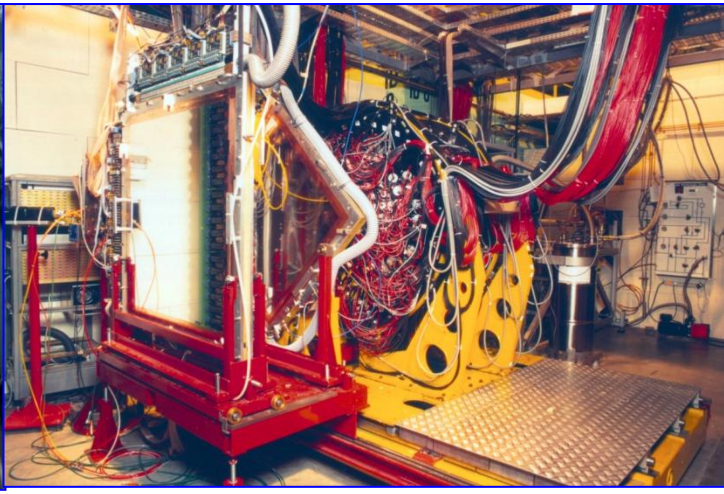
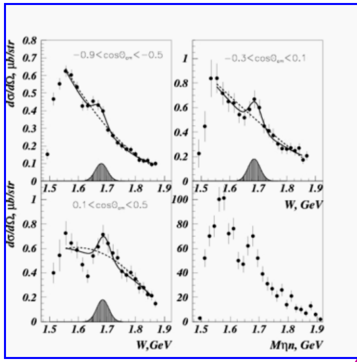
Evidence for resonant structures at W~1.68 and W~1.72 GeV in Real Compton scattering on the proton (experiment GRAAL, ESRF, Grenoble, France).



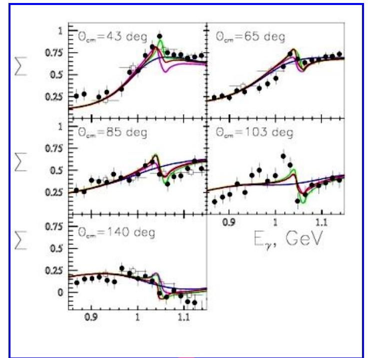
Viacheslav Kuznetsov

in collaboration with colleagues from Universities of Catania, Rome, Torino, Bochum etc.

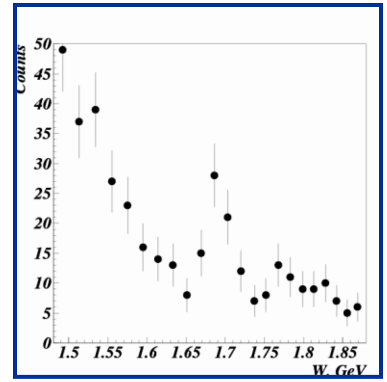
Graal γn→ηn

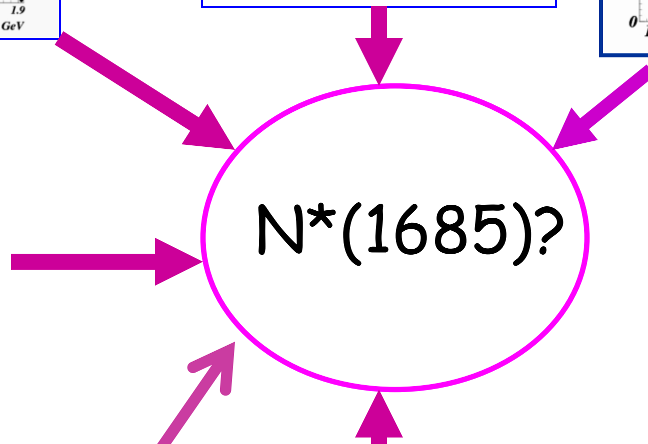


Graal γp→ηp

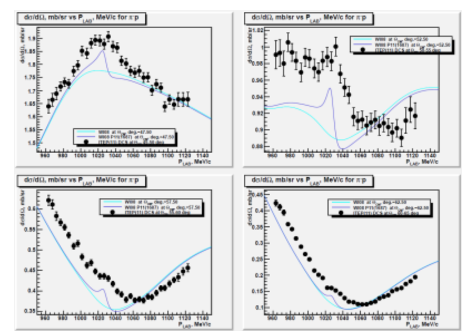


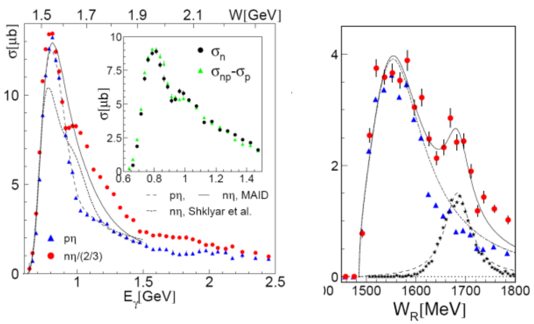
Graal γn→γn



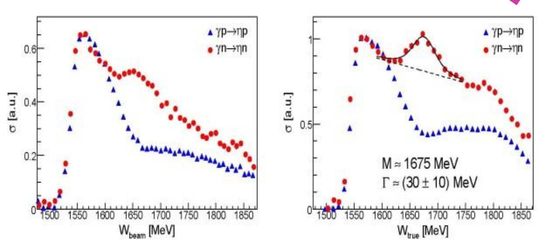


EPECUR πp→πp

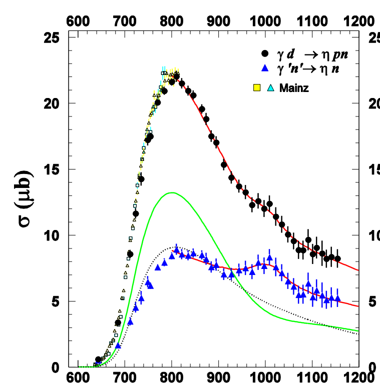




CBELSA/TAPS γn→ηn



Mainz γn→ηn



LNS-Sendai γn→ηn

Neutron anomaly

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

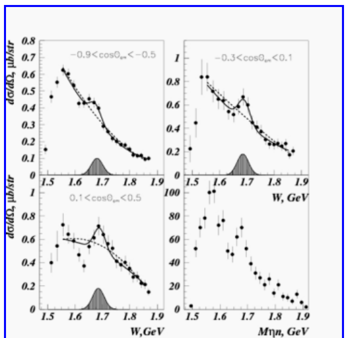
- **Interference of Known resonances** V. Shklyar, H. Lenske , U. Mosel , PLB650 (2007) 172 (Giessen group): A. Anisovich et al. EPJA 41, 13 (2009), hep-ph/0809.3340 (Bonn-Gatchina group); X.-H. Zong and Q.Zhao, Arxiv:1106.2892

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

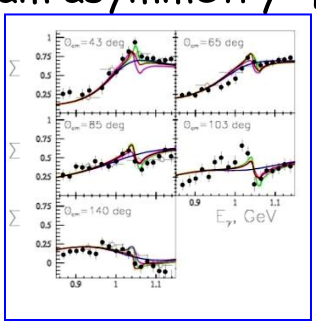
M.Doring, K. Nakayama, PLB683, 145 (2010), nucl-th/0909.3538

One benchmark signature of N*(1685) is the strong photoexcitation on the neutron and suppressed (but not zero) photoexcitation on the proton. Such a resonance would appear in cross section on the proton as a minor peak/dip structure which may not be resolved in experiment. On the contrary, its signal may be amplified in polarization observables being amplified due to the interference with other resonances.

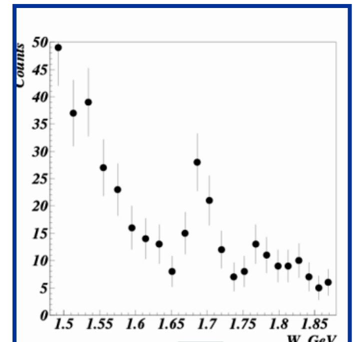
Cross section γn→ηn



Beam asymmetry γp→ηp



Cross section γn→γn



Beam asymmetry γp→γp

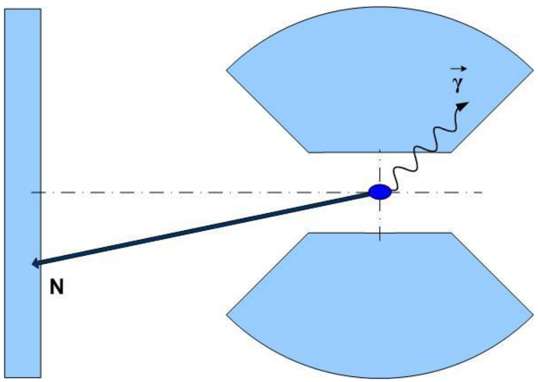
?

Compton scattering on the proton at GRAAL
(recent results)

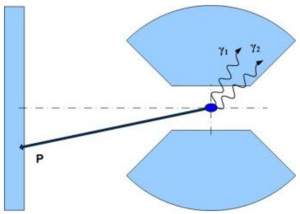
$$\gamma p \rightarrow \gamma p$$

Compton scattering and the π^0 background.

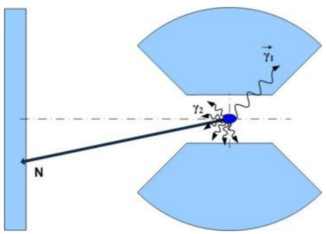
Compton scattering



π^0 background



Symmetric π0 decay, two photon hits are mixed in one BGO cluster.

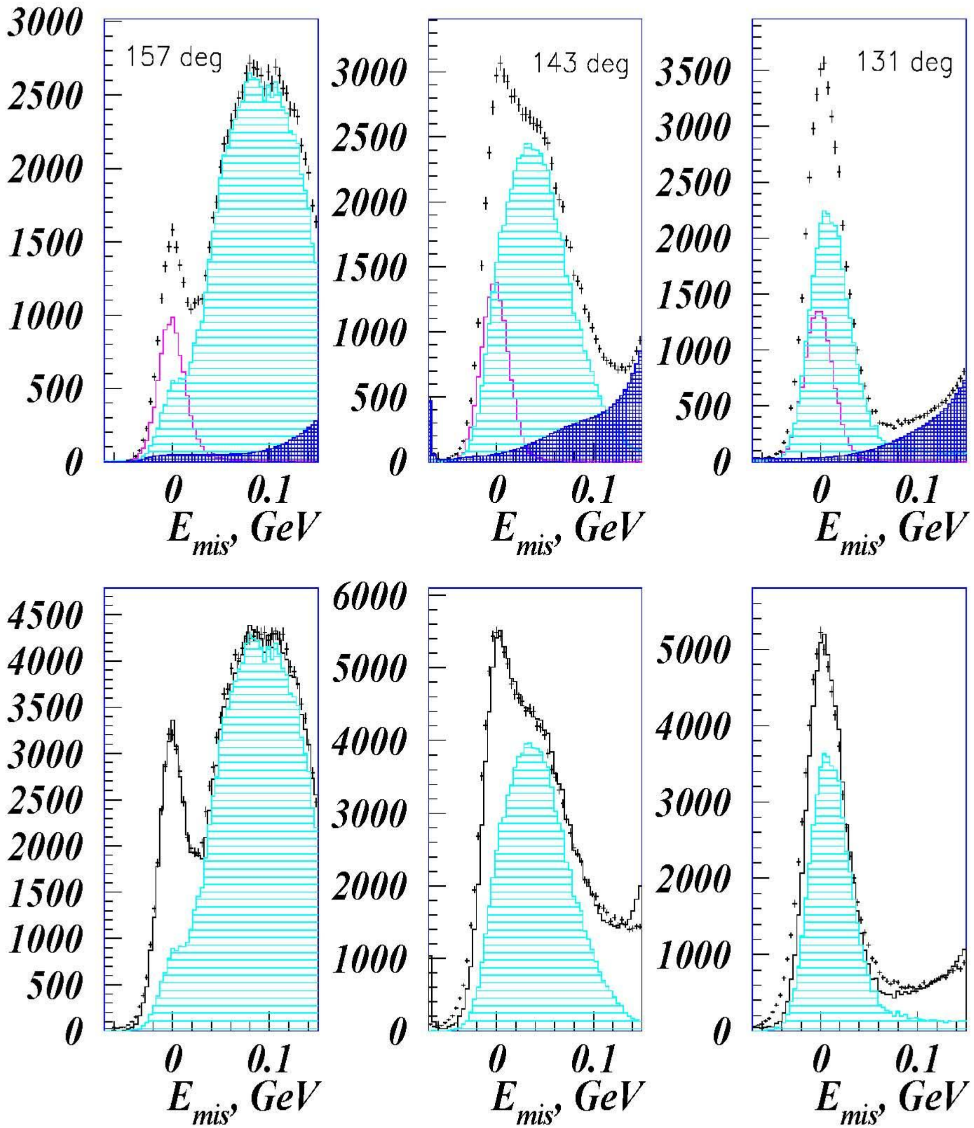


Asymmetric π0 decays, the second low-energy photon may not be detected.

Main identification parameter is
Missing energy

$$E_{mis} = E_{\gamma} - E_{\gamma'} - T_p(\Theta_p)$$

Simulation and Data



Simulations:

Magenta: Compton

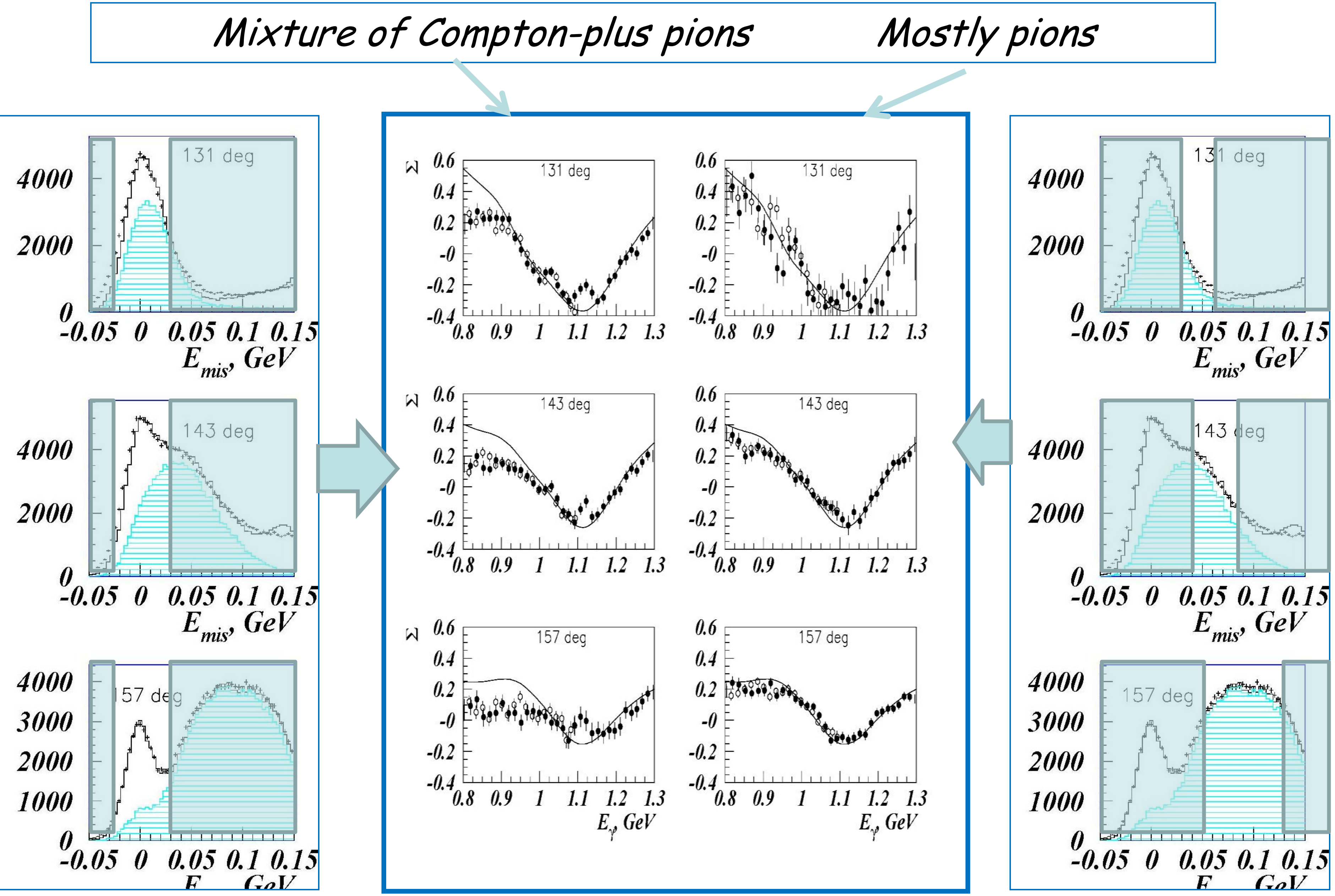
Green : the pion background

Blue: other reactions

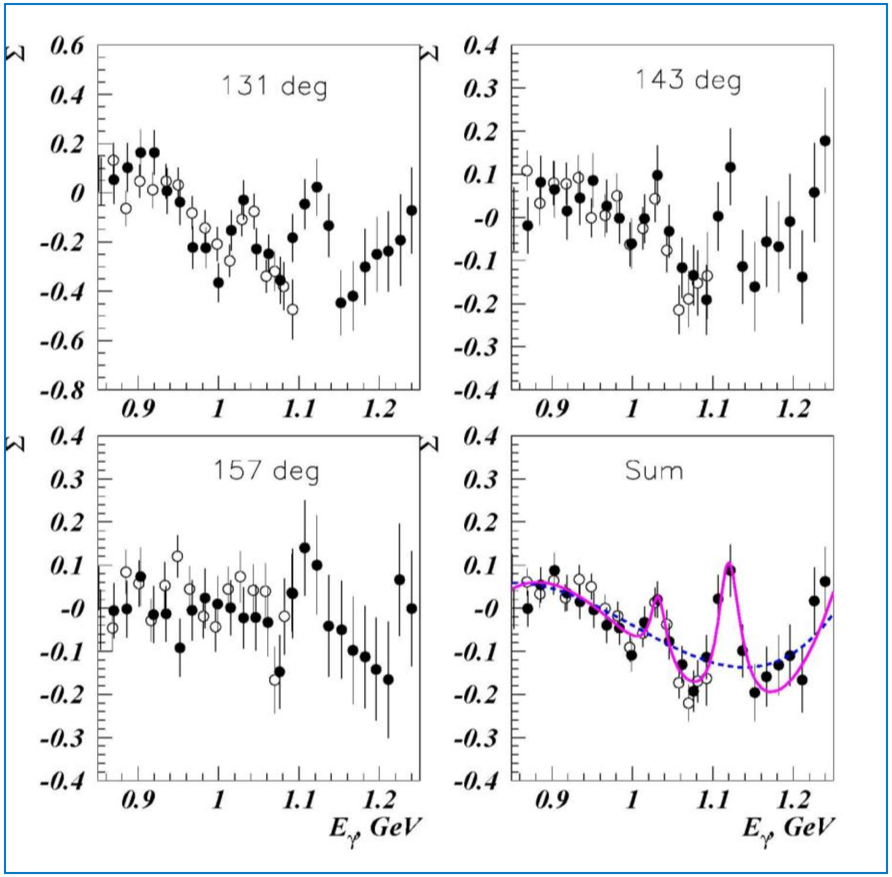
Data:

Green is the estimated contamination of pion photoproduction.

Beam asymmetry with the main and side-band cuts.



Beam Asymmetry for Compton scattering



Two narrow resonant structures!

Fits:

4-order polynomial (background hypothesis)

X^2=77/39

4-order polynomial+BW1+BW2

$$BW = \frac{(E_\gamma - E_r)\sin(\varphi) + \Gamma\cos(\varphi)}{(E_\gamma - E_r)^2 + \frac{\Gamma^2}{4}}$$

X^2=27/33

Results

$E_1 = 1.036\ GeV$	$\Gamma_1 = 25\ MeV$	$W_1 = 1.681 \pm 0.006\ GeV$	$\Gamma_{w1} = 16 \pm 6\ MeV$
$E_2 = 1.119\ GeV$	$\Gamma_2 = 35\ MeV$	$W_2 = 1.726 \pm 0.007\ GeV$	$\Gamma_{w1} = 21 \pm 8\ MeV$

Summary:

- Two resonant structures at W~1.68 and W~1.72 GeV are observed;
- One more challenge for the explanation of the ``neutron anomaly" in terms of the interference of well-known resonances;
- W~1.68 GeV and W~1.72 GeV are close to the thresholds of $K\Lambda$ and ωp photoproductions. This favors the assumption of the cusp effect. However, there are open questions: i)why it is not seen in pionphotoduction; ii) Could it occur in Comptons scattering; iii) Why the structure at W~1.72 GeV is not seen in η photoproduction?
- The only explanation that accommodates all experimental findings at W~1.68 GeV is the existence of N*(1685) resonance. The observation of the second structure at W~1.72 GeV adds more puzzle.....

Thank you for your attention!

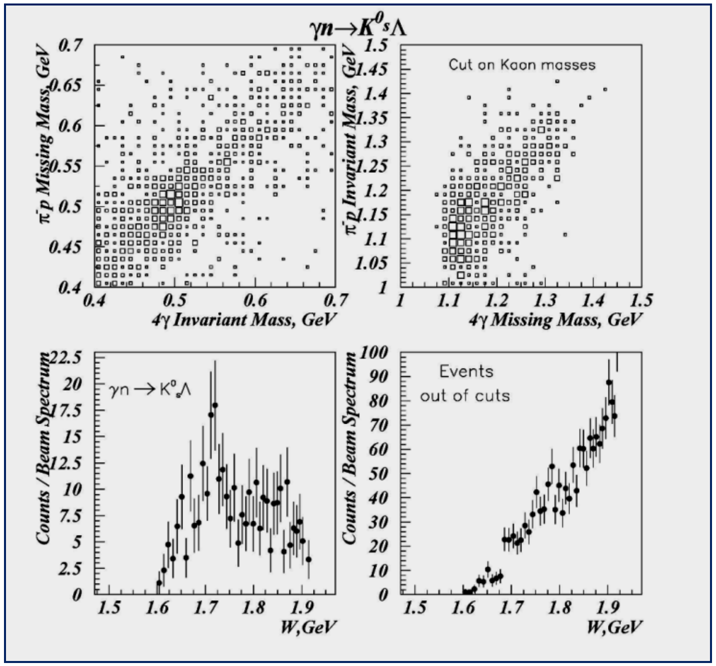
Resonant Structure at W~1.72 GeV?

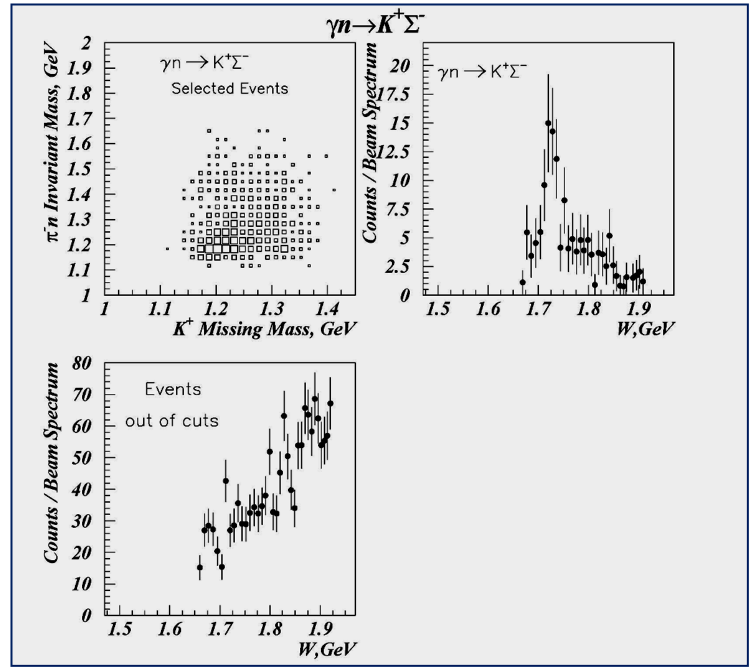
Some other results

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

Old (2003) preliminary GRAAL Analysis (remains uncompleted)

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



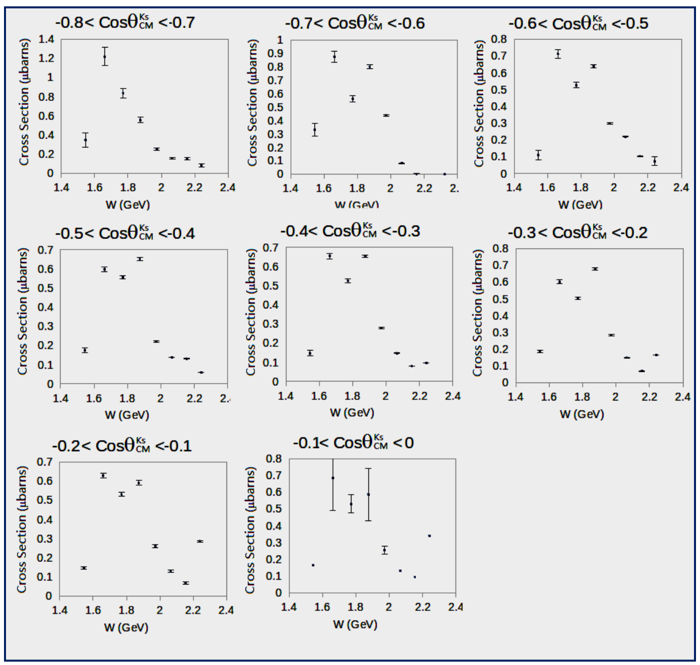


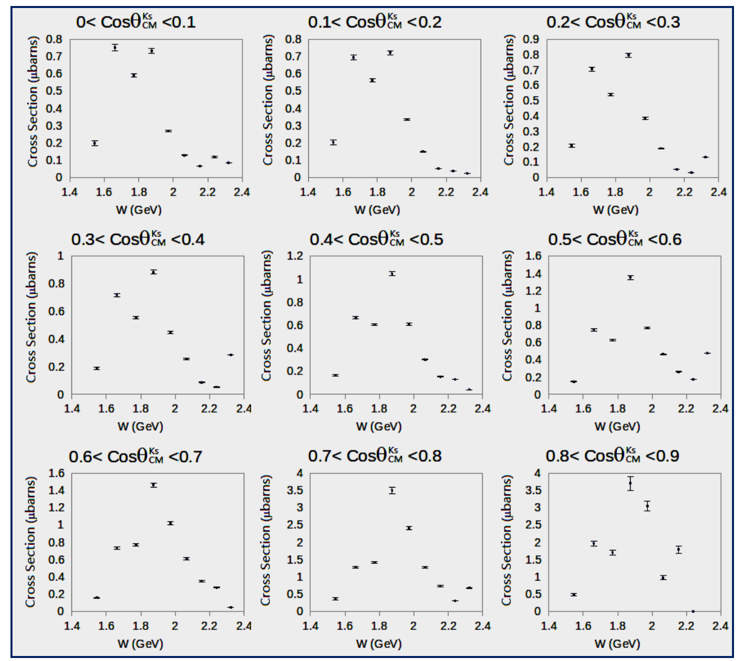
Peak near W~1.72 GeV?

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

Talk of Taylor at NSATR2013 Workshop

Peak at 1.7 GeV!

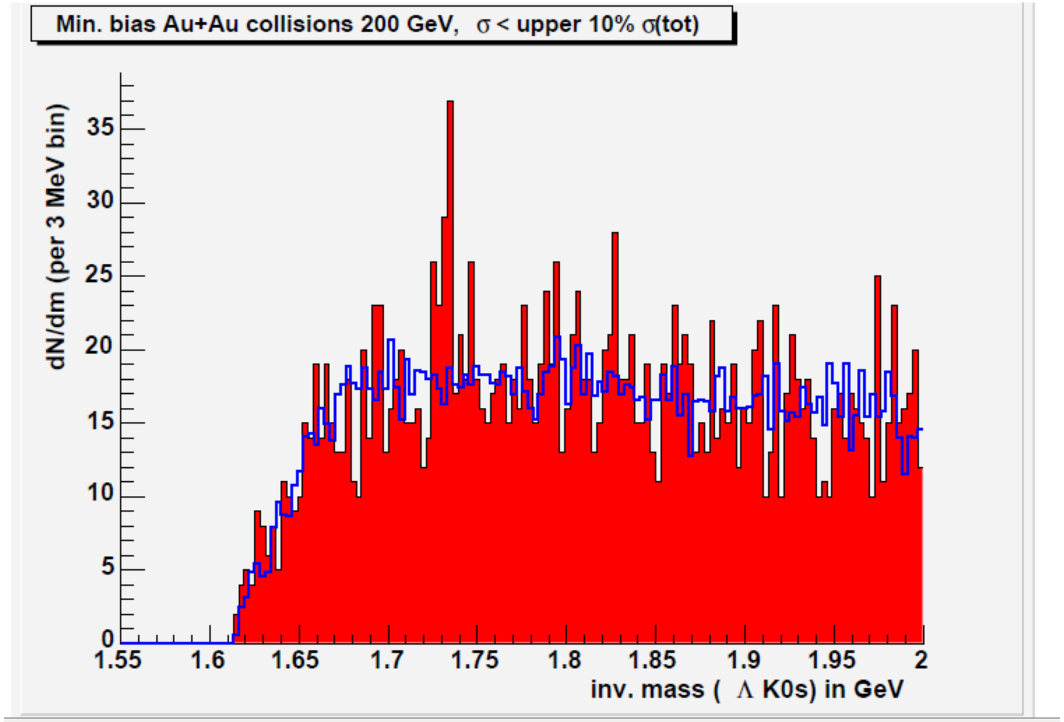




Old (2003) preliminary results from STAR

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

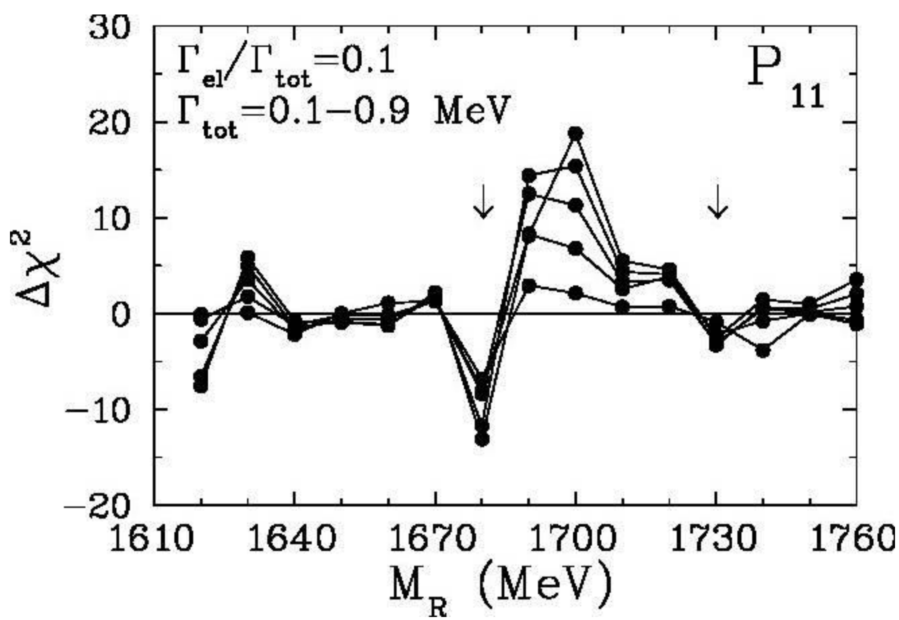
R.Arndt, Ya.Azimov, M.Polyakov, I.Strakovsky, R.Workman

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

Phys.Rev. C69 (2004) 035208

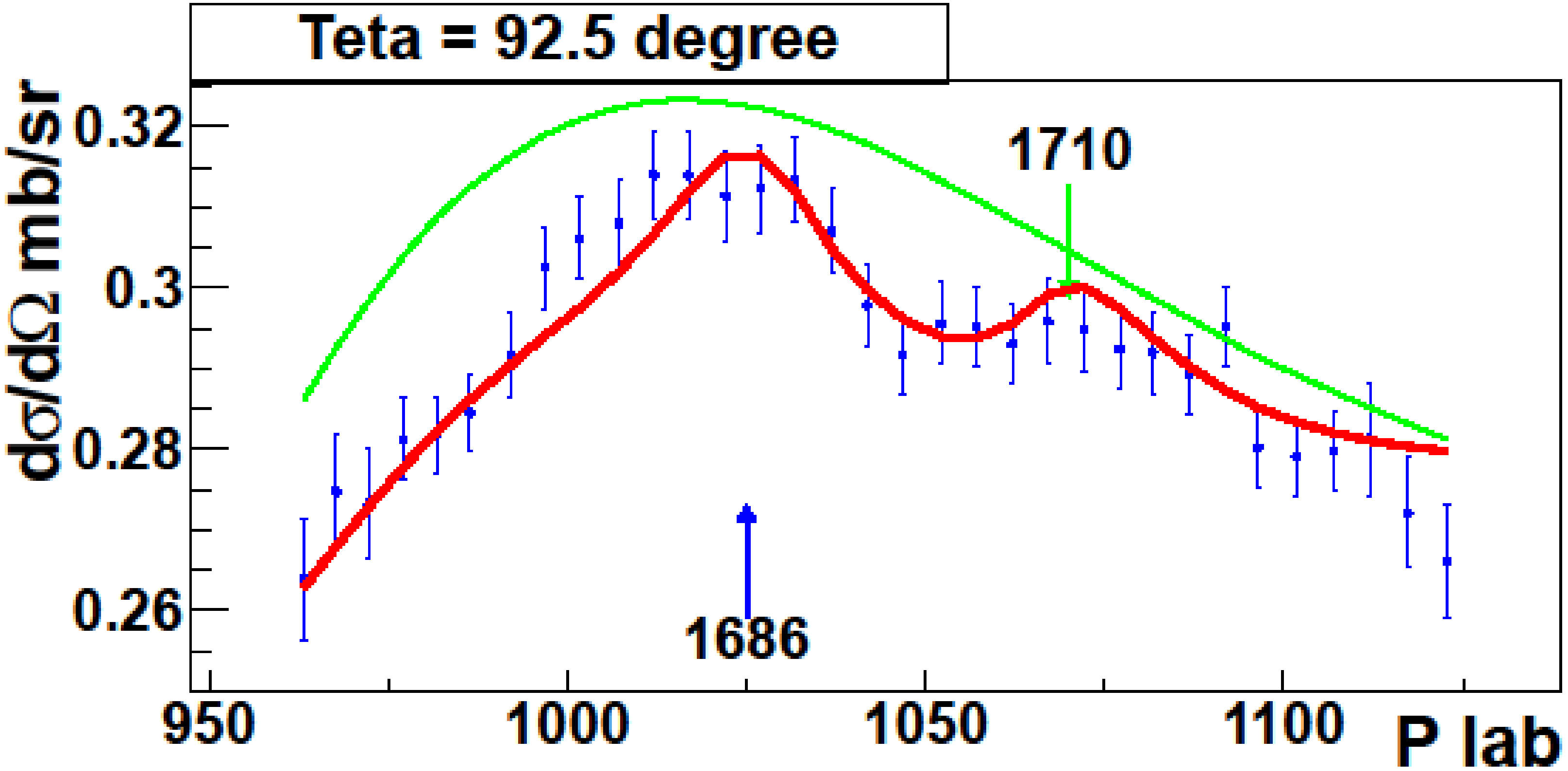
Nucl-th/0312126;

`` … 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!