A2 collaboration: status achievements and problems

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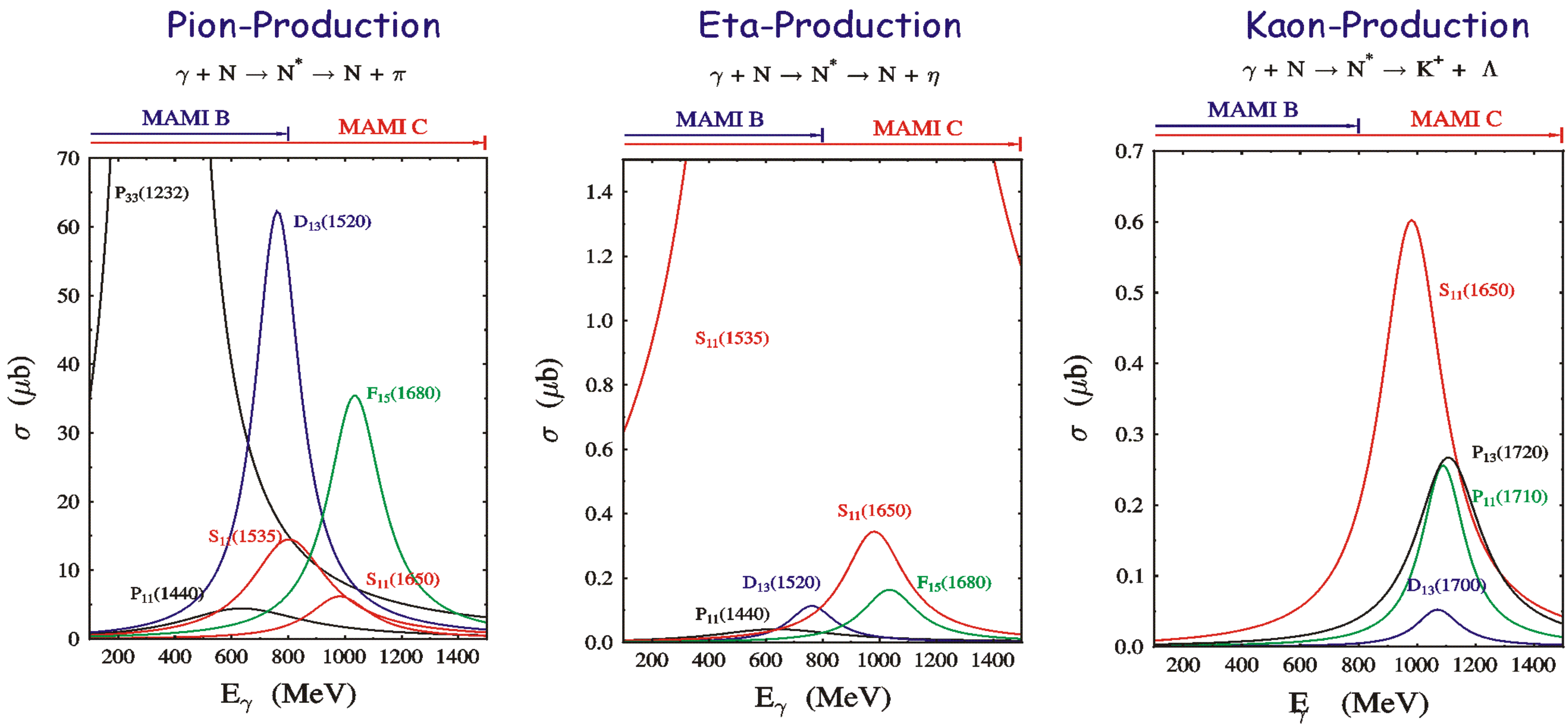
The A2 collaboration on MAMI-C is the only facility that produce now the new experimental data in medium energy physics. Now the upgrading of several medium energy experimental sets in progress(BONN,JLAB,GRAAL) So the analysis of A2 experimental set in comparison with other challenging experimental set is important for choosing of experimental program..
The status and upgrading of experimental set is presented.
Now the physics program is concentrated on taking data from new polarized target.
The results of preliminary processing of new experimental data and results are presented.
The plans of futures experiments of A2 collaboration are discussing.
The MPL of PNPI and PNPI-ITEP collaboration are obtaining new data on pion beam. and may supplement the gamma-beam data
The possible including of PNPI-ITEP experiments in common physics program are discussing.

Nucleon Resonances

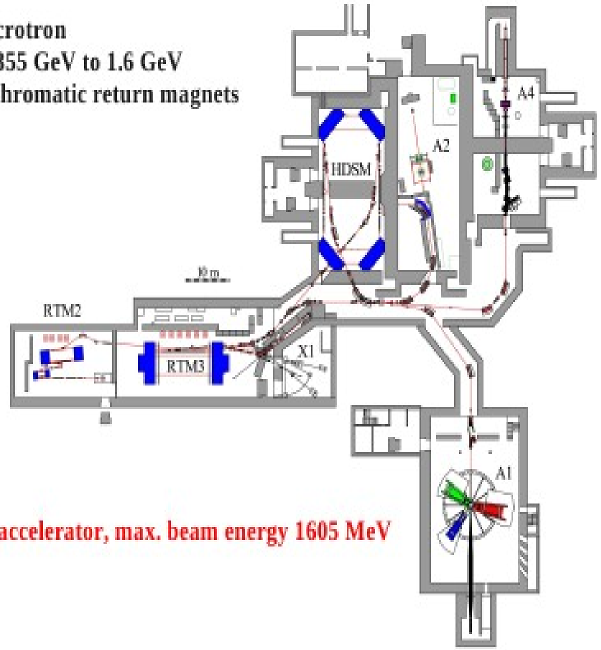


problem : overlapping resonances
polarization observable

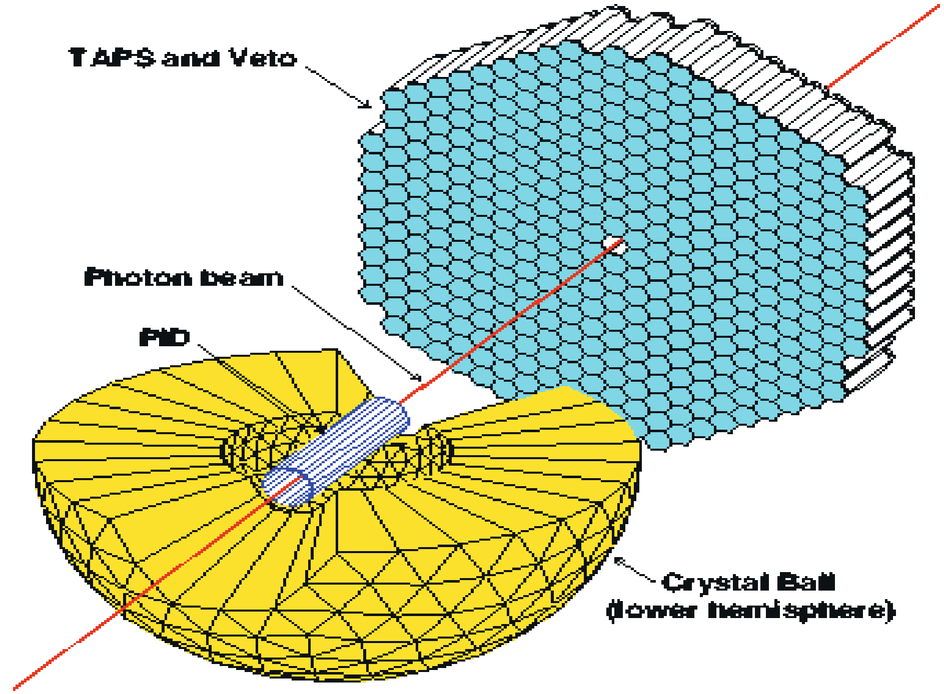
MAMI C : polarized photons, polarized targets
and recoil-proton polarimeter

MAMI-C: electron accelerator @Mayence

harmonic double sided microtron
- energy increase from 0.855 GeV to 1.6 GeV
- 2HF structures and 2 achromatic return magnets



continuous wave electron accelerator, max. beam energy 1605 MeV



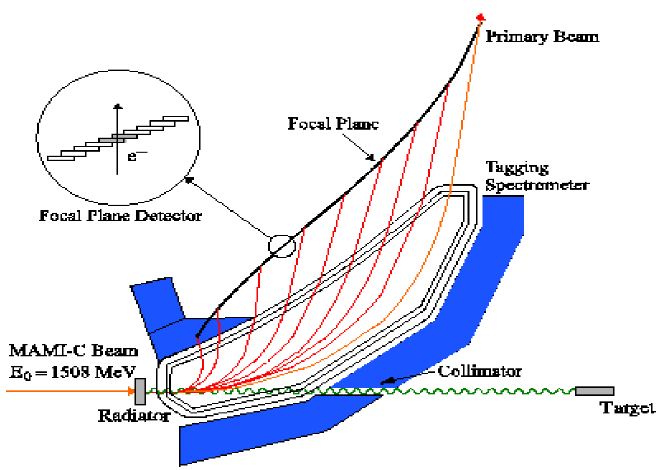
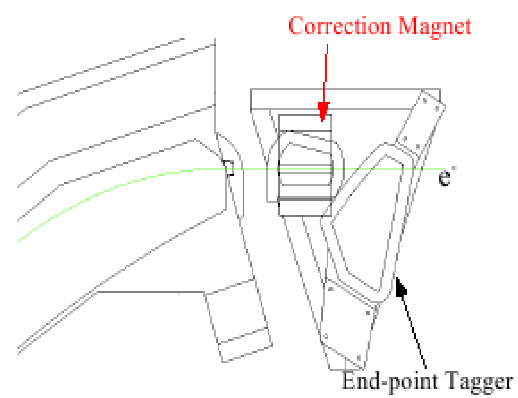


Figure 8: The Glasgow photon tagging spectrometer.

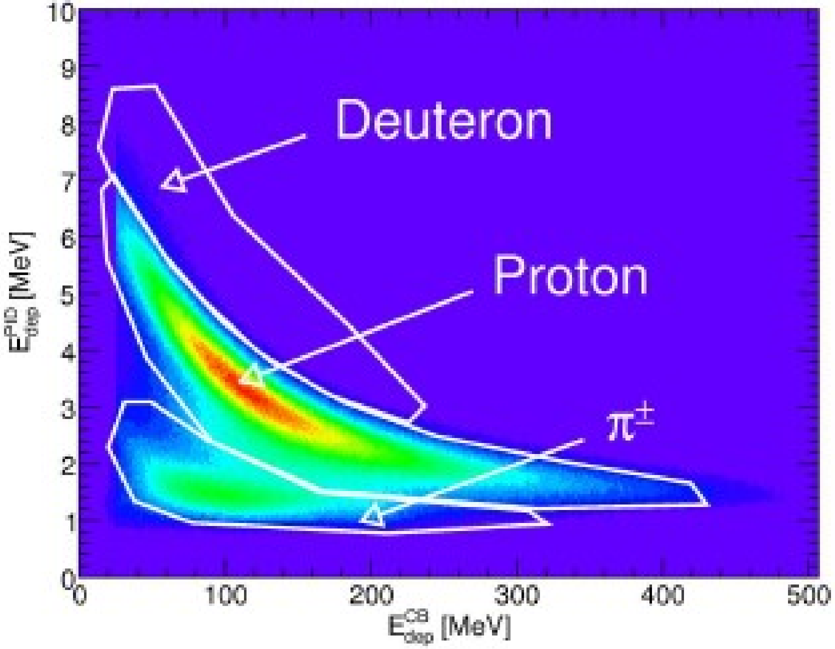
End-Point Tagger

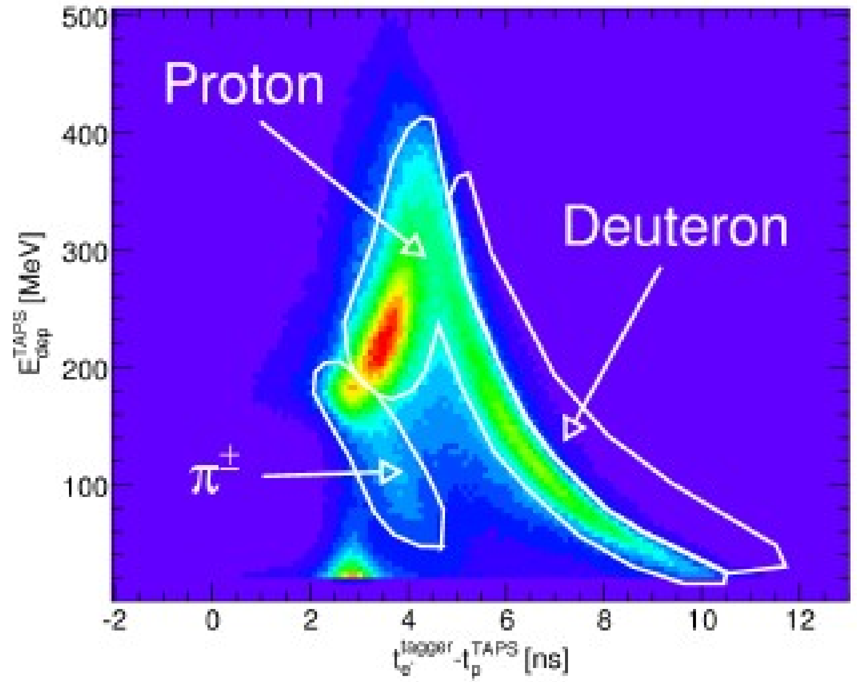
- Similar concept as for main Tagger
- 64 channels
- Energy range (≈150 MeV) from η' threshold to 10 MeV below E_0
- Energy resolution $\Delta E = 2.3$ MeV
- Correction magnet needed
- Also threshold for f_0, a_0 and $K\Lambda$ photoproduction in this range!

Disadvantage:
- Only one tagging device at a time

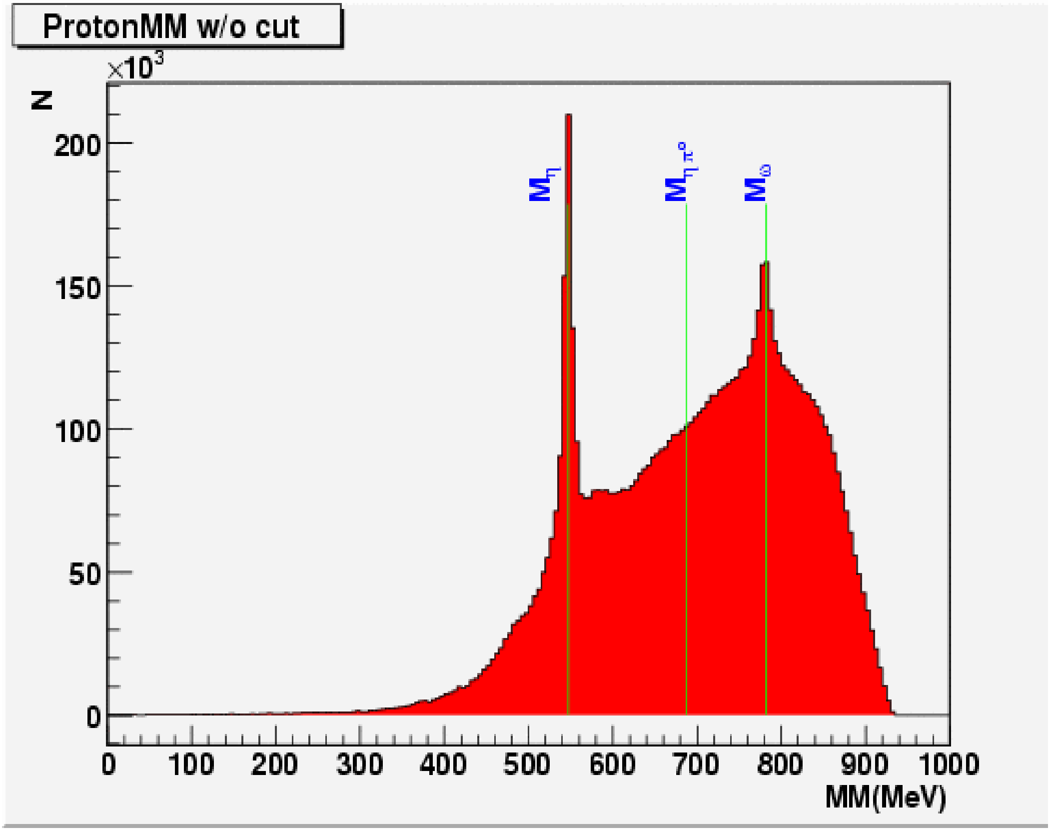


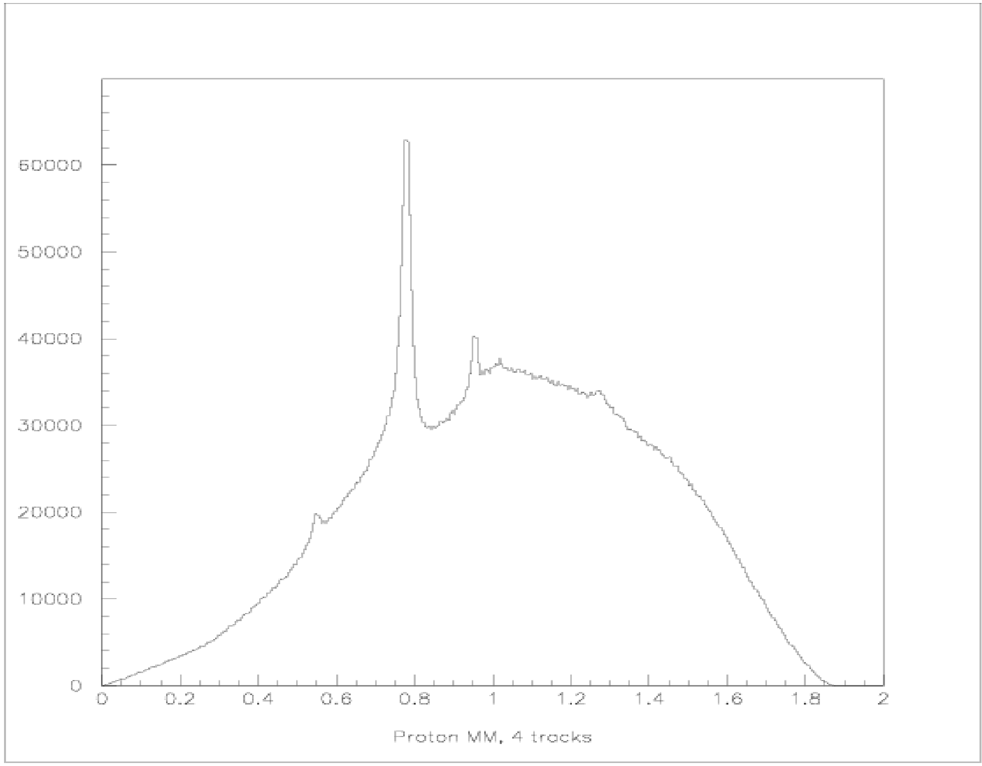
Timeline:
- Beamline modifications start beginning 2011
- First tests mid of 2011?





Particle identification :
Left : CB dE/E
Right :TAPS TOF/E

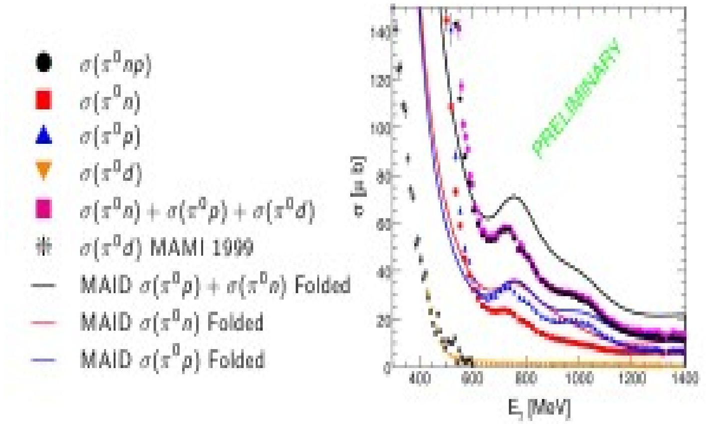


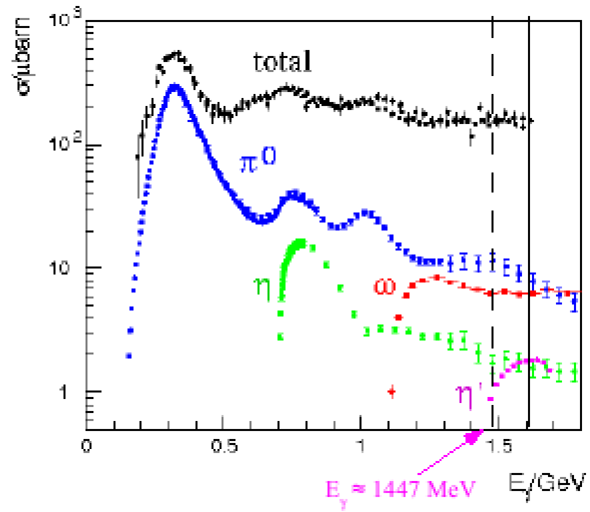


The comparison of missing-mass spectra from CB&TAPS and CLAS experimental sets. The CLAS is aimed mainly on study of charged final states using magnetic spectrometer. CB&TAPS is aimed on neutral final states.

Nevertheless the missing-mass resolutions for protons is rather similar.

The main advantage of A2 experimental set is high beam energy resolution.





Tagger energy range: 4.7 to 93% of E_0

Maximum energy tagged for E_0=1604 MeV is 1491 MeV

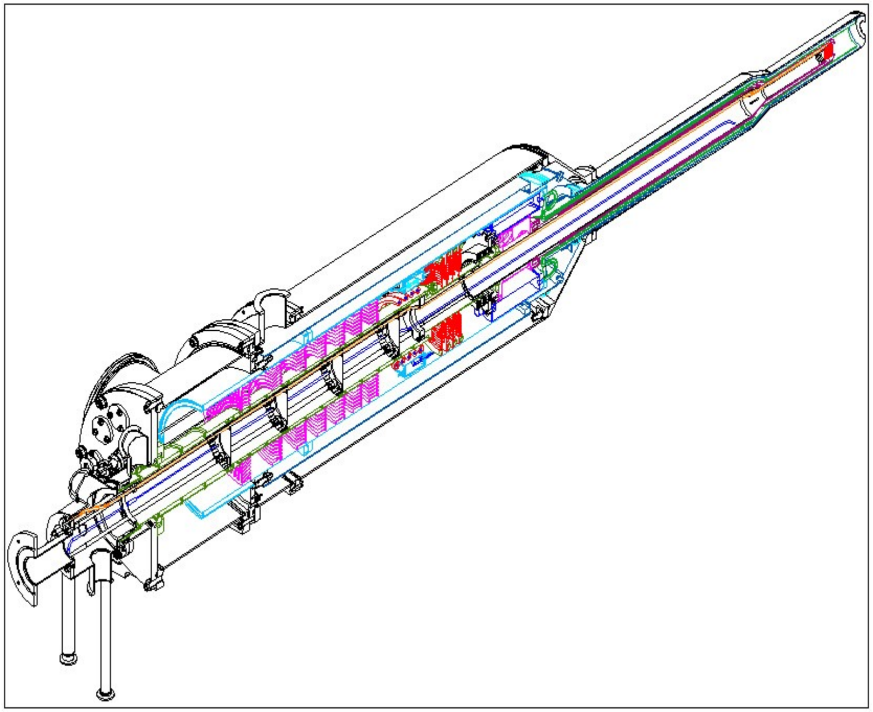
But:

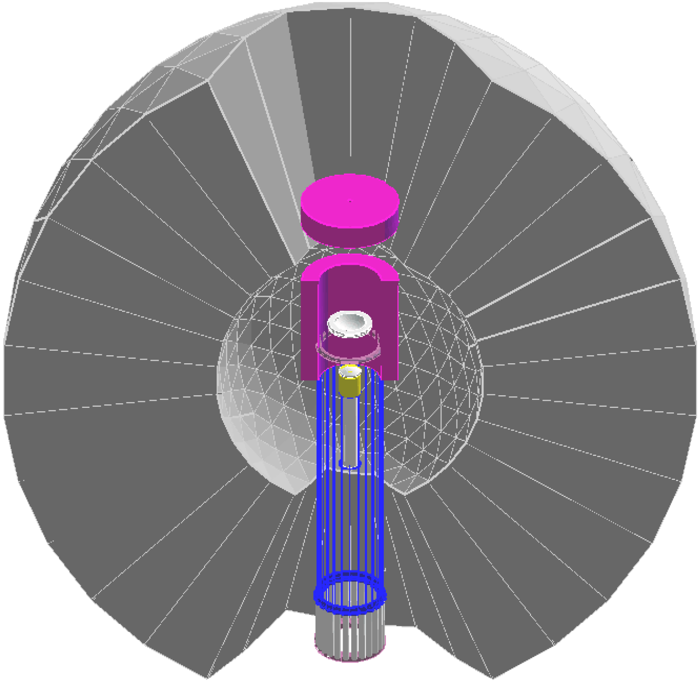
- η' is an interesting field
- Studies of η' decays at high rates possible with the CB

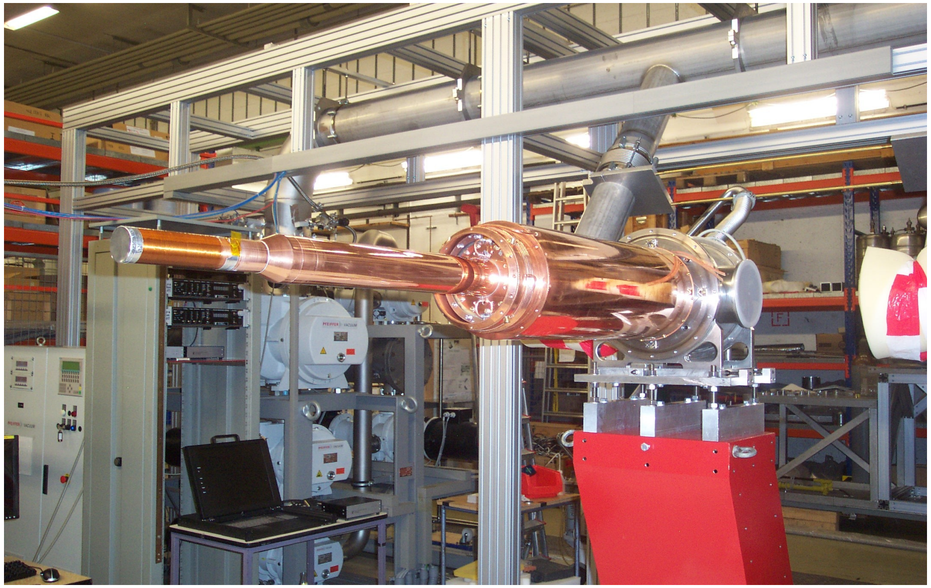
The goal of new tagger — to obtain marked eta-prime
Experiments:
eta-prime – N interaction study(comparison with pi0 and eta
eta-prime decay
resonances with decay on eta-prime

The main feature of eta, omega and eta-prime production -- sharp rising of cross-section near threshold.
The threshold of reaction coincide with bumps in total cross-sections.

Status of A2 experimental set

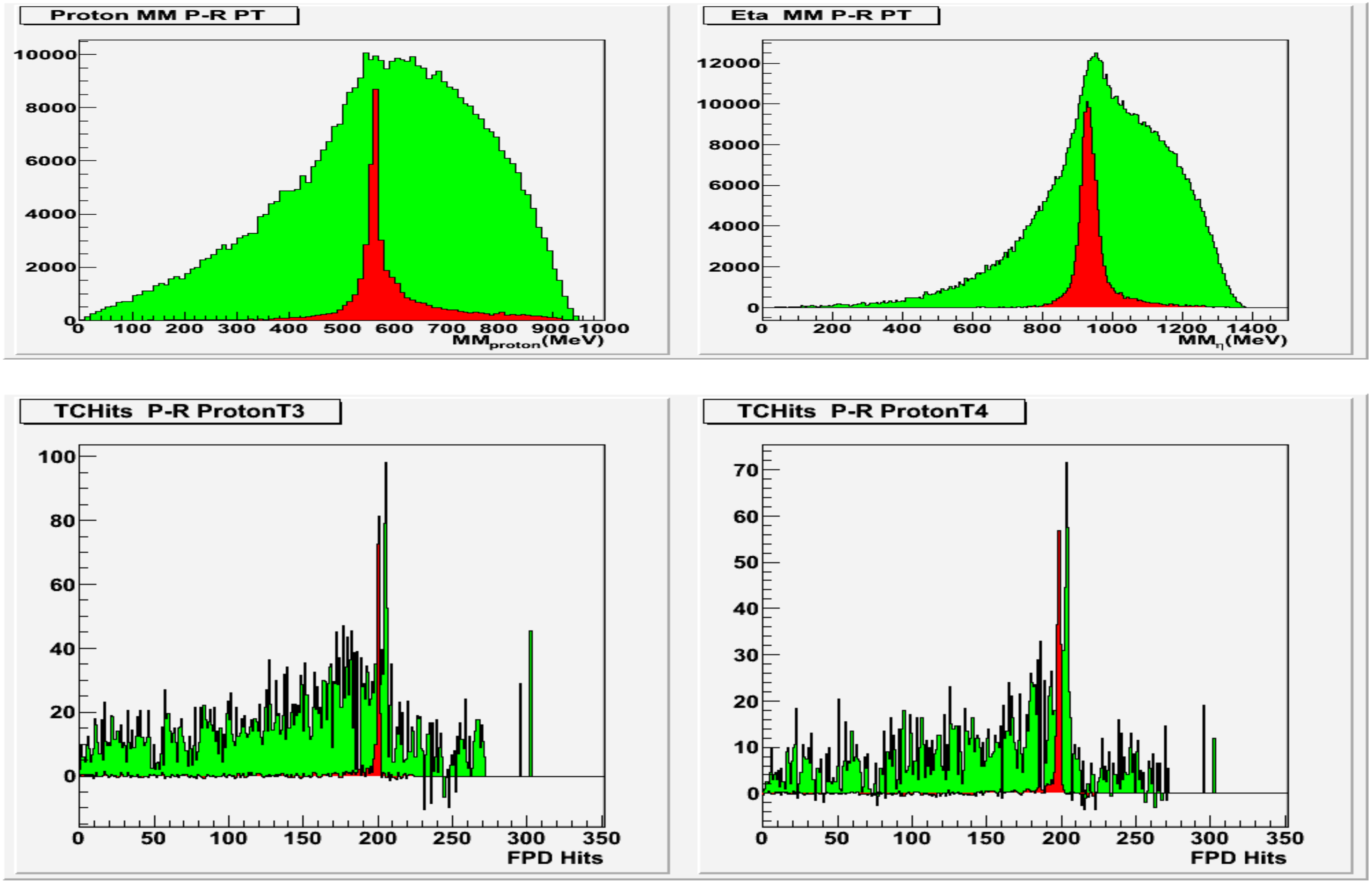






The full set of experimental opportunities:
Polarized beam—circular and linear
Polarized target—transverse and longitude
Recoil proton polarimeter(double scattering on carbon

The physics program mainly based on prediction of MAID-SAID and will be strongly influenced by analysis of unpolarized data and first results on polarized target.
For example — nature of neutron anomaly (pentaquark?)



The next couple of years – data taking on polarized target

Comparison of H and PT data

Top MM of eta and recoil proton Red — H, green — PT

Bottom —TC

The hidrogen peak from H on PT clearly seen. The width the same as for H target

Polarization Measurements

Eight observables can be measured w/o a polarimeter for the recoil nucleon. 16 polarization observables in photoproduction of pseudoscalar mesons .

	Photon Beam		
Target	Unpolarized	Circlularly Polarized	Linearly Polarized
unpolarized	$d\sigma/d\Omega$	______	Σ
Longitudinal	________	E	G
Transverse	T	F	H, P

Spin Observables

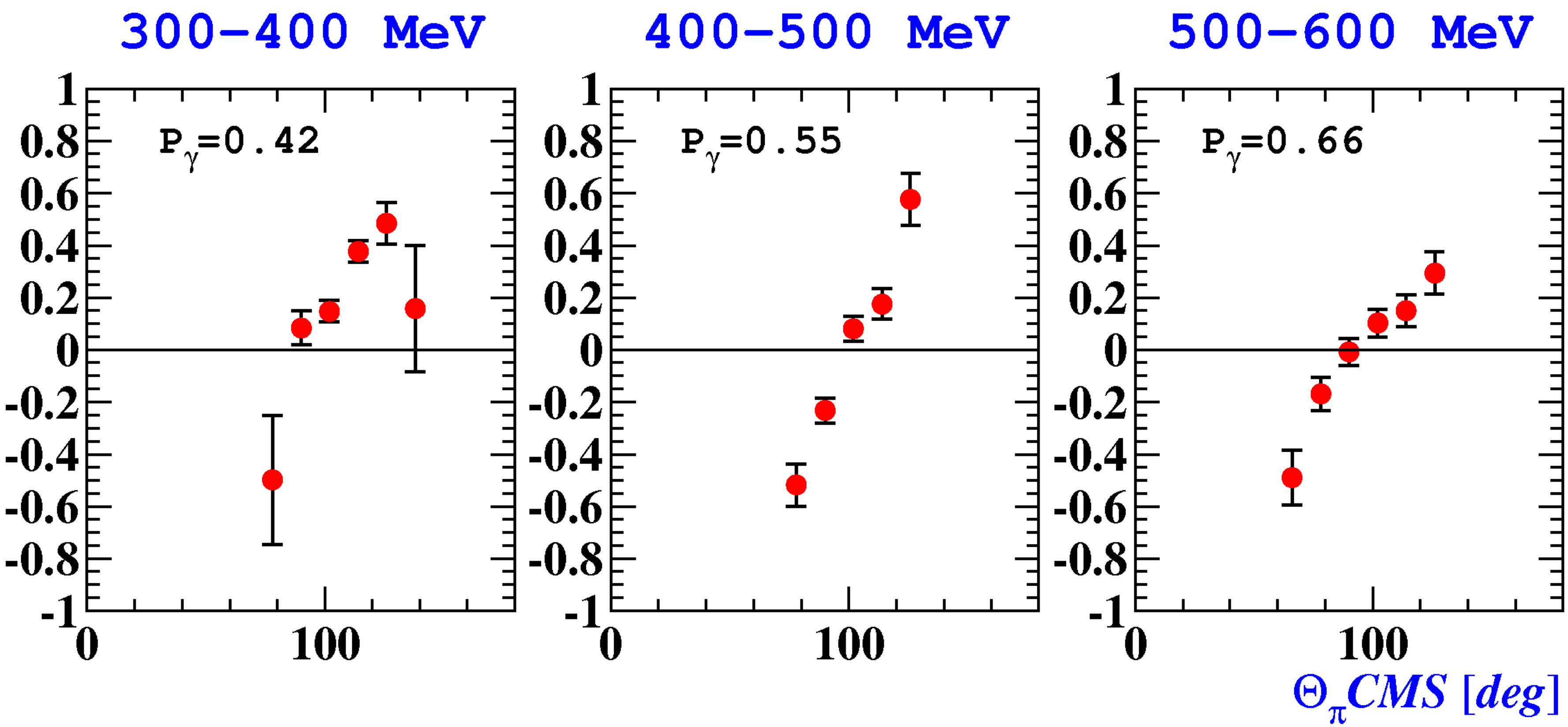
Table 1
Observables

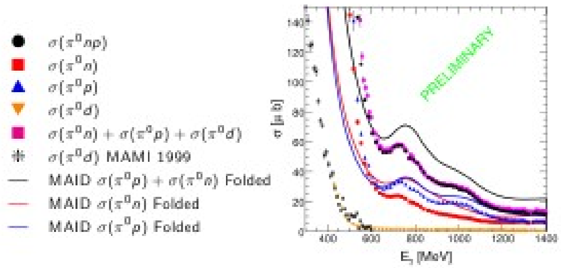
Usual symbol	Helicity representation	Transversity representation	Experiment required [a)]	Type
$d\sigma/dt$	$\lvert N\rvert^2+\lvert S_1\rvert^2+\lvert S_2\rvert^2+\lvert D\rvert^2$	$\lvert b_1\rvert^2+\lvert b_2\rvert^2+\lvert b_3\rvert^2+\lvert b_4\rvert^2$	$\{-;-;-\}$	S
$\Sigma\, d\sigma/dt$	$2\mathrm{Re}(S_1^* S_2 - ND^*)$	$\lvert b_1\rvert^2+\lvert b_2\rvert^2-\lvert b_3\rvert^2-\lvert b_4\rvert^2$	$\{L(\frac{1}{2}\pi,0);-;-\}$ $\{-;y;y\}$	S
$T\, d\sigma/dt$	$2\mathrm{Im}(S_1N^* - S_2D^*)$	$\lvert b_1\rvert^2-\lvert b_2\rvert^2-\lvert b_3\rvert^2+\lvert b_4\rvert^2$	$\{-;y;-\}$ $\{L(\frac{1}{2}\pi,0);0;y\}$	S
$P\, d\sigma/dt$	$2\mathrm{Im}(S_2N^* - S_1D^*)$	$\lvert b_1\rvert^2-\lvert b_2\rvert^2+\lvert b_3\rvert^2-\lvert b_4\rvert^2$	$\{-;-;y\}$ $\{L(\frac{1}{2}\pi,0);y;-\}$	S
$G\, d\sigma/dt$	$-2\mathrm{Im}(S_1S_2^* + ND^*)$	$2\mathrm{Im}(b_1b_3^* + b_2b_4^*)$	$\{L(\pm\frac{1}{4}\pi);z;-\}$	BT
$H\, d\sigma/dt$	$-2\mathrm{Im}(S_1D^* + S_2N^*)$	$-2\mathrm{Re}(b_1b_3^* - b_2b_4^*)$	$\{L(\pm\frac{1}{4}\pi);x;-\}$	BT
$E\, d\sigma/dt$	$\lvert S_2\rvert^2-\lvert S_1\rvert^2-\lvert D\rvert^2+\lvert N\rvert^2$	$-2\mathrm{Re}(b_1b_3^* + b_2b_4^*)$	$\{c;z;-\}$	BT
$F\, d\sigma/dt$	$2\mathrm{Re}(S_2D^* + S_1N^*)$	$2\mathrm{Im}(b_1b_3^* - b_2b_4^*)$	$\{c;x;-\}$	BT
$O_x\, d\sigma/dt$	$-2\mathrm{Im}(S_2D^* + S_1N^*)$	$-2\mathrm{Re}(b_1b_4^* - b_2b_3^*)$	$\{L(\pm\frac{1}{4}\pi);-;x'\}$	BR
$O_z\, d\sigma/dt$	$-2\mathrm{Im}(S_2S_1^* + ND^*)$	$-2\mathrm{Im}(b_1b_4^* + b_2b_3^*)$	$\{L(\pm\frac{1}{4}\pi);-;z'\}$	BR
$C_x\, d\sigma/dt$	$-2\mathrm{Re}(S_2N^* + S_1D^*)$	$2\mathrm{Im}(b_1b_4^* - b_2b_3^*)$	$\{c;-;x'\}$	BR
$C_z\, d\sigma/dt$	$\lvert S_2\rvert^2-\lvert S_1\rvert^2-\lvert N\rvert^2+\lvert D\rvert^2$	$-2\mathrm{Re}(b_1b_4^* + b_2b_3^*)$	$\{c;-;z'\}$	BR
$T_x\, d\sigma/dt$	$2\mathrm{Re}(S_1S_2^* + ND^*)$	$2\mathrm{Re}(b_1b_2^* - b_3b_4^*)$	$\{-;x;x'\}$	TR
$T_z\, d\sigma/dt$	$2\mathrm{Re}(S_1N^* - S_2D^*)$	$2\mathrm{Im}(b_1b_2^* - b_3b_4^*)$	$\{-;x;z'\}$	TR
$L_x\, d\sigma/dt$	$2\mathrm{Re}(S_2N^* - S_1D^*)$	$2\mathrm{Im}(b_1b_2^* + b_3b_4^*)$	$\{-;z;x'\}$	TR
$L_z\, d\sigma/dt$	$\lvert S_1\rvert^2+\lvert S_2\rvert^2-\lvert N\rvert^2-\lvert D\rvert^2$	$2\mathrm{Re}(b_1b_2^* + b_3b_4^*)$	$\{-;z;z'\}$	TR

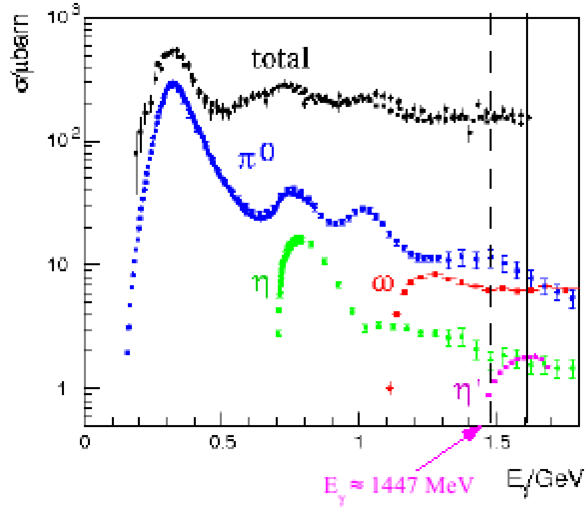
[a)] Notation is $\{P_\gamma; P_T; P_R\}$ where:
P_γ = polarisation of beam, $L(\theta)$ = beam linearly polarised at angle θ to scattering plane,
C = circularly polarised beam;
P_T = direction of target polarisation;
P_R = component of recoil polarisation measured.
In the case of the single polarisation measurements we also give the equivalent double polarisation measurement.

$\gamma p \rightarrow \pi^{o} p$

Double polarization observable F







Tagger energy range: 4.7 to 93% of E_0

Maximum energy tagged
for E_0=1604 MeV is 1491 MeV

But:
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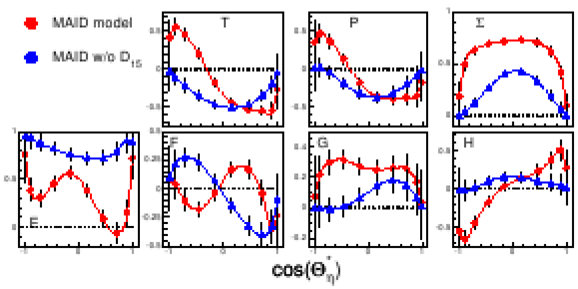
- Studies of η' decays at high rates possible with the CB

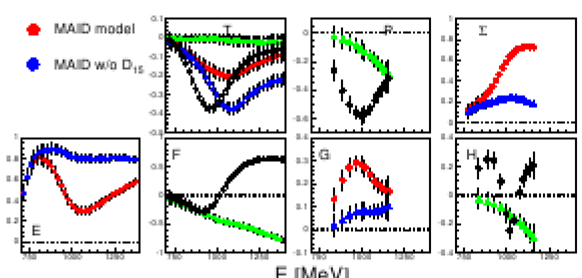
polarization observables: expected sensitivity

- **expected sensitivity (MAMI: E, T, F; ELSA: Σ, G, H, P)**



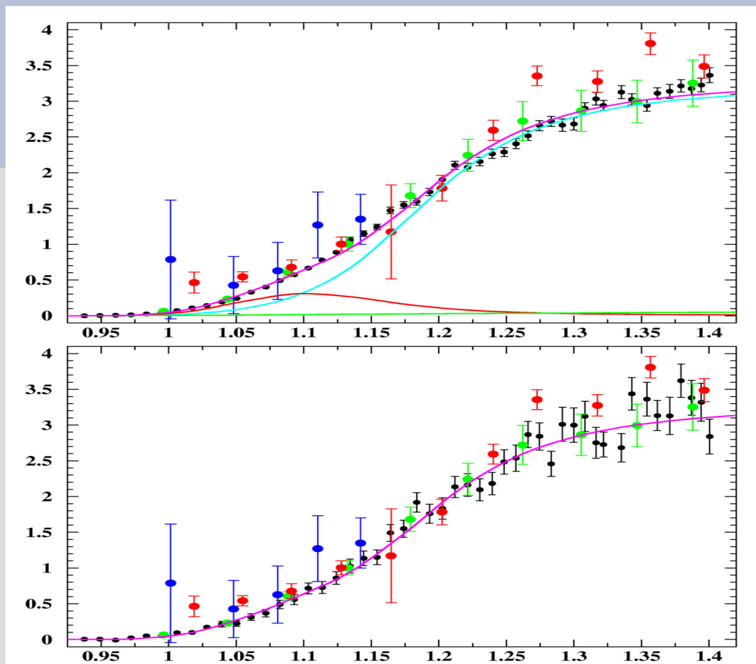
- angular distributions at 1 GeV

- energy dependencies



The goal of new tagger — to obtaine marked eta-prime
Experiments:
eta-prime decay
resonances with decay on eta-prime
Reactio mechanizm(next slide)
Program exist but strong influence of first results

$\gamma p \rightarrow \pi^o(\gamma\gamma)\ \eta(\gamma\gamma)\ p$



circles:

blue – Tohoku 06

red – CB@ELSA 04

(syst. err. 20% is not included)

green – GRAAL 08

black – this work

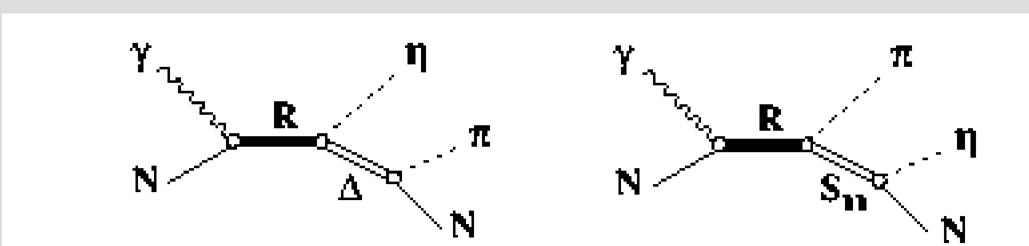
lines:

violet – best fit

light-blue – $\Delta(1700)D_{33}$

red – $\Delta(1600)P_{33}$

green – Born terms



Mainz-Tomsk model

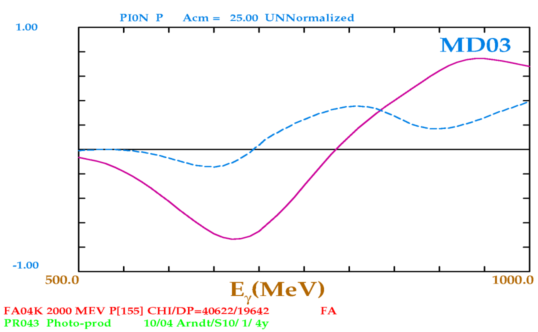
Reaction model with
two decays channels.
The high statistics permits
to study reaction mechanizm
without additional data
The polarized target gives the
possibility to study

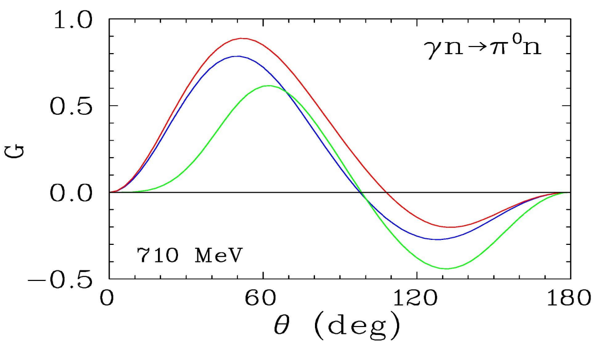
Photoproduction of π^0, $\pi^0\,\pi^0$, $\pi^0\,\eta^0$ on polarized deuterium

- In order to extract reliable N* resonance parameters from meson photoproduction data, PWAs must be extended to include additional reactions.
- Single-channel πN analyses alone do not provide the necessary constraints for a full and unambiguous determination of resonance properties.
- This is particularly true for resonances that have only a weak coupling to the πN state.

- We will use a polarized deuterium target to make double polarization measurements.
- We propose to begin with a transversely polarized target to take advantage of the fact that JLab will not be ready to run transversely polarized deuterons until last 2010.
- These experiments are complementary to charged final-state measurements and will further the investigation of low-lying resonances.

Examples of PSA predictions for observables

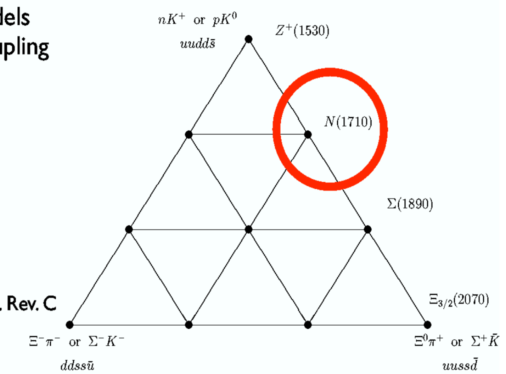




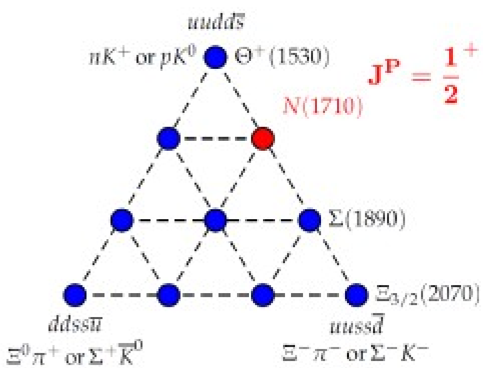
Theoretical predictions for the neutron (2)

New narrow nucleon resonance $P_{11}(1680)$?

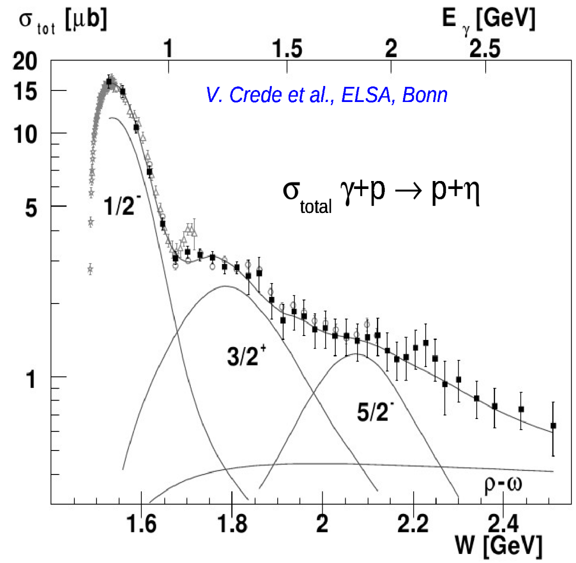
non-strange member of the anti-decuplet: models predict strong coupling to the neutron



R.A. Arndt et al. Phys. Rev. C 69 (2004) 035208



Differing Pictures of W~1680 MeV Structure



At Mainz

- The excitation function (and with sufficient statistics the $d\sigma/d\Omega$) can be measured to a tagged-photon energy resolution of ~1 MeV.
- π, multi-π, η, κΛ....channels can be measured simultaneously and compared.
- Σ asymmetry @ ~1.05 GeV is possible...energy bins?
- Circular single spin asymmetry possible for multi-meson final states.

Explanations of the ~1680 MeV bump observed in d(γ,n η).

Antidecuplet States
D. Diakonov et al., Z..Phys. A359:305,1997
M.V. Polyakov & A. Rathke, Eur. J. Phys. A18:691,2003
Baryon spectrum expressed as rotational excitations of a soliton. Expect strength in neutron photoproduction with analagous proton channels relatively suppressed

Alternative "Non-Exotic"
W.-T. Chiang et al., NPA700:429,2002
Eta-MAID...large D15 contribution
(assuming a 17% Nη decay branching ratio)
V. Shklyar et al, Phys.Lett. B650:172,2007
Coupled-channels effects of $S_{11}(1535)$, $S_{11}(1650)$, $P_{11}(1710)$

So far no confirmed structure in p(γ,p η).
Structure in the Legendre coefficients?
Structure in Σ ?
If there is a narrow structure it will not be smeared by Fermi motion.
Free-particle partial-wave analysis more straightforward.

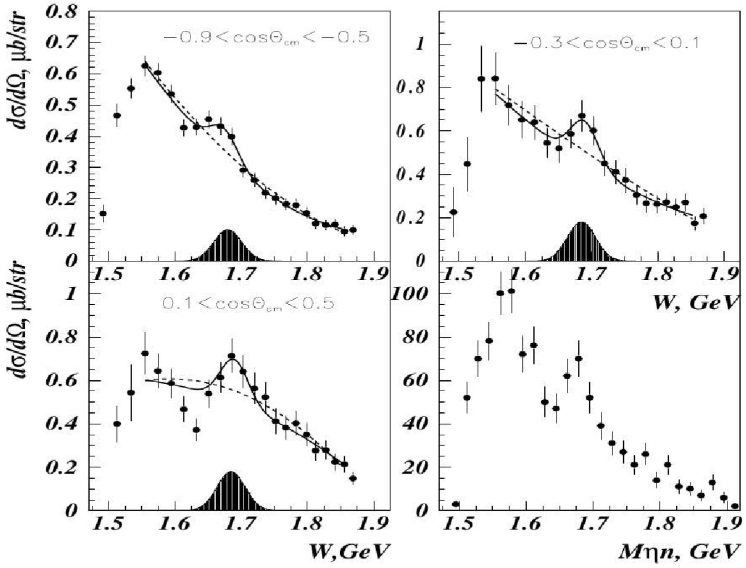
So far the experimental evidence for narrow states is "not overwhelming" with several significant NULL results.
Spring-8 still "see" a 1540 MeV "Θ^{++}" bump

H(γ,ηp) @MAMI-C, J.R.M. Annand, Mainz, March 2009

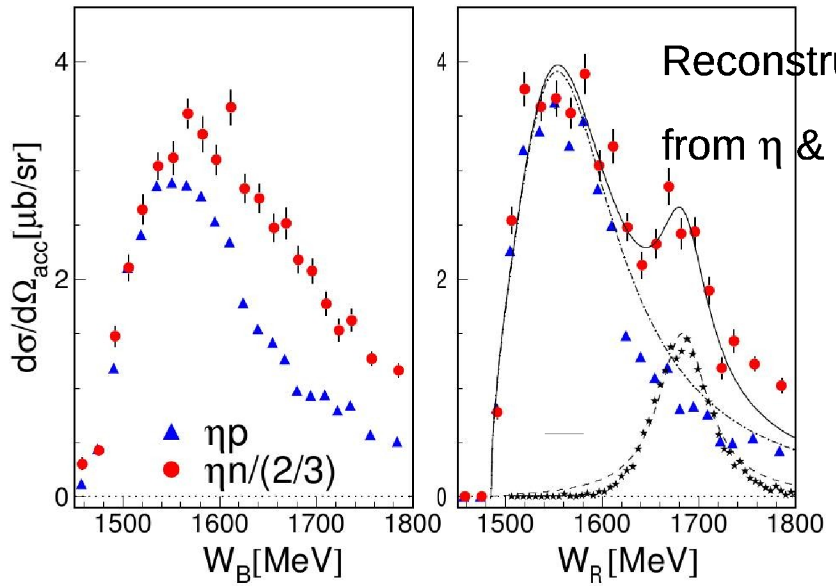
Now two experiments in progres MAINZ and ITEP

What is seen for $d(\gamma,n\eta)$?

V.Kuznetsov et al., arXiv:0807.2316 [hep-ex]



I. Jaegle et al., Phys.Rev.Lett.100:252002,2008.



Kuznetsov background subtracted "peak" has width σ ~ 20 MeV

Integrated Strength of background subtracted structure ~ 10 μb/sr away from backward angles.

S_{11} background ~ 0.5 μb/sr in bump region.

If the bump is intrinsically narrow σ ~ 1 MeV then with suitably high E_γ resolution, then one should "easily see" a structure with a factor 20 lower cross section.

MAMI has much higher intensity than GRAAL or ELSA...aim to determine p(γ,pη) upper limit < 0.1 μb/sr (still needs to be quantified)

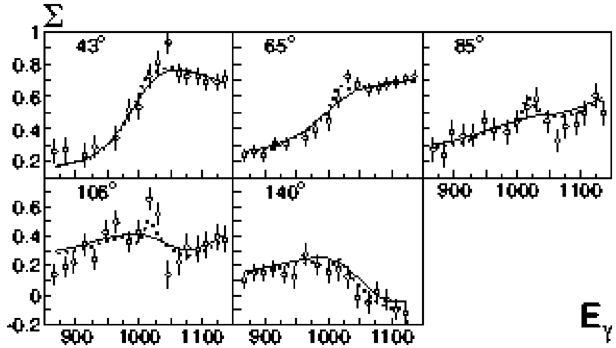
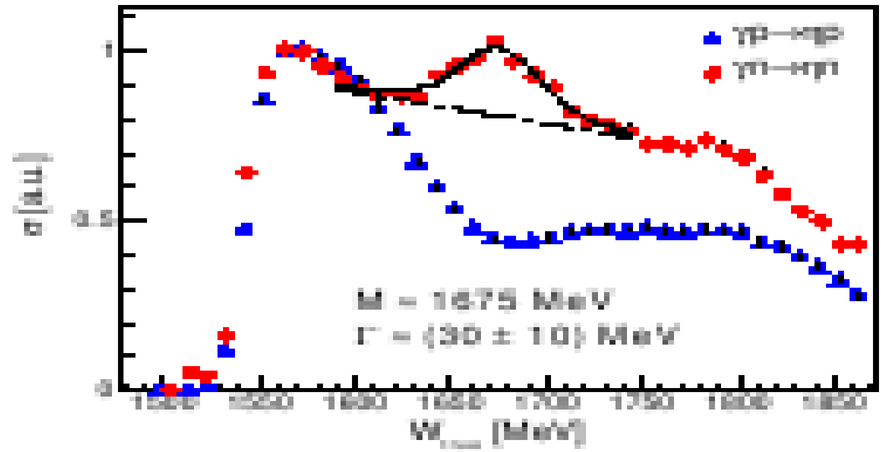
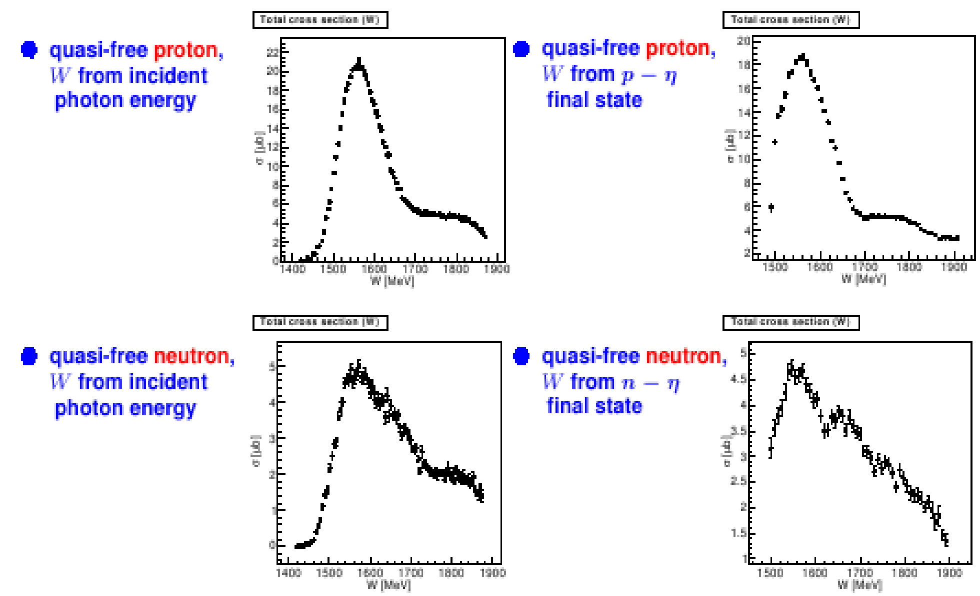


Fig. 12. Beam asymmetry for the reaction $\gamma p \to \eta p$ [17]. The PWA description is shown as solid line (solution 1) and dotted line (solution 3).

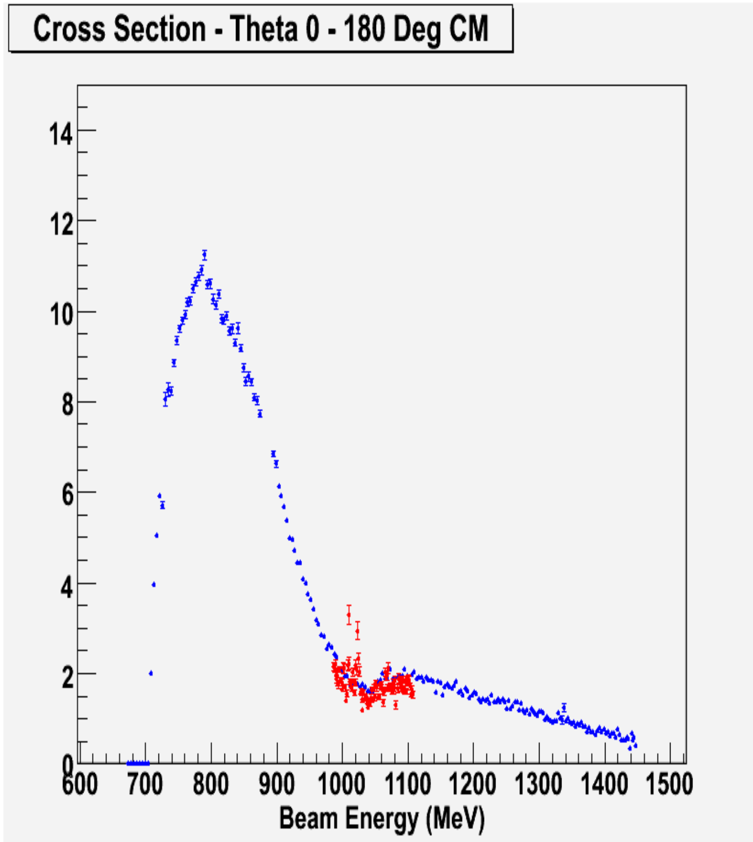


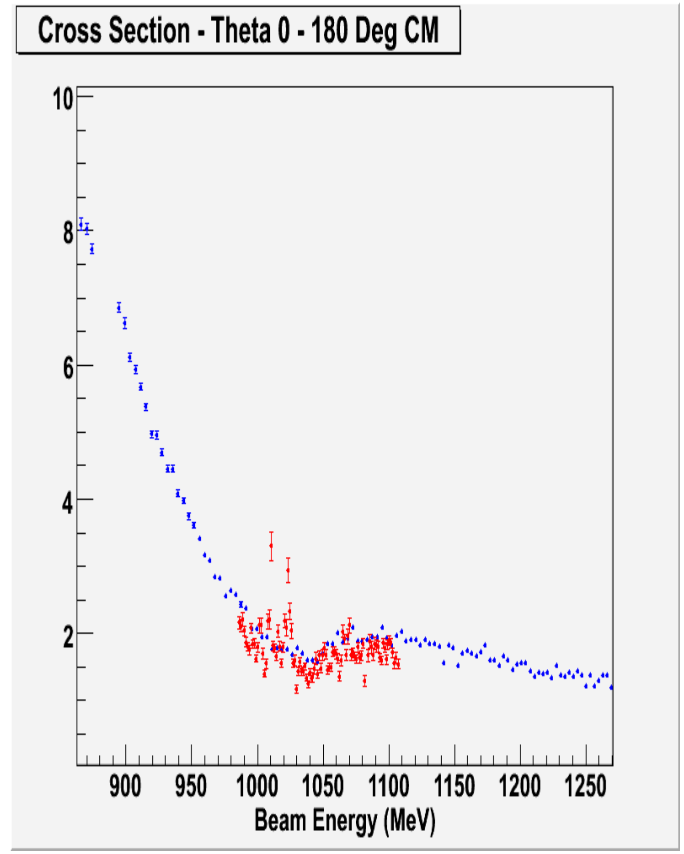
similar results for ^{3}He target

L. Witthauer et al.



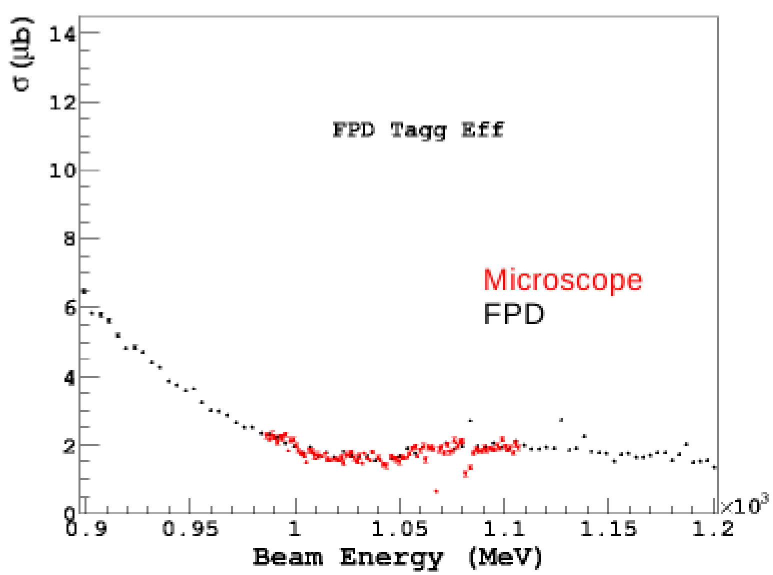
The bump t 1680
Bump is clearly seen in eta-n systems (right — last A2 data
Bump is seen is Sigma(GRAAL data)
The similar effect on 3He target





- Using microscope tagging efficiency
- Noisy channels due to noise in tagging efficiency

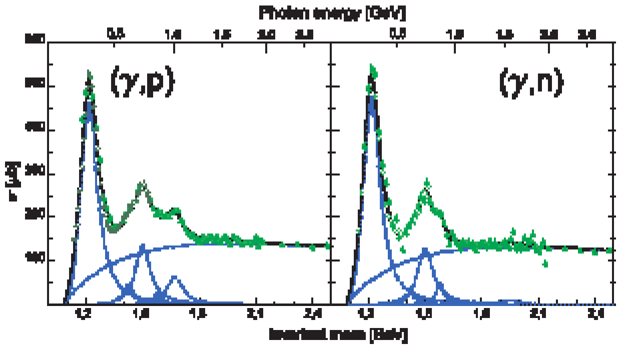
- Use interpolated tagging efficiency from FPD measurement
- No sign of structure that could be interpreted as a narrow resonance at 1045 MeV region



No bump 1680
in eta-p
A2 data

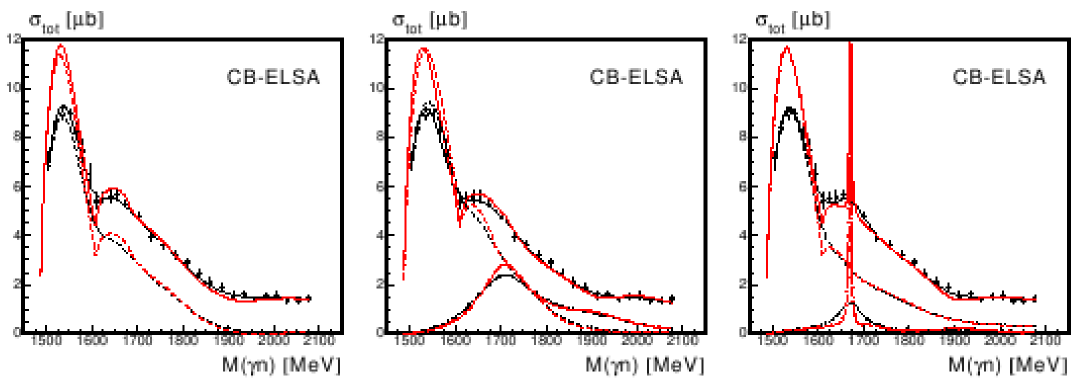
electromagnetic excitations of the neutron

- importance of measurements off the neutron:
  - different resonance contributions
  - needed for extraction of iso-spin composition of elm. couplings



- complications due to use of nuclear targets (deuteron):
  - coincident detection of recoil nucleons
  - Fermi motion, nuclear effects like FSI, coherent contributions

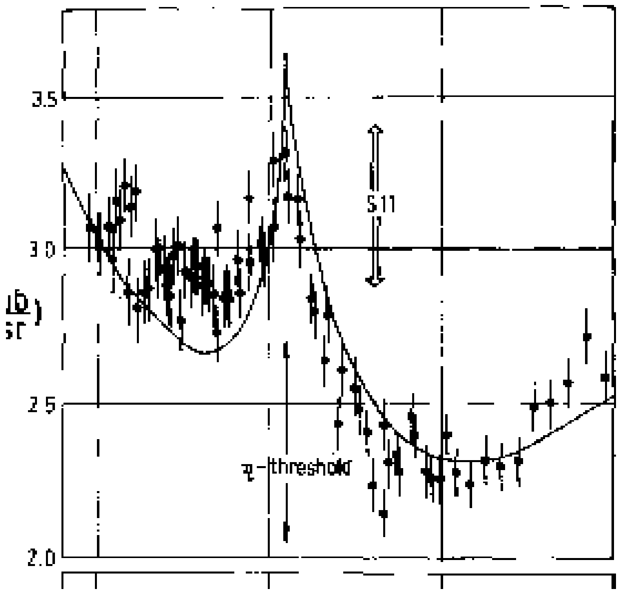
Bonn-Gatchina-Model analysis



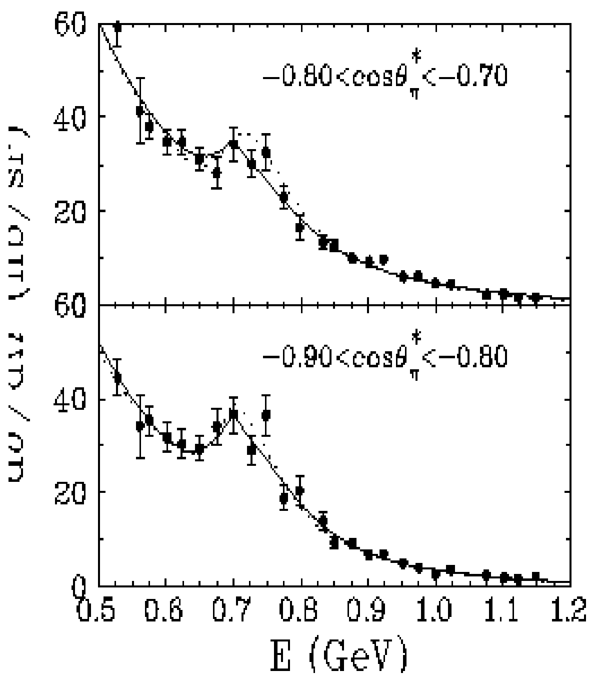
- different scenarios to reproduce 'bump' structure:
  - left: interference in S_{11}-sector: adjusting phases etc.
  - center: introduction of conventional (broad) P_{11} resonance
  - right: introduction of very narrow P_{11} resonance

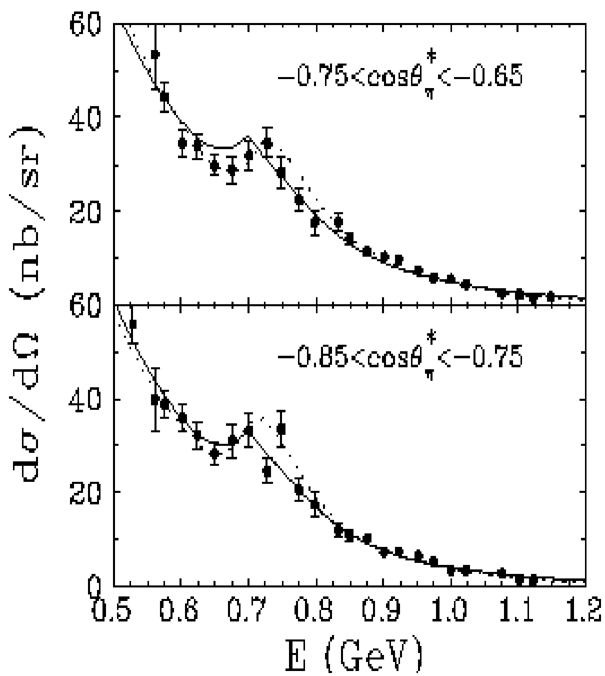
What is a nature of "bump"?

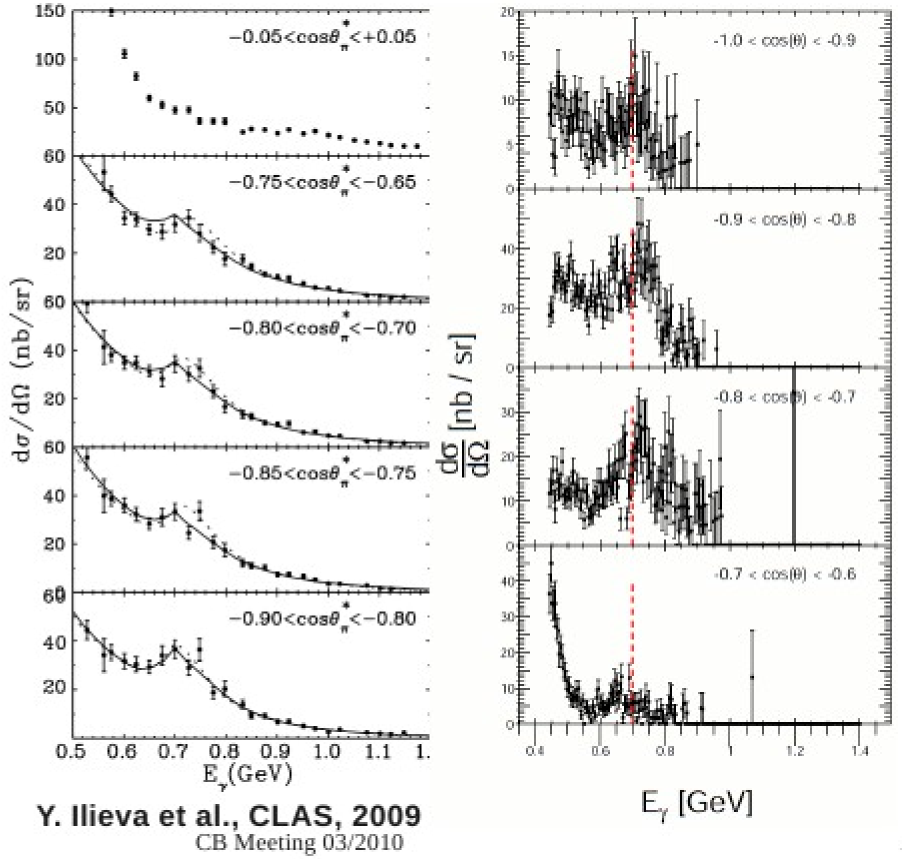
The effects may seriously influence on data interpritation



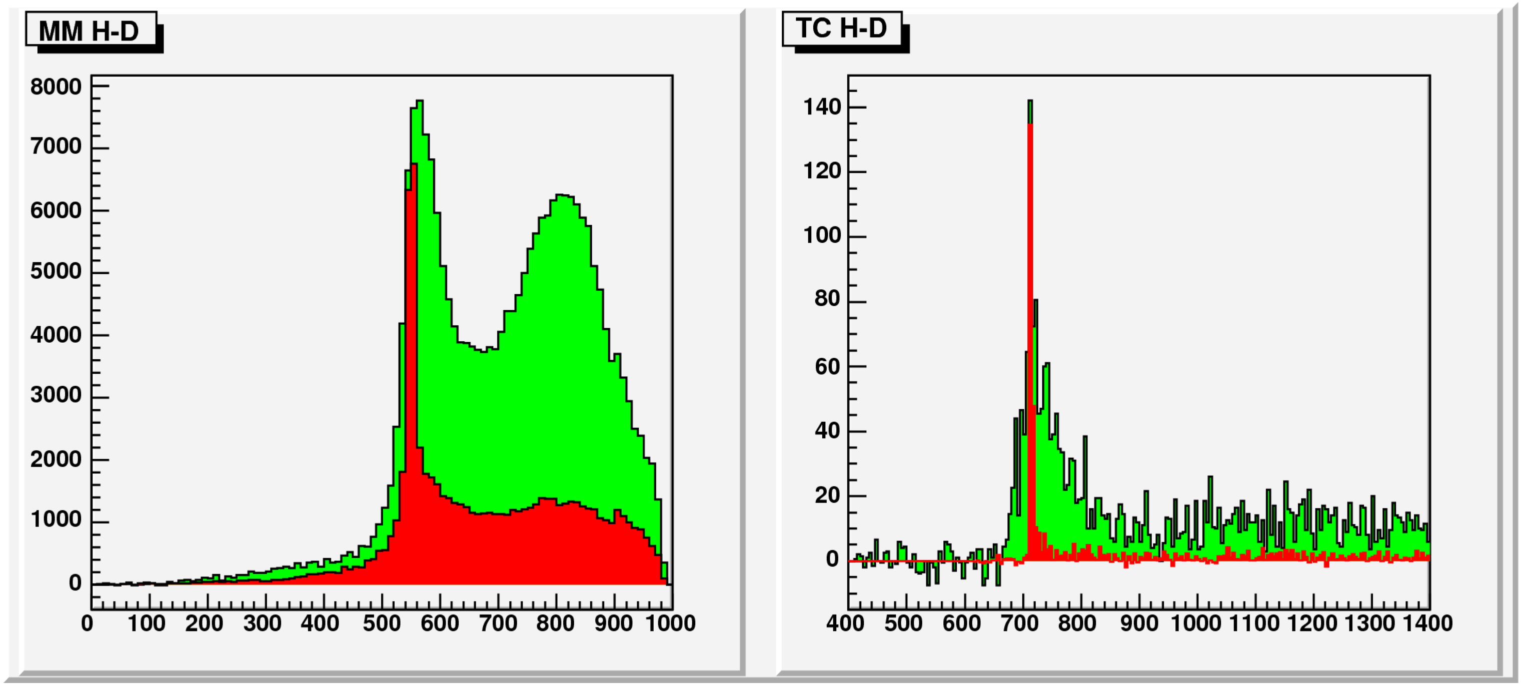
The width of «threshold effects» is about 10 MeV
so we need good beam energy resolution (1MeV)
for its study







Coherent production eta on deutron.
Right — A2 data
The eta-production in intermadiate state may produce a narrow bump
No any resonance needed to explaine bump



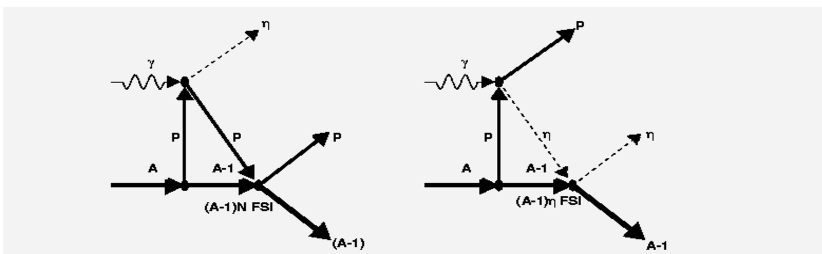
Comparison of MM and TC for H and D targets
Red — H target
Green — D target
The effect of Fermi motion is clearly seen in TC

Conclusion:
The strong effect of FSI eally exist and must be taken into accout during data processing
The data cut of deuteron data strongly influence on FSI

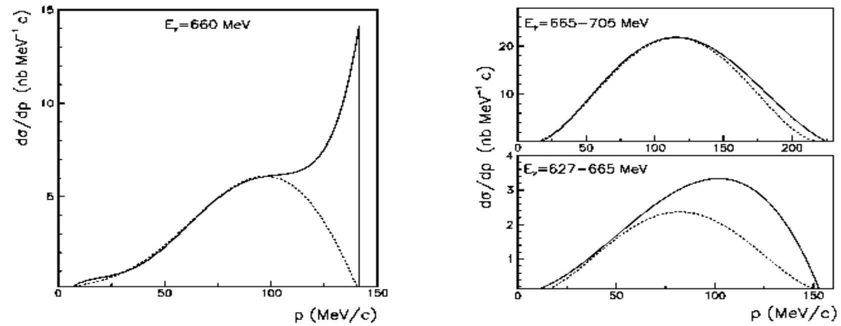
Deuteron problems

There are two approaches:: neuteron is free and may be used as neuteron target or strong final state interaction is exist

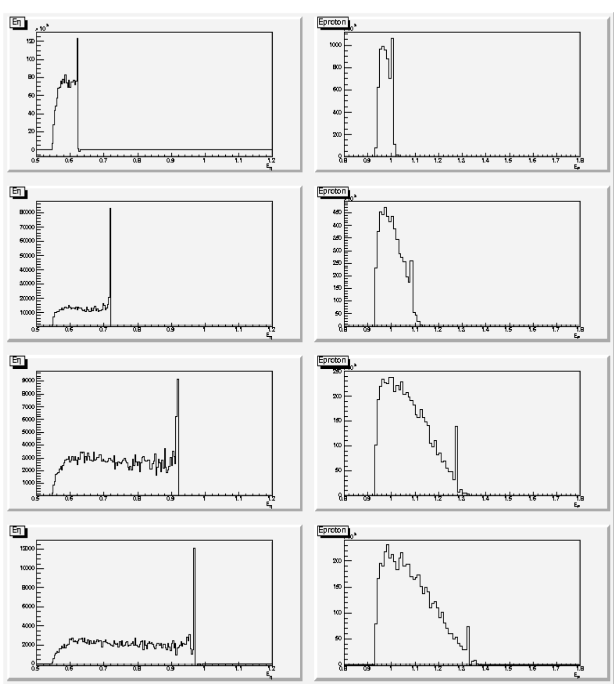
Mechanizm



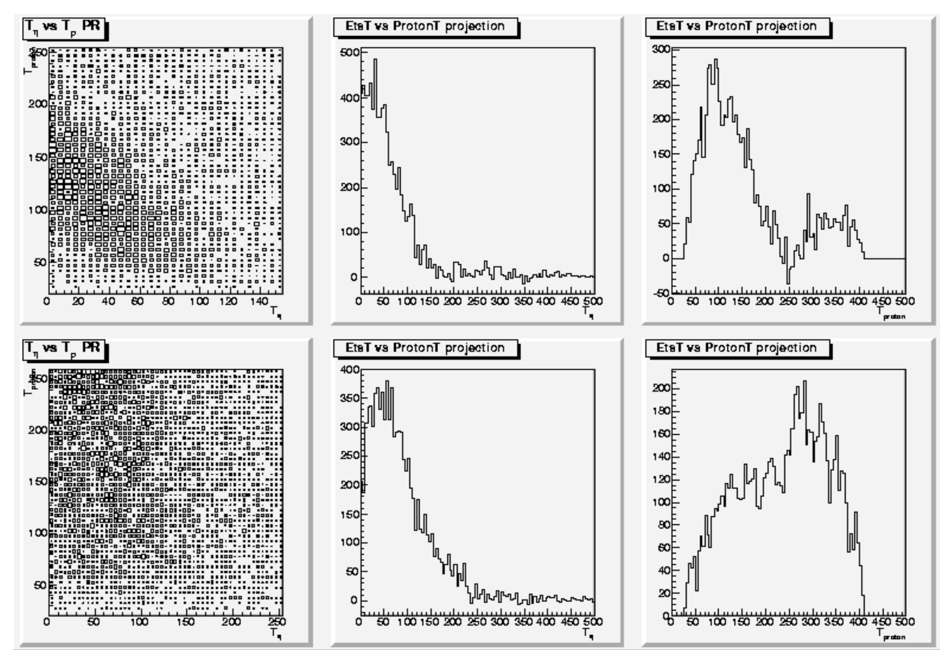
Calculation



Simulation



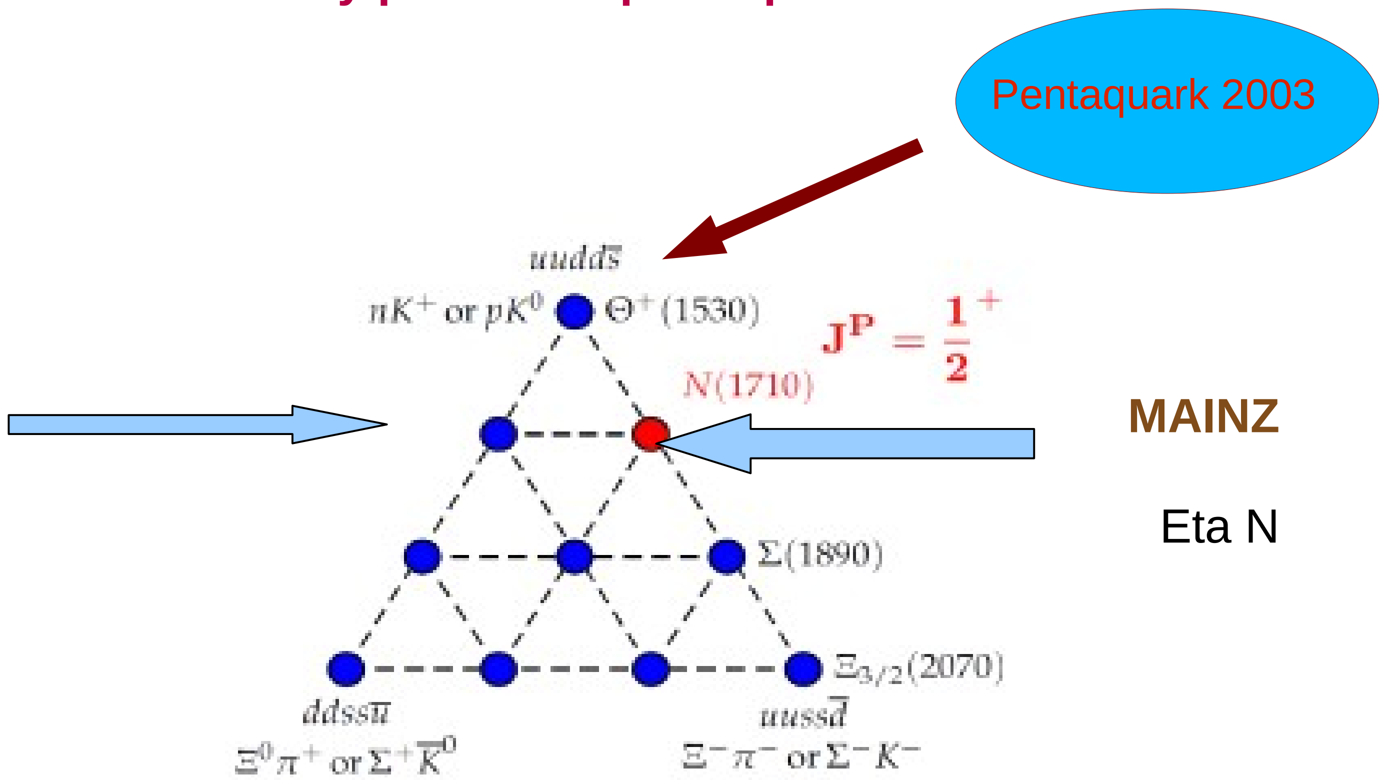
Data



Neutron anomaly problem – pentaquark?

PNPI-ITEP

pi- p
K Lambda



MAINZ

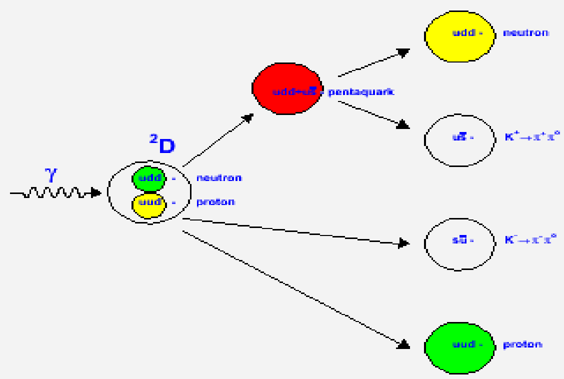
Eta N

Pentaquark 2003 – LEPS,ITEP,CLAS,ELSA (s = +1, q =1), I = 0)

Neutron anomaly – GRAAL,LNS,BONN,A2 (s = 0, q = 0, I = 1/2)

Two experiments in progress::
PNPI – ITEP
A2 – polarized observable

The importance of nature of neutron bump (Sarantzev)



The “pentaquark” or “neuteron anomaly” really observed on neutron target.
There are a lot of possibilities to get bump.

Current experiments

Resonance formation on hydrogen

PNPI-ITEP:

$\pi^- + p \to \pi^- + p$ **at energy 1050 MeV**

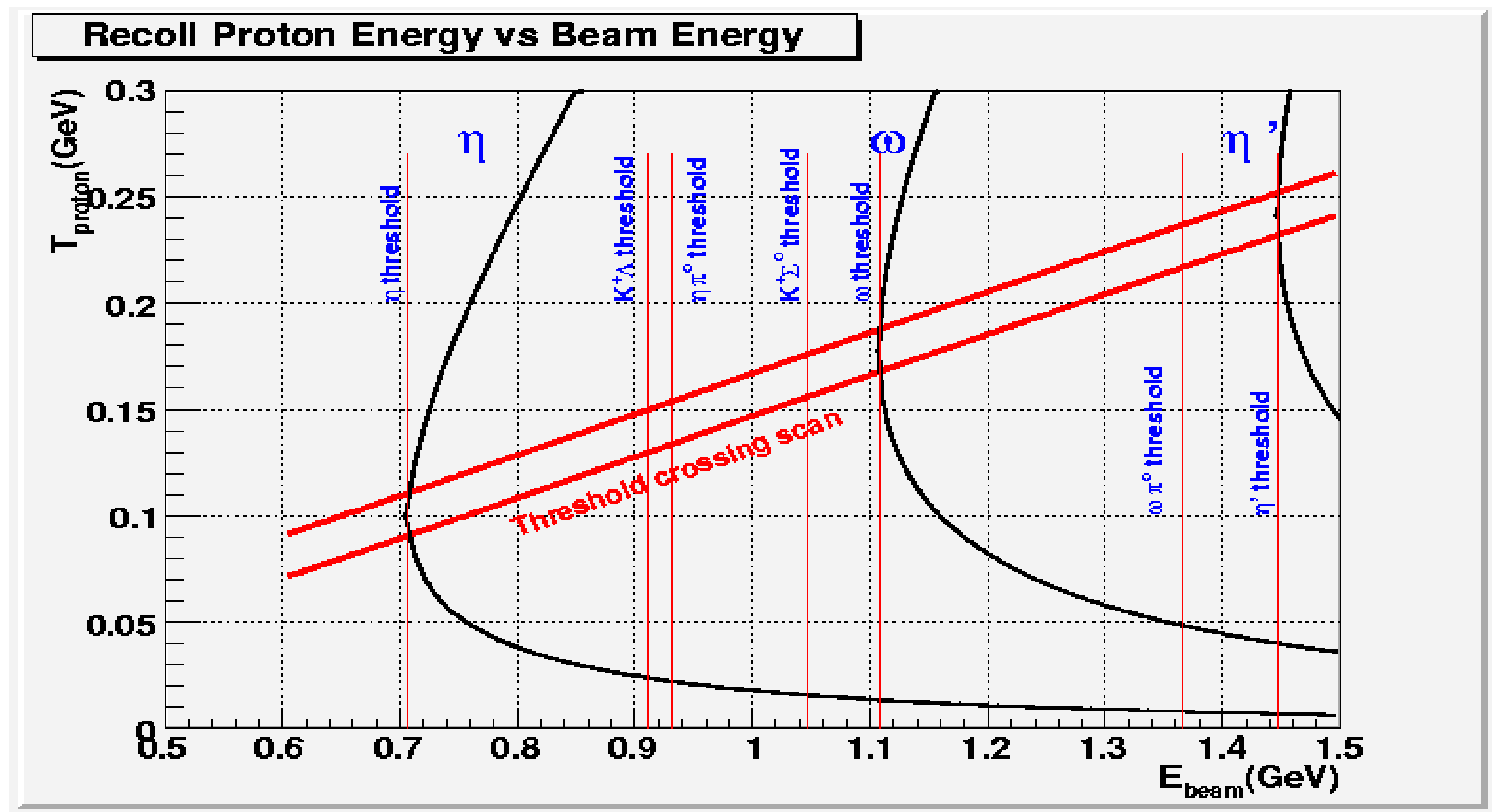
A2 collaboration:

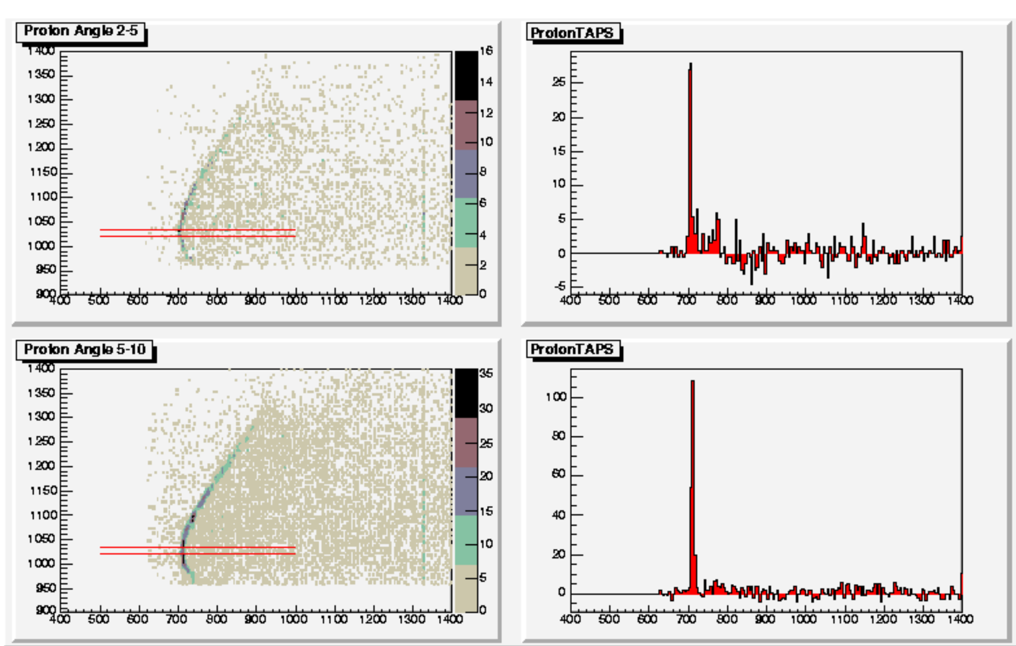
$\gamma + \vec{p} \to \eta + p$ **at energy 1100 MeV**

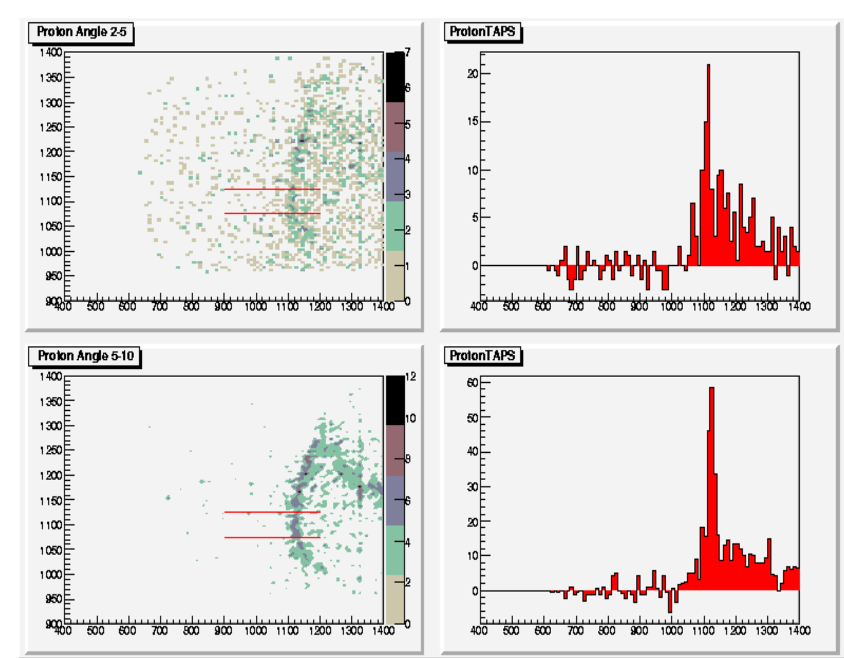
The main features of “pentaquark” experiments:

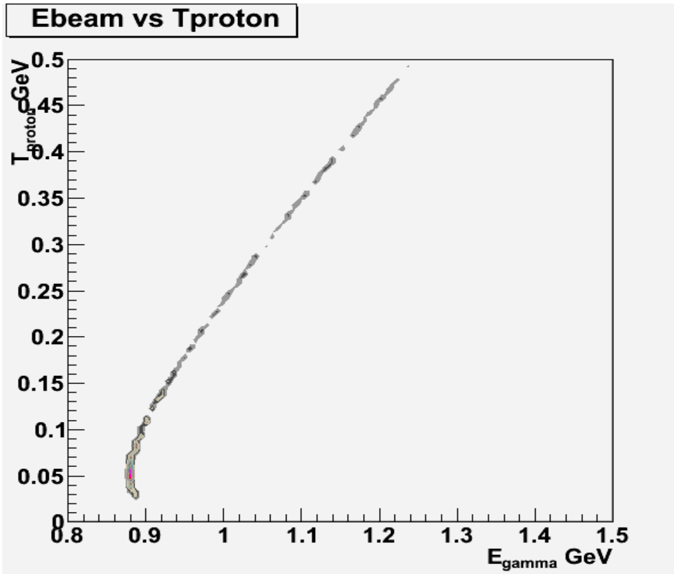
Neutron target(Deuteron)
Many particle final states
Exsclusive process
The wids is determinad by energy resolution of exppermental set and really no ideas how to improve it:
So far no information about quantum numbers of possible resonance or whatever nature of structure -- single abd double polarization observables are needed.
Competing reaction:
gp(n)->LambdaK+(n) -> K-p K+(n)

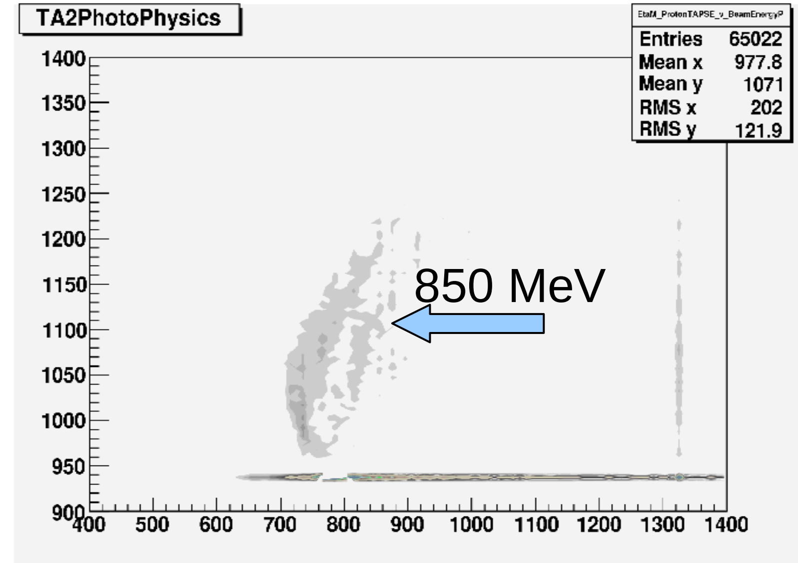
The new independent experiments are needed
No real ways to improve energy resolution
The new method are needed for independent confirmation of bump and its nature.


Recoil Proton Energy vs Beam Energy
T_proton(GeV)
E_beam(GeV)
η
ω
η '
η threshold
K⁺λ threshold
ηπ° threshold
K⁺Σ° threshold
ω threshold
ωπ° threshold
η' threshold
Threshold crossing scan

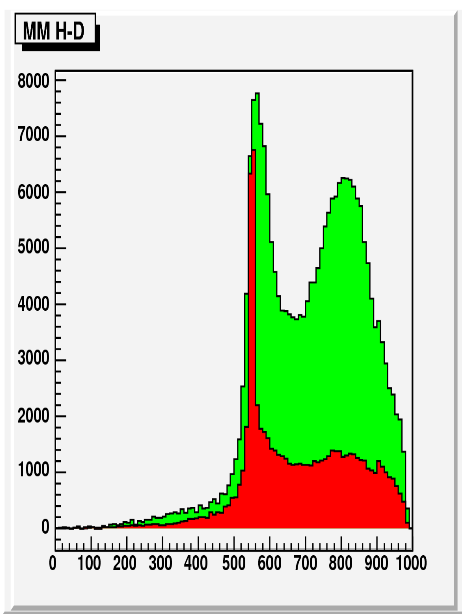

Proton Angle 2-5
ProtonTAPS
Proton Angle 5-10
ProtonTAPS

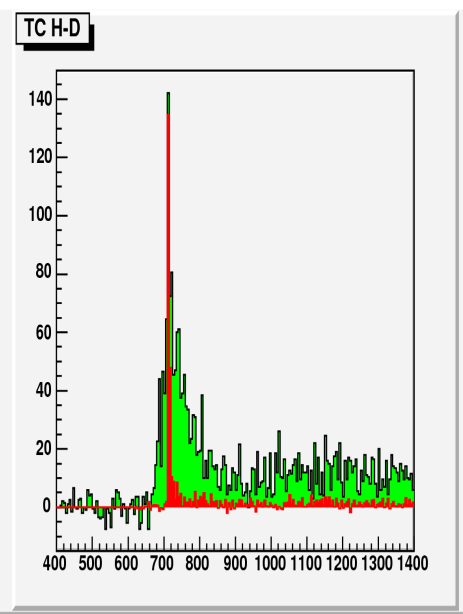

Proton Angle 2-5
ProtonTAPS
Proton Angle 5-10
ProtonTAPS





TC technique for reaction
g + D -> R(1680) + p





TC technique for A2 data
New locus?

Comparison of TC and MM technique for deutron and hydrogen targets
The sensivity of TC technique for Fermi motion 4 times better then MM method.

Conclusion:
There are two types of experiments on deuteron
1.Experimnts with high beam energy resolution. In this case the results are folded by Fermi motion.
2. Experiment with measurements of final state energy.. Even with standard energy resolution the energy resolution in c.m. Frame 3-4 times better than smearing due to Fermi motion.

So in case of ITEP beam(1.5 MeV energy resolution) the best experiment is a study of R(1680) production o deuteron in 2-body kinematics.
For PNPI beam with poor energy resolution te best way is the reconstruction of energy from final state energies. The forward detector are needed for both detectors. As the recpil nucleons are mainly come out in narrow forward cone the dimension of forward detector should be not vary large. May be the best way is to use «SHANS» as a forward detector both fior protons and neutrons.

R(1680)

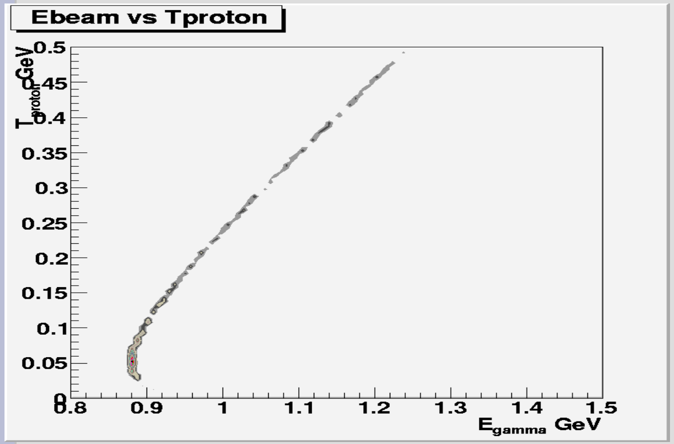
TC — meaurment of reonance width — example omega width

.

The first problem – the nature of “neutron anomaly”
The importance of nature of R(1680) – Sarantzev
TC – additional confirmation of R(1680) existance
TC – different final state
TC – different FSI – good beam energy resolution needed
TC – method of resonance width measurement
TC method may be applied both – A2 and PNPI-ITEP experiments

Pentaquark problem still exist. Experiments are planned in MAINZ and PNPI-IHEP. The TC method may be applaied for looking for R(1680)(eta-neuteron system) on deuteron targetin reaction:

γ + D --> eta + N(P) --> R(1680) + P --> eta + N + P



Kinematics of R(1680) production

Reaction γ +D -> R + P – two-body final state
Kinematics of recoil proton

Experiment EPECUR in ITEP(ITEP-PNPI collaboration on pion beam):

1. two charged states
2. deuteron target

The TC method may be applied for pentaquark search for on D-target.
The experimental set must be added by proton detectors.

Bump(1680) nature: possible experiments

Main proces:

$\gamma + {}^2D \to \gamma + n(p) \to \Theta^+ + K^-(p)$ 10 body or more final state and np interaction

$\Theta^+ \to K^+ + n \to \pi^+ + \pi^0 + n$

$K^-(p) \to \pi^- + \pi^0 + p$

EPECUR(PNPI-ITEP)

$\pi^- + p \to \pi^- + p$ 1000 MeV DCS = 0.24mb/sr resonance effect 0.05%

$\pi^- + p \to K^0 + \Lambda^0 \to \pi^+ + \pi^- + \pi^- + p$ DCS 1 mb resonance effect 15%

Possible experiments on deuteron: MAINZ and PNPI-ITEP (900 MeV)

π -beam 2MeV energy resolution low background

$\pi^+ + {}^2D \to \pi^+ + n(p) \to \eta + p(p) \to R(1680) + p$ pp FSI

$\pi^- + {}^2D \to \pi^- + p(n) \to \eta + n(n) \to R(1680) + n$ nn FSI

$\gamma + {}^2D \to \gamma + p(n) \to \eta + p(n) \to R(1680) + n$ np FSI

$\gamma + {}^2D \to \gamma + n(p) \to \eta + n(p) \to R(1680) + p$ np FSI

Experimental set upgrade:

Proton/neutron forward detector -- SHANS or UCLA neutron counters

Main advantage -- p/n go out in a small cone for TC technique

Two experiments in progress::

PNPI-ITEP on pion beam

eta-p final state on polarized target

The neutron anomaly really exist

Is it a resonance or anomaly?

The importance of nature of resonance(Sarantzev?)

The new independent information are needed.

Pentaquark

Main proces:

$\gamma + {}^2D \rightarrow \gamma + n(p) \rightarrow \Theta^+ + K^-(p)$

$\Theta^+ \rightarrow K^+ + n \rightarrow \pi^+ + \pi^0 + n$

EPECUR(PNPI-ITEP)

$\pi^- + p \rightarrow \pi^- + p$ 1000 MeV DCS = 0.24mb/sr resonance effect 0.05%

$\pi^- + p \rightarrow K^0 + \Lambda^0 \rightarrow \pi^+ + \pi^- + \pi^- + p$ DCS 1 mb resonance effect 15%

Possible experiments on deuteron:

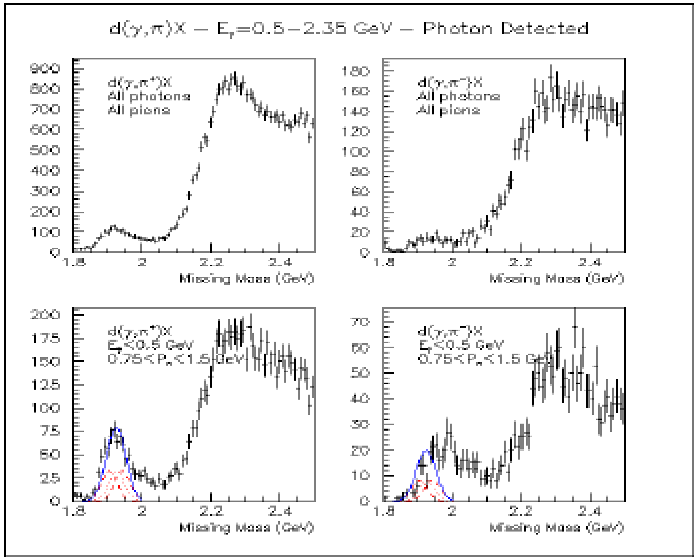
$\pi^+ + {}^2D \rightarrow \pi^+ + n(p) \rightarrow \eta + p(p) \rightarrow R(1680) + p$

$\pi^- + {}^2D \rightarrow \pi^- + p(n) \rightarrow \eta + n(n) \rightarrow R(1680) + n$

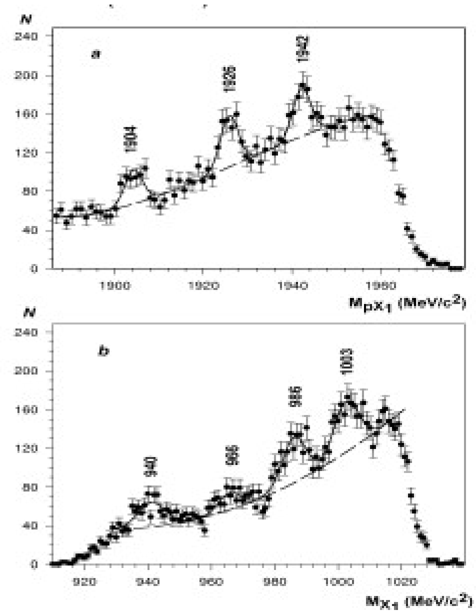
$\gamma + {}^2D \rightarrow \gamma + p(n) \rightarrow \eta + p(n) \rightarrow R(1680) + n$

$\gamma + {}^2D \rightarrow \gamma + n(p) \rightarrow \eta + n(p) \rightarrow R(1680) + p$

Problem of low-masses resonances



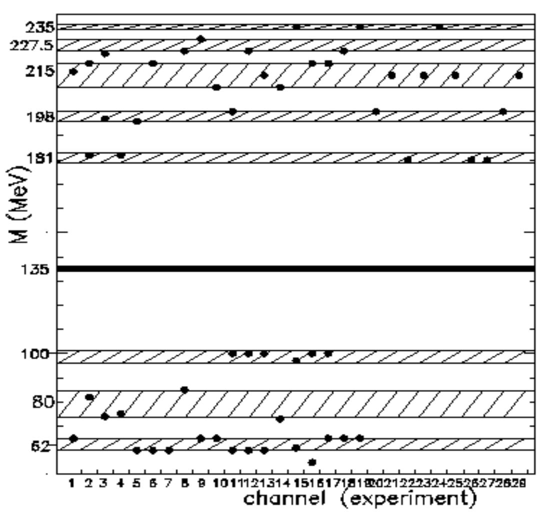
JLAB



INS

References in cb16_Filkov

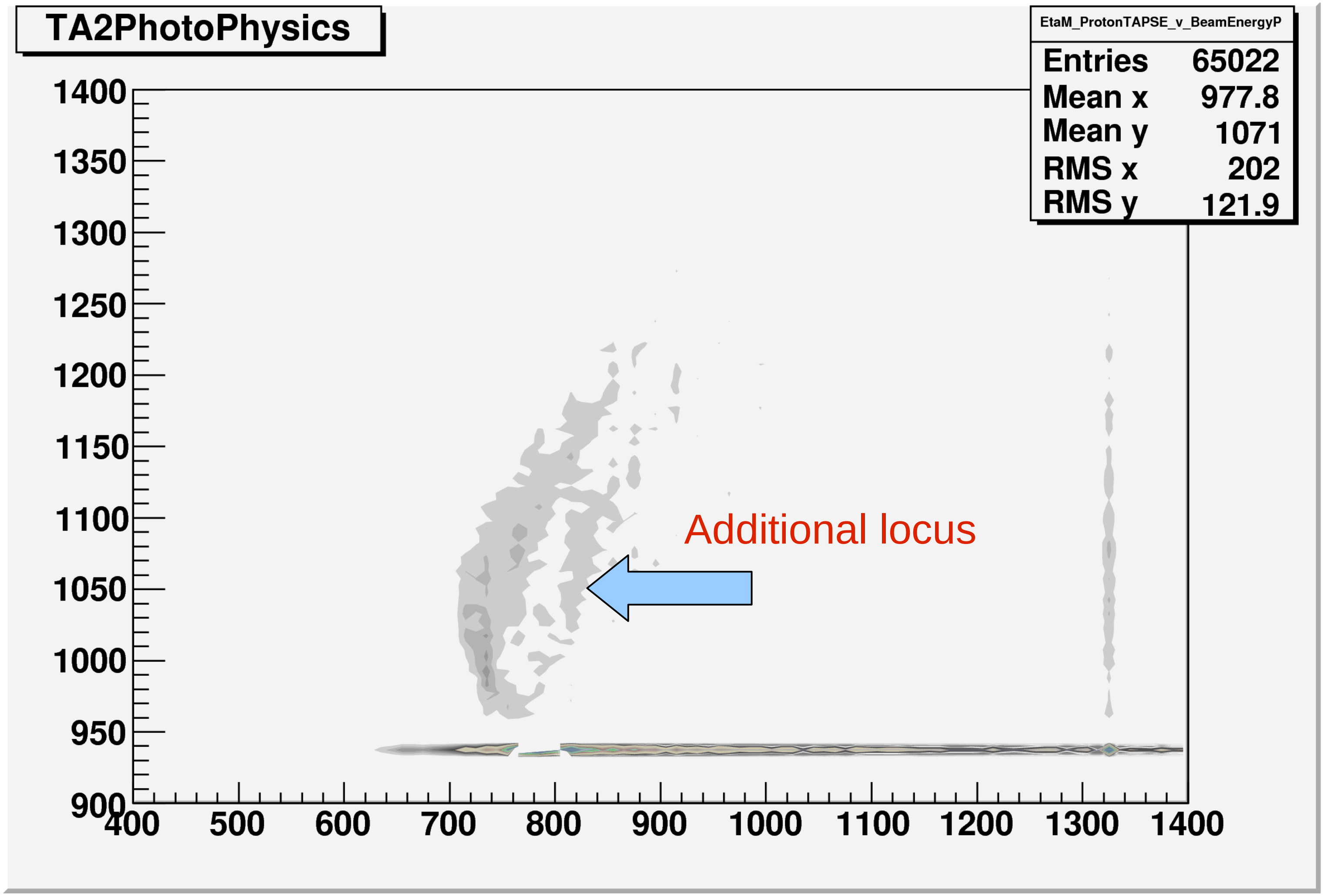
$p + d \to p + X \to p + p\, X_1$



Summary of low mass mesons

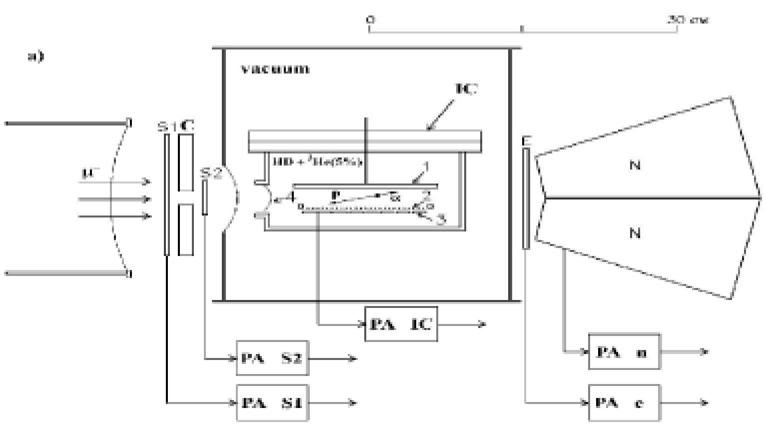
The all indication are obtained in charged modes. No data with neutral decays
No data on pion beam
The statistics is good enough but problem with independing confirmation

Threshold-crossing with eta-cut
Additional locus with mass 850 MeV



Properties of an active target (ionization chamber)

1. Filling gas--H2, D2, T2, He3, He4… at pressure 5-200 bar.
2. Registration of all charged particles (p,d,t, He3....) inside of an active target with the energy in the range of 0,2-10 MeV.
3. Energy resolution 20-30 keV(rms).
4. Efficiency of detection charge particles (T>0.2MeV) is ~100%.
5. Measurements of the interaction point inside of the gas volume with resolution of ~0.5-3 mm (rms).
6. Avoiding the wall effects on the level of less than 1%.

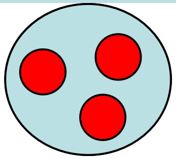


The looking for low-masses resonances on pion beam by TC method

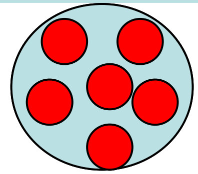
Experimental set consists of active target for measurement of recoil particle and calorimetr for g-ray detecting

The most perspective experiment are on neuteron(from deutron0 as we have not good enough energy beam resolution

Search for supernarrow dibaryons in the reaction $\gamma + {}^3He \rightarrow N + \gamma NN$



nucleon



6-quark state (dibaryon)

1. Experimental discovery of SND would have important consequences for particle and nuclear physics and astrophysics.
3. Three candidates for SNDs have been observed in INR. However, in order to argue more convincingly that the states found are really SNDs, an additional experimental investigation of such states production is needed.
7. The new experiment to search for SND at MAMI-C in the reactions $\gamma + {}^3He \rightarrow N + \gamma NN$ and $\gamma + {}^3He \rightarrow p + \gamma d$ is proposed.

The TC technique may be applied for looking for SNR on pion beam PNPI

The gas target may be used for low energy nucleans registration

Conclusion

- The existence of «neutron anomaly» is confirmed by the new experiment on MAMI-C
- The «neutron anomaly» is observed on 3He nuclei
- The precision experiment with high beam energy resolution shows the absence of effect on proton
- The obtained experimental data on deuteron demonstrate the strong influence of nuclear effects in deuteron which should be taken into account in interpritation of neutron data as neutron target.
- The nearest plan for study of «neutron anomaly» - polarization experiments to confirm the effects in polarization.
- New experiments on deuteron with TC technique to study existence and nature of «neutron anomaly» is perspective on MAMI-C.
- New experiments on deuteron with TC technique to study existence and nature of «neutron anomaly» is perspective for PNPI-ITEP collaboration.
- New experiments on deuteron with forward detector on pion beams supplements the experiments on gamma beam and may be performed in PNPI.. The using of active target Is interesting for looking for low-masses resonances

The offered program permits to unite the activity of of MAINZ, ITEP and PNPI in common program