

Лаборатория мезонной физики ОФВЭ

**Отчет о ходе выполнения научно-исследовательской
работы**

«Барионная спектроскопия и физика с η -мезонами.»

- 1. Бонн, CB-ELSA**
- 2. Бонн, BGO-OD**
- 3. Майнц, CB+TAPS**

2011 г.

Сравнение результатов анализов и предсказаний моделей для числа N^* and Δ -резонансов.

References	N^* – resonance number	Δ – resonance number
Rev. of Part. Phys. (1980)	26	19
Rev. of Part. Phys. (2010)	21	22
KH80	21	18
KA84	18	16
CMB (Phys.Rev.D 20 1979)	16	13
T.P.Vrana et al.(nucl-th/9910012)	14	13
SM95 (Phys.Rev.C 52 1995)	13	8
FA02 (Phys.Rev.C 69, 2004)	10	7
SP06 (nucl-th/0605082)	13	9
S.Capstick et al.(Phys.Rev.D 49,1994)	40	27
U.Loring et al.(hep-ph/0103289)	99	82
Skyrme model (Phys.Rev.D31,1985)	10	13
J.Vijande et al.(hep-ph/0312165)	19	21

Photon		Target		Recoil		Target-Recoil					
				x'	y'	z'	x'	x'	z'	z'	
		x	y	z			x	z	x	z	
unpolarized	σ	0	T	0	0	P	0	$T_{x'}$	$-L_{x'}$	$T_{z'}$	$L_{z'}$
linearly	$-\Sigma$	H	$(-P)$	$-G$	$O_{x'}$	$(-T)$	$O_{z'}$	$(-L_{z'})$	$(T_{z'})$	$(-L_{x'})$	$(-T_{x'})$
circularly	0	F	0	$-E$	$C_{x'}$	0	$C_{z'}$	0	0	0	0

For Meson Photoproduction:

- 16 possible observables for each individual channel
- 8 are needed for complete experiment for each channel
- for amplitude analysis
- Recoil Polarization must be included

Current Experimental Situation and Phenomenology

- MAMI, ELSA and JLab:
 - “complete experiments” for *e.g.* $\gamma, \pi\gamma, \eta\gamma, K$
 - Some measurements for *e.g.* $\pi\pi, \pi\eta$
 - linearly and circularly polarized photons
 - longitudinal and transverse polarized targets
 - recoil polarization of outgoing nucleon
 - recoil polarimeter - only at MAMI

Current Phenomenology • Coupled-channel (multi-channel) analyses – Database still limited

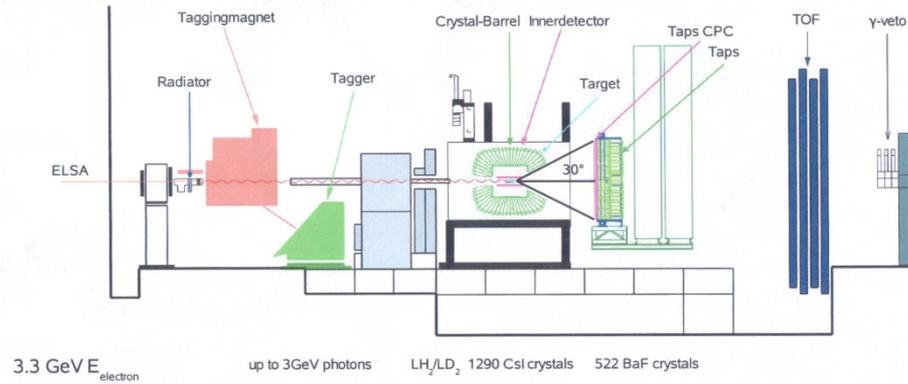
- High-precision analyses of π, η, KY photoproduction are in progress
 - SAID (GW – Institute for Nuclear Studies)
 - MAID (JGU – KPH)
 - BoGa(UB – HISKP)
 - EBAC (JLab – Theory Center)

**Экспериментальные данные по спиновой физике в гамма-протон
взаимодействии на установке CB-ELSA (Бонн)
“Crystal Barrel”**

Участники от Лаборатории мезонной физики:

**Д.Е. Баядилов, Ю.А. Белоглазов, А.Б. Гриднев, И.В. Лопатин,
Д.В. Новинский, А.К. Радьков, В.В. Сумачёв.**

Experimental Setup

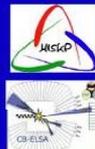
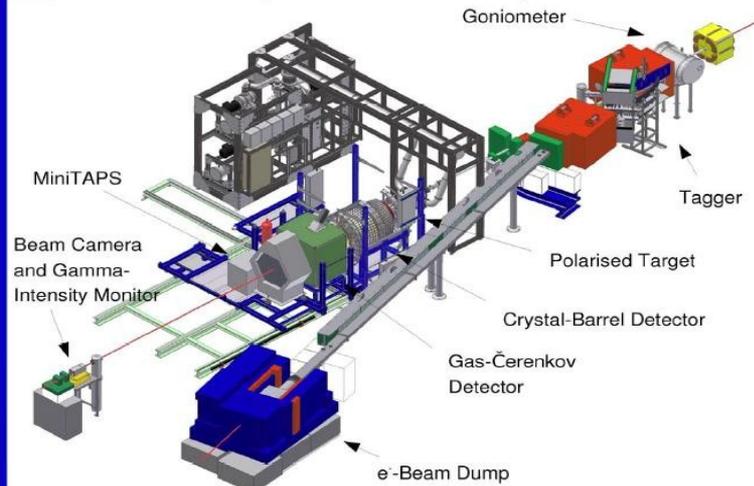


4 π geometry, high sensitivity to multiphoton final states
physics aims:
meson production and baryon spectroscopy

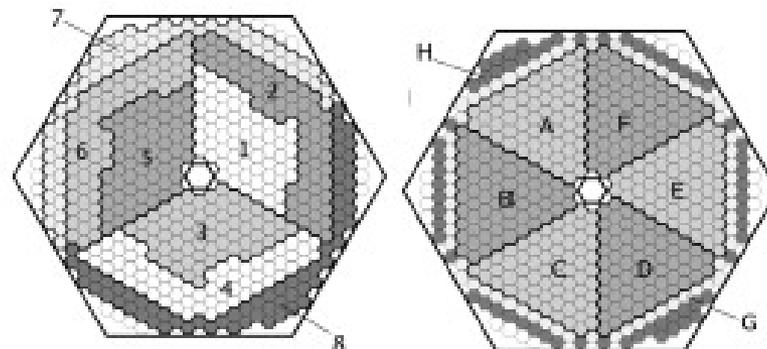
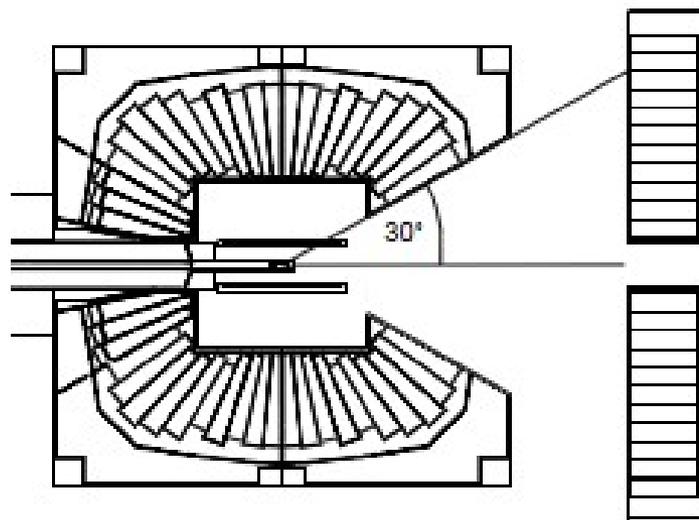
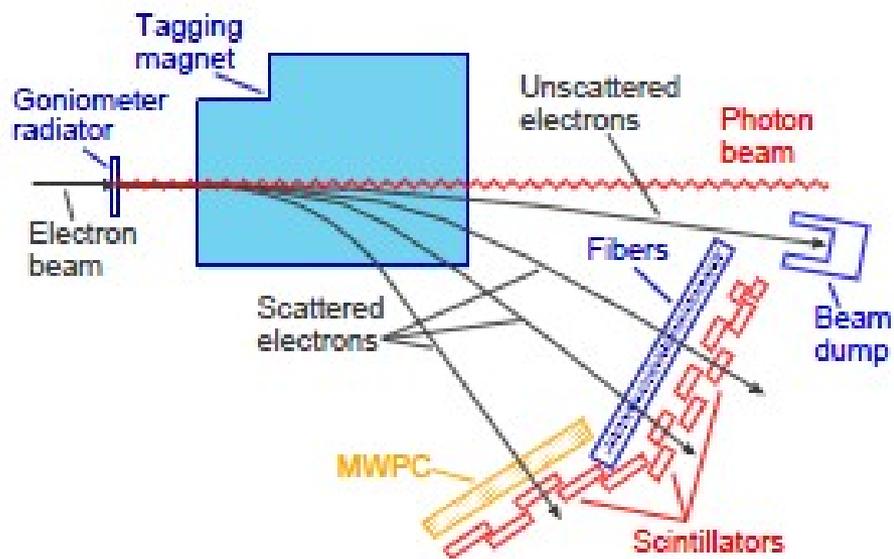


universität **bonn**

The Crystal-Barrel Experiment



ЛМФ 2011 (Гамма-нуклон)



1 - С начала года дополнительный цикл измерений на дейтериевой мишени с продольной поляризацией.

2 – Завершение набора статистики при поперечной поляризации мишени для получения значений наблюдаемых P , H и T .

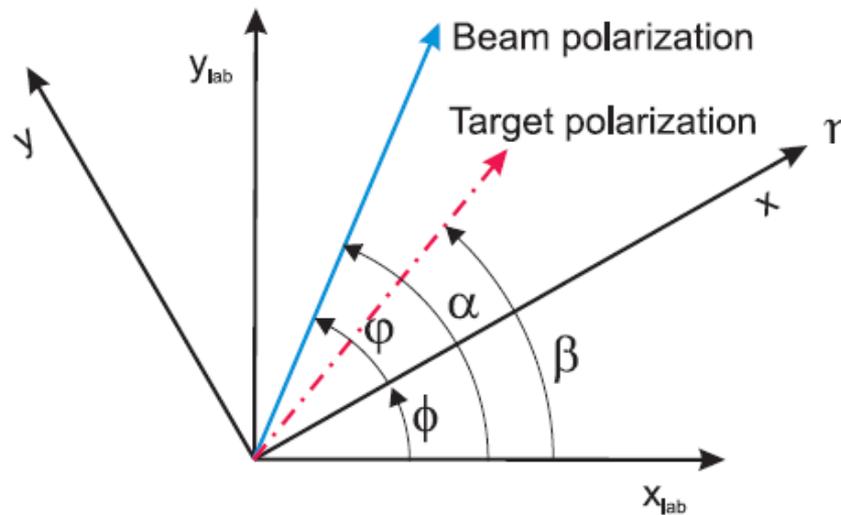
Target: dButanol, long. pol.

Energy: 2.4 GeV

1 марта – 11 апреля и 6 -22 июня: за 1400 часов ускорительного времени набрано $2 \cdot 10^9$ млрд. соб.

Первые опубликованные результаты с двойной поляризацией следует ожидать в 2012 г.

Measurement of the polarisation observables T , P and H in the reaction $\vec{\gamma}\vec{p} \rightarrow p\eta$



$$\left[\frac{d\sigma}{d\Omega} \right]_{pol} = \frac{d\sigma_0}{d\Omega} \cdot \{ 1 - \delta_t \cdot [\Sigma \cos 2(\alpha - \phi) + H\Lambda \cos(\beta - \phi) \cdot \sin 2(\alpha - \phi) + P\Lambda \sin(\beta - \phi) \cdot \cos 2(\alpha - \phi)] + T\Lambda \sin(\beta - \phi) \}$$

4 публикации за 2011 г.

R. Ewald et al. Anomaly in the $K^0_s \Sigma^+$ photoproduction cross section off the proton at the K^* threshold. Dec 2011.

arXiv:1112.0811 [nucl-ex]

V. Crede et al. Photoproduction of Neutral Pions off Protons. Phys.Rev.C84:055203,2011.

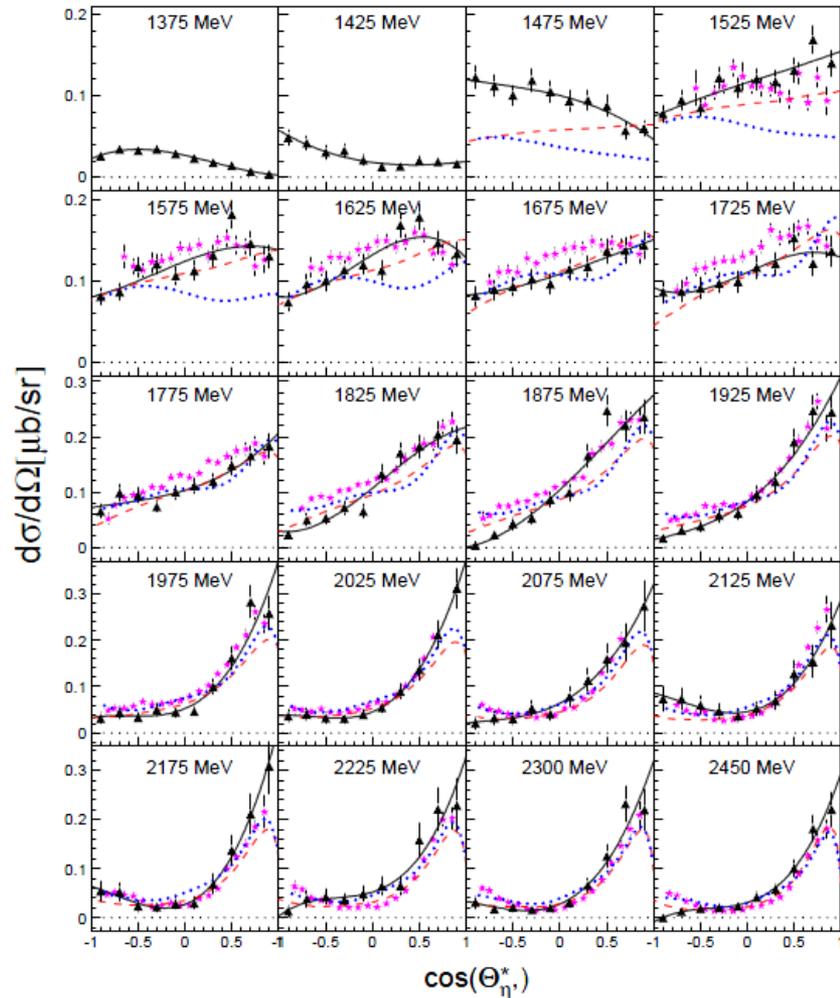
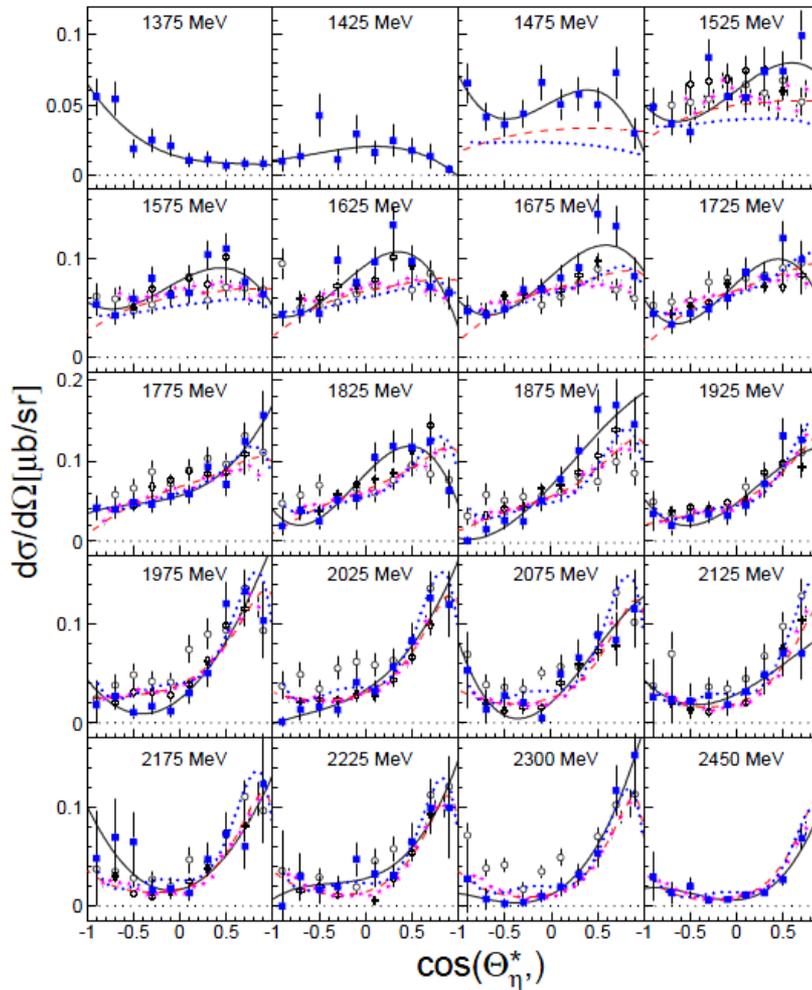
I. Jaegle et al. Quasi-free photoproduction of η -mesons off the deuteron. Eur.Phys.J.A47:89,2011.

I. Jaegle et al. Photoproduction of η' -mesons off the deuteron. Eur.Phys.J.A47:11,2011.

Photoproduction of η' -mesons off the deuteron

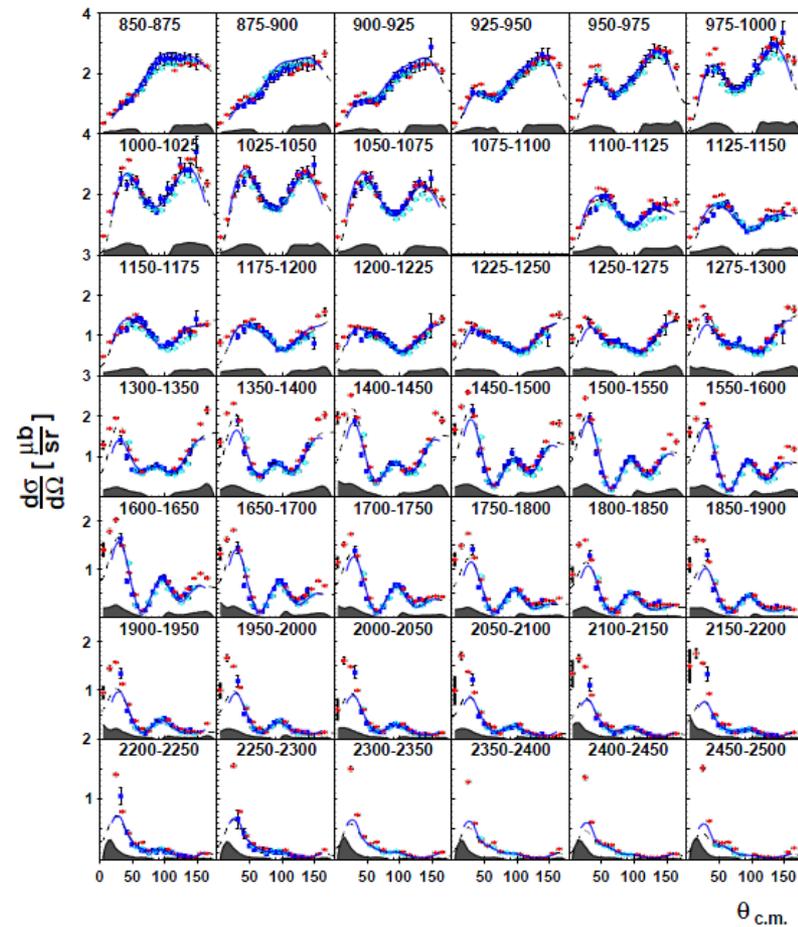
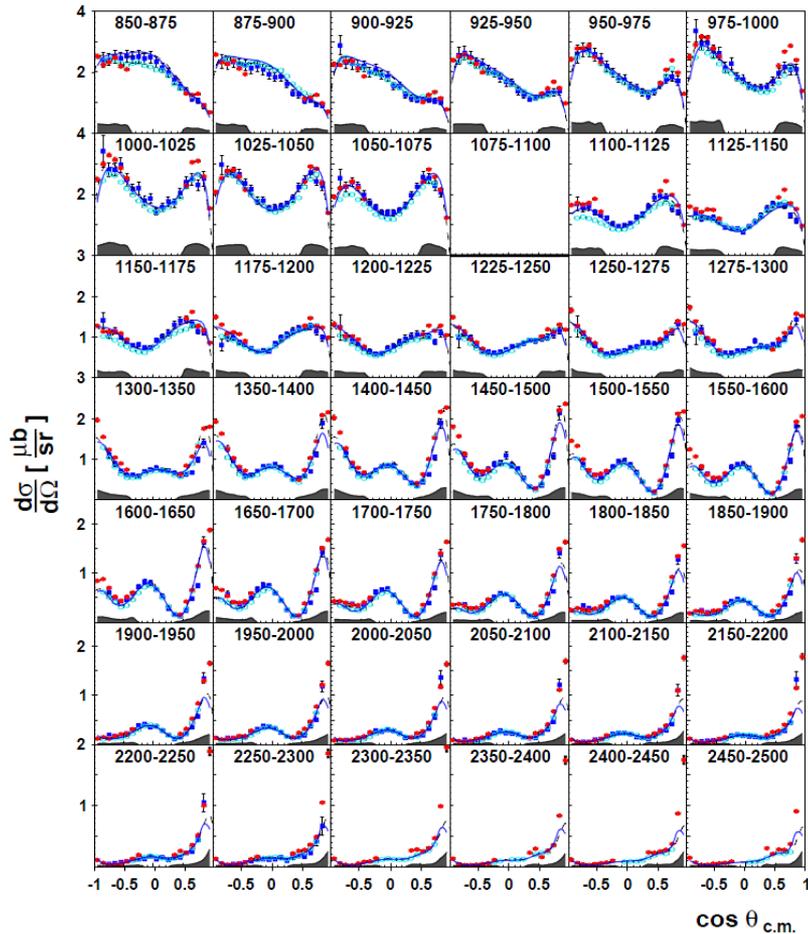
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I. Jaegle et al.: Quasi-free photoproduction of η' -mesons off the deuteron



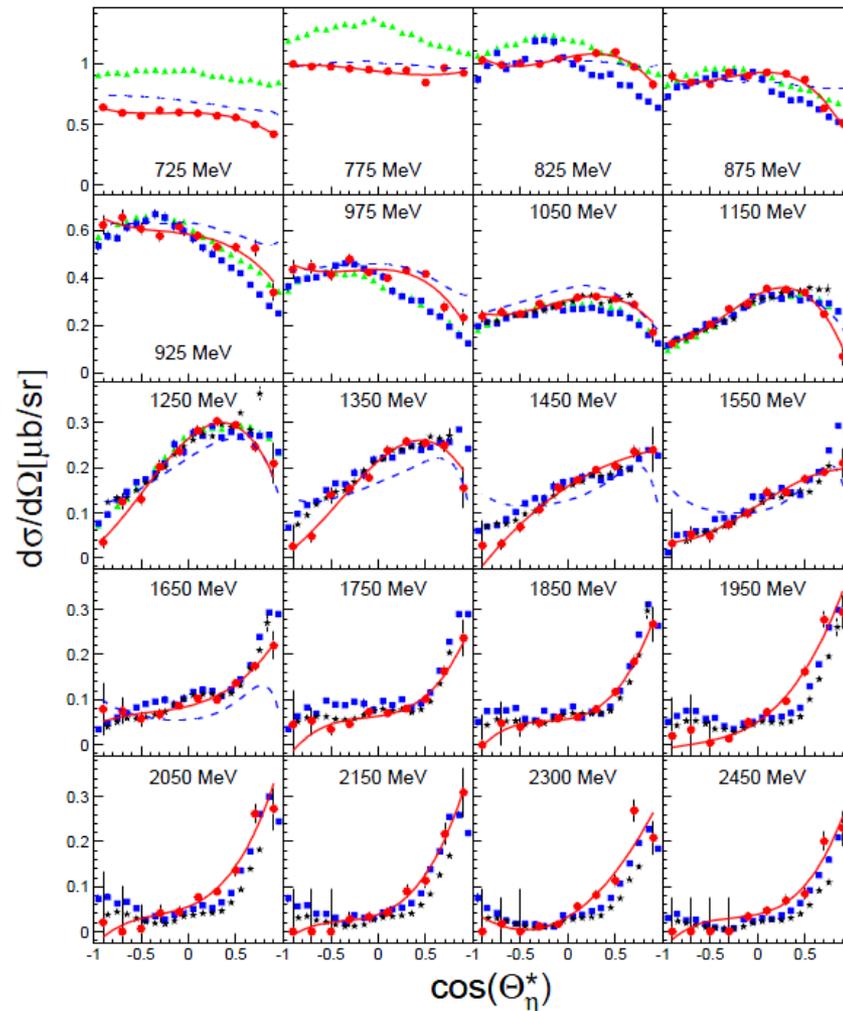
Photoproduction of Neutral Pions off Protons

$$\frac{d\sigma}{d\Omega} = \frac{N_{\pi^0 \rightarrow \gamma\gamma}}{A_{\pi^0 \rightarrow \gamma\gamma}} \frac{1}{N_\gamma \rho_t} \frac{1}{\Delta\Omega} \frac{1}{\frac{\Gamma_{\pi^0 \rightarrow \gamma\gamma}}{\Gamma_{\text{total}}}},$$



Quasi-free photoproduction of η -mesons off the deuteron

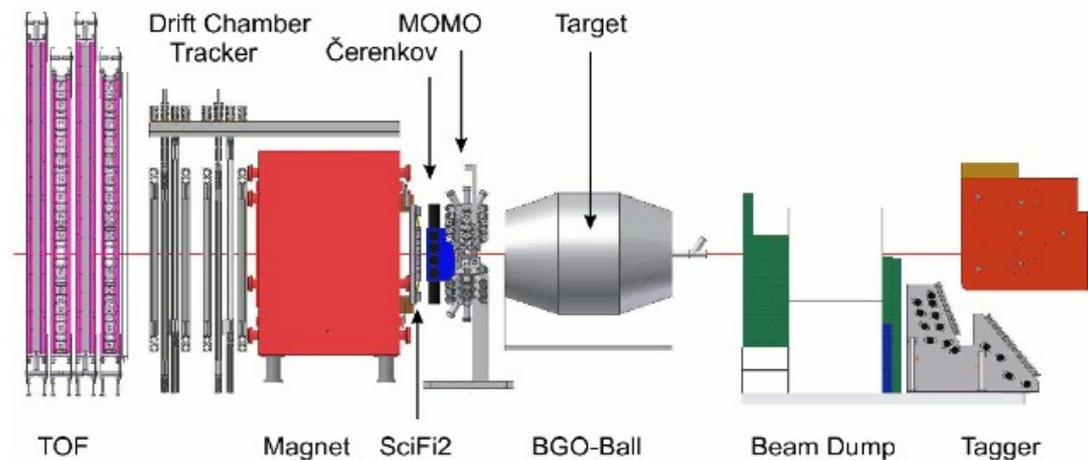
I. Jaegle et al.: Quasi-free photoproduction of η -mesons off the deuteron



Commissioning of the BGO-Open Dipole setup at beamline S of ELSA.

experimental setup

general information

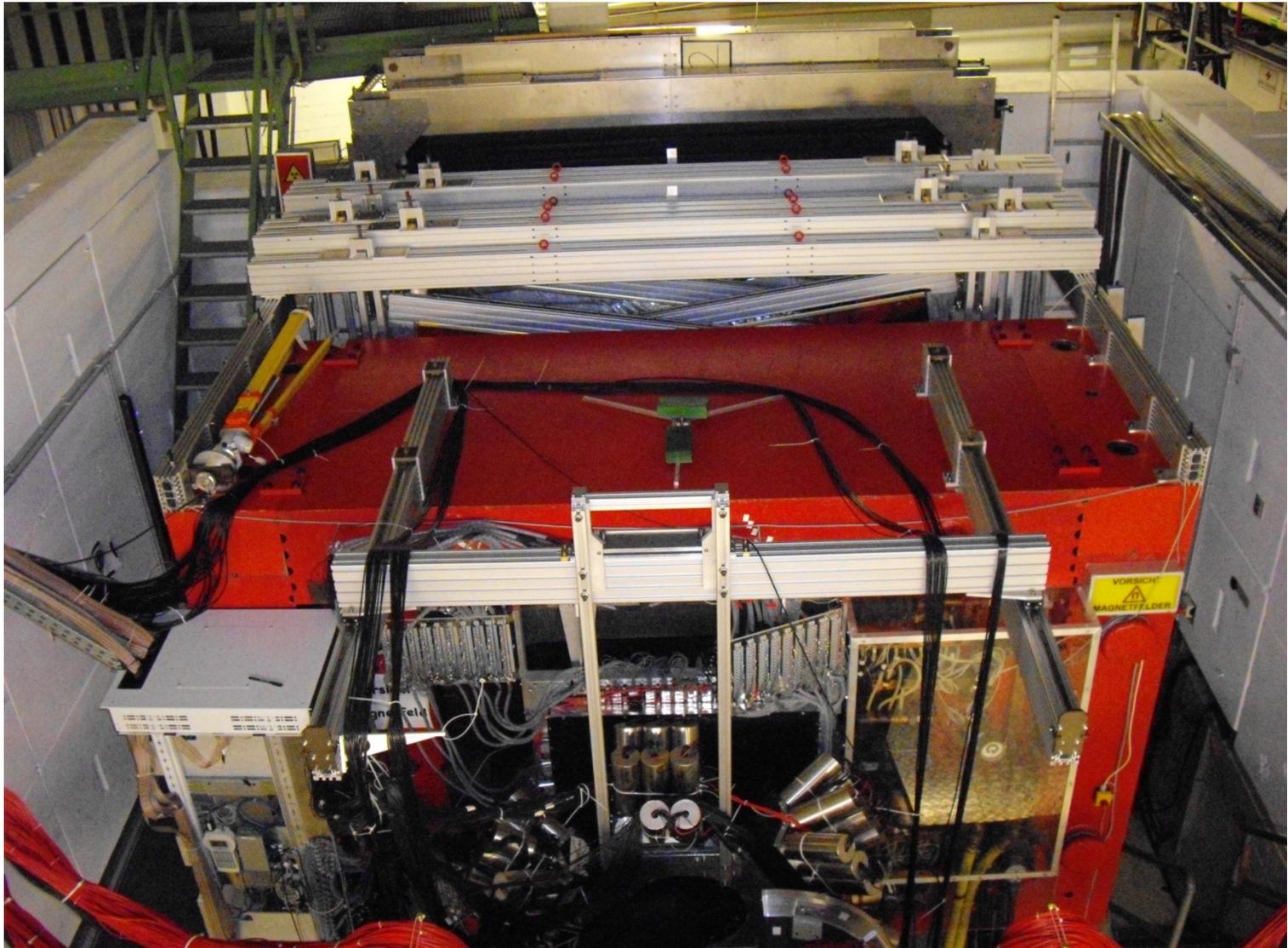


Коллаборация BGO-OD (ELSA) создана в 2009 г.

Участники от Лаборатории мезонной физики:

**Д.Е. Баядилов, А.Б. Гриднев, И.В. Лопатин,
Д.В. Новинский, В.В. Сумачёв.**

ЛМФ 2011 (Гамма-нуклон)



The DC construction.

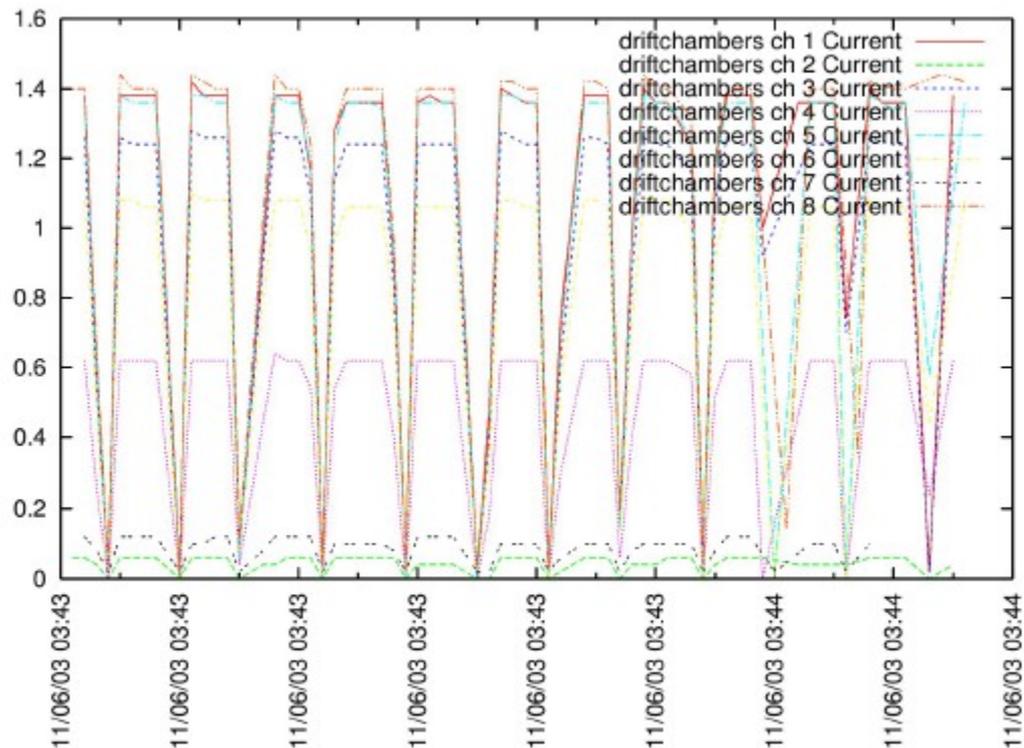
8 drift chambers are produced by PNPI according to agreement 153K-300-2/2007

(Detector Trackers №2 and №3 for B1 project.)

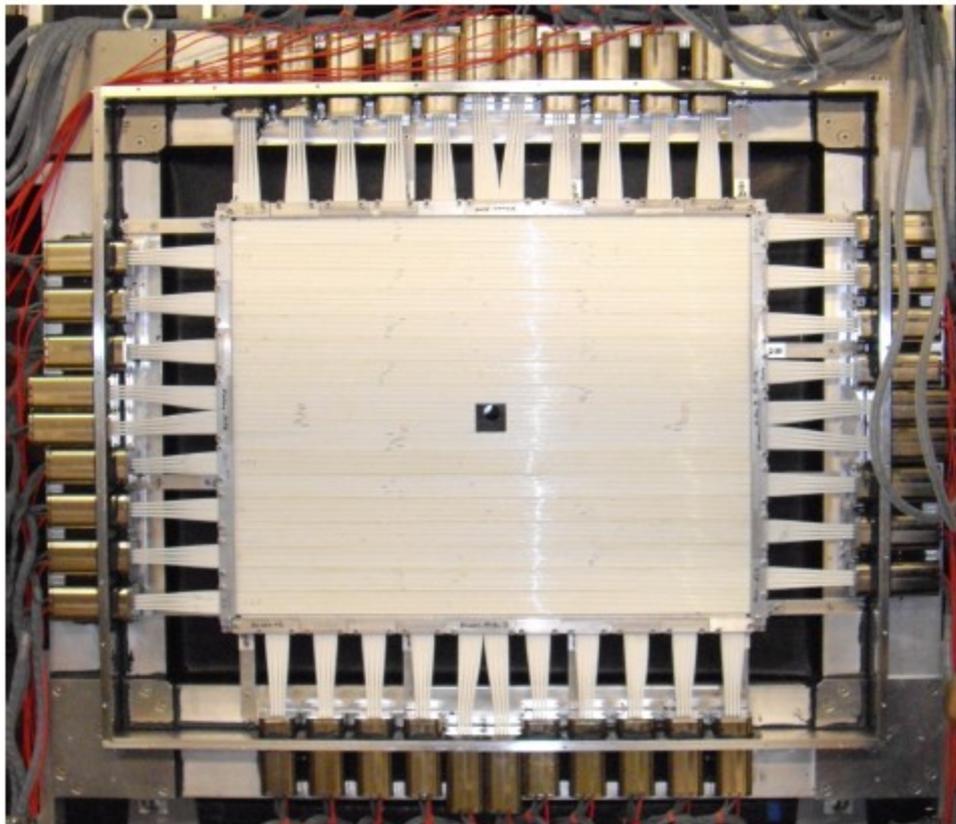
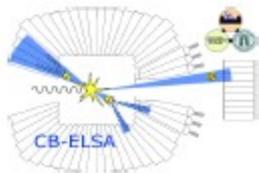
Configuration	Quantity
Horizontal sensitive wires (X)	2 chambers
Vertical sensitive wires (Y)	2 chambers
Inclined sensitive wires (U, V)	4 chambers

DC sensitive area		
Horizontal area	2456	mm
Vertical area	1232	mm

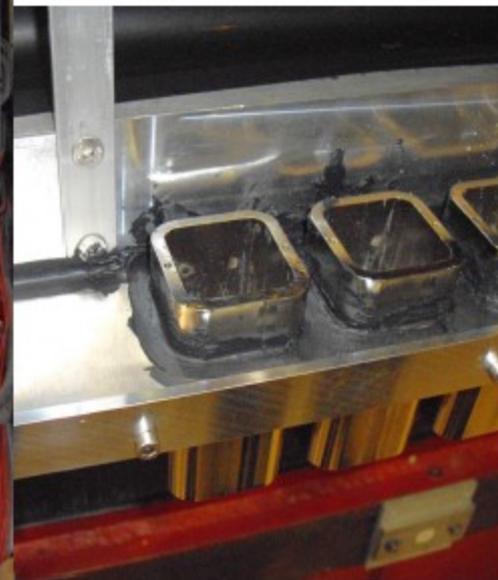
В 2011 г. проведено несколько циклов - «методических» измерений



Ток камер при рабочем напряжении не превысил 1,5 мкА



SciFi2 трековый детектор



Project for B1 Collaboration

“Bound states of the mesons and hyperons in the nuclei”

Gridnev A.B. Bayadilov D.E.

In a frame of B1 collaboration for the experiments with a beam of tagged photons with energies up to 1500 MeV , PNPI scientific group proposed an experiment on investigation of bound states of η -meson with light nuclei.

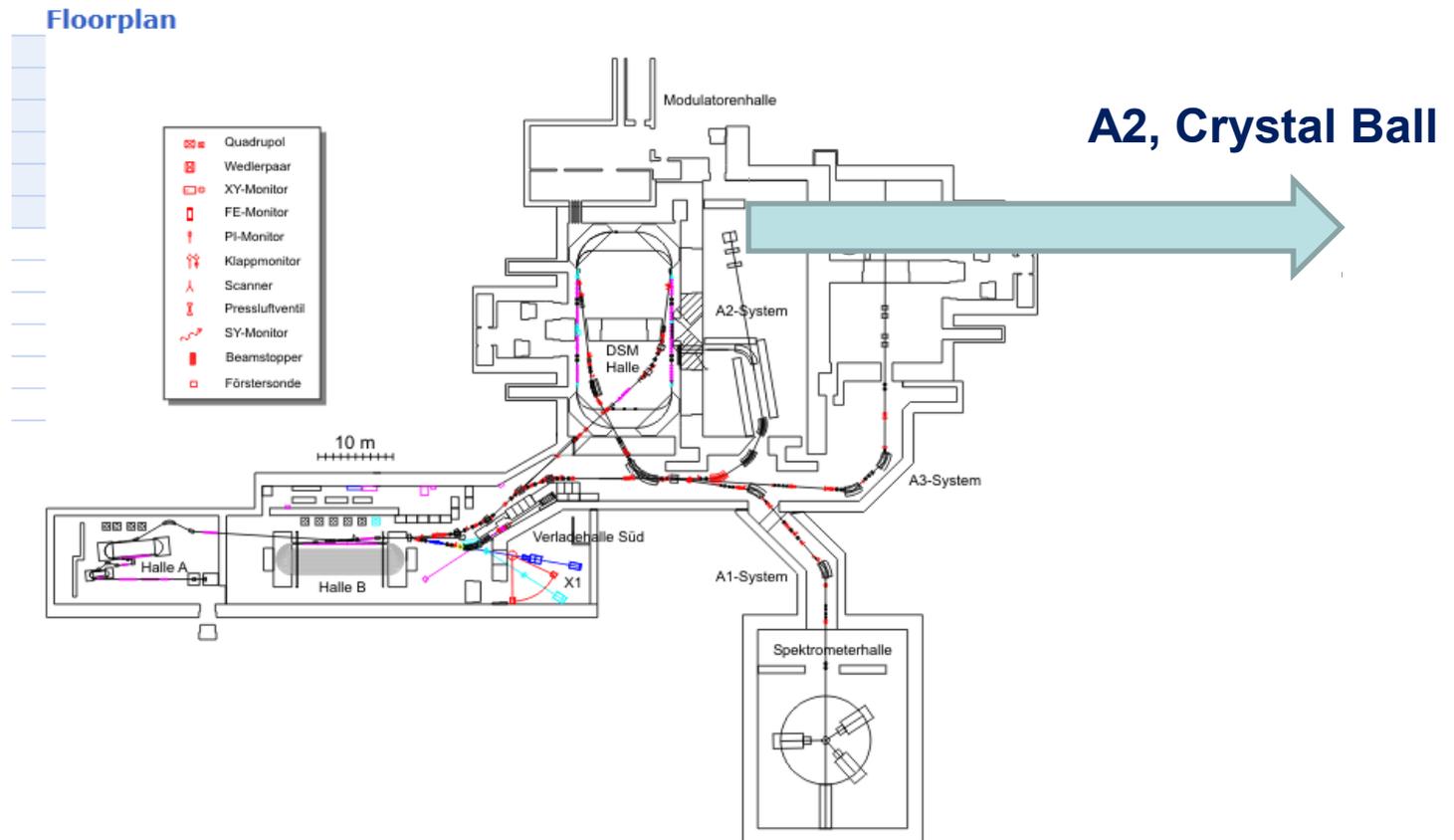
Bound systems of strongly interacting particles have been extensively utilized to extract information about the various aspects of hadron-nucleon interaction. Familiar examples are studied of ΛN and ΣN interactions in a nuclear medium via analysis of the energy spectra of Λ - and Σ - hypernuclei. The strong attraction in ηN - interaction was found in analysis [1, 2], leads to possible existence new type nuclei - bound state η - meson with nucleus (η - mesic nucleus) . The value of this attraction is depend on real part of the ηN - scattering length. The reactions $\pi^- p \rightarrow \eta n$ and $\gamma p \rightarrow \eta p$ close to the threshold usually used to study ηN interaction. However in ref. [3] was found that the real part of the ηN - scattering length cannot be determined from cross sections of these reactions and a complicated multichannel should be used. This is the reason of large spread of the a_{η} values reporting in different analysis (Table I)

С.П. Круглов
 А.А. Кулбардис
 В.С. Бекренев
 А.Б. Старостин



Crystal Ball @ MAMI - Experiment

Welcome to the Crystal Ball @ MAMI - Experiment homepage. This page informs you of the current status, news, latest experiments and publications with the Crystal Ball detector at MAMI in Mainz / Germany.





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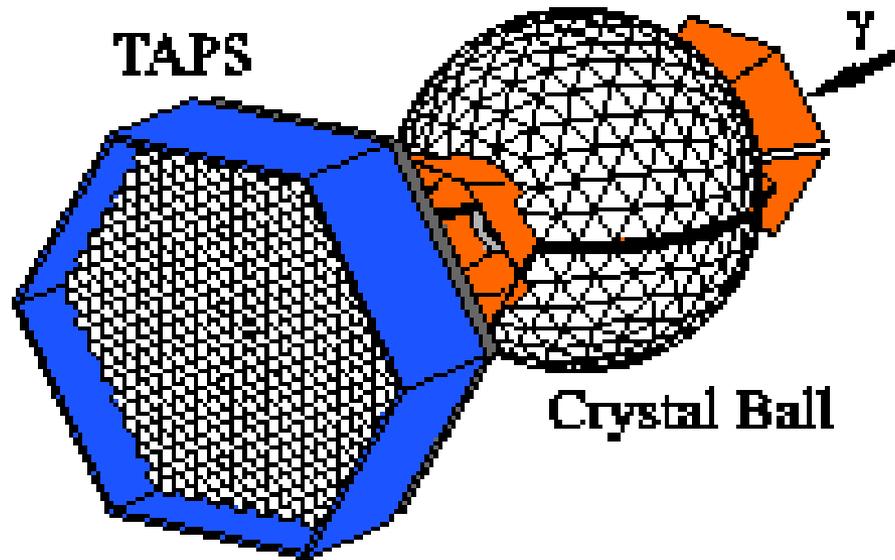


Fig. 1. The Crystal Ball/TAPS setup.

- За 2011 г. произведено 3 сеанса набора статистики на поляризованной мишени и 2 сеанса на углеродной мишени
- Создание установки End Point Tagger – для получения меченого пучка γ -квантов с возможностью изучать реакции с γ' -мезоном.
- Обработка полученных ранее экспериментальных данных

За 2011 г. коллаборацией Crystal Ball опубликованы следующие работы (всего - 5):

A. Starostin et al. **Measurement of $3\pi^0$ photoproduction on the proton from threshold to 1.4 GeV.**

arXiv:1101.3744 [nucl-ex]

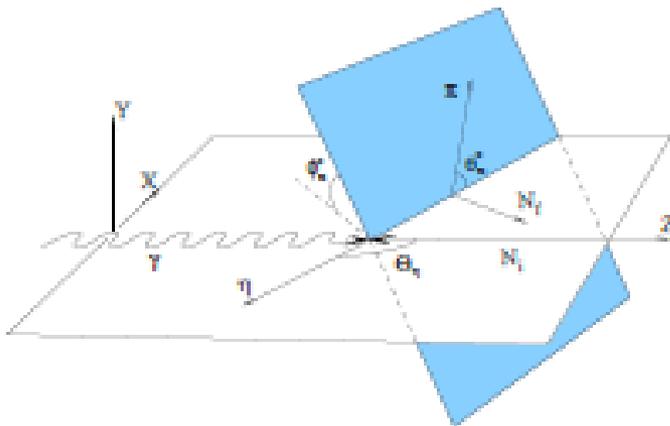
F. Pheron et al. **Coherent photoproduction of η -mesons off ^3He – search for η -mesic nuclei.**

Submitted to Phys. Lett.

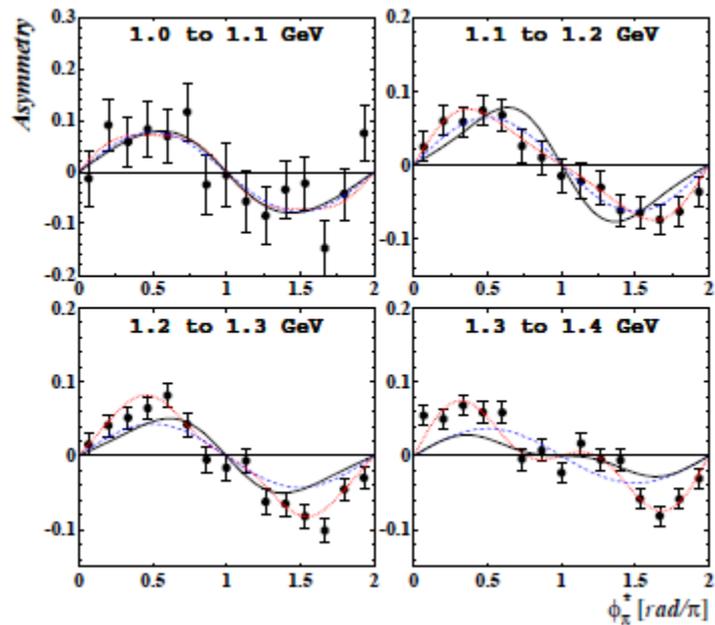
V.L. Kashevarov et al. **First measurement of the circular beam asymmetry in the $\gamma p \rightarrow \pi^0 \gamma p$.**

arXiv:1009.4093 [nucl-ex]

First measurement of the circular beam asymmetry in
the $\gamma p \rightarrow \pi^0 \eta p$ reaction



$$W^c(\phi) = \frac{2\pi}{\sigma} I^c(\phi) \frac{d\sigma}{d\phi} = \frac{1}{I_\gamma} \frac{\pi}{\sigma} \frac{d\sigma^+ - d\sigma^-}{d\phi}$$



Планы на 2012 г.

Бонн, CB-ELSA:

Сеанс набора статистики ~ 4 недели

Модернизация установки

Бонн, BGO-OD:

Доработка по предложению эксперимента

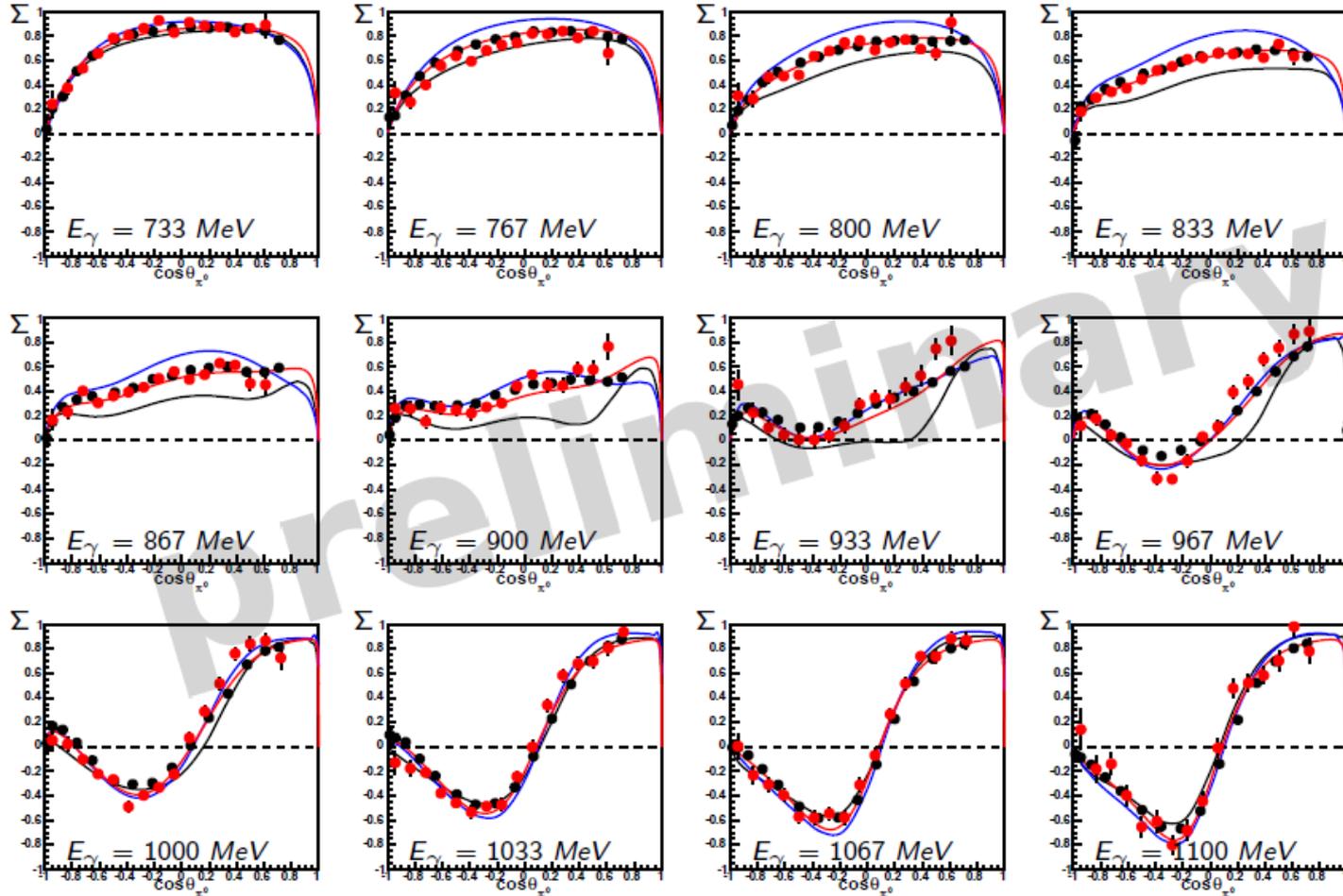
Участие в сменах

Майнц, CB-TAPS:

Участие в сменах

Участие в обработке

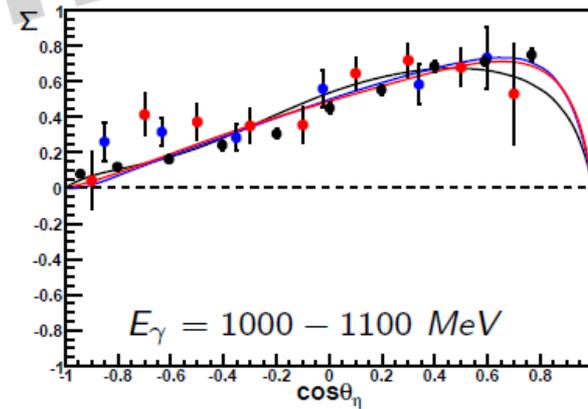
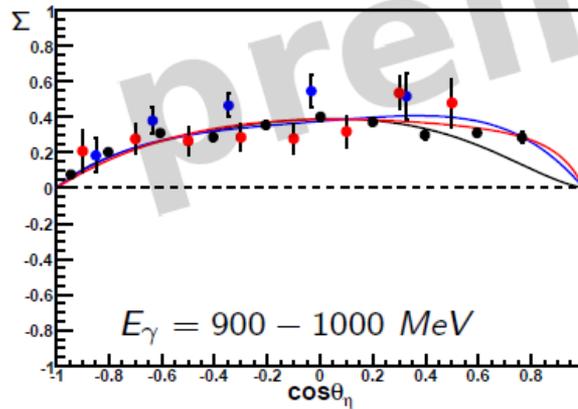
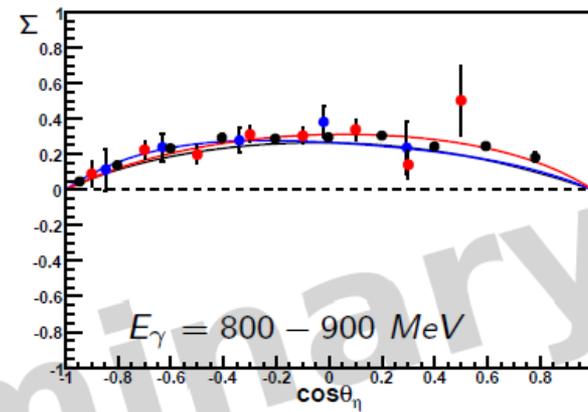
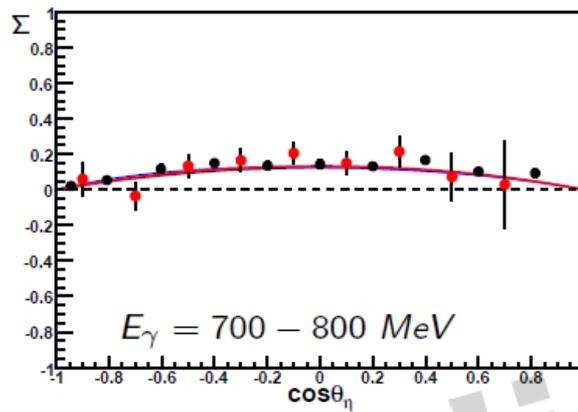
$\gamma p \rightarrow p\pi^0$: Strahlasymmetrie Σ



Datenpunkte: ● diese Analyse ● GRAAL

Vorhersagen: – BnGa – MAID – SAID

$\gamma p \rightarrow p\eta$: Strahlasymmetrie Σ



Datenpunkte: ● diese Analyse ● GRAAL ● D. Elsner

Vorhersagen: - BnGa - MAID - SAID