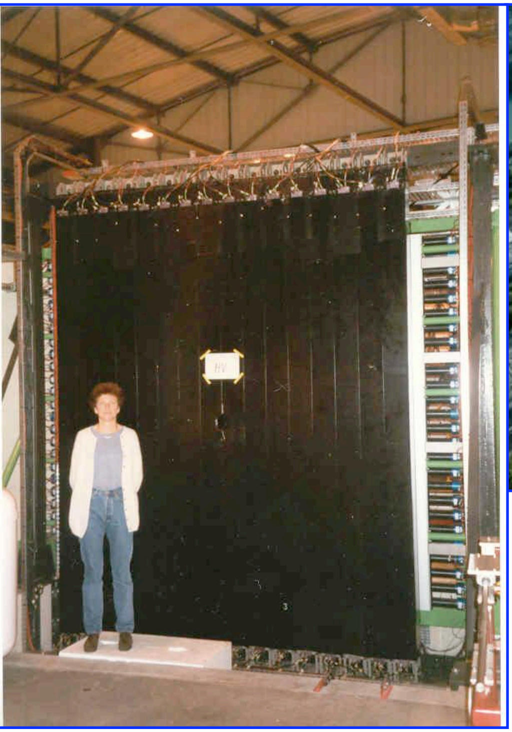
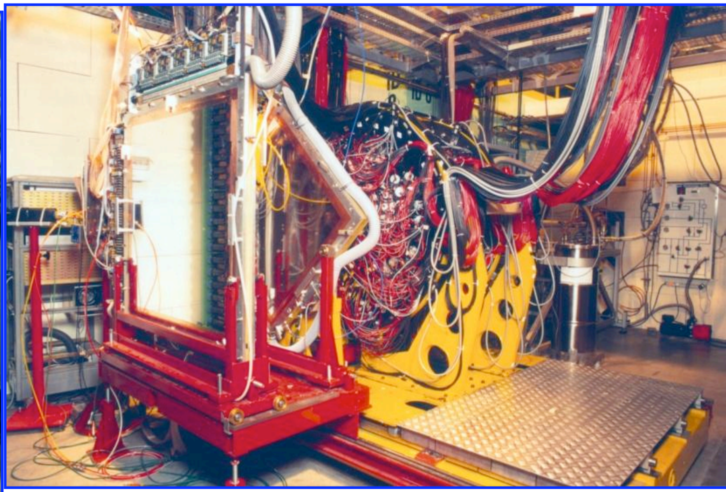
Evidence for Narrow N*(1685) Resonance





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Outline

- Experimental Review on eta photoproduction on the neutron: Evidence for N*(1685) or interference of known resonances?;

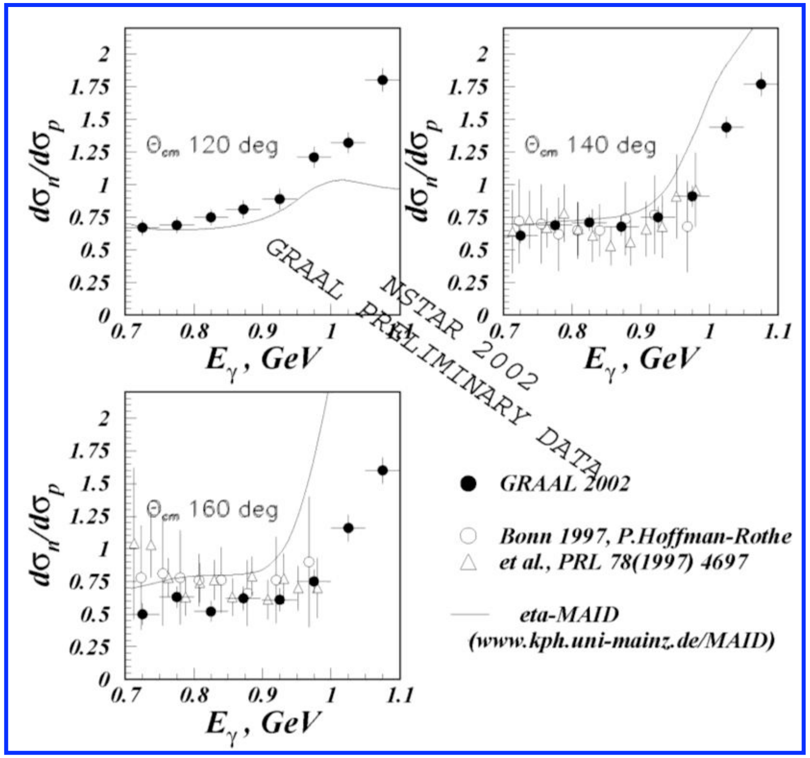
- Alavailable interpretations and discussion;

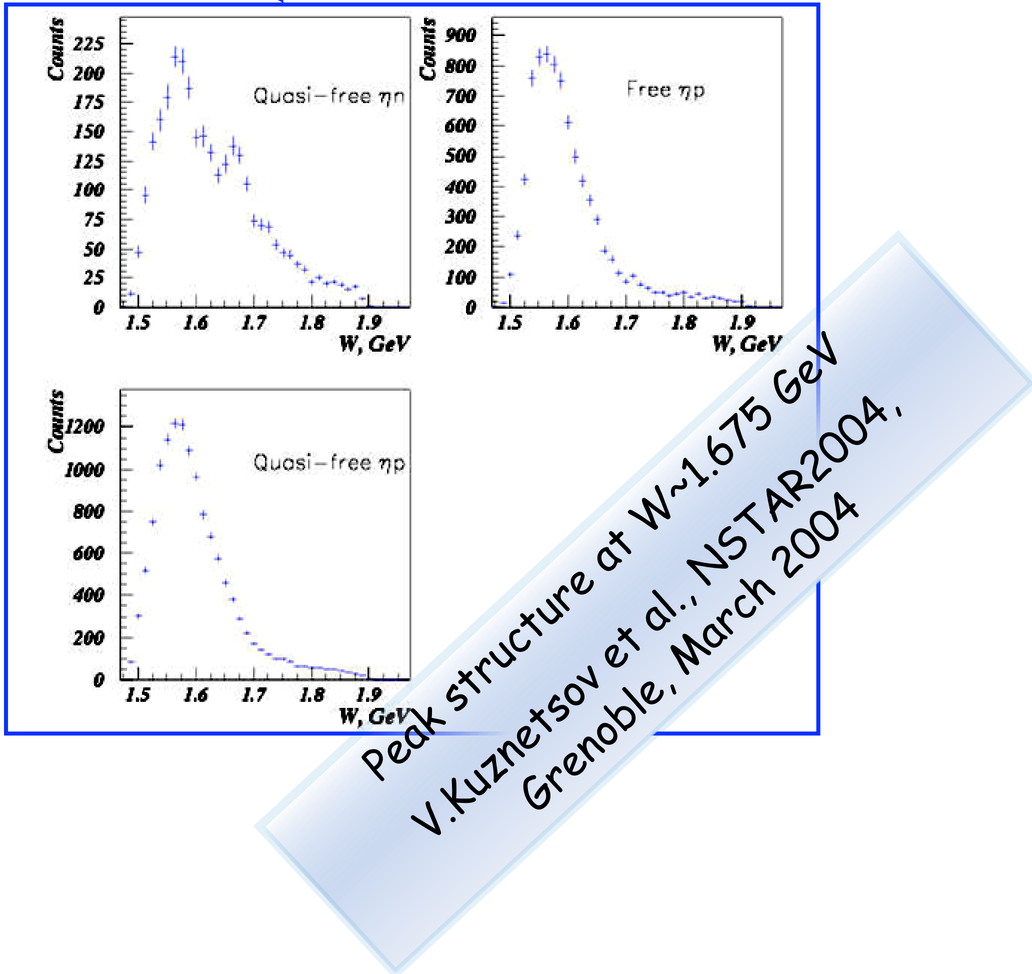
- Search for N*(1685) in other reactions;

- Summary&Conclusions

History of Experiments: First results on $\gamma n \to \eta n$ from GRAAL

``On Photoexcitation of exotic Antidecuplet",
M.Polyakov, A.Rathke, EPJA 18, 691, 2003, Hep-ph/0303138



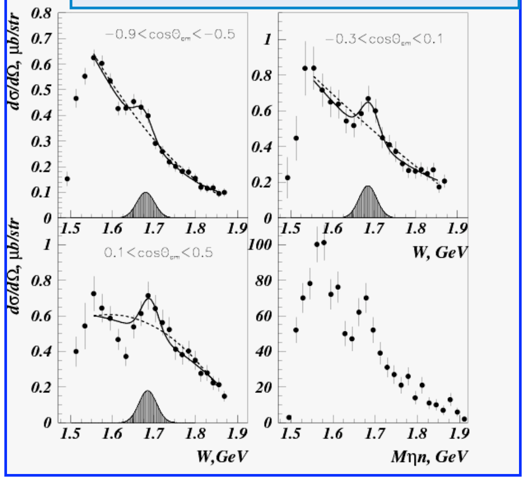


Sharp rise in the ratio of σ_n/σ_p

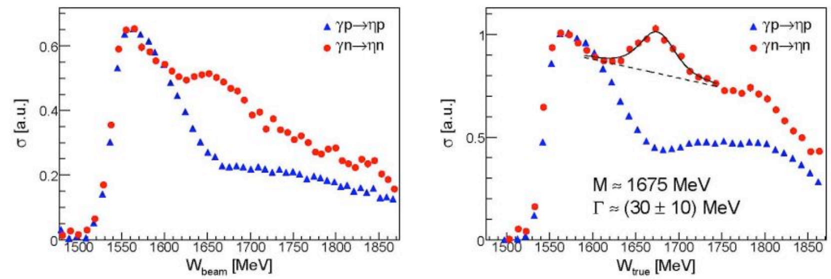
V.Kuznetsov et al., NSTAR2002, Pittsburgh, October 2002

Available data on γn→ηn

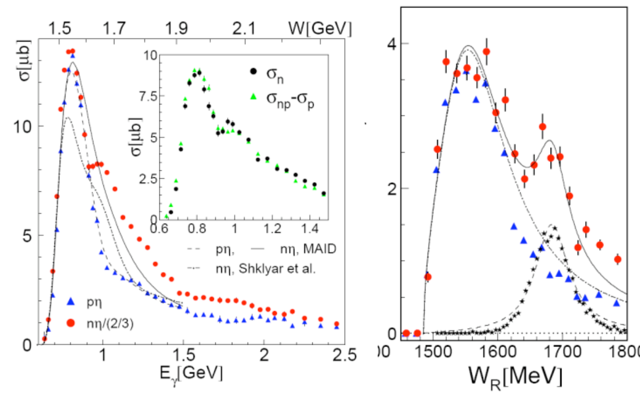
GRAAL: γn→ηn,
V.Kuznetsov et al., Phys Lett. B647, 22,(2007); hep-ex/0606065.



A2@Mainz: γn→ ηn, D.Wertmuller, Chinese Physics, **C33**, 1(2009), nucl-ex:1001.3840

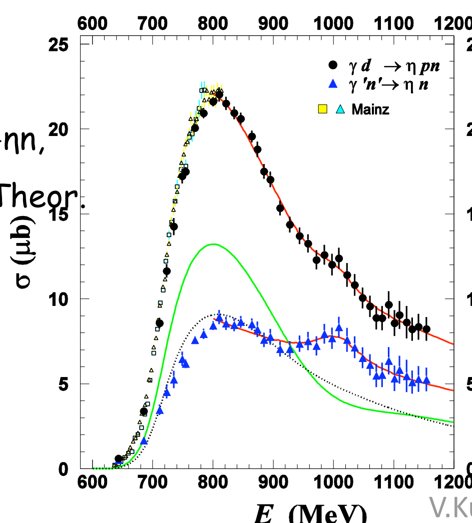


CBELSA/TAPS: γn→ηn, J.Jeagle, Phys. Rev. Lett. 100:252002 (2008); nucl-ex/0804.4841



LNS-Sendai: γn→ηn,

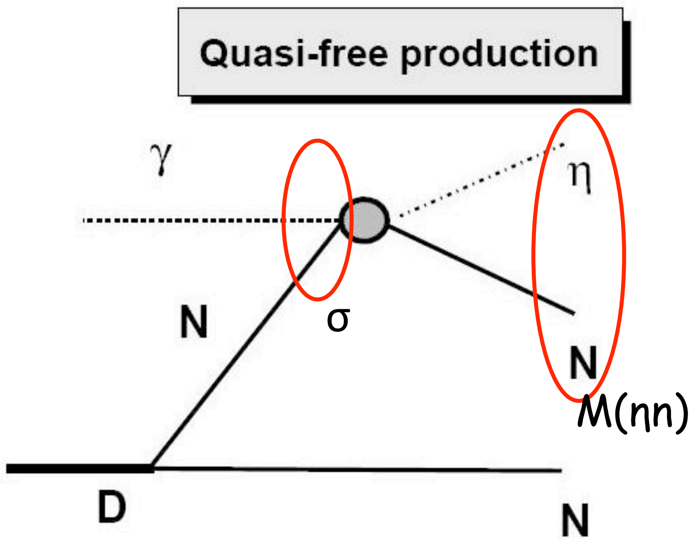
F.Miyahara, Prog. Theor. Phys. Suppl. **168**, 90(2007)

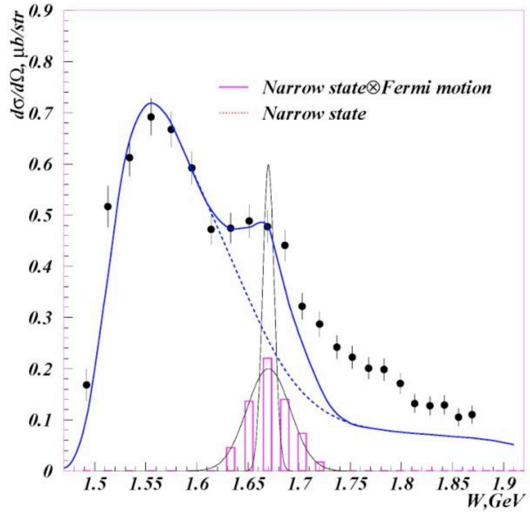


Narrow peak structure in the γn→ηn quasi-free cross section and in M(ηn) spectrum at

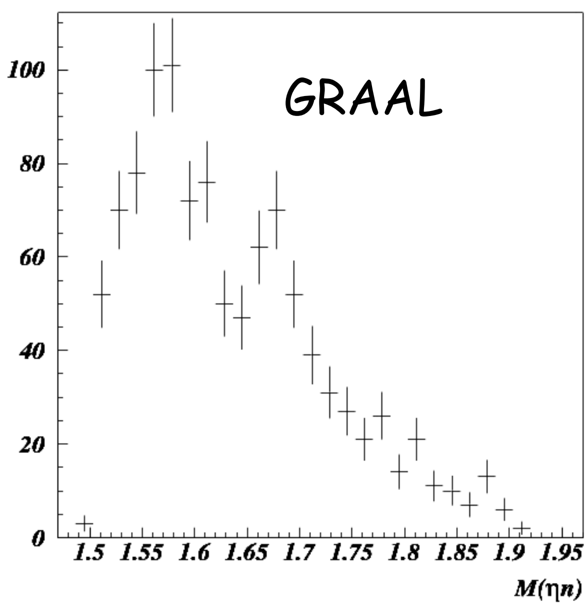
W~1.67-1.685 GeV !

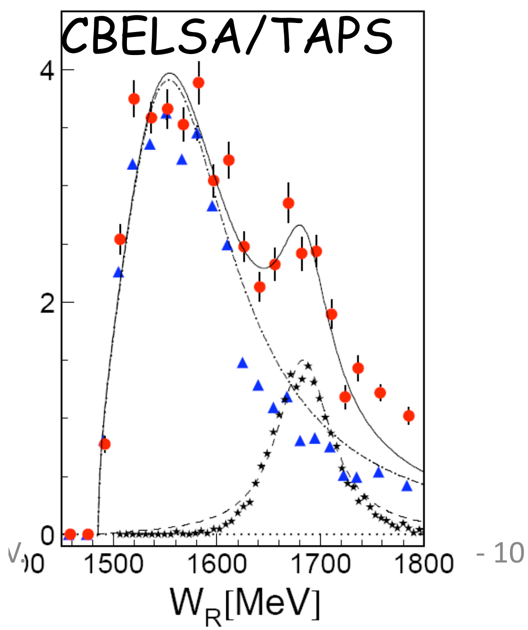
Quasi-free cross section is obtained assuming the target neutron to be at rest.. In reality the neutron bound in a deuteron target is not at rest → Experimental cross section is smeared by Fermi motion





The width of the bump in the quasi-free cross section is close to that expected for a narrow resonance smeared by Fermi motion.

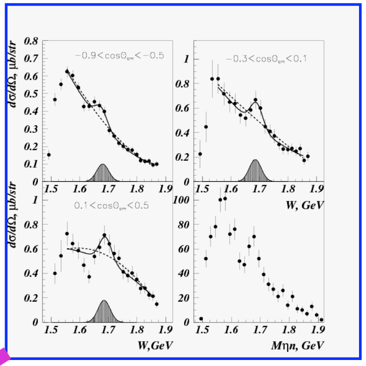


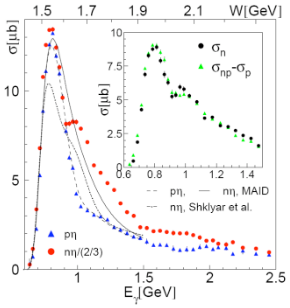


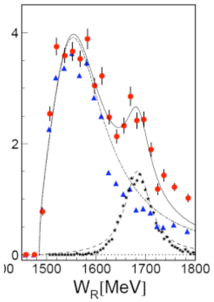
The invariant mass of the final-state η and the neutron is not affected by Fermi motion. The width of the peaks in the invariant-mass spectra are close to the instrumental resolution (40 MeV at GRAAL and 60 MeV at CBELSA/TAPS).

Do we see a new resonance?

Graal γn→ηn

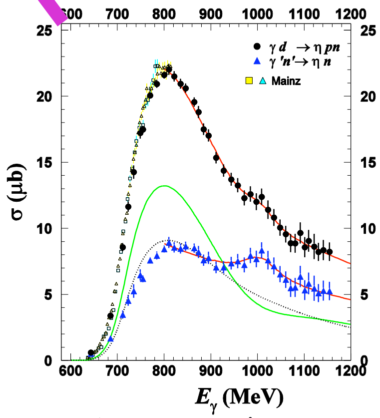






CBELSA/TAPS γn→ηn

New N*?



LNS-Sendai γn→ηn

Available intrepretations

New narrow nucleon resonance: Ya.Azimov, V.Kuznetsov, M.Polyakov, and I.Strakovsky, EPJA 25, 325(2005); A.Fix, M.Polyakov, and L.Tiator, EPJA 32,311(2007), hep-ph/0702034.

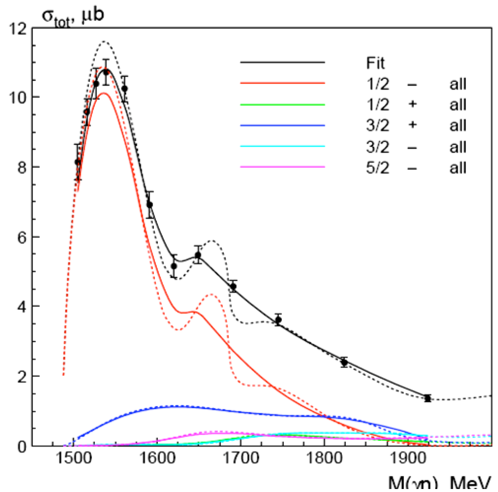
Interference of S11(1650) and P11(1710) .

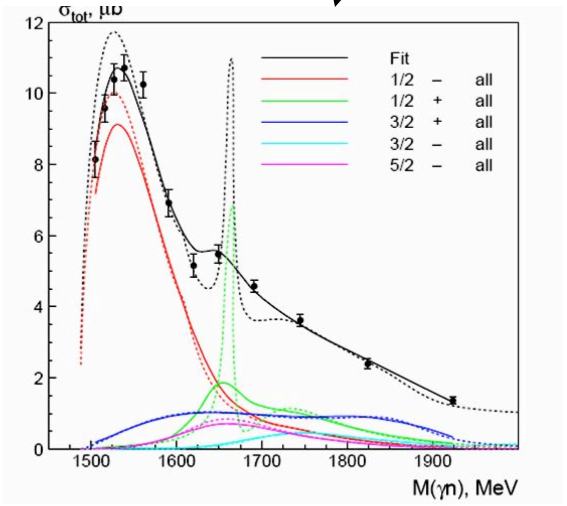
V. Shklyar, H. Lenske , U. Mosel , PLB650 (2007) 172 (Giessen group)

Interference effects of S11(1535) and S11(1650) or narrow P11(1670) resonance

A. Anisovich et al. ArXiv: hep-ph/0809.3340 (Bonn-Gatchina group)

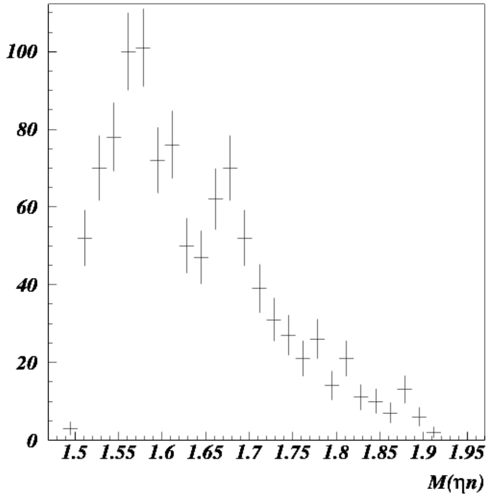
Fit of CBTAPS/ELSA data



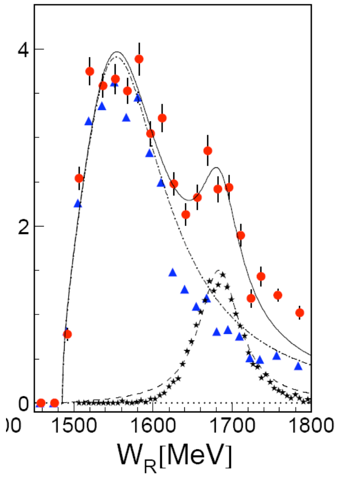


→ Situation has to be understand

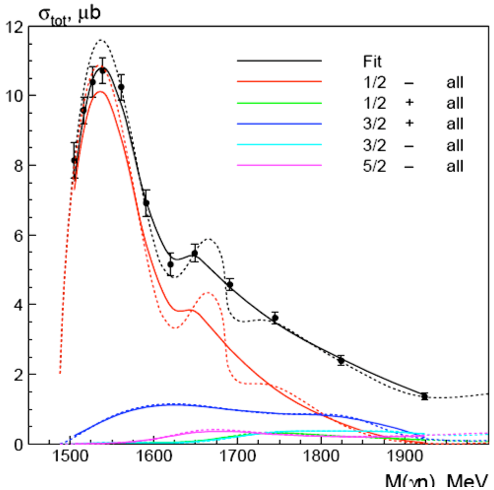
Fisrt Comments



Could Bonn-Gatchina and Geissen groups reproduce M(ηn) spectra?



Graal: Instrumental resolution ~40 MeV. The width of the peak is similar.



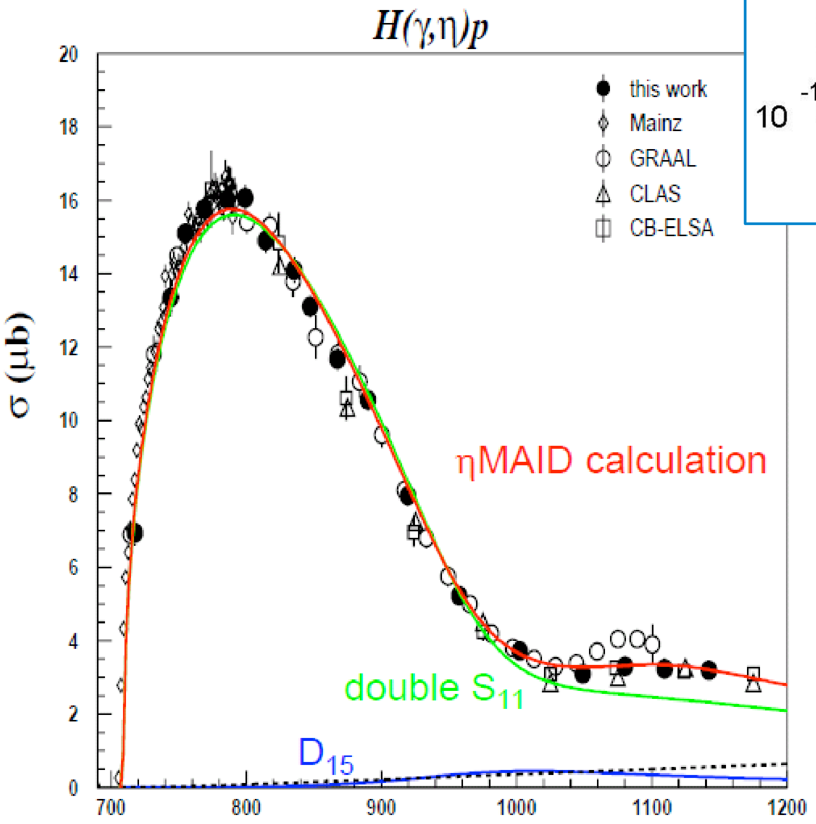
CBTAPS-ELSA: Instrumental resolution ~60 MeV. The width of the peak is again similar.

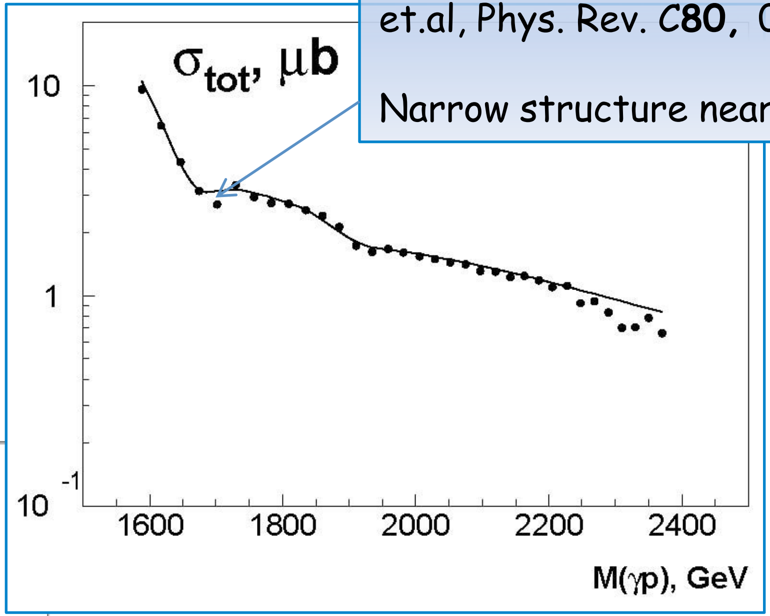
Assumptions on the interference of known resonances seem to contradict to the observed narrow peaks in the M(ηn) invariant-mass spectra from GRAAL and CBTAPS-ELSA. The structure in the calculated cross section is essentially wider. More is coming….

Search for N(1685) in other reactions

Total cross section for

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





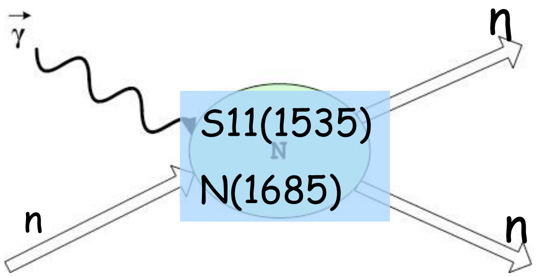
New data from CBELSA/TAPS V.Crede et.al, Phys. Rev. C**80**, 055202, 2009

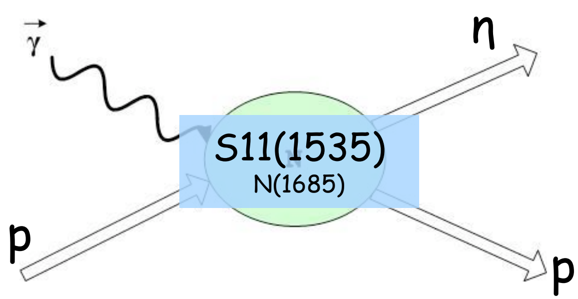
Narrow structure near W~1.68 GeV?

A narrow structure near W=1.68 GeV (Eγ≈1.05 GeV) is not (or poorly) seen in the eta photoproduction cross section on the free proton.

→ N(1685) photoexcitation on the proton (if it exists) is suppressed

Do we really see a narrow N(1685) resonance? Test with γp→ηp beam asymmetry data



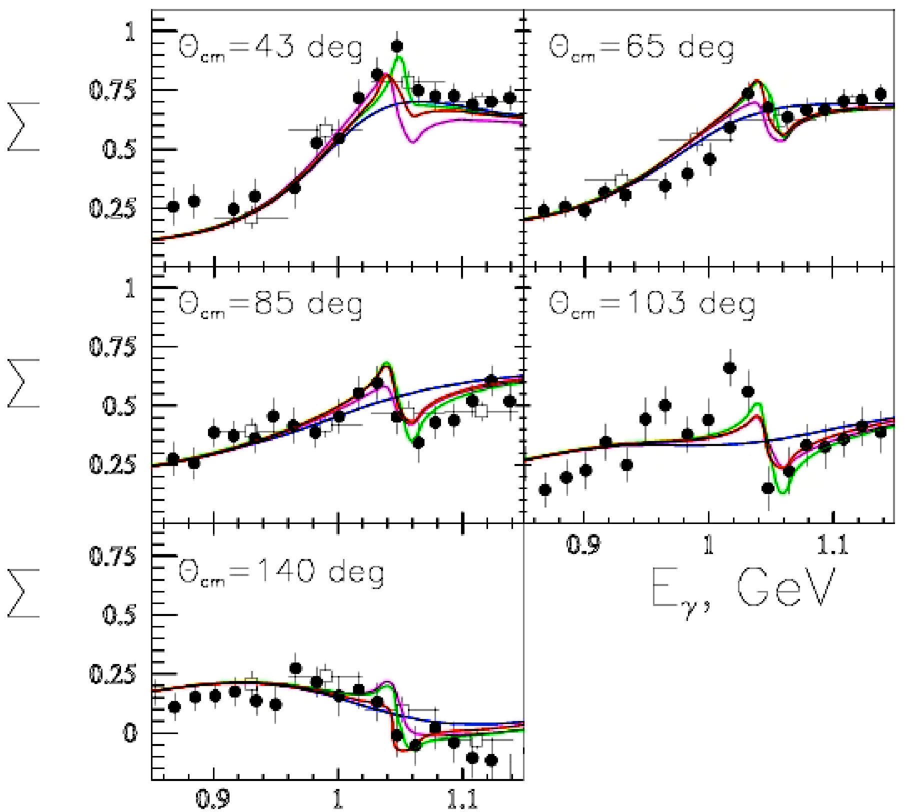


If photoexcitation of any resonance occurs on the neutron, it should also occur on the proton, even being suppressed by any reasons.

The signal of a weakly photoexcited resonance may not be seen in the cross section on the proton because of the S11(1535) dominance, but it may appear in polarization observables. On the contrary, the interference of known resonances would not generate any structure on the proton.

GRAAL beam asymmetry for eta photoproduction on free proton with fine energy binning.

V. Kuznetsov, M.V.Polyakov, et al., hep-ex/0703003
V. Kuznetsov, M.V.Polyakov, et al., Acta Physica Polonica , 39 (2008) 1949
V. Kuznetsov, M.V.Polyakov., JETP Lett., 88 (2008) 347



Well pronounced structure at W=1.685 GeV

Fit: smooth SAID multipoles
+ a narrow resonance
Blue – SAID only
Magenta – SAID + narrow P11(1688)
Green – SAID +narrow P13(1688)
Red – SAID + narrow D13(1688)

M=1.685±10 GeV, Γ≤30 MeV

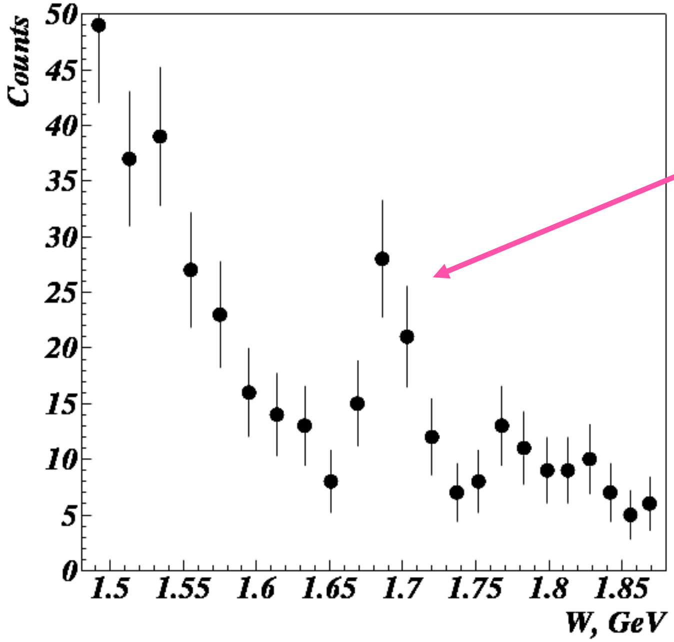
Comments on publication of O.Bartalini et.al . nucl-ex/07071385 are in backup slides.

Backward-angles Compton scattering on the neutron at GRAAL

$\gamma n \rightarrow \gamma n$

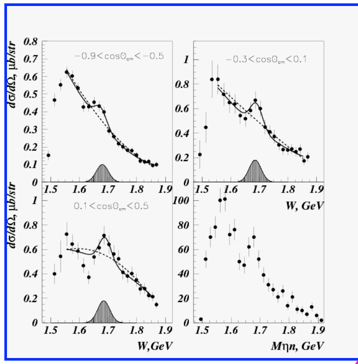
*First **Preliminary** Results*

(Details will be given in my Talk by Tuesday)

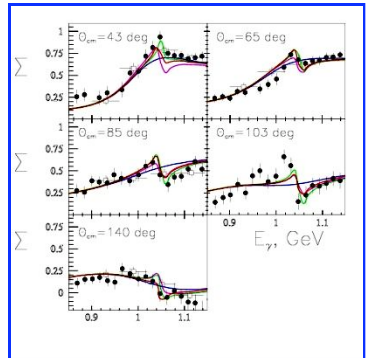


Narrow peak at W=1.685 GeV in Compton scattering on the neutron which is not seen in Compton scattering on the proton.

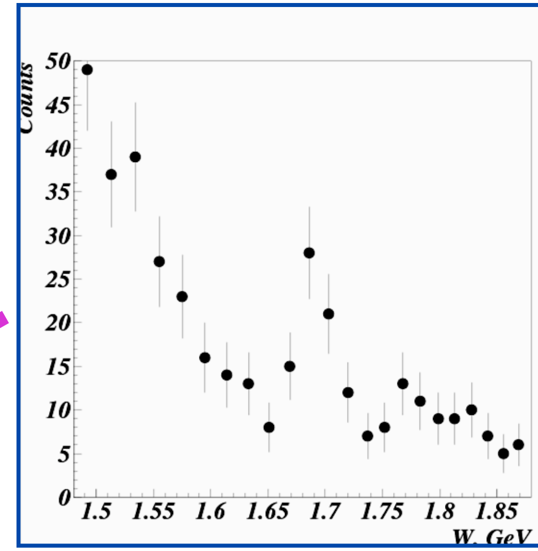
Graal γn→ηn



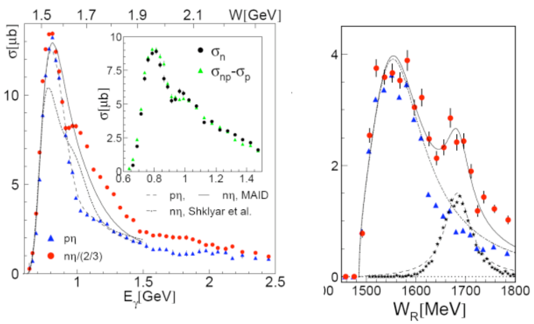
Graal γp→ηp



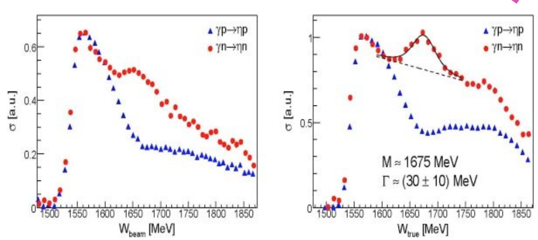
Graal γn→γn



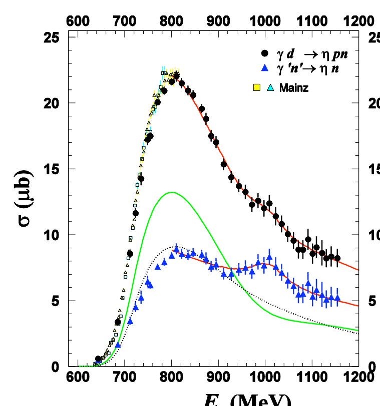
N*(1685)



CBELSA/TAPS γn→ηn



Mainz γn→ηn



LNS-Sendai γn→ηn

The only explanation that accommodates all experimental findings is the existence of a narrow N(1685) resonance (V.Kuznetsov, M.Polyakov, JEPT Lett. 88,347(2008)).

Properties of N*(1685)

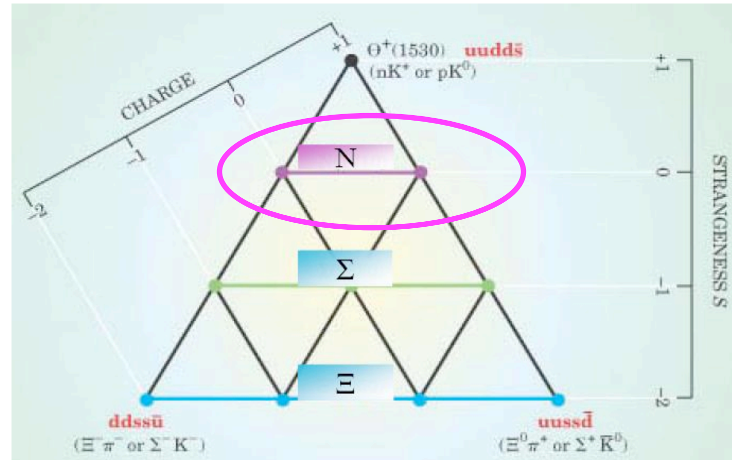
- M=1685±10 MeV
- Γ≤30 MeV
- Isospin ½
- S=0
- Strong photoexcitation on the neutron and suppressed photoexcitation on the proton
- Quantum numbers

P11, or P13, or D13

Reactions: γn→ηn; γn→γn

The properties of N*(1685) are close to those predicted for the second member of the exotic antidecuplet.

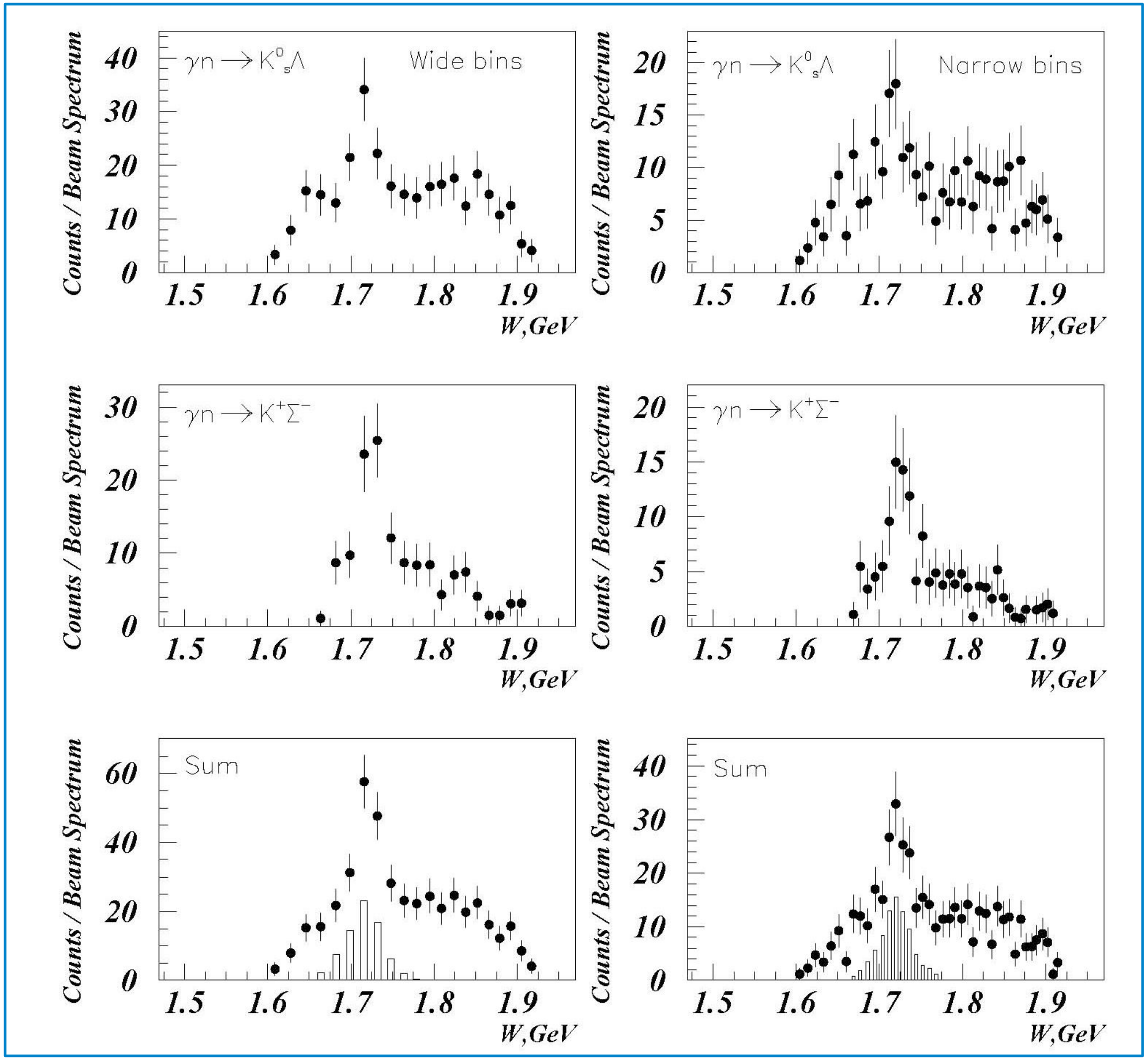
Expected properties of the second member of the χQM antidecuplet (D.Diakonov, V.Petrov, M.Polyakov)



- M= 1650 – 1690 MeV
- Γ≤30 MeV
- Isospin ½
- S=0
- Strong photoexcitation on the neutron and suppressed (~100 times) photoexcitation on the proton
- Quantum numbers P11
- Reactions: γn→ηn; γn→γn; γn→ KΛ

Preliminary analysis of γn→KΛ and γn→K⁺Σ⁻ at GRAAL

Peak structure at 1.73 GeV (to be confirmed in the further analysis)



Thank you for your attention!