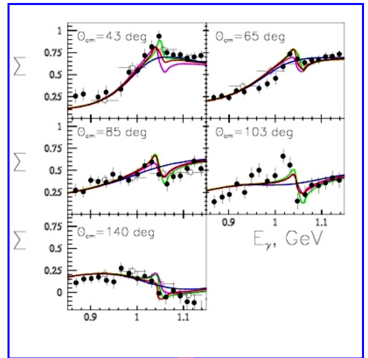


Search for exotics might be critical!

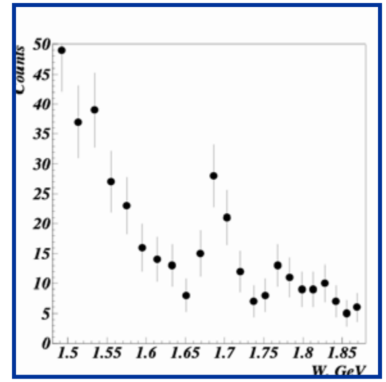
Graal γn→ηn



Graal γp→ηp

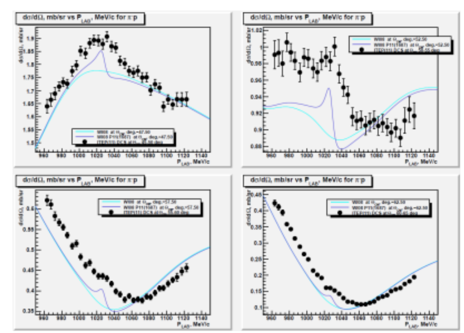


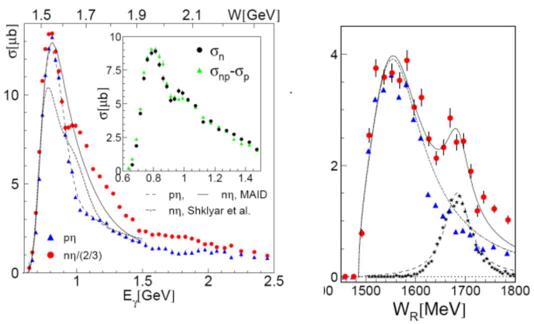
Graal γn→γn



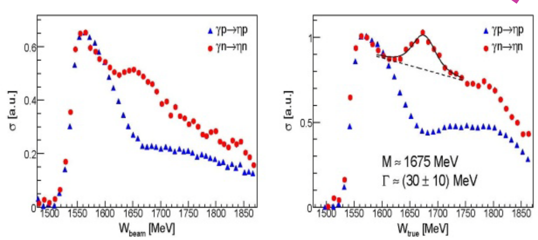
N*(1685)

EPECUR πp→πp

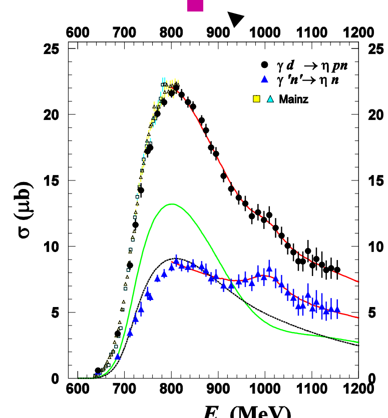




CBELSA/TAPS γn→ηn



Mainz γn→ηn



LNS-Sendai γn→ηn

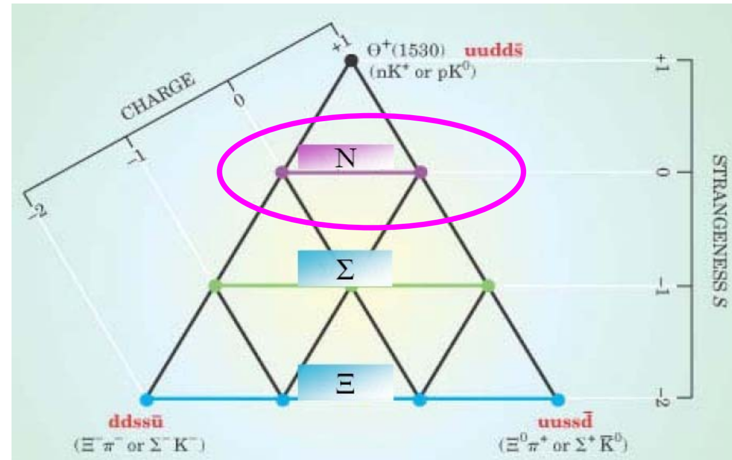
At present, the only explanation that accommodates all experimental findings is the existence of a narrow N(1685) resonance.

Properties of tentative N(1685)

- M=1685±10 MeV
- Γ≲30 MeV
- Isospin ½
- S=0
- Quantum numbers S11 or P11
- Strong photoexcitation on the neutron and suppressed (~100 times) photoexcitation on the proton
- Small branching ratio to πN final state

The existence of so narrow resonance was never predicted by quark models

Expected properties of the second member of the χQM antidecuplet [10,1/2-]



- M= 1650 – 1690 MeV
- Γ≲30 MeV
- Isospin ½
- S=0
- Strong photoexcitation on the neutron and suppressed (~100 times) photoexcitation on the proton
- S Small branching ratio to πN final state
- Quantum numbers P11

Interpretations:

Narrow resonance

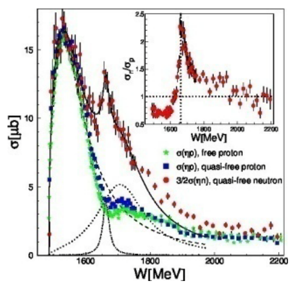
- Y.Azimov, V.Kuznetsov, M.Polaykov, and I.Strakovsky, Eur. Phys. J. A **25**, 325, 2005.
- A.Fix, L.Tiator, and M.Polyakov, Eur. Phys. J. A **32**, 311, 2007.
- K.S.Choi, S.I. Nam, A.Hosaka, and H-C.Kim, Phys. Lett. B **636**, 253, 2006.
- K.S.Choi, S.I. Nam, A.Hosaka, and H-C.Kim, Prog. Theor. Phys. Suppl. **168**, 97, 2008.
- G.S.Yang, H.S.Kim, Arxiv:1204.5644

- **Interference of Known resonances** V. Shklyar, H. Lenske , U. Mosel , PLB650 (2007) 172 (Giessen group): A. Anisovich et al. EPJA 41, 13 (2009), hep-ph/0809.3340 (Bonn-Gatchina group); X.-H. Zong and Q.Zhao, Arxiv:1106.2892

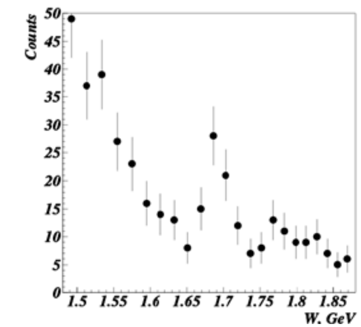
- **Intermediate sub-threshold meson-nucleon state**

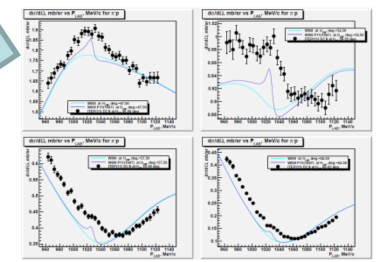
M.Doring, K. Nakayama, PLB683, 145 (2010), nucl-th/0909.3538

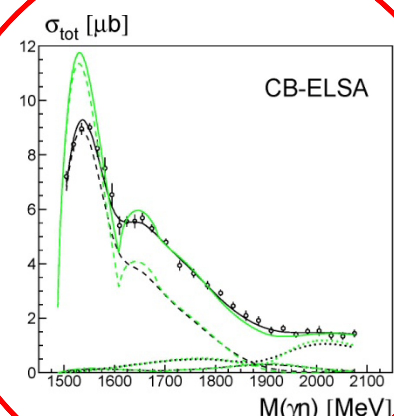
Interference of known resonances



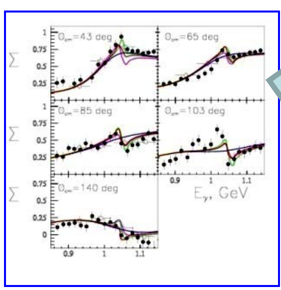
Real width is more narrow



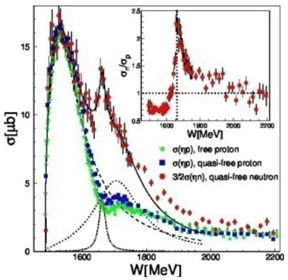




Unlikely can be seen in Compton and pion scattering as these reactions are governed by other resonances

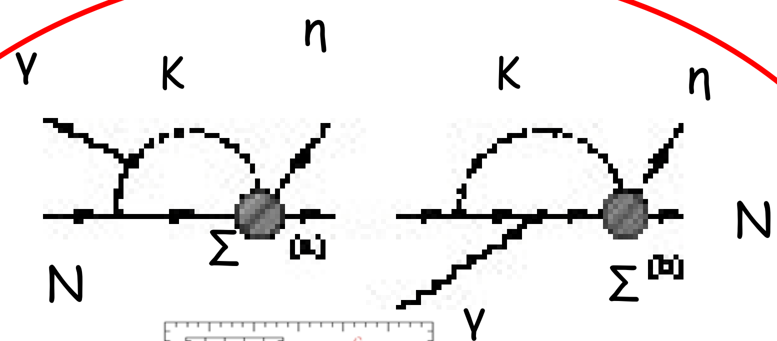


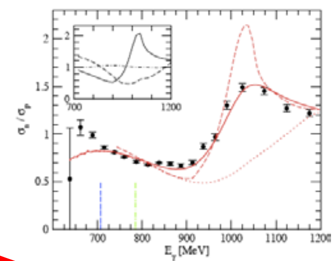
Doesn't explain the structure on the free proton



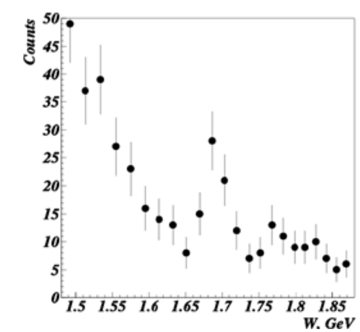
Cusp effect: open questions

Real width is essentially more narrow





Unlikely can be seen in Compton scattering



Why it is not seen in π^0 photoproduction on the neutron and on the proton while it is seen in $\pi^- p \to \pi^- p$?
Why there is no similar peak corresponding to the virtual KΛ ?

New results from A2@MaMic

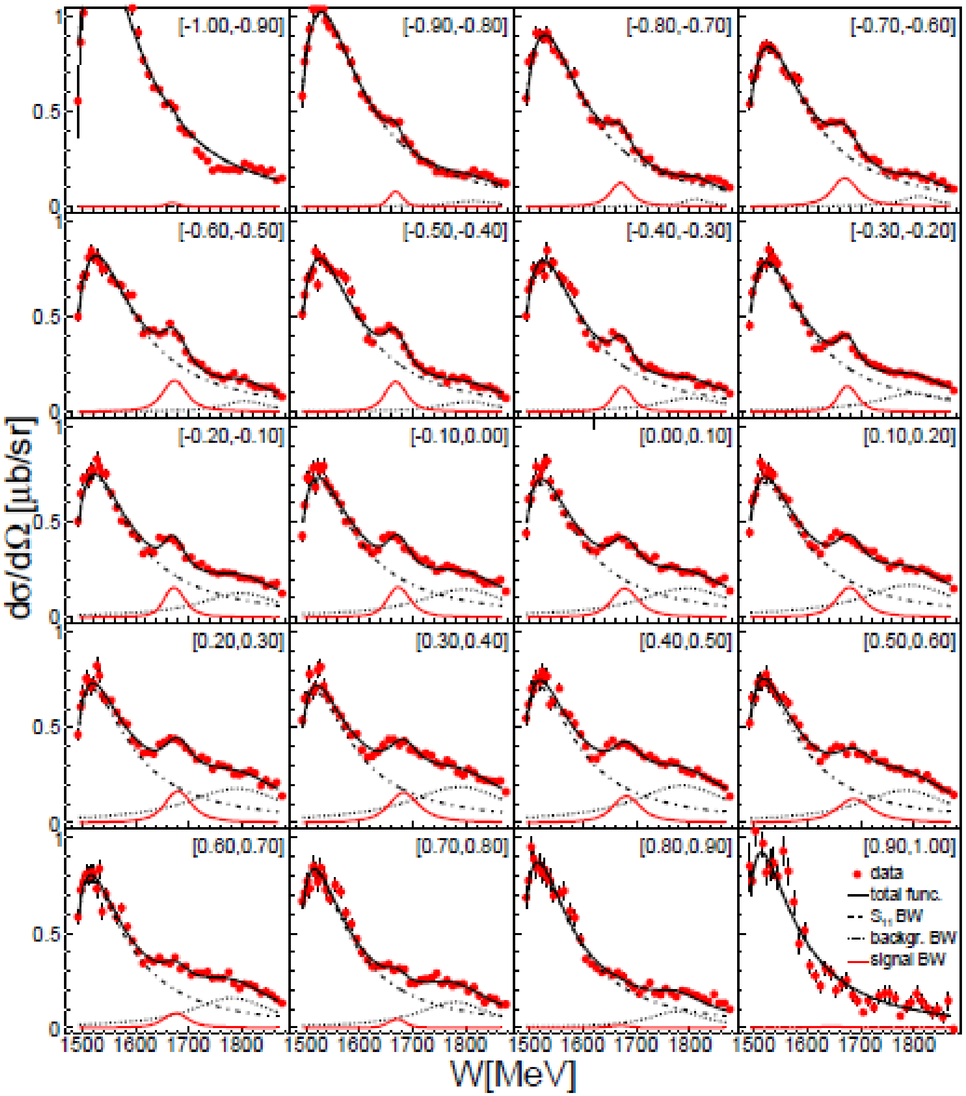
A narrow structure in the excitation function of eta-photoproduction off the neutron

A2 Collaboration (D. Werthmuller (Basel U.) *et al.*). Nov 12, 2013.
Published in **Phys.Rev.Lett. 111 (2013) 232001**
e-Print: arXiv:1311.2781 **[nucl-ex]** |

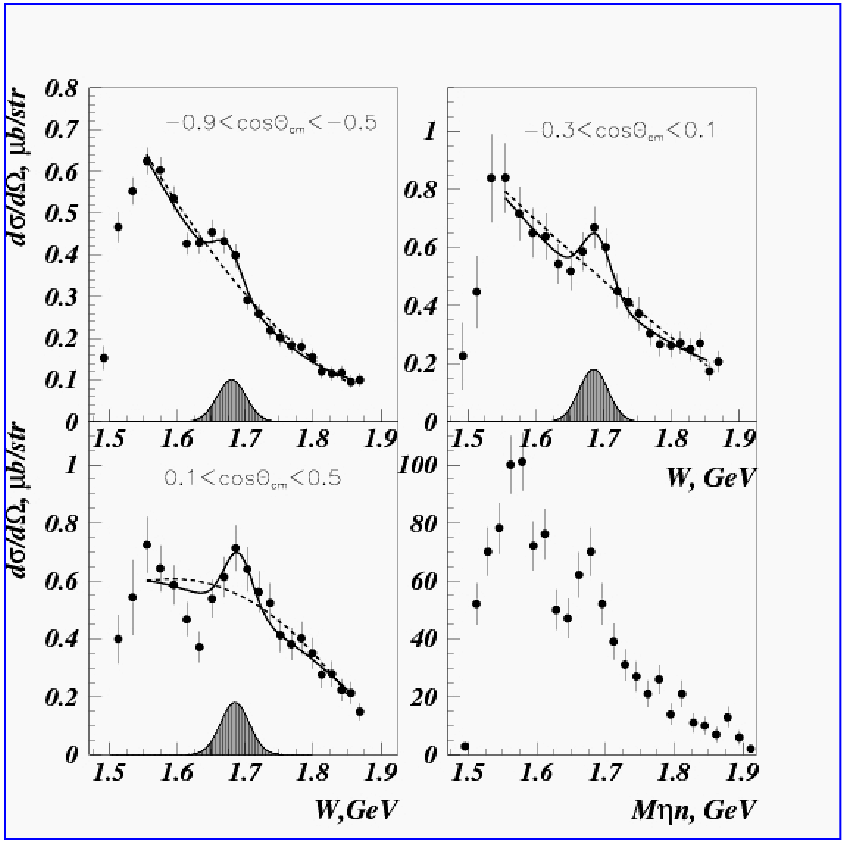
Photo- and electroproduction of mesons has become a primary tool for the investigation of the excitation spectrum of the nucleon [1–4]. So far, most efforts have been devoted to the excitation spectrum of the proton, simply because free neutron targets are not available. However, since the electromagnetic excitations are isospin dependent, such measurements are indispensable. Experiments therefore have to make use of quasi-free neutrons bound in light nuclei, in particular in the deuteron. The specific problems of using quasi-free neutron targets have been studied in detail during the last few years [5–8].

An exciting result was a narrow structure in the excitation function of η-photoproduction off the neutron, which was first reported from the GRAAL experiment in Grenoble [9] and subsequently seen in measurements at ELSA in Bonn [5, 6], and at LNS in Sendai [10]. The study of η-photoproduction off the neutron was motivated by several unresolved issues. Prior to the above mentioned experiments, η-photoproduction off the deuteron (or other light nuclear targets) had been studied with incident photon energies below 1 GeV [11–15]. There, it is dominated by the excitation of the $S_{11}(1535)$ resonance [16, 17] (see [1] for a summary). However, reaction models like the η-MAID model [18] predicted a rapid change of the neutron/proton cross section ratio at higher incident-photon energies. The electromagnetic excitation of the

Surprisingly, all experiments which tried to identify a corresponding structure in the $\gamma n \to \eta n$ reaction reported a positive result [5, 6, 9, 10]. Recently, evidence for this structure was also claimed for the $\gamma n \to \gamma' n$ reaction[24].
The Review of Particle Physics [23] lists the results as tentative evidence for a one-star isospin I = 1/2 nucleon resonance close to 1.68 GeV with narrow width and otherwise unknown properties.



Recent data from A2@MaMiC

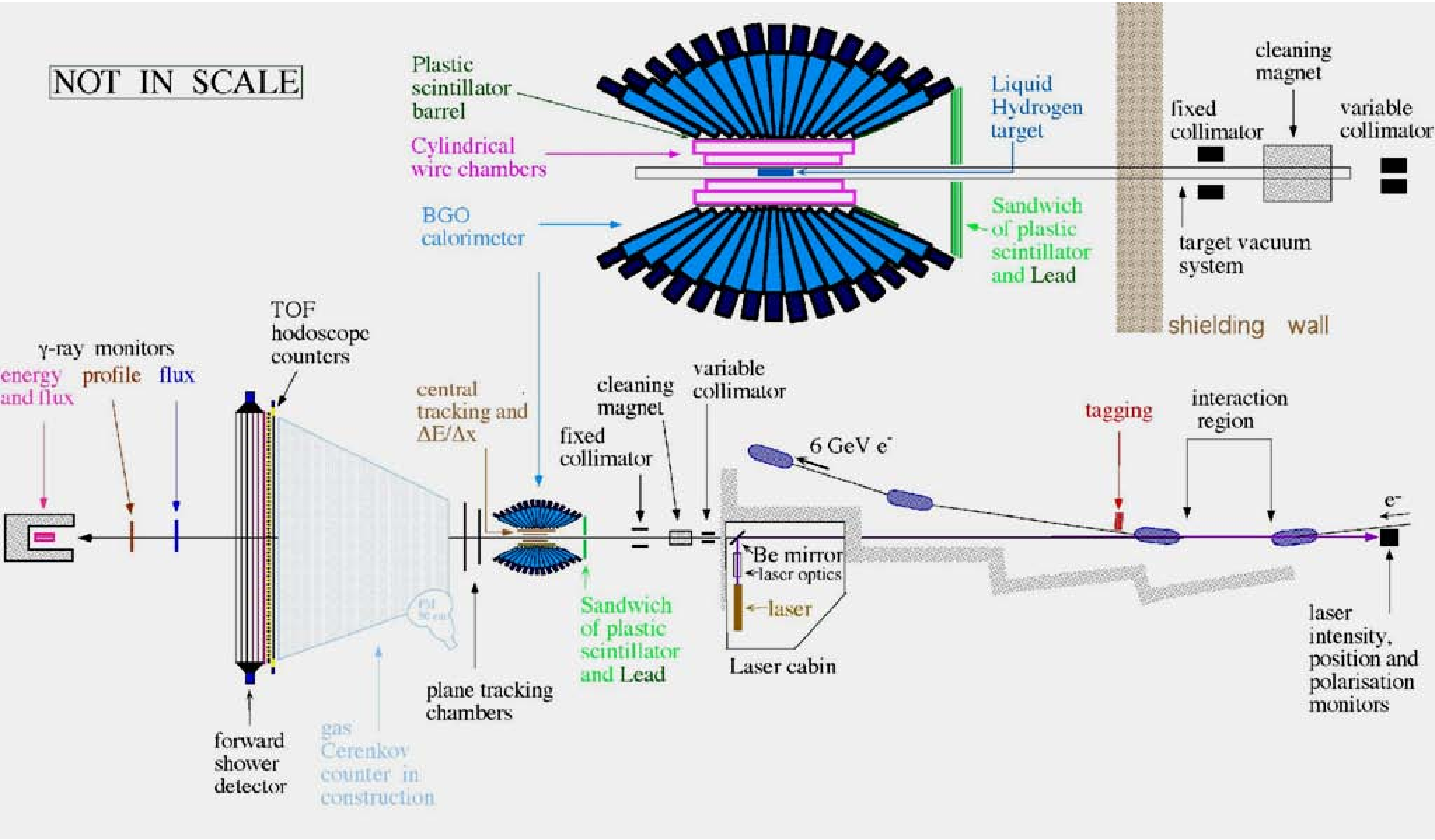


First GRAAL results on γn→ηn
V.Kuznetsov et al., Phys. Lett. B647, 23, 2007(hep-ex/0606065)

Some Preliminaries from GRAAL

- Cut-dependence of quasi-free cross section and the width of N*(1685);
- Search for N*(1685) in $\gamma n \to \pi^- p$;
- Compton scattering on the proton $\gamma p \to \gamma p$;

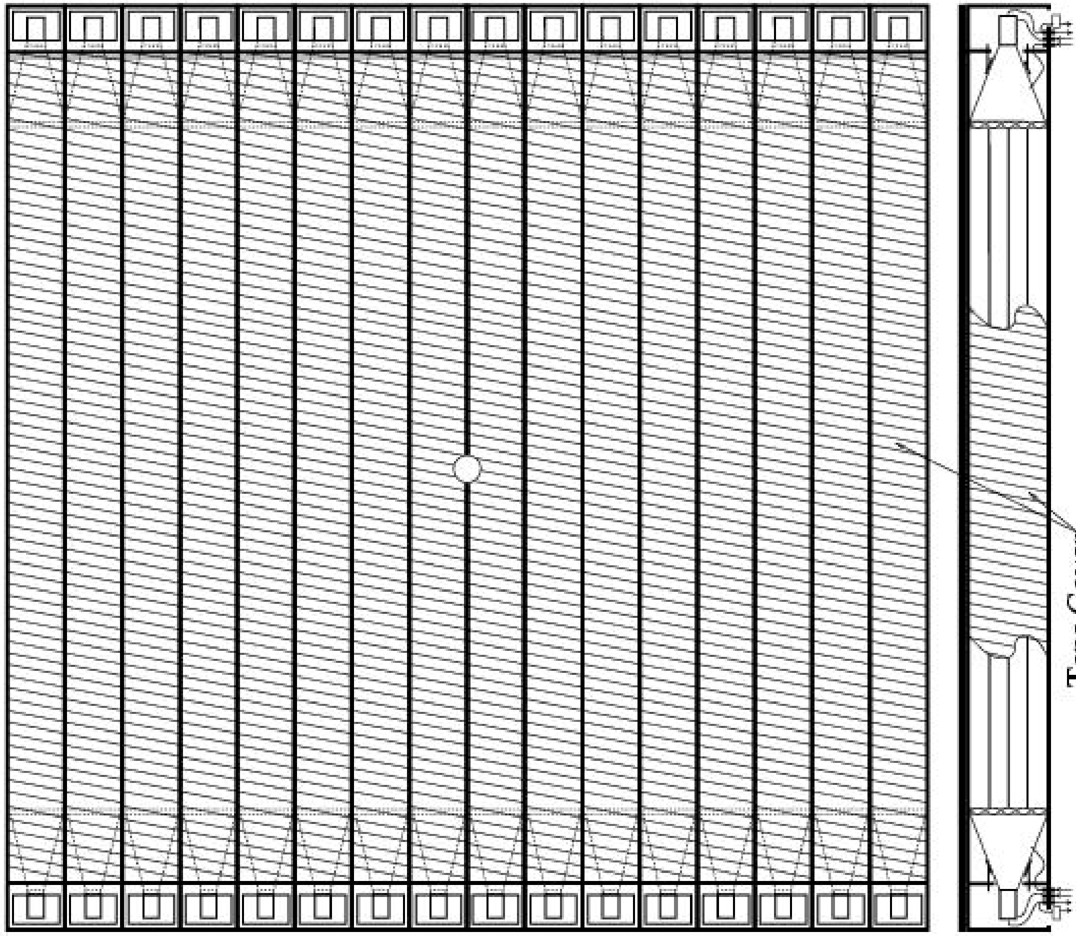
GRAAL Setup


NOT IN SCALE
Plastic scintillator barrel
Cylindrical wire chambers
BGO calorimeter
Liquid Hydrogen target
Sandwich of plastic scintillator and Lead
fixed collimator
cleaning magnet
variable collimator
target vacuum system
shielding wall
TOF hodoscope counters
γ-ray monitors
energy and flux
profile
flux
central tracking and ΔE/Δx
cleaning magnet
variable collimator
fixed collimator
6 GeV e⁻
tagging
interaction region
e⁻
Be mirror
laser optics
laser
Laser cabin
Sandwich of plastic scintillator and Lead
plane tracking chambers
forward shower detector
gas Cerenkov counter in construction
laser intensity, position and polarisation monitors

GRAAL forward lead-scintillator wall (``Russian Wall")

V.Kouznetsov et al., NIM A **487** (2002) 396.

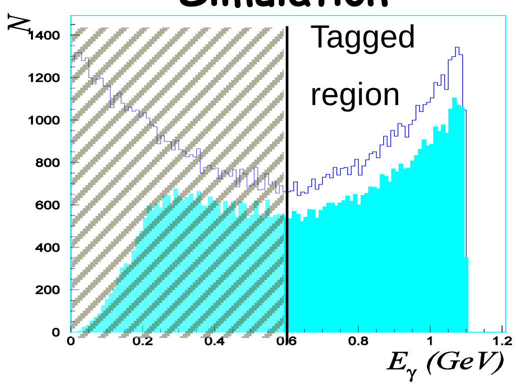
An assembly of 16 modules. Each module is a sandwich of four 3000x40 mm2 bars with 3 mm thick lead plates between them. A 25 mm thick steel plate at the front of the module acts as a main converter and as a module support.



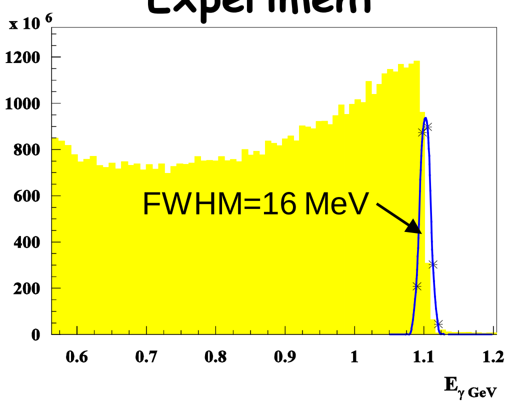
Compton Beam

Energy Spectrum

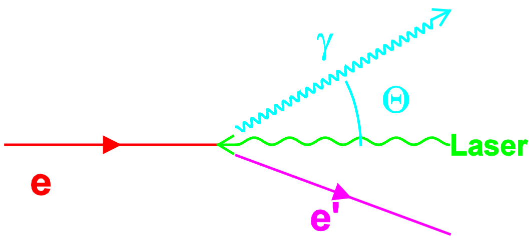
Simulation



Experiment



$\Phi_{tag} \sim 10^6\ \gamma/s$

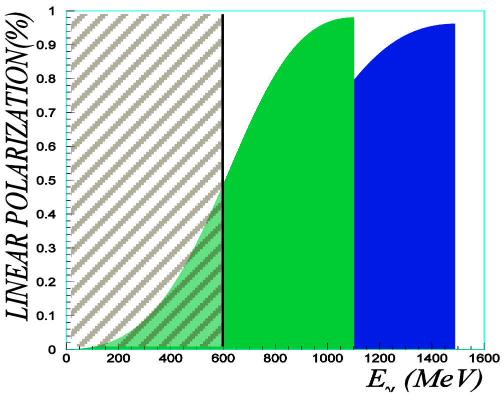


$E_e^{ESRF} = 6027.6 \pm 0.6$ MeV

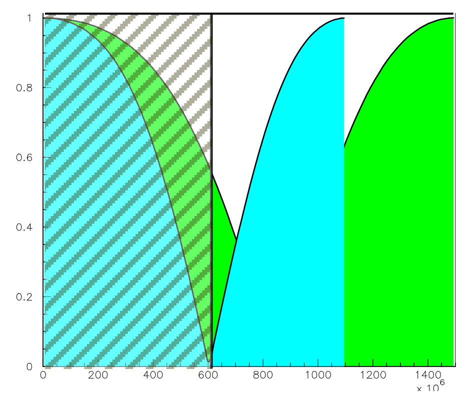
λ(nm)	E_γ(MeV)
514	1100
351	1483
300	1660

Polarisation

Linear



Circular



What does mean quasi-free cross section?

To fit experimental data , the cross section calculated for the free neutron, is then smeared by Fermi motion using the deuteron wave function

This formula is from A.Anisovich et al., Hep-ph/0809.3340

$$\frac{d^2\sigma_{\rm qf}}{d\Theta}(W,\theta_{cm}) \propto \int d|\vec{p}_N||\vec{p}_N|^2 f^2(\vec{p}_N)\frac{d\cos(\theta_N)d\phi_N}{4\pi}\frac{d\sigma_{\rm free}}{d\Theta}(W^*,\theta^*_{cm})d\Phi$$

Cut-dependent Integral

Cut-dependent function

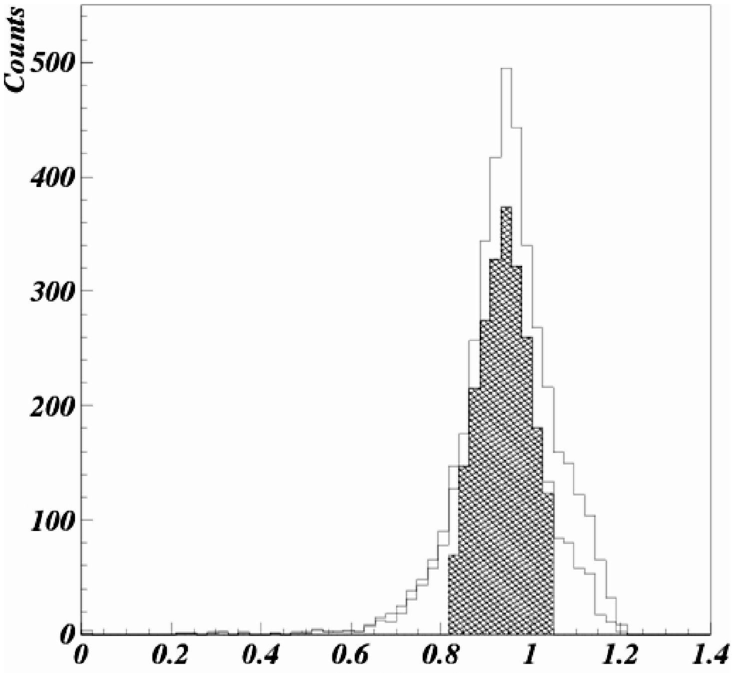
Cut-dependent FSI effects(not discussed here)

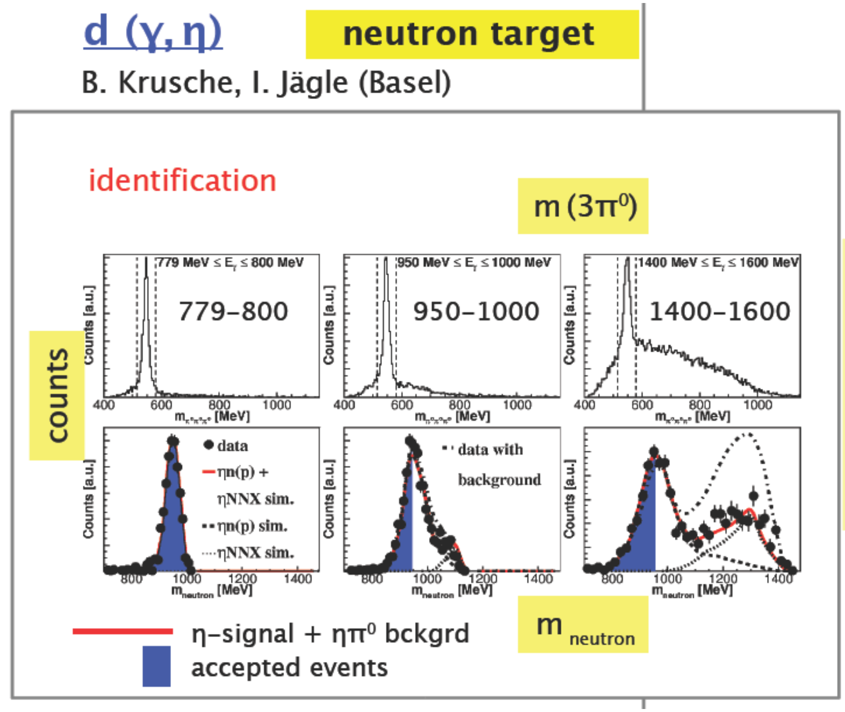
Is this formula applicable for experimental data?

Dependence on the cut on the neutron missing mass $MM(\gamma n,\eta)=\mathrm{sqrt}((E_\gamma+m_n)_2-\mathbf{p}^2_n)$

As well as the qf cross section. MM is calculated assuming the target neutron to be at rest.

GRAAL and CBTAPS-ELSA groups used different cuts on the neutron missing mass.





GRAAL: Symmetric cut around the neutron mass

CBELSA-TAPS: Asymmetric cut $MM(\gamma n,\eta)<0.94$

Could this cut affect the experimental cross sections?

Simple Calculations by M.Polyakov

Smearing of the qf cross section is

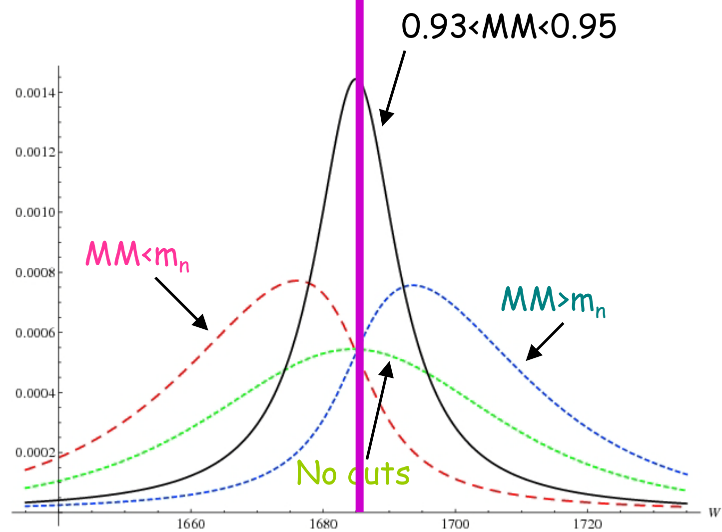
$$W^* - W \approx p_z E_\gamma / W$$

W* is the real center-of-mass energy, W is deduced from the photon energy assuming the target neutron to be at rest (the quantity really used in experiment). The smearing is mostly defined by the Z-projection of the momentum of the target neutron on the beam axis.

$$MM = m_n + p_z \alpha\left(W, \cos\theta_{\rm cm}\right) + \frac{|\vec{p}_\perp||p^*_\eta|}{m_n} \sin\theta_{\rm cm} \cos\Phi$$

Neutron missing mass is also smeared by Fermi motion! Any cut on the neutron missing mass MM means the selection of events with certain values of the Z-component, and, therefore, affects the smearing of the cross section!

$$\alpha\left(W, \cos\theta_{\rm cm}\right) \equiv \frac{E_\gamma}{m_n}\left[1 - \frac{E^*_\eta}{W} - \frac{W^2 + m_n^2}{W^2 - m_n^2}\frac{|p^*_\eta|}{W}\cos\theta_{\rm cm}\right] \geq 0$$



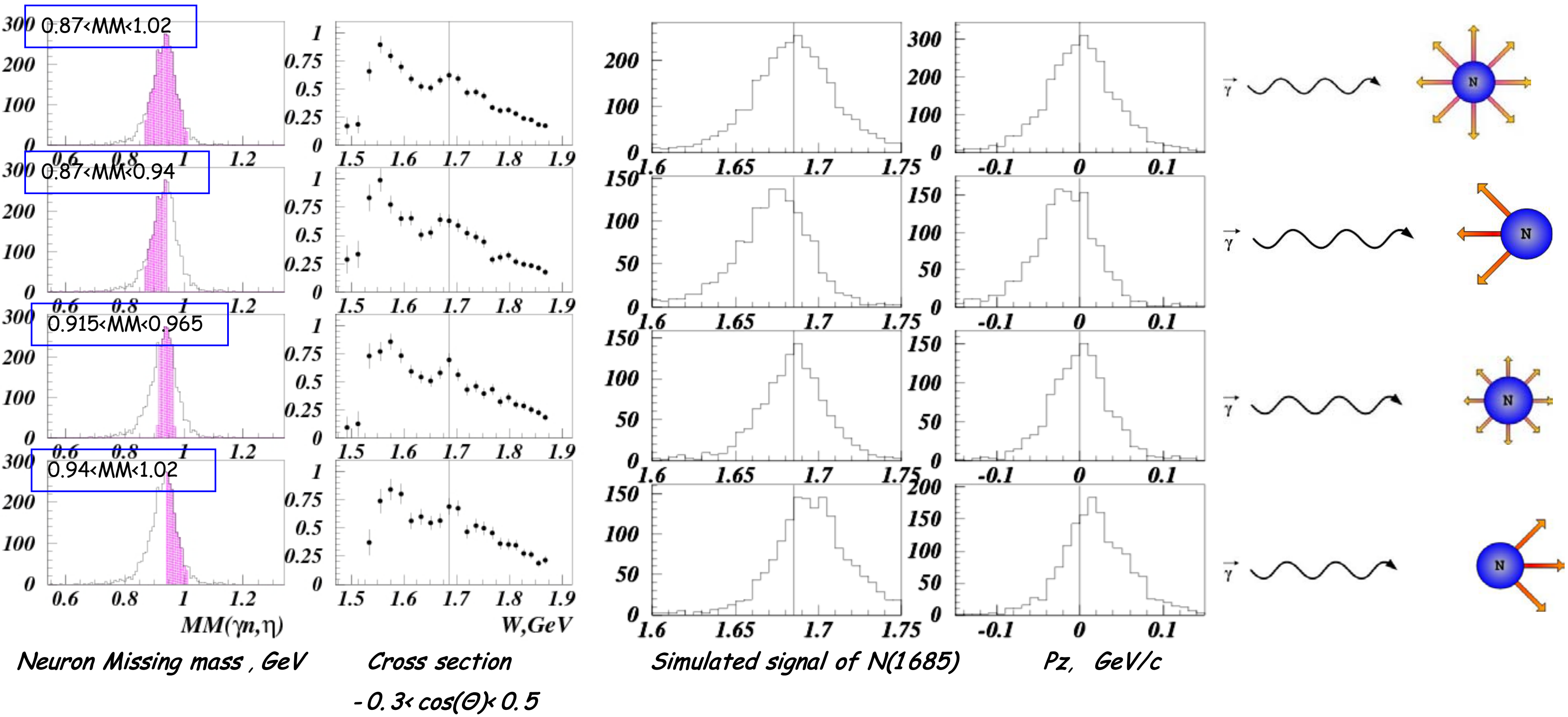
Smearing of a narrow N(1685) resonance with different cuts on the neutron missing mass.

These cuts shift the peak position!

$\gamma n \rightarrow \eta n$ *cross* section with different cuts on the neutron missing mass

Experimental Data

Simulations

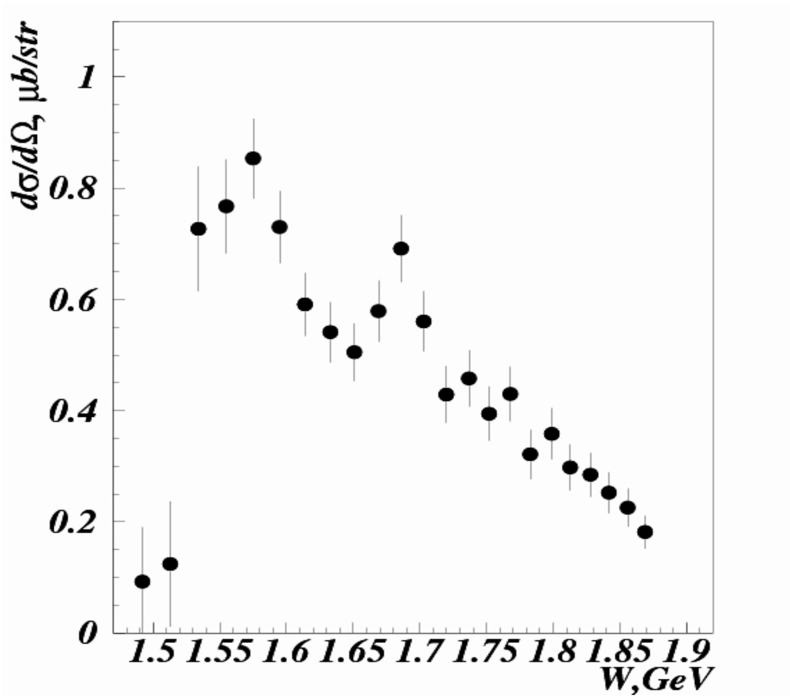


The width and the position of the peak in the $\gamma n \rightarrow \eta n$ cross section are affected by the cut on the neutron missing mass!

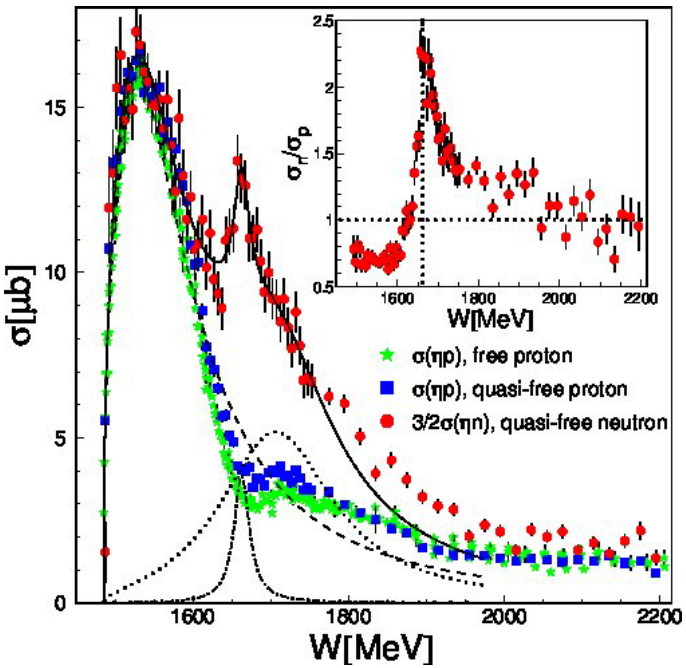
Really narrow structure!

The effect of Fermi motion of the target neutron is reduced

GRAAL



CBTAPS/ELSA



Γ≤ 25 MeV

Γ~ 25 MeV

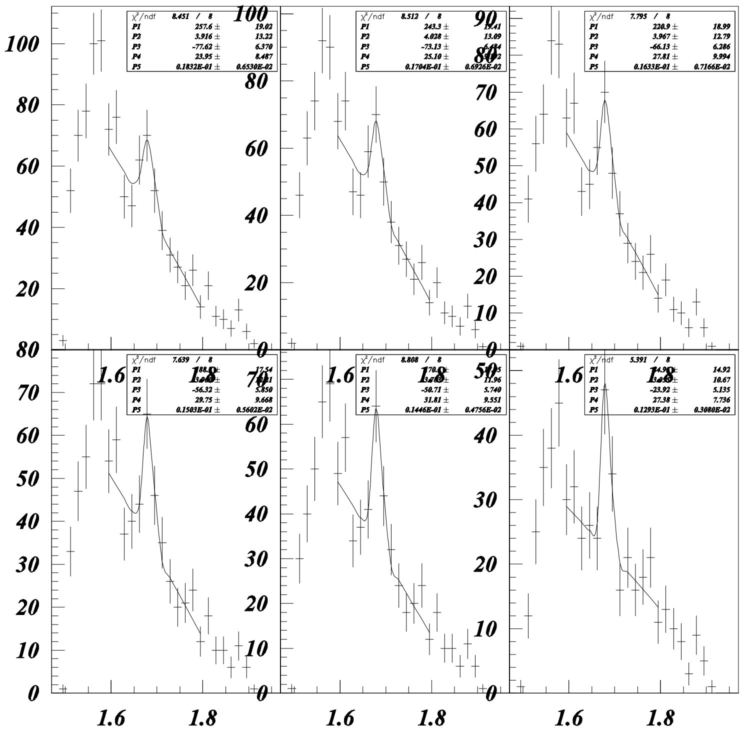
Dependence of M(ηn) spectrum on TOF resolution

(different cuts on the neutron light output in the Russian Wall at GRAAL"

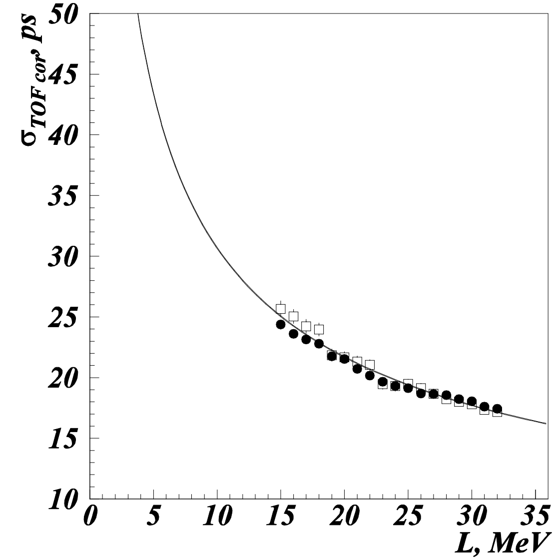
$\sigma(M(\eta n)) \sim \sigma_{TOF}$

$\sigma_{TOF} \sim 1/\mathrm{sqrt}(\text{Light output})$

L>5MeV L>10 MeV L>15 MeV



L>20MeV L>30 MeV L>40 MeV



``Test Measurements of prototype counters for CLAS12 Central Time-of-Flight System using 45-MeV protons",

V.Kuznetsov et al, CLAS-Note 2009-016, Arxiv 0905.4109 [Phys-Det].

Narrow peak

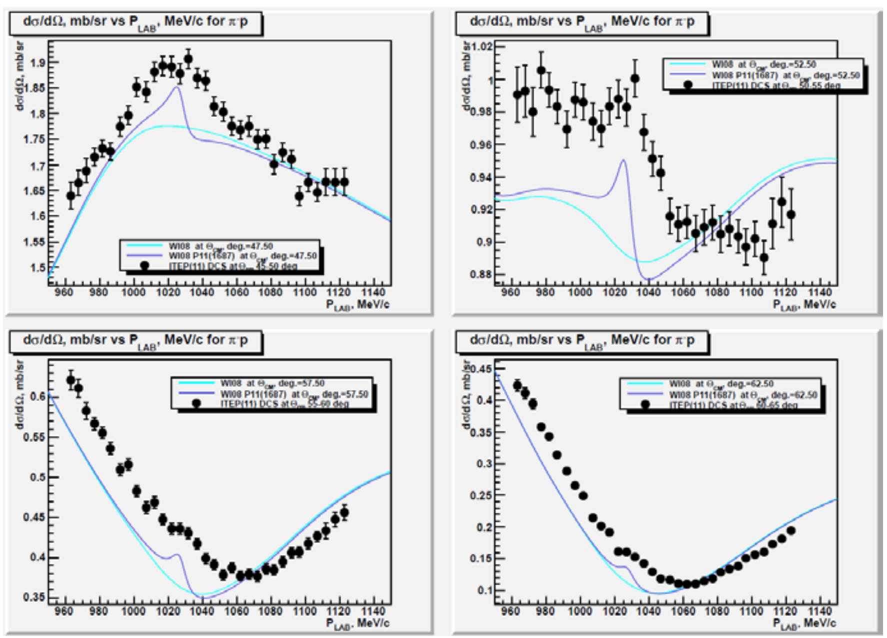
$\Gamma \leq 20$ MeV

Russian Wall at GRAAL,

Single pion photoproduction on the neutron
$\gamma n \rightarrow \pi^- p$ and $\gamma n \rightarrow \pi^0 n$

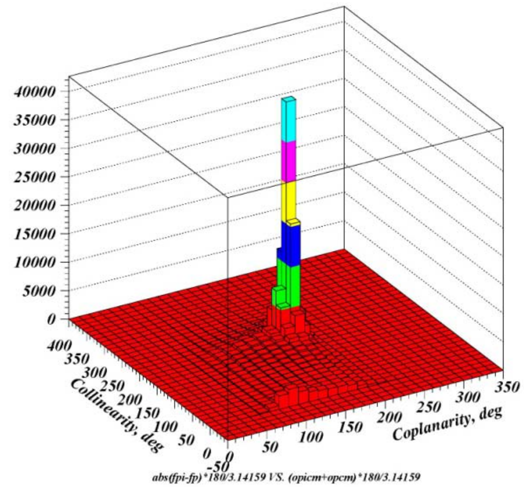
Motivation: *EPECUR Collaboration reported a small but well established structure at W=1.686 GeV in $\pi^- p \rightarrow \pi^- p$, which is associated with the decay of N*(1685) to πN final state.*

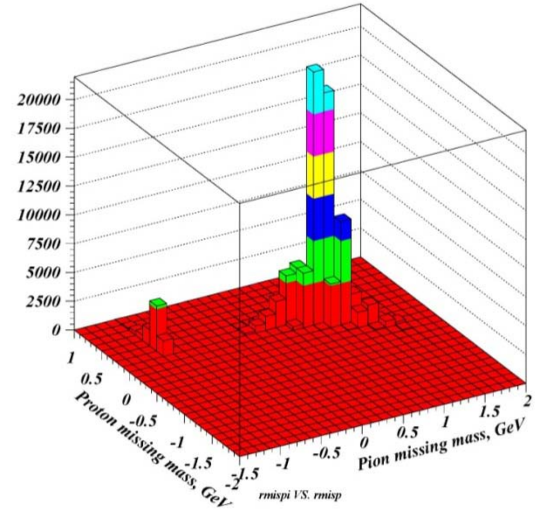
It should also be seen in $\gamma n \rightarrow \pi^- p$ and $\gamma n \rightarrow \pi^0 n$!



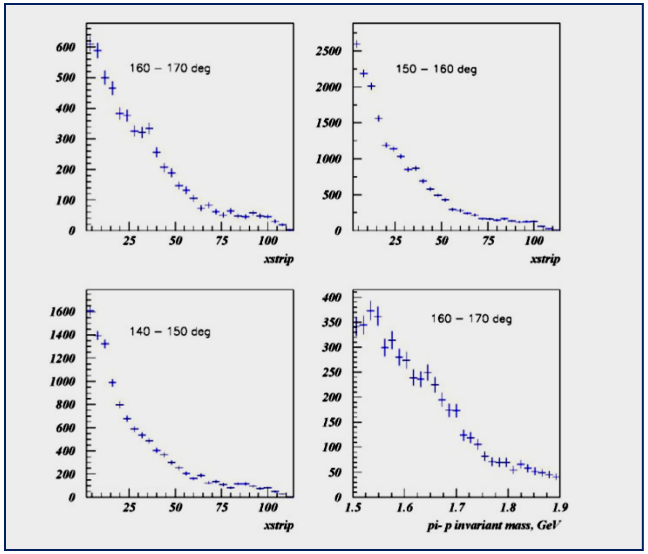
Prompt analysis of $\gamma n \rightarrow \pi^- p$

Cuts:





Reaction Yield:
Small structure at
W~1.68 GeV !



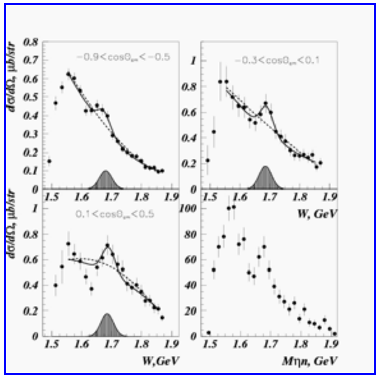
Compton scattering on the proton

$$\gamma p \rightarrow \gamma p$$

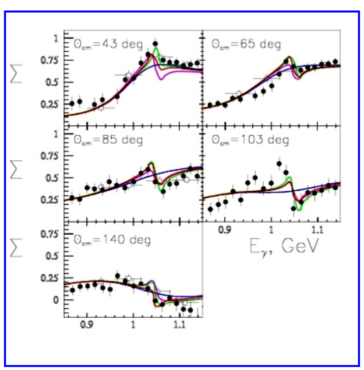
First Preliminary Outcome

Motivation

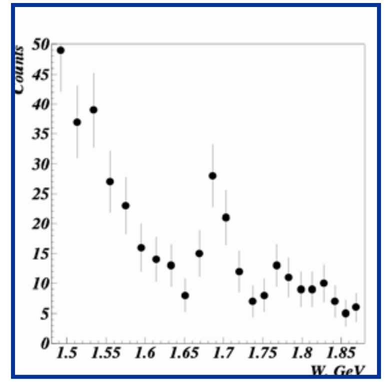
Cross section γn→ηn



Beam asymmetry γp→ηp



Cross section γn→γn

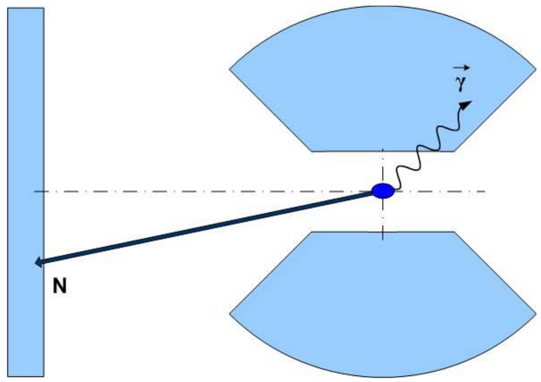


Beam asymmetry γp→γp

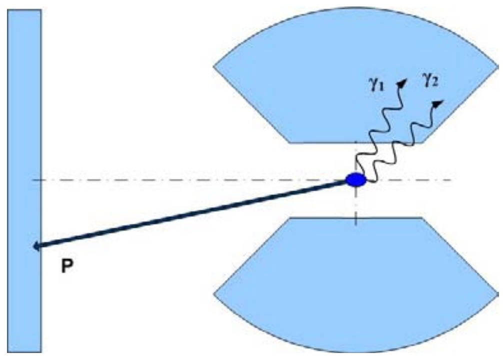
?

The main problem of Compton scattering measurements is the π^0 background.

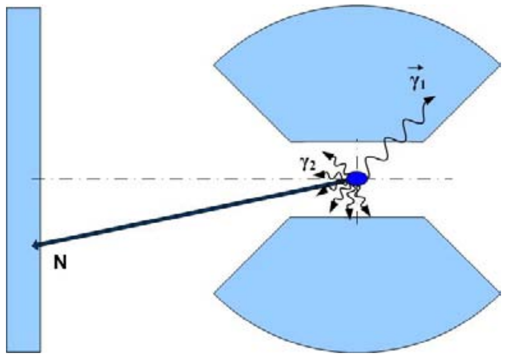
Compton scattering



π^0 background

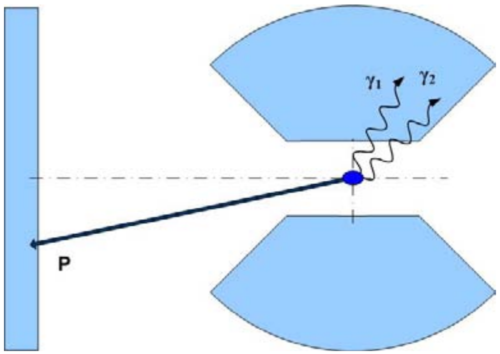


Symmetric $\pi 0$ decay, two photon hits are mixed in one BGO cluster.

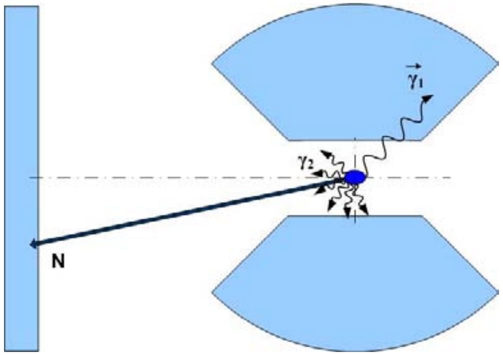


Asymmetric $\pi 0$ decays, the second low-energy photon may not be detected.

Rejection of π0 background



Symmetric decays are rejected by the analysis of cluster shapes in the BGO Ball. Efficiency of this rejection is ~99%. If the pion is emitted at backward angles, its energy is low. Such events are suppressed.

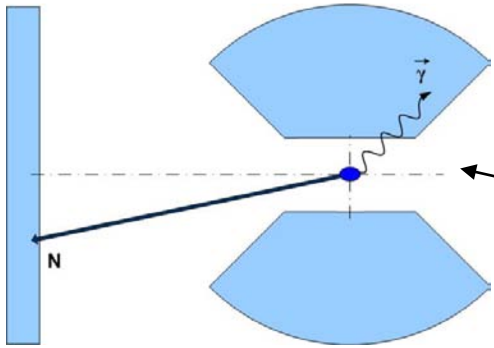


Asymmetric decays: If the first photon is emitted at **the backward angles,** the low-energy second photon can be detected in the Russian Wall or the BGO Ball.

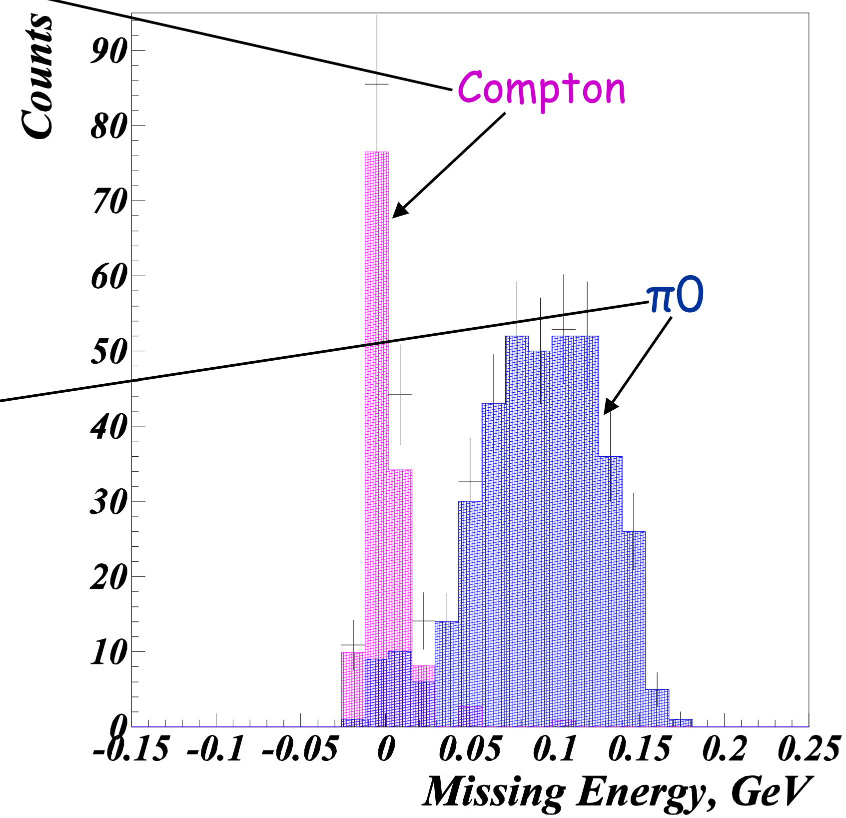
→ **Discrimination of Compton scattering from π^0 events is possible at backward angles.**

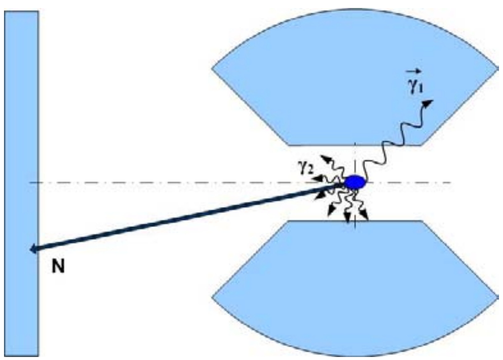
$\gamma p \rightarrow \gamma p$ Simulations

Missing Energy $E_{mis}=E_{tag}-E_p(\Theta_p)-E_\gamma$

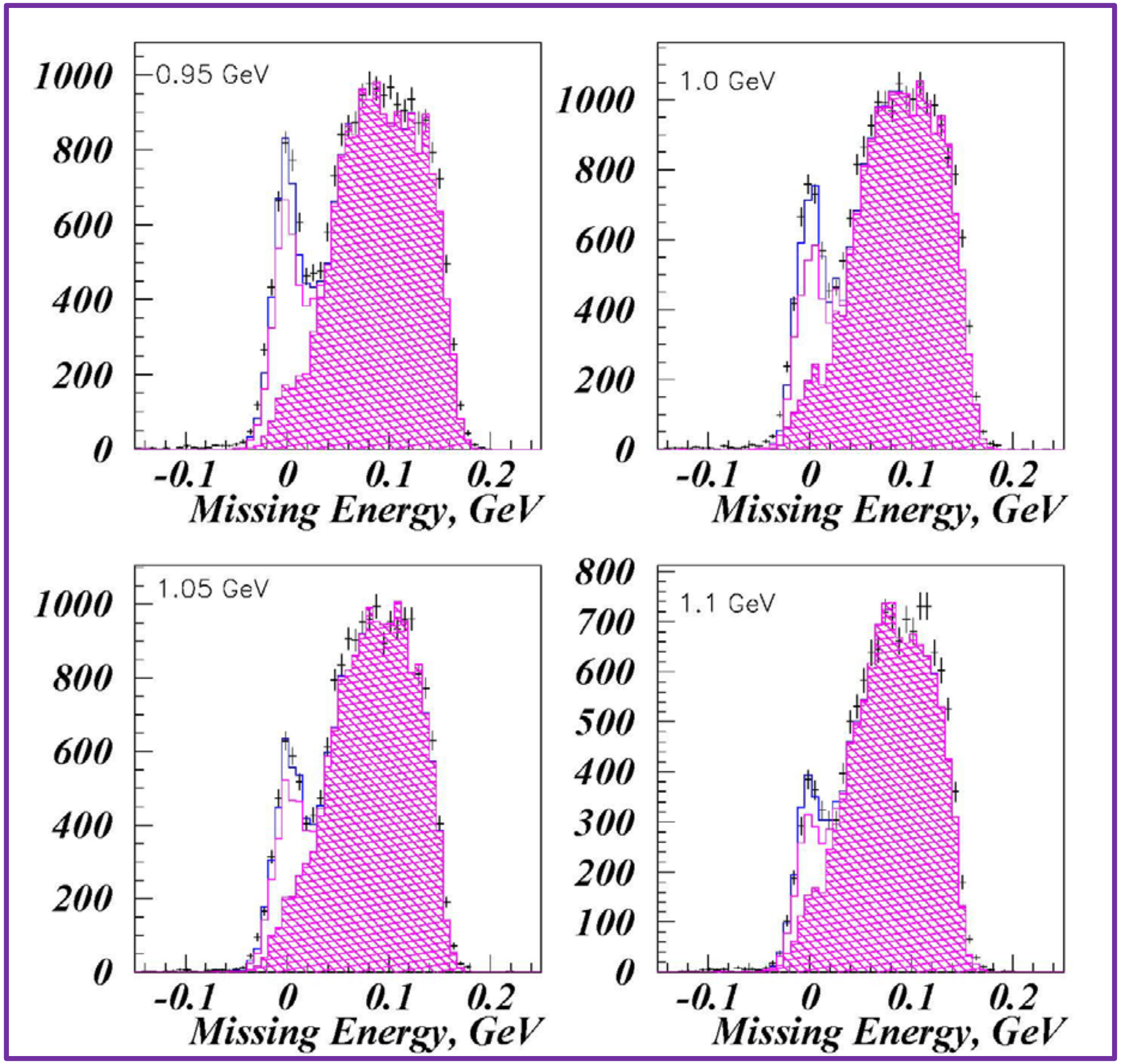


150<Θcm<165 deg





Current analysis 151 – 165 deg



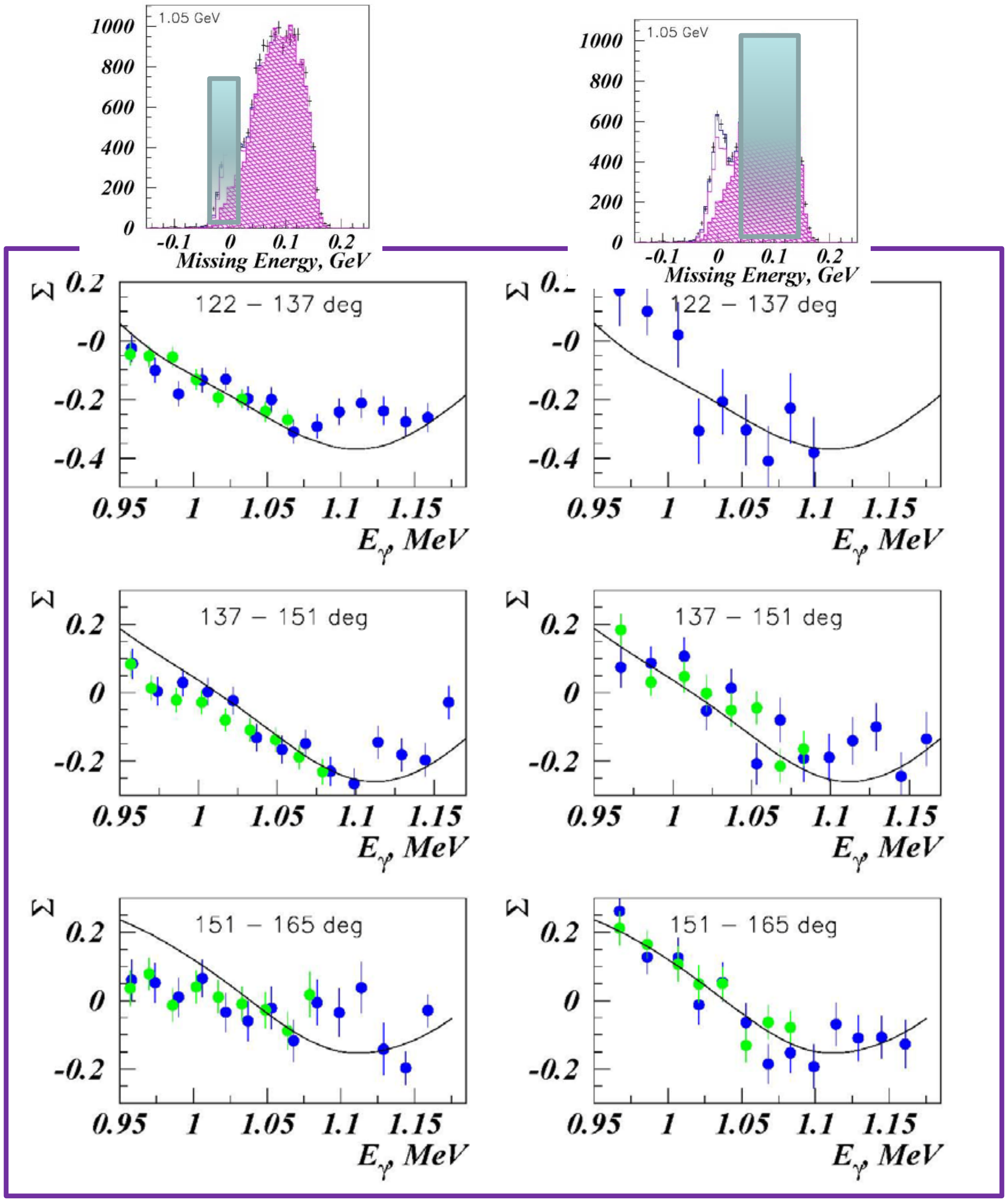
Blue – data

Magenta line: normalysed simulations (Compton + π^0)

Magenta dashed area: Contamination of π^0

Blue line: Simulations, the contribution of Compton is corrected to fit data.

Simulations are normalized in the region E_{mis} = 0.05 - 0.1 GeV, where there are 99% of π^0 events



Beam asymmetry with the main (left) and side-band cuts

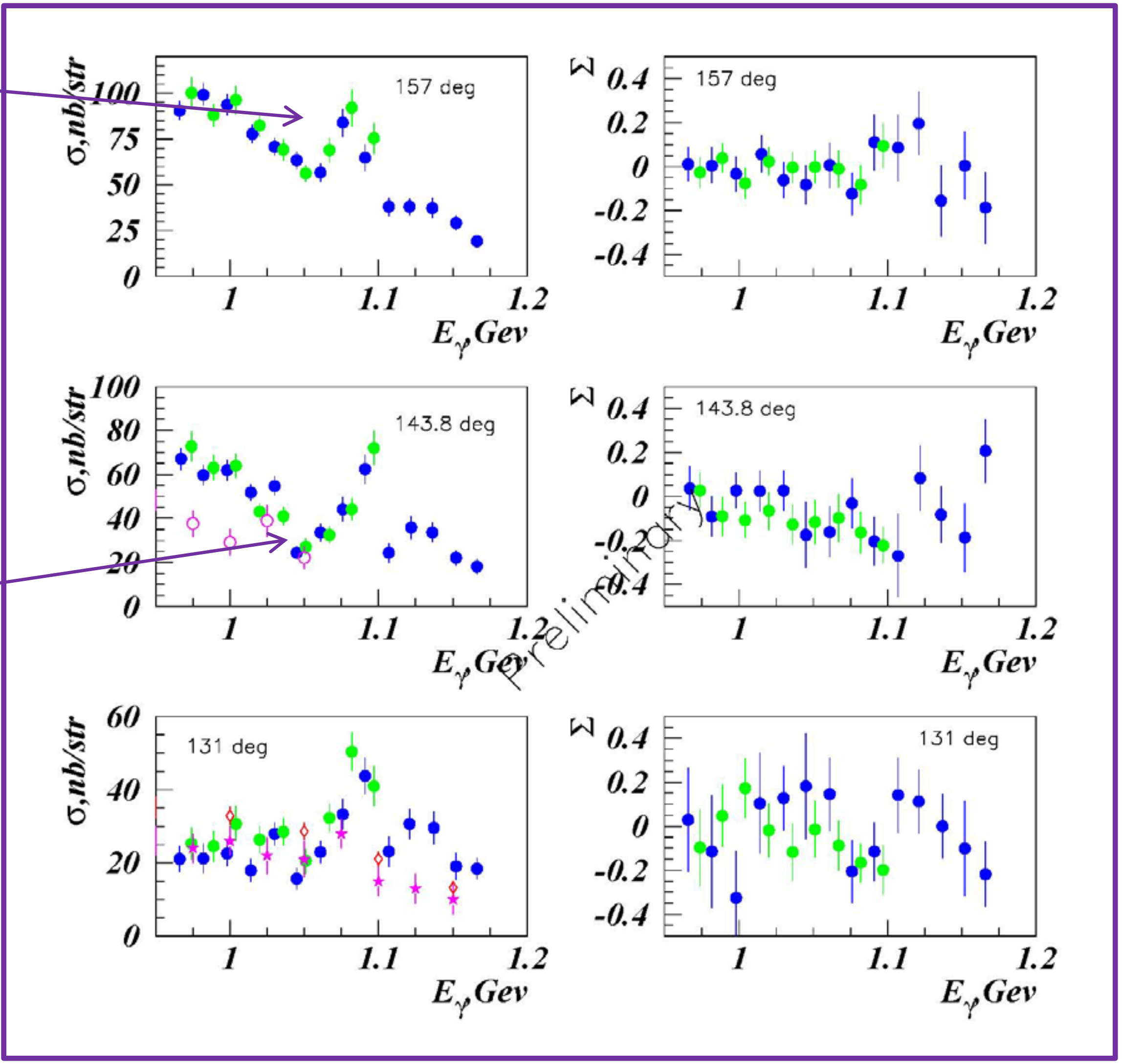
Solid line is the SAID beam asymmetry for π^0s

$\gamma p \rightarrow \gamma p$

Peak at
W~1.71 GeV

Dip at
W~1.685 GeV ?

Current normalization error 20% for cross section



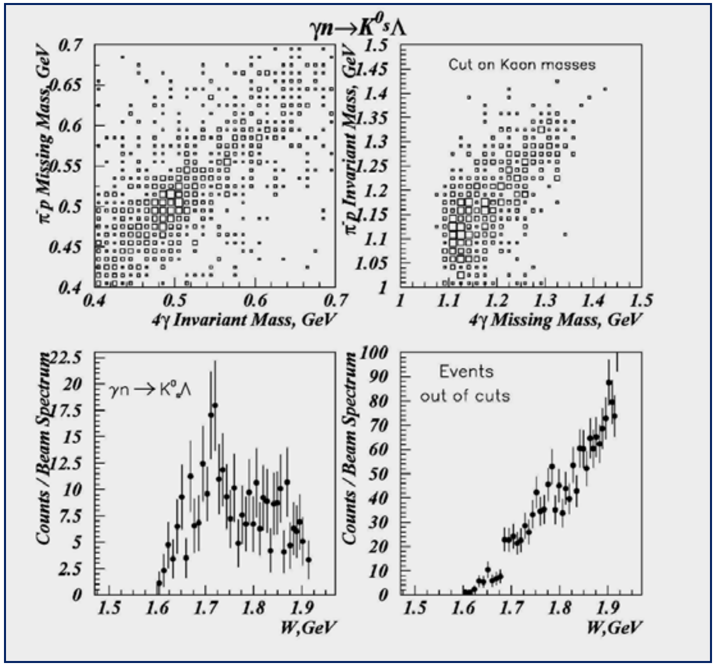
Resonant Structure at W~1.71 GeV?

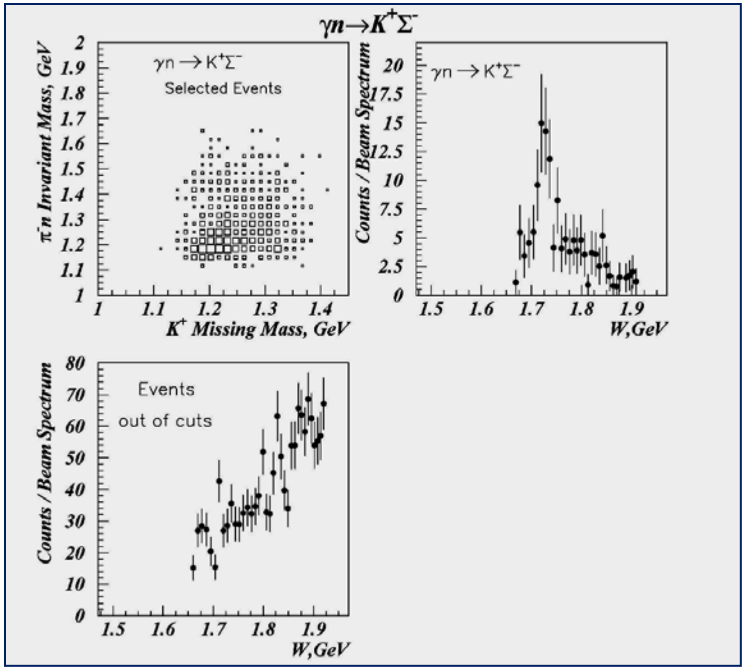
Some other results

$\gamma n \to K^0{}_s \Lambda$, $\gamma n \to K^+ \Sigma^-$

Old (2003) preliminary GRAAL Analysis (remains uncompleted)

V.Kuznetsov for the GRAAL Collaboration, Talk at Worksho "Pentaquarks 2004", Trento, February 2004.



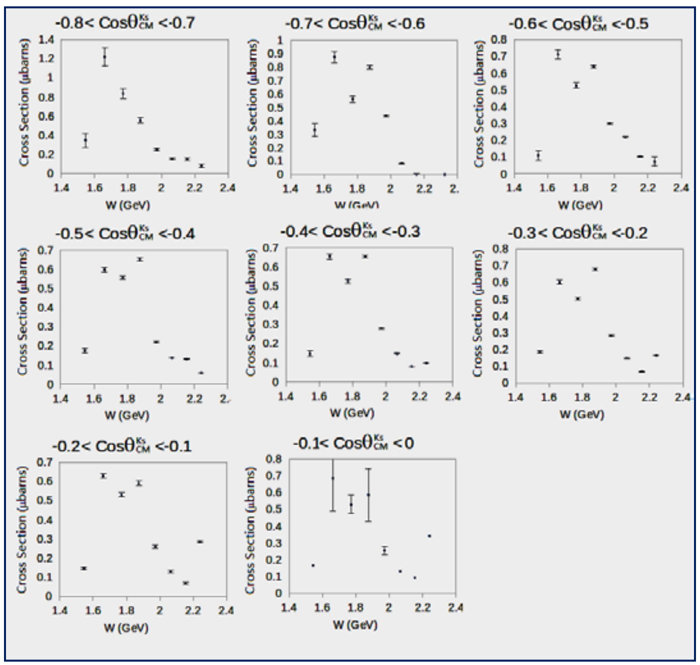


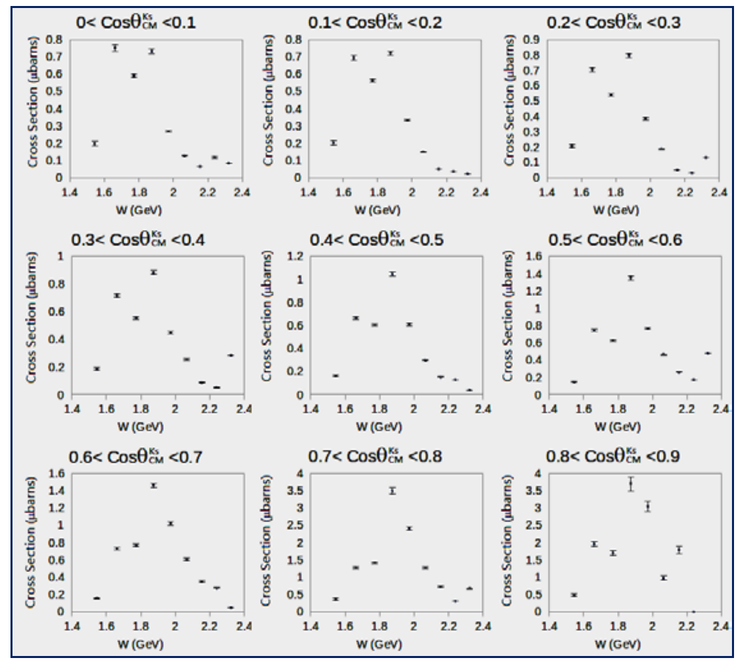
Peak near W~1.72 GeV?

Preliminary data on $\gamma n \to K^0_s \Lambda$ from CLAS

Talk of Taylor at NSATR2013 Workshop

Peak at 1.7 GeV!

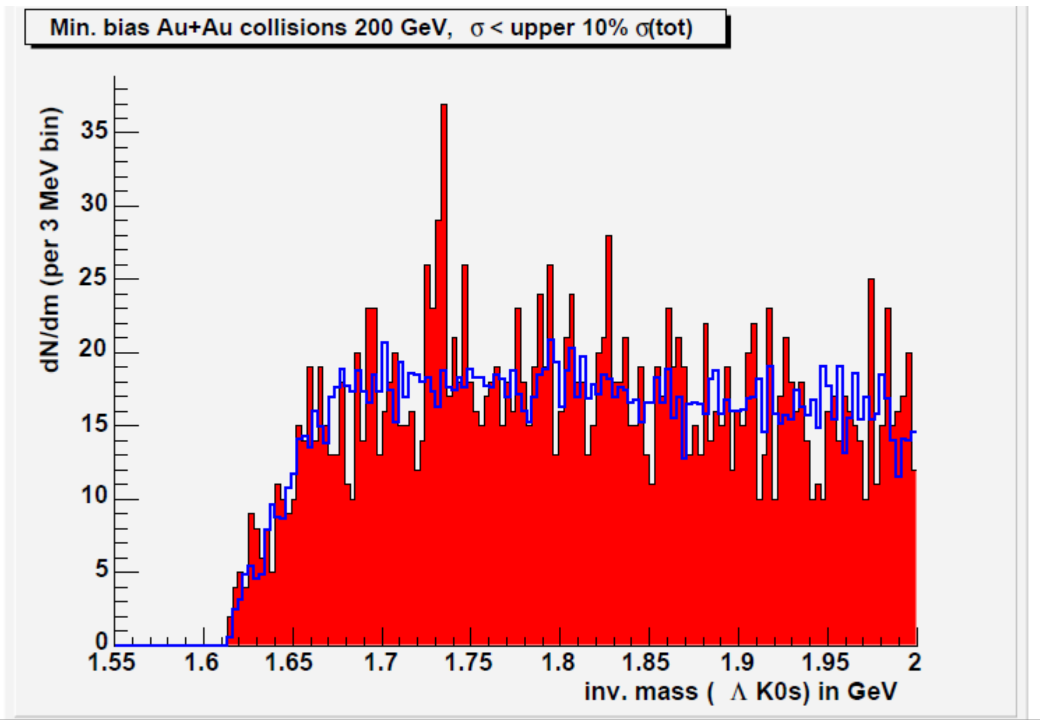




Old (2003) preliminary results from STAR

S. Kabana for the STAR Collaboration, Talk at Worksho "Pentaquarks 2004", Trento, February 2004.

S. Kabana for the STAR Collaboration,
PoS of 20th Winter Workshop on Nuclear DynamicsTrelawny Beach, Jamaica March 15{20, 2004)



SAID PWA

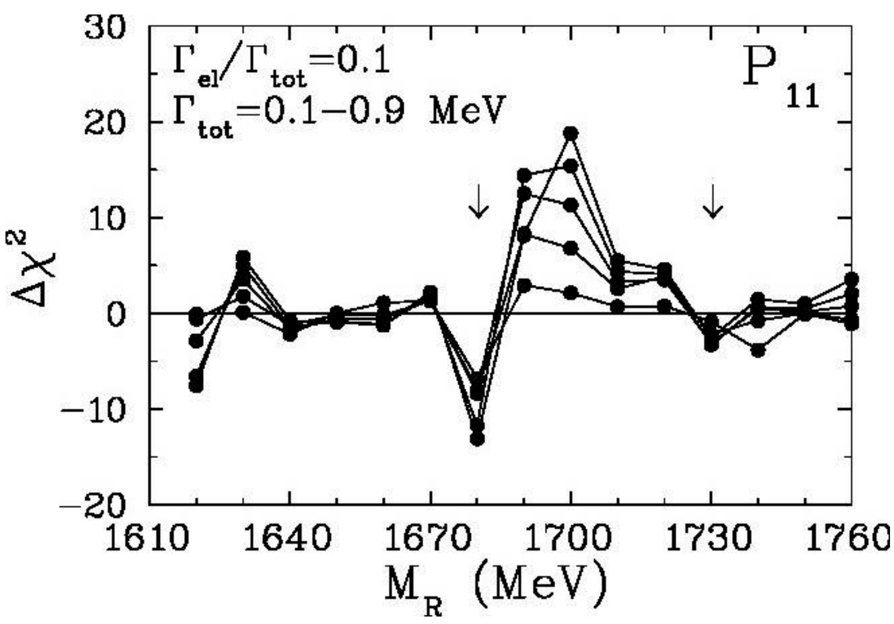
R.Arndt, Ya.Azimov, M.Polyakov, I.Strakovsky, R.Workman

``Nonstrange and other flavor partners of the exotic θ^+ baryon"

Phys.Rev. C69 (2004) 035208

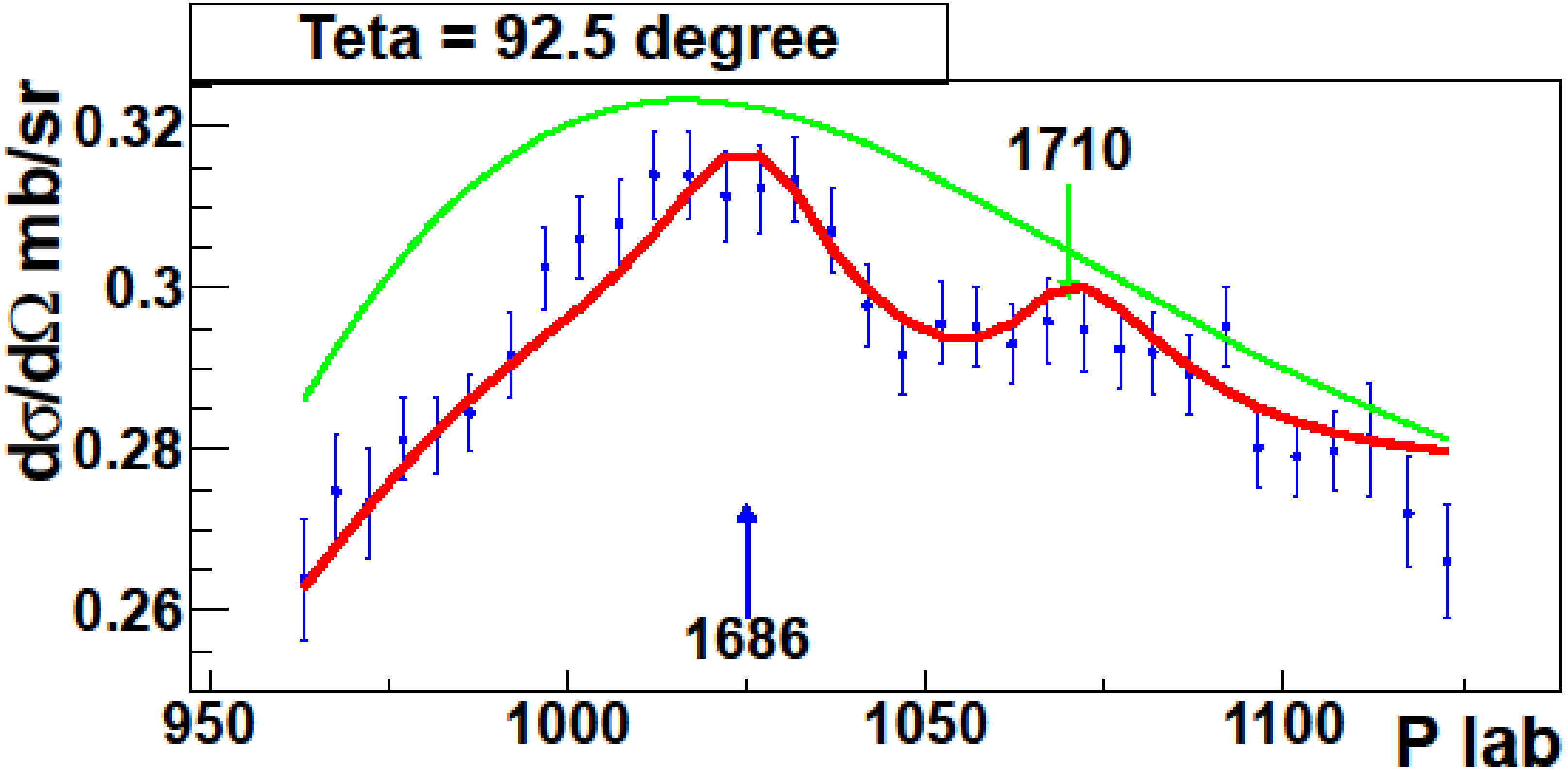
Nucl-th/0312126;

`` … given our present knowledge of the θ^+, the state commonly known as the N(1710) is not the appropriate candidate to be a member of the antidecuplet. Instead we suggest candidates with nearby masses, N(1680) (more promising) and/or N(1730) (less promising, but not excluded). Our analysis suggests that the appropriate state should be rather narrow and very inelastic…"



Recent updates from EPECUR $\pi^- p \to \pi^- p$

A. Gridnev, Private Communication



Thank you for your attention!

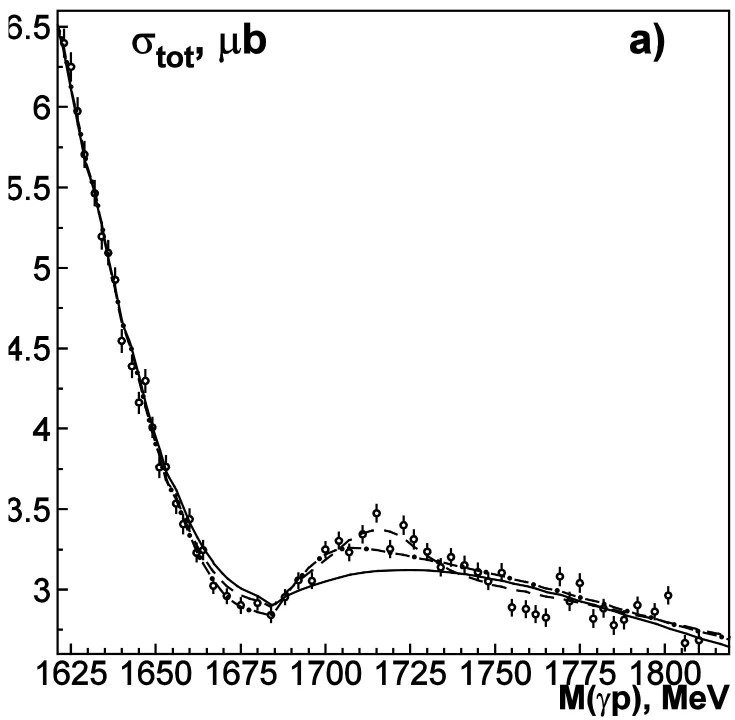
Bonn-Gatchina PWA of new MAMI data

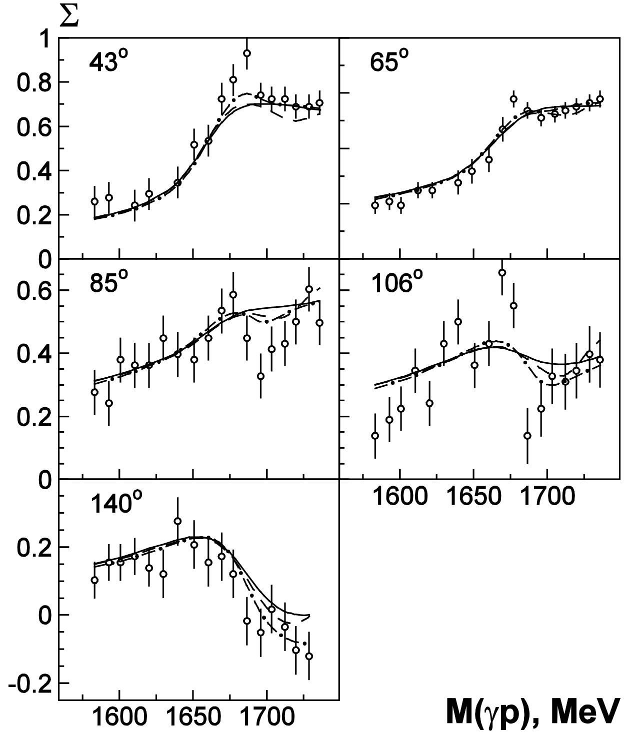
``Search for Narrow Nucleon Resonance in γp-> ηp."

A. V. Anisovich, E. Klempt, V. Kuznetsov, V. A. Nikonov, M. V. Polyakov, A. V. Sarantsev, U. Thoma.,Arxiv 1108.3010.

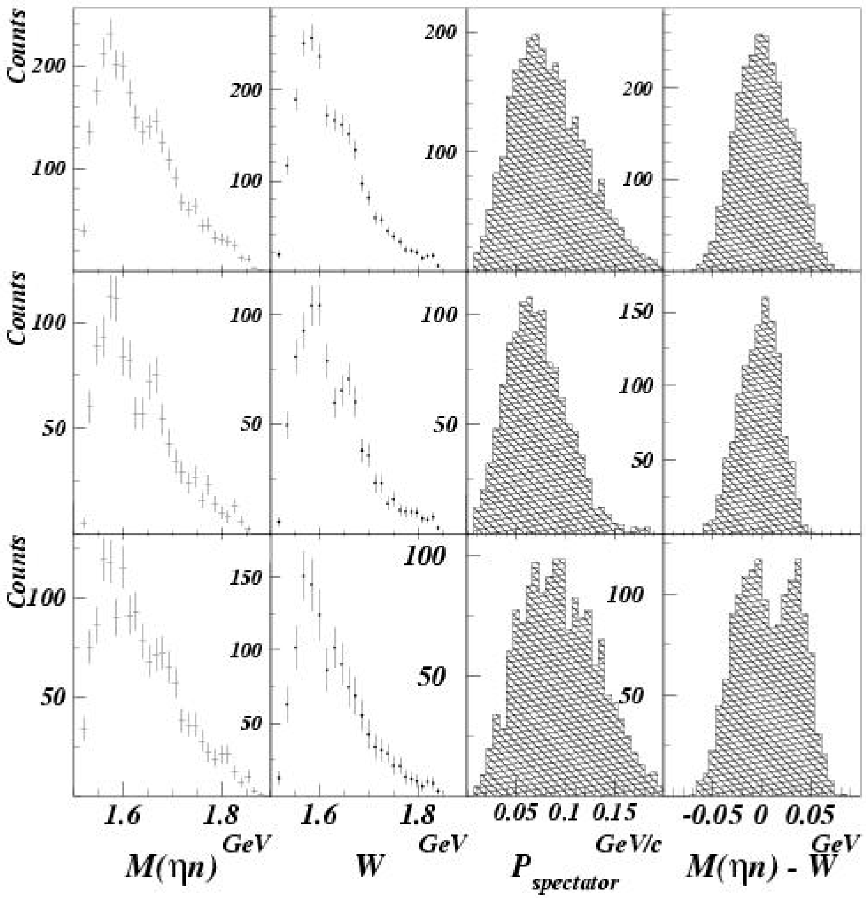
Standard PWA shows a systematic deviation from the the data in the mass interval of 1650-1750 MeV.

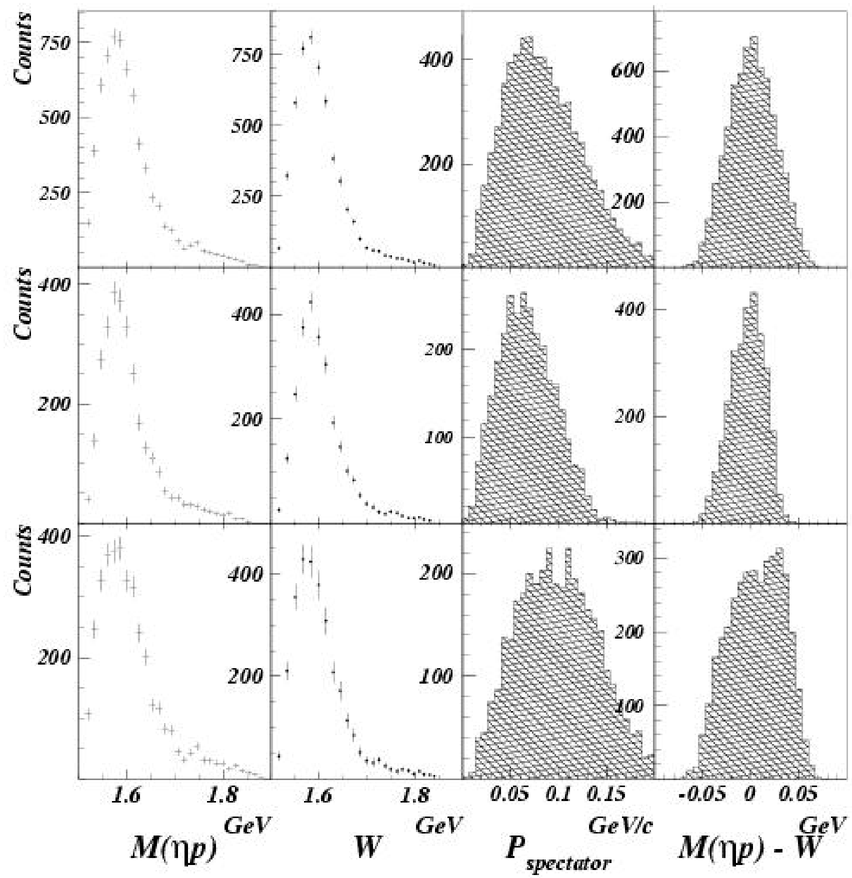
The description of the data can be improved significantly assuming the existence of a narrow resonance at about 1700 MeV, the width 30-40 MeV, and with small photo-coupling to the proton.





Yield of γN→ηN: Data and MC





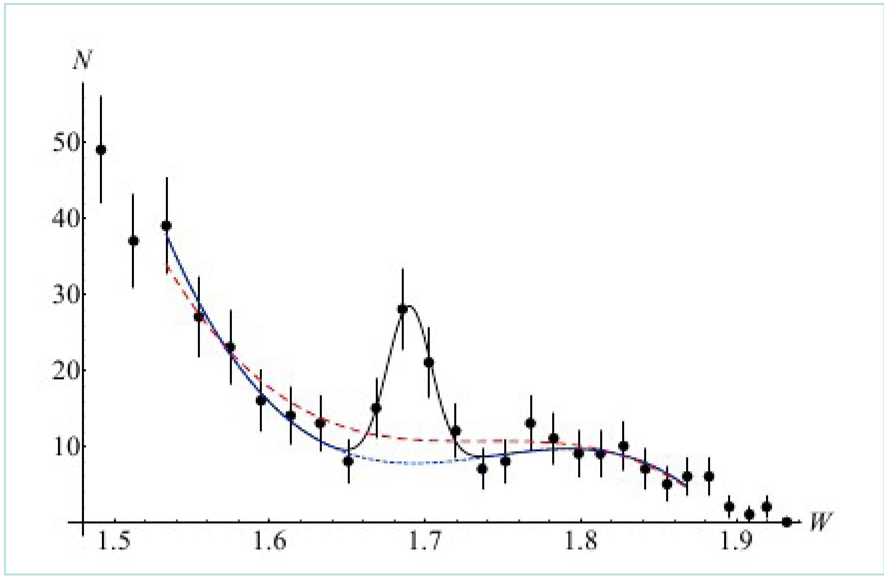
Soft cuts

Tight cuts

Quasi-free neutron

Quasi-free proton

~4.6 σ

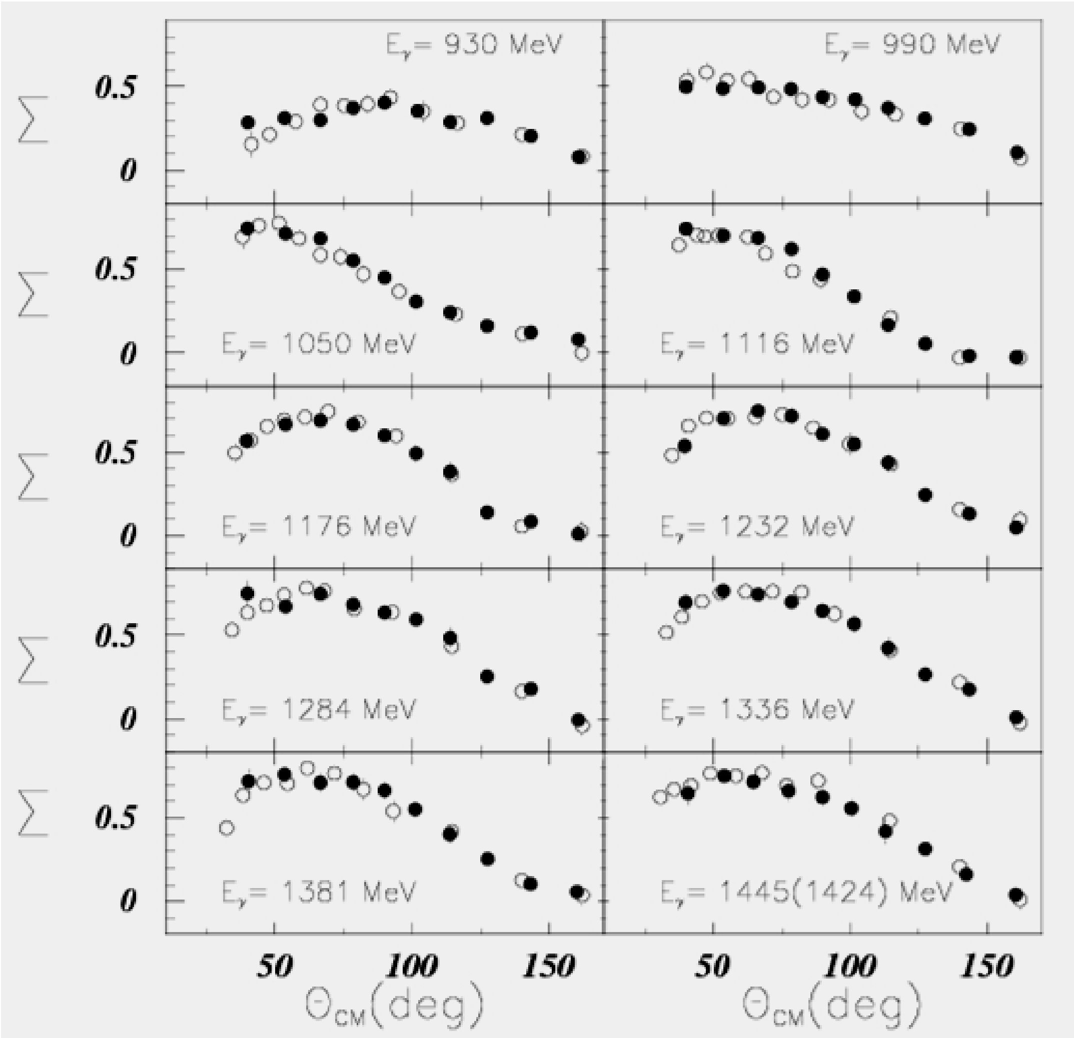


Comments on O.Bartalini *et al.* (by the GRAAL Collaboration (?)) ``Measurement of eta photoproduction on the proton from threshold to 1500 MeV", Nucl-ex:0707.1385.

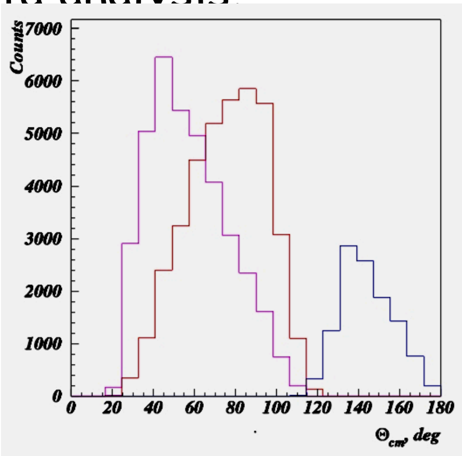
Data analysis has been performed by A.Lleres, LPSC Grenoble.

Authors claimed no evidence for a narrow N(1670) state in beam asymmetry and cross section data for eta photoproduction on the proton.

Comparison of O.Bartalini et al.(black circles) with the old GRAAL publication V.Kuznetsov, πN News Letters, **16**, 160(2002) (open circles) (angular dependences)

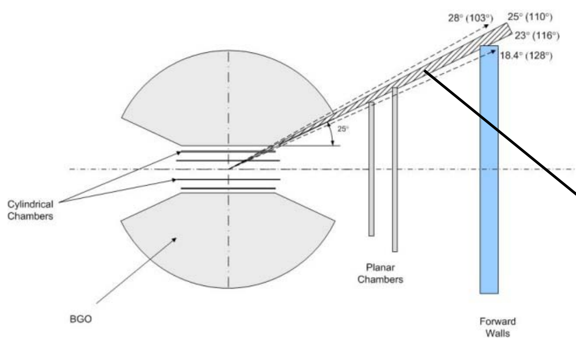


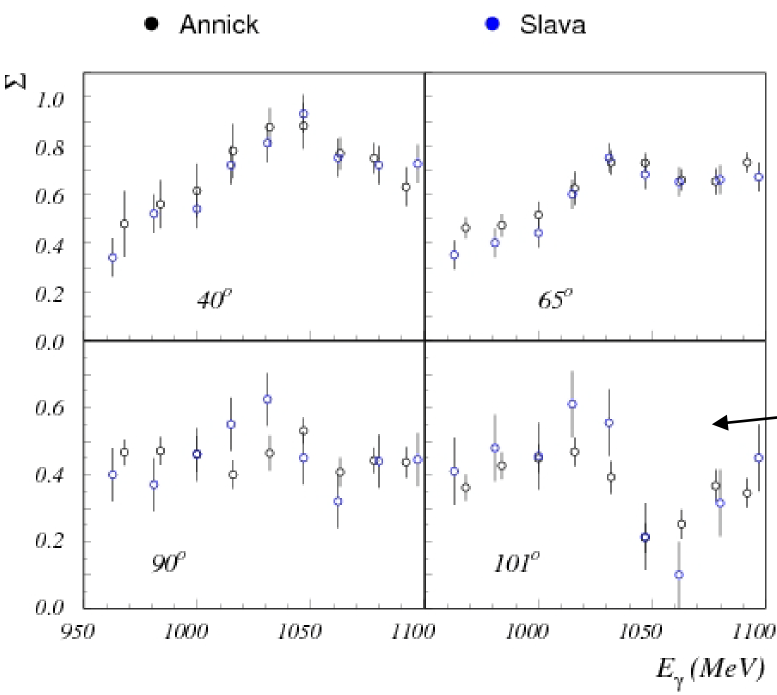
Despite the triple increase of statistics, new data are less accurate at forward angles! The reason is that events in which one of the photons from η→2γ decay is detected in the forward wall, are excluded from data analysis.

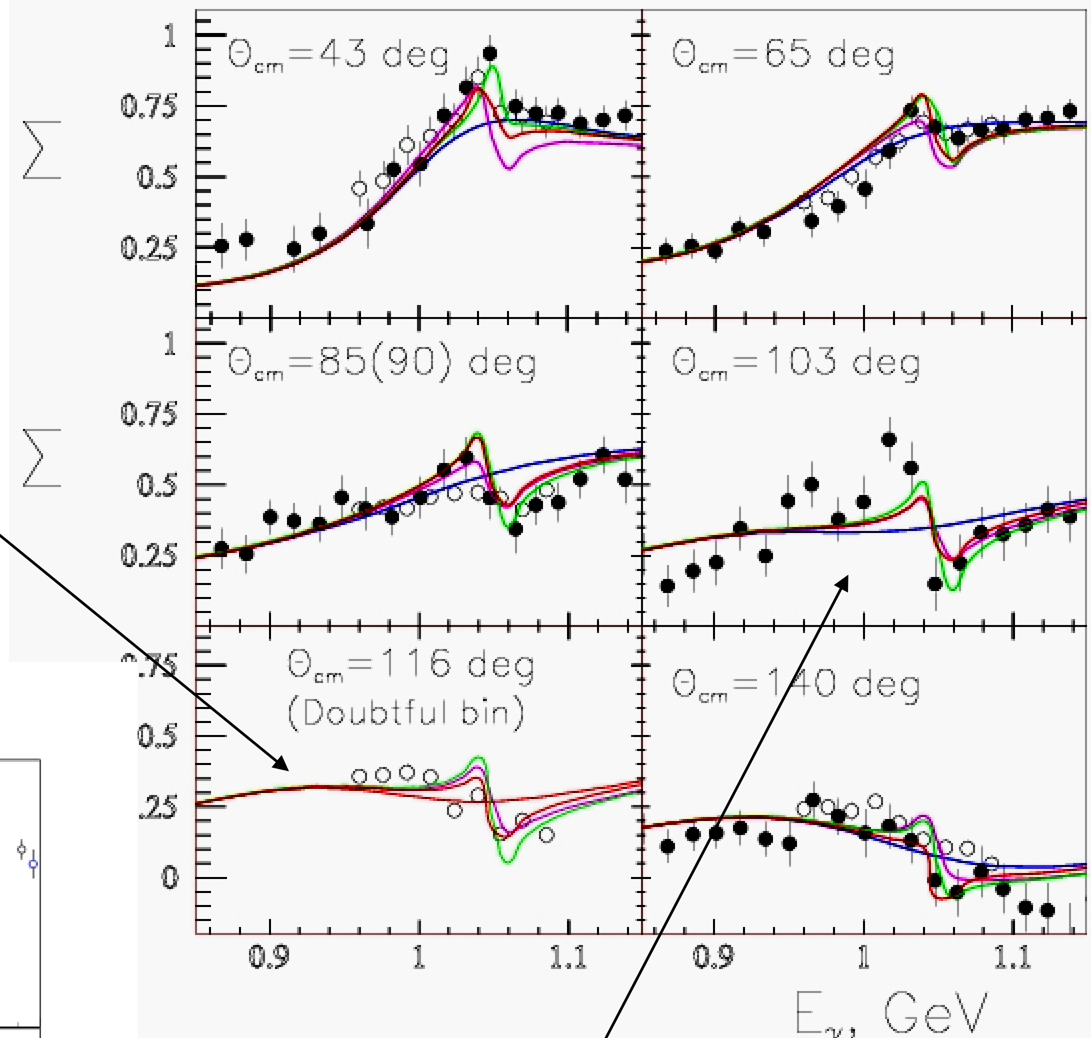


γp→ηp Yield for different types of events

Comparison of O.Bartalini et al. (open circles) and our results (black circles). Main difference is at 103/116 deg.







The same dip structure at 103 deg!

Comparison wilh preliminary results done by A.Lleres (A.Lleres, private communication (E-mail from Feb 5, 2007)).

What does mean quasi-free cross section?

To fit experimental data , the cross section calculated for the free neutron, is then smeared by Fermi motion using the deuteron wave function

This formula is from A.Anisovich et al., Hep-ph/0809.3340

$$\frac{d^2\sigma_{\rm qf}}{d\Theta}(W,\theta_{cm}) \propto \int d|\vec{p}_N||\vec{p}_N|^2 f^2(\vec{p}_N)\frac{d\cos(\theta_N)d\phi_N}{4\pi}\frac{d\sigma_{\rm free}}{d\Theta}(W^*,\theta^*_{cm})d\Phi$$

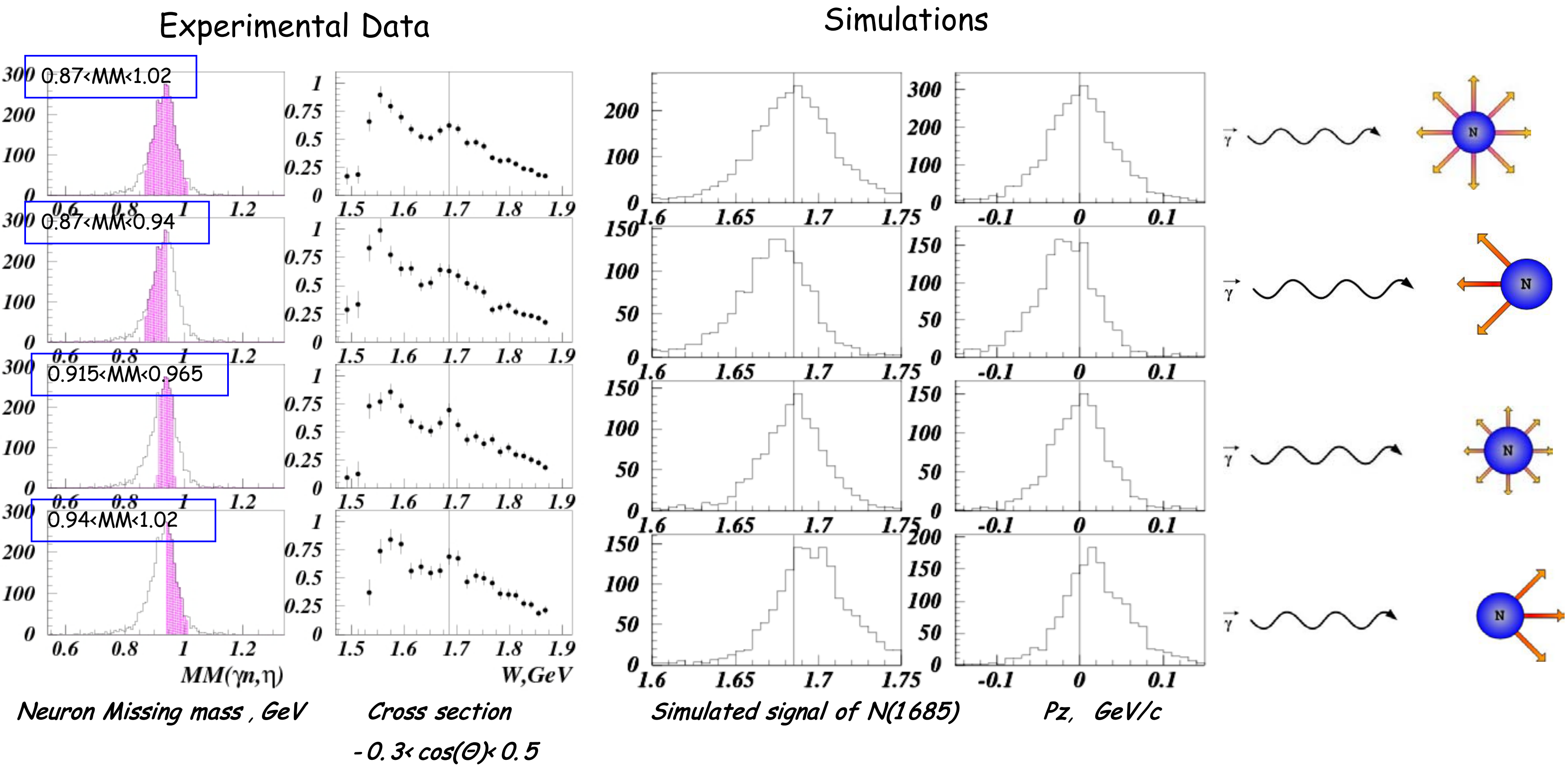
Cut-dependent Integral

Cut-dependent function

Cut-dependent FSI effects(not discussed here)

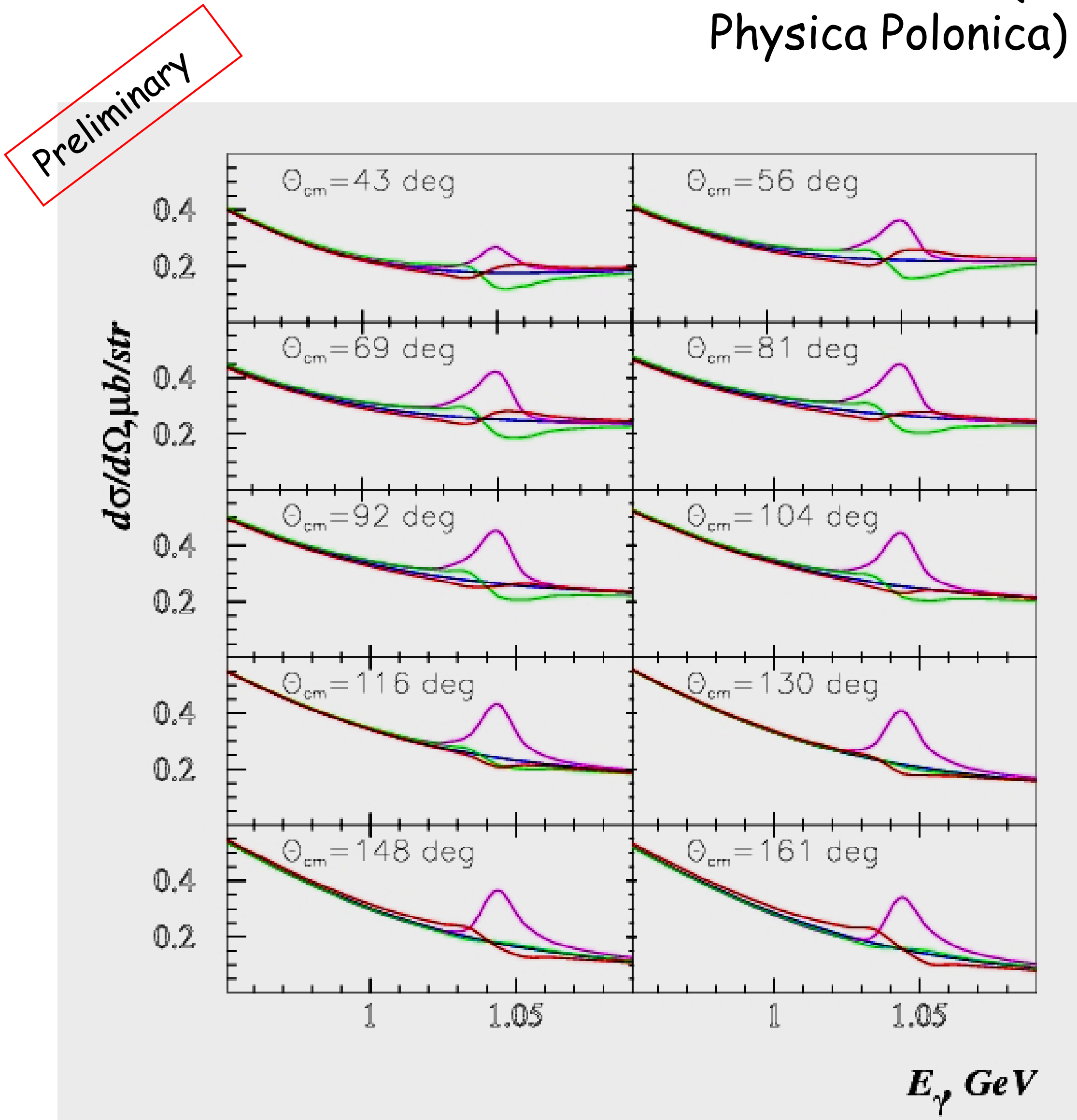
Is this formula applicable for experimental data?

γn→ηn cross section with different cuts on the neutron missing mass



The width and the position of the peak in the γn→ηn cross section are affected by the cut on the neutron missing mass!

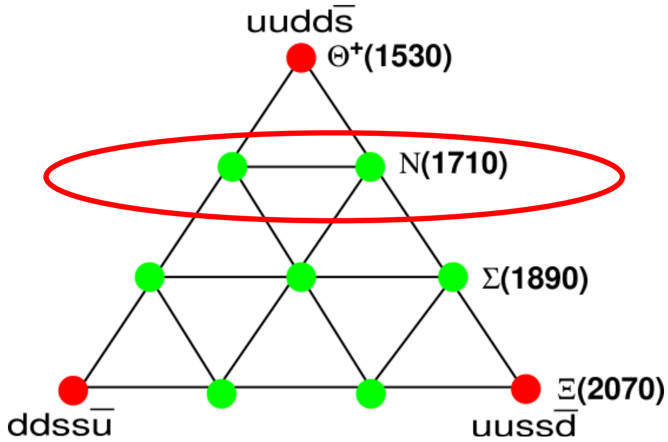
Calculation of cross sections (Published in Acta Physica Polonica)



Blue – SAID only
Magenta – SAID + P11
Green – SAID +P13
Red – SAID + D13

P13 would generate a small .dip structure st forward angles.

Observation of anomaly near W~1.685 Gev



M.Polyakov and A.Rathke
``On photoexcitation of baryon antidecuplet”
Hep-ph/0303138; Eur.Phys.J. A18, 691-695(2003)

``…qualitative feature (of the second member of the antidecuplet, the P11) … dominance of photoexcitation from the neutron target”.

``…antidecuplet ``friendly” photoreactions…

$$\gamma n \rightarrow K^+ \Lambda, \quad \gamma n \rightarrow \eta n, \gamma n \rightarrow \gamma n$$

In these channels the antidecuplet part of the nucleon resonances should be especially enhanced, whereas in the analogous channels with the proton target the anti-10 component is relatively suppressed….”

INTREPRETATIONS OF THIS STRUCTURE AS NEW NARROW RESONANCE

- Y.Azimov, V.Kuznetsov, M.Polaykov, and I.Strakovsky, Eur. Phys. J. A **25**, 325, 2005.
- A.Fix, L.Tiator, and M.Polyakov, Eur. Phys. J. A **32**, 311, 2007.
- K.S.Choi, S.I. Nam, A.Hosaka, and H-C.Kim, Phys. Lett. B **636**, 253, 2006.
- K.S.Choi, S.I. Nam, A.Hosaka, and H-C.Kim, Prog. Theor. Phys. Suppl. **168**, 97, 2008.
- G.S.Yang, H.S.Kim, Arxiv:1204.5644

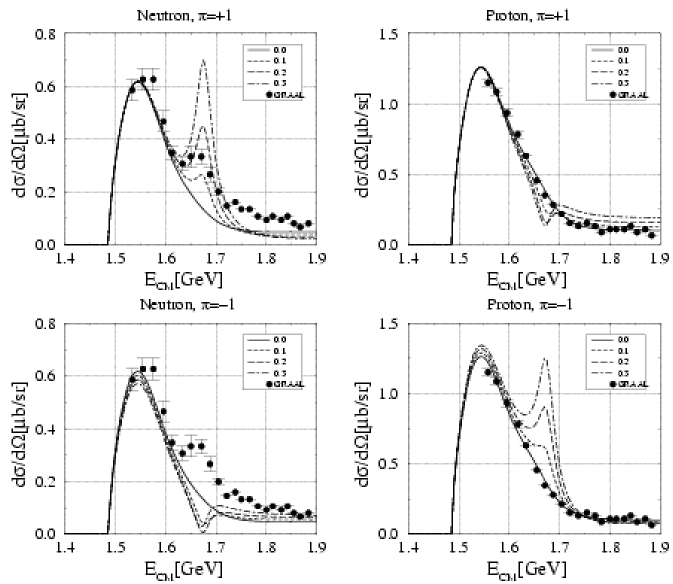
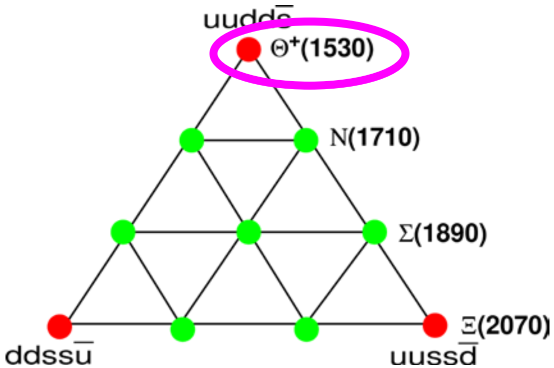


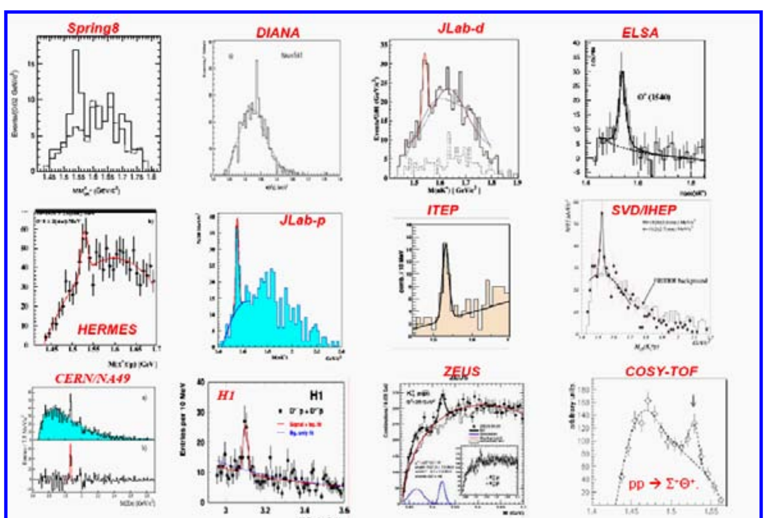
FIG. 2: The differential cross sections as functions of the total energy in the center of mass (CM) energy frame. We depict them in different targets (neutron at left column and proton at right one), parities of $N^*(1675)$ (positive at upper two panels and negative at lower two ones). The four curves in each panel indicate $\mu_{\gamma N N^*} = 0.0,\ 0.1,\ 0.2,\ 0.3\,\mu_N$. The experimental data are taken from Ref. [25].

Some remarks on the recent (non)observation of $\Theta^{+}(1540)$



χQM antidecuplet

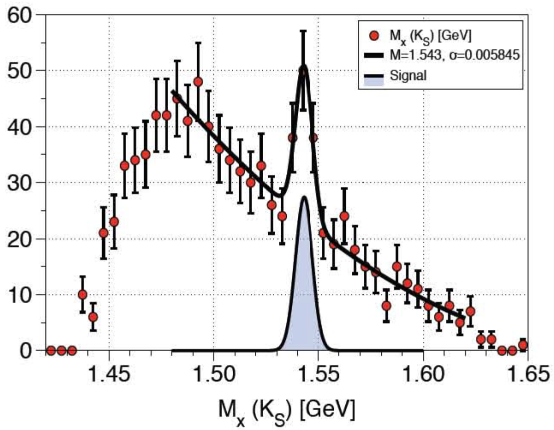
In 2002 – 2004 12 groups published the evidence for a narrow S=+1 baryon (plus ~12 preliminary results) which was attributed to the lightest member of the exotic antidecuplet Θ+(1540)



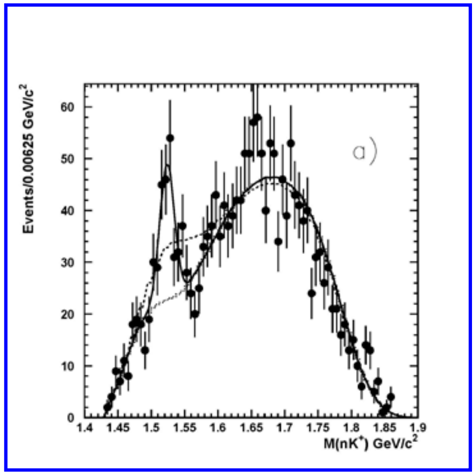
In 2005 – 2007 there were generous negative reports on the search for this particle. Some groups (CLAS, COSY) did not confirm their previous positive results in high-statistics experiments.

RECENT RESULTS

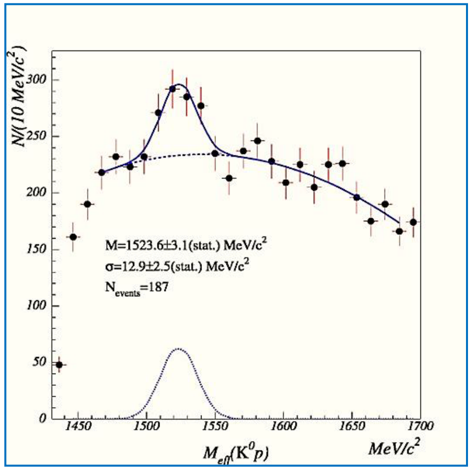
M.Amoryan et al., (part of CLAS), Phys.Rev. C 85,:035209 (2012)



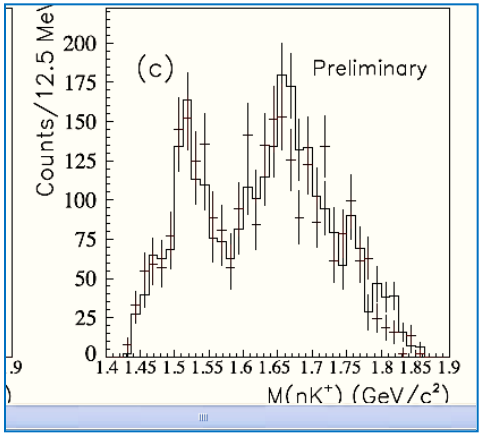
LEPS (T.Nakano et al, nucl-ex/0812.1035)



SVD-2 (A.Aleev et al., Nucl-ex/0803.3313)



LEPSII (M.Niiyama et al., Nucl. Phys. A (in press))



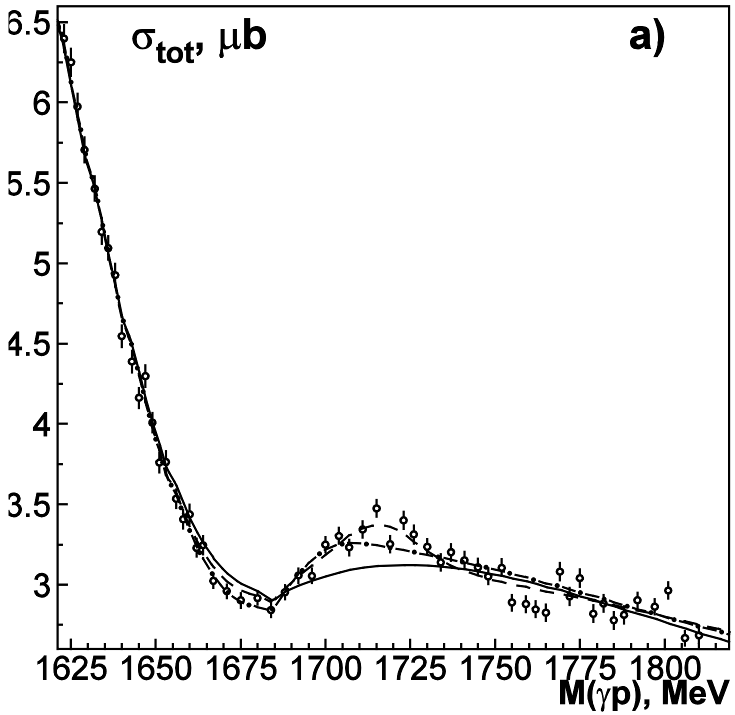
Bonn-Gatchina PWA of new MAMI data

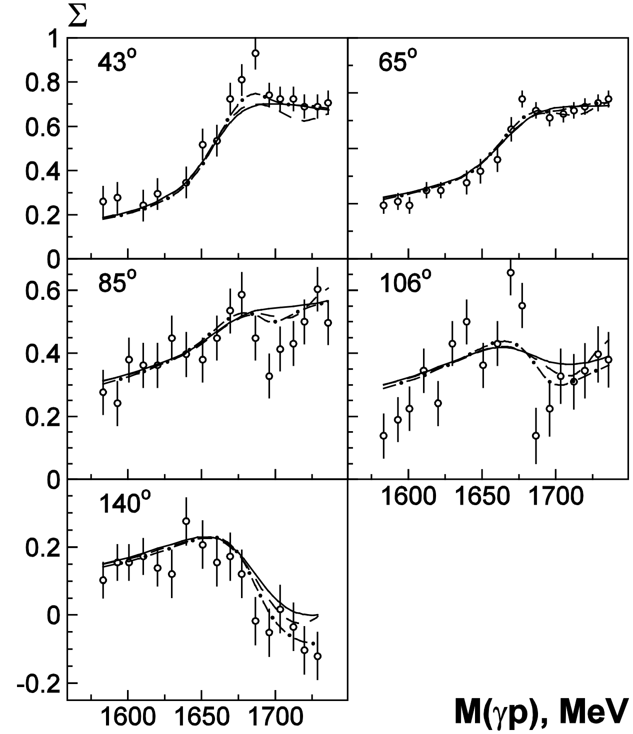
``Search for Narrow Nucleon Resonance in γp-> ηp."

A. V. Anisovich, E. Klempt, V. Kuznetsov, V. A. Nikonov, M. V. Polyakov, A. V. Sarantsev, U. Thoma.,Arxiv 1108.3010.

Standard PWA shows a systematic deviation from the the data in the mass interval of 1650-1750 MeV.

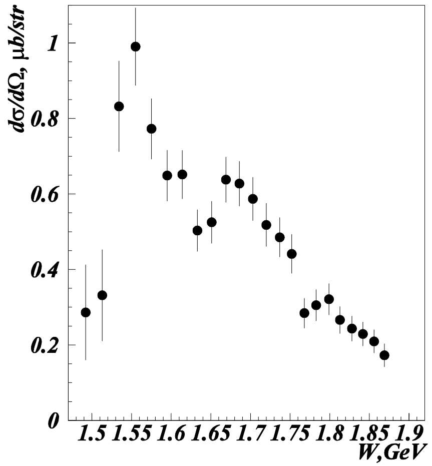
The description of the data can be improved significantly assuming the existence of a narrow resonance at about 1700 MeV, the width 30-40 MeV, and with small photo-coupling to the proton.



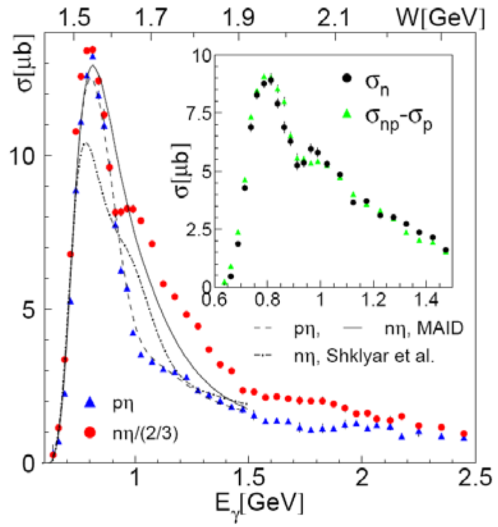


Cross sections with the asymmetric cut MM(γn,η)<0.94

GRAAL



CBELSA-TAPS



With the asymmetric cut on the neutron missing mass GRAAL and CBTAPS-ELSA cross sections look similar. Peak is wide and is located at 1.67 GeV.

Has this effect been taken into account in the fitting procedure by Bonn-Catchina and Giessen groups?