ЛМФ 2014 (гамма-нуклон)

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**

2014 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

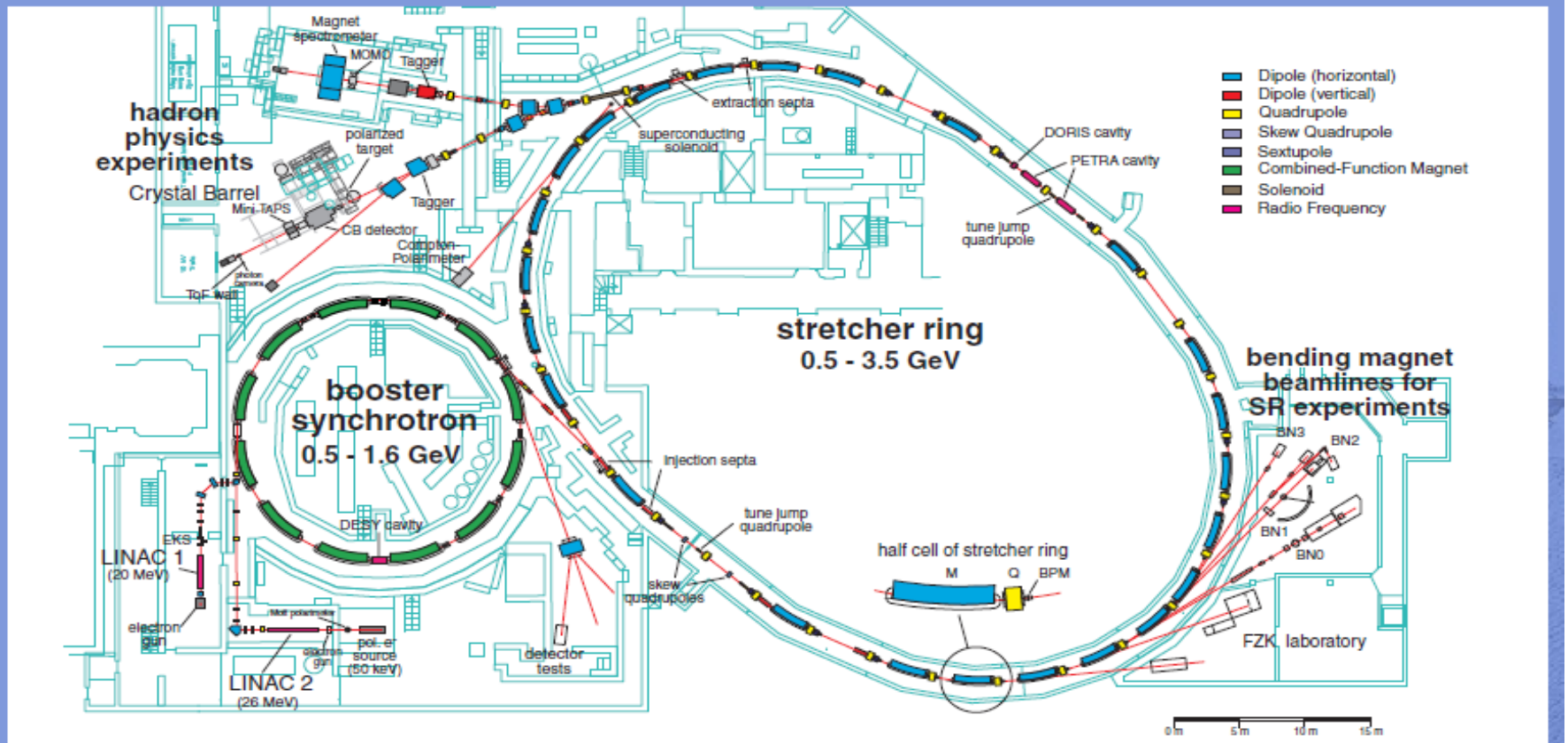
Экспериментальные данные по спиновой физике в гамма-протон взаимодействии на установке CB-ELSA (Бонн)

Участники от Лаборатории мезонной физики:

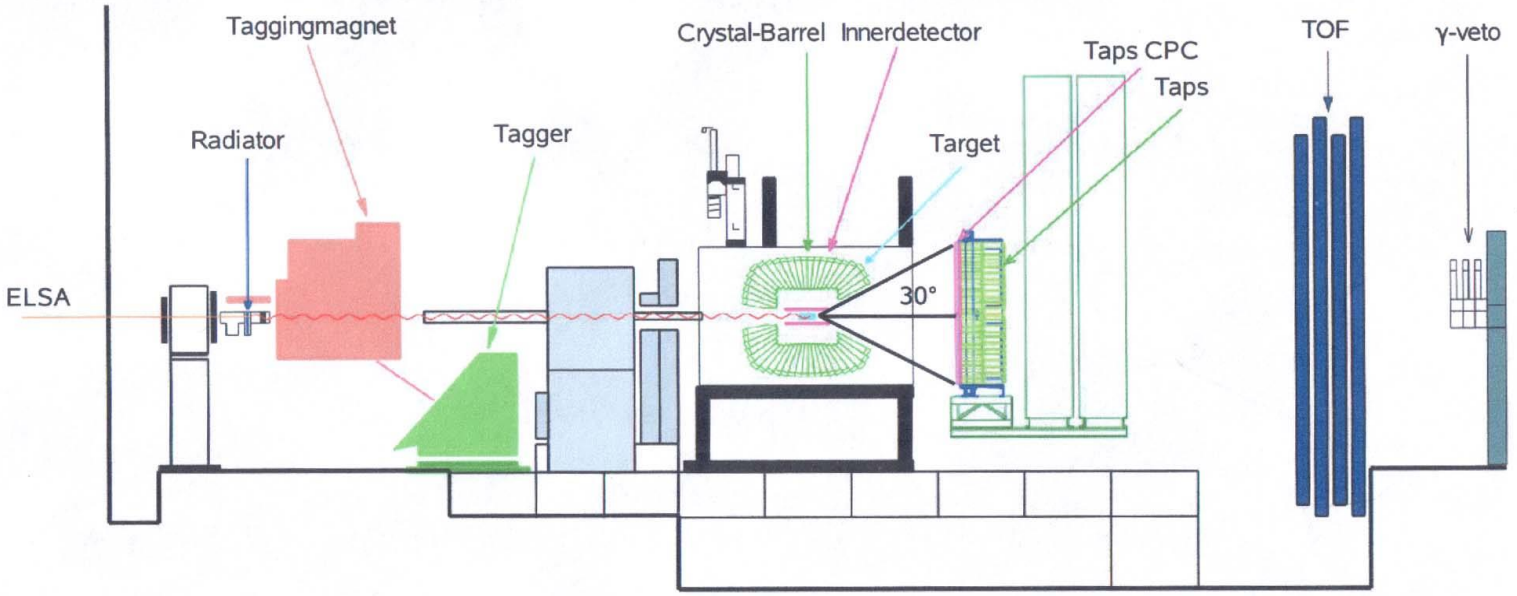
Д.Е. Баядилов, Ю.А. Белоглазов, А.Б. Гриднев, И.В Лопатин,
Д.В. Новинский, А.К. Радьков, В.В. Сумачёв.

Ускоритель - ELectron Stretcher Anlage (ELSA)

- Energy range 0.5–3.5 GeV
- Max. extracted intensity ∼ 1nA
- Electron polarisation ∼ 60–80%



Experimental Setup

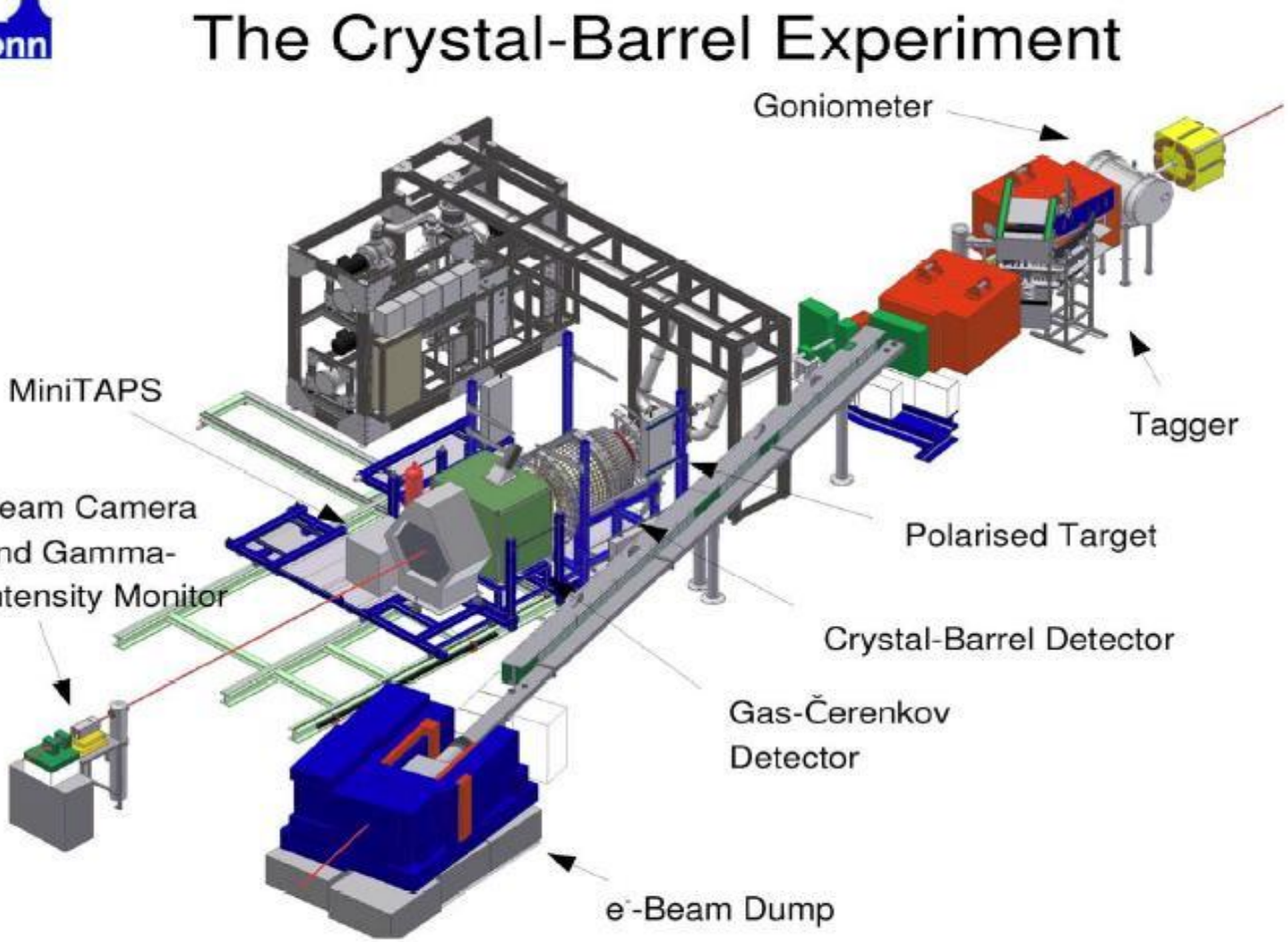


3.3 GeV $E_{electron}$ up to 3GeV photons LH_2/LD_2 1290 CsI crystals 522 BaF crystals

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

Схема установки CB-ELSA

universitätbonn



Measurement of polarisation observables in $K^0_s\Sigma^+$ photoproduction off the proton

R. Ewald[a,1], A.V. Anisovich[b,c], B. Bantes[a], O. Bartholomy[b], D. Bayadilov[b,c], R. Beck[b], Y.A. Beloglazov[c], K.-T. Brinkmann[f], V. Crede[e], H. Dutz[a], D. Elsner[a], K. Fornet-Ponse[a], F. Frommberger[a], Ch. Funke[b], A. B. Gridnev[c], E. Gutz[f], J. Hannappel[a], W. Hillert[a], P. Hoffmeister[b], I. Jaegle[d], O. Jahn[a], T.C Jude[a,*], J. Junkersfeld[b], H. Kalinowsky[b], S. Kammer[a], V. Kleber[a,2], Frank Klein[a], Friedrich Klein[a], E. Klempt[b], B. Krusche[d], M. Lang[b], H. Löhner[g], I.V. Lopatin[c], D. Menze[a], T. Mertens[f], J.G. Messchendorp[g], V. Metag[f], M. Nanova[f], V.A. Nikonov[b,c], D. Novinski[b,c], R. Novotny[f], M. Ostrick[a,3], L. Pant[g,4], H. van Pee[b], A. Roy[g,5], A.V. Sarantsev[b,c], S. Schadmand[g,6], C. Schmidt[b], H. Schmieden[a], B. Schoch[a], S. Shende[g], V. Sokhoyan[b], A. Süle[a], V.V. Sumachev[c], T. Szczepanek[b], U. Thoma[b], D. Trnka[f], R. Varma[g], D. Walther[b], Ch. Wendel[b]

[a] *Physikalisches Institut, Universität Bonn, Germany*
[b] *Helmholtz Institut für Strahlen- und Kernphysik, Universität Bonn, Germany*
[c] *Petersburg Nuclear Physics Institute, Gatchina, Russia*
[d] *Departement Physik, Universität Basel, Switzerland*
[e] *Department of Physics, Florida State University, Tallahassee, USA*
[f] *II. Physikalisches Institut, Universität Gießen, Germany*
[g] *Kernfysisch Versneller Instituut, Groningen, The Netherlands*

Abstract

The reaction $\gamma p \to K^0_S \Sigma^+$ is studied in the photon energy range from threshold. Linearly polarised photon beams from coherent bremsstrahlung enabled the first measurement of photon beam asymmetries in this reaction up to $E_\gamma = 2250$MeV. In addition, the recoil hyperon polarisation was determined through the asymmetry in the weak decay $\Sigma^+ \to p\pi^0$ up to $E_\gamma = 1650$MeV. The data are compared to partial wave analyses, and the possible impact on the interpretation of a recently observed cusp-like structure near the K^+ thresholds is discussed.

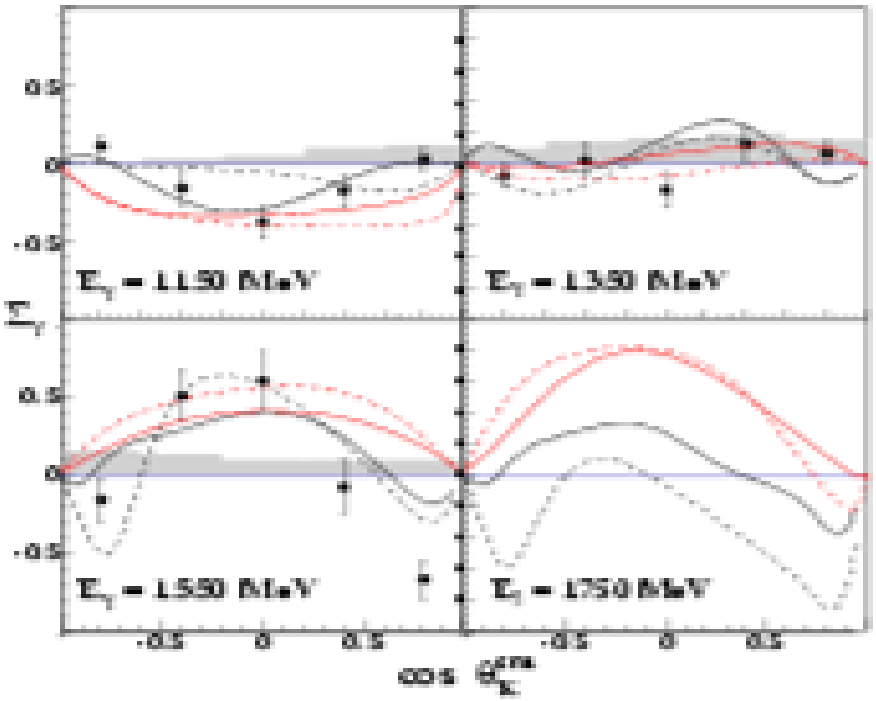


Fig.2 Angular distribution of the photon beam asymmetry Σ_γ in the three bins of photon energy indicated in the diagrams.

Solutions:

BG2011-02m – black dashed

BG2011-02 -- black solid

K-MAID standard – red solid

K-MAID modified -- red dashed

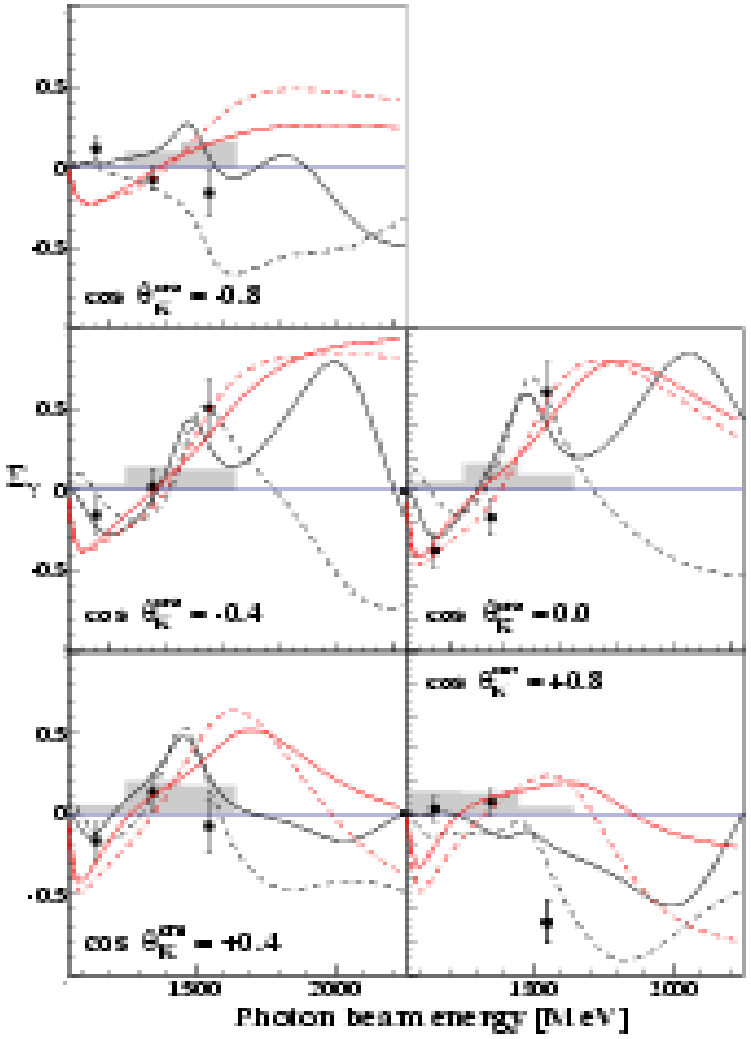


Fig 3. Energy dependence the photon beam asymmetry Σ_γ in the measured five bins of cos Θ^{cm}_K . Errors and curves as in Fig.2.

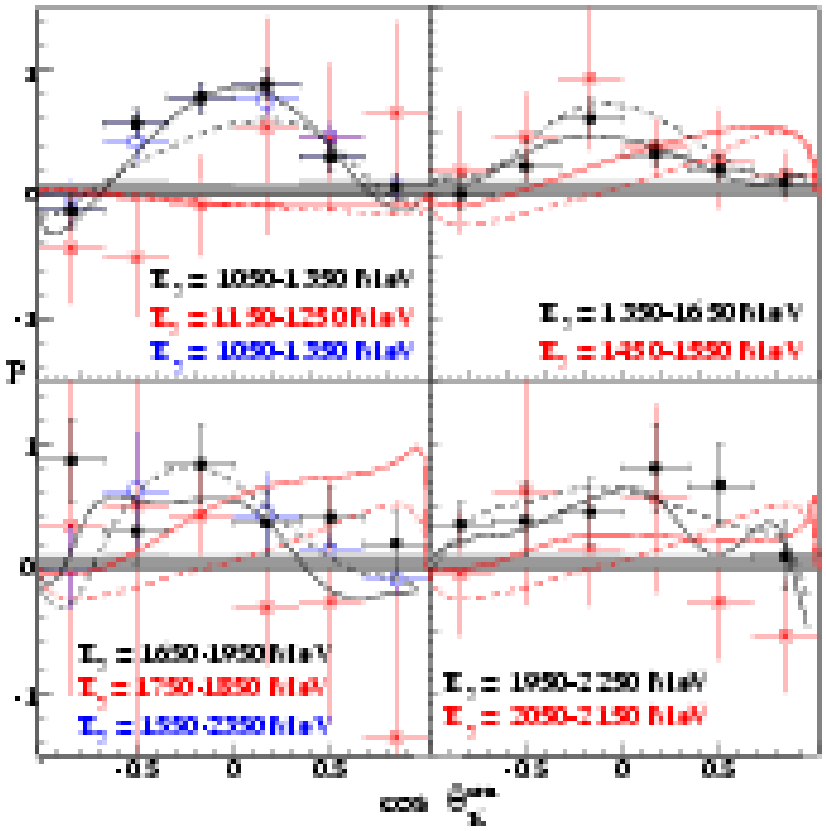


Fig. 4: Recoil polarization of the Σ^+ in the four bins of photon energy indicated in the diagrams. The results of the present measurements (black dots) are compared to the previous CBELSA/TAPS (red crosses) and SAPHIR (blue squares) data.

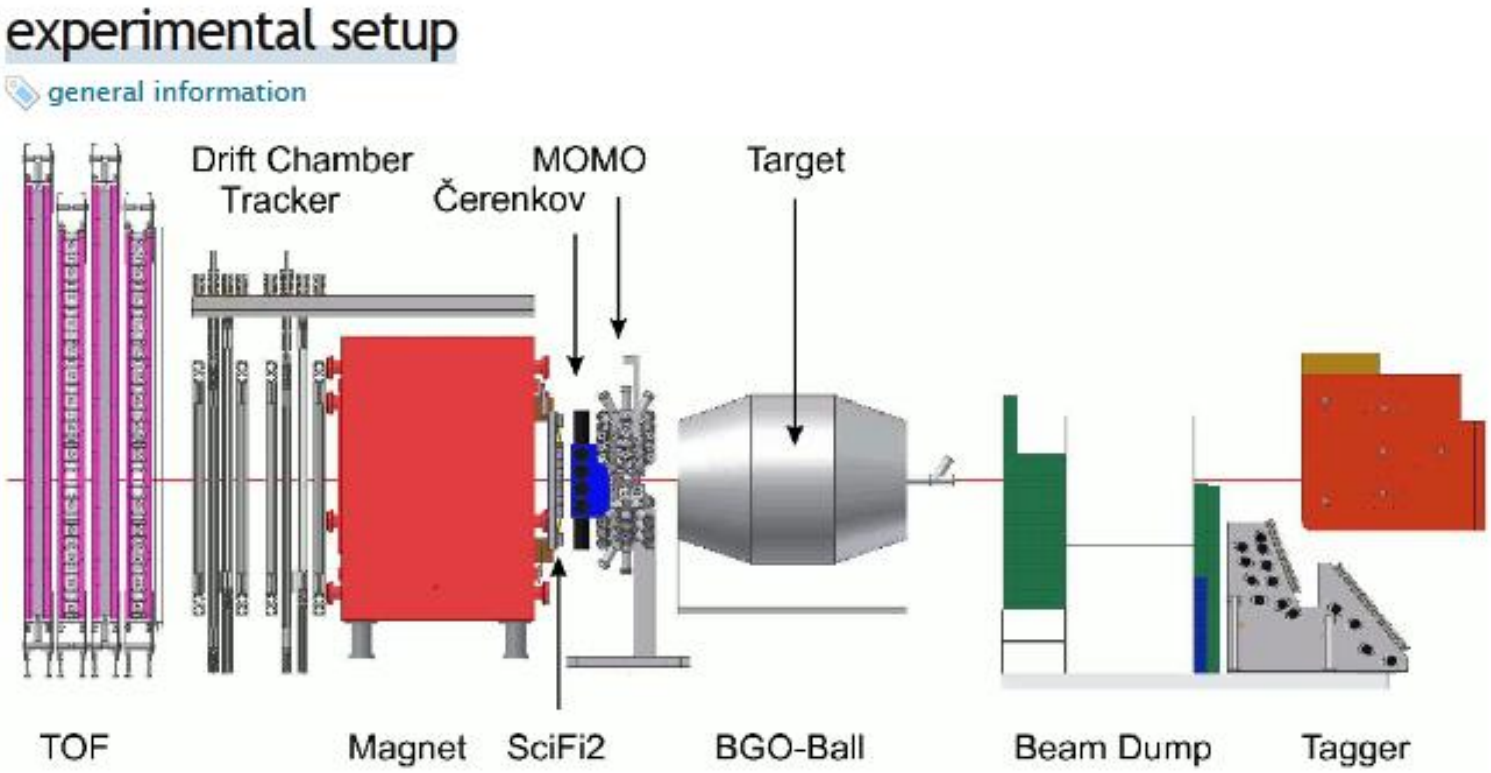
ЛМФ 2014 (гамма-нуклон)

BGO-OD-Kollaboration
Tina Bantes[1], Dair Bayadilov[2], Reinhard Beck[2], Max Becker[2], Andreas Bella[1], John Bieling[1], Sabine Boese[2], Alessandro Braghieri[3], Kai Brinkmann[2], Dmytro Burdeynyi[4], Gordon Diefenthal[2], Rachele Di Salvo[5], Hartmut Dutz[1], Holger Eberhardt[1], Daniel Elsner[1], Alessia Fantini[5], Torsten Frese[1], Frank Frommberger[1], Vladimir Ganenko[4], Gianpiero Gervino[6], Francesco Ghio[7], Giorgio Giardina[8], Bruno Girolami[7], Derek Glazier[9], Stefan Goertz[1], Anatoly Gridnev[10], Daniel Hahne[1], Daniel Hammann[1], Jürgen Hannappel[1], Wolfgang Hillert[1], Alexander Ignatov[11], Fahimeh Jahanbakhsh[2], Oliver Jahn[1], Rainer Jahn[2], Russell Johnstone[1], Rainer Joosten[2], Tom Jude[1], Fritz Klein[1], Karsten Koop[2], Bernd Krusche[12], Alexander Lapik[11], Paolo Levi Sandri[7], Igor Lopatin[10], Giuseppe Mandaglio[8], Francesco Messi[1], Roberto Messi[5], Dario Moricciani[5], Vladimir Nedorezov[11], Dmitry Noviskiy[10], Paolo Pedroni[3], Maria Romaniuk[8], Tigran Rostomyan[12], Carlo Schaerf[5], Hartmut Schmieden[1], Georg Siebke[1], Victorin Sumachev[10], Viacheslav Tarakanov[10], Valentina Vegna[1], Petr Vlasov[2], Dieter Walther[2], Dan Watts[9], Hans-Georg Zaunick[2] und Thomas Zimmermann[1] — [1]Physikalisches Institut, Nussallee 12, D-53115 Bonn — [2]Helmholtz-Institur für Strahlen und Kernphysik, Nussallee 14–16, D-53115 Bonn — [3]INFN sezione di Pavia, Via Agostino Bassi, 6 - 27100 Pavia Italy — [4]National Science Center Kharkov Institute of Physics and Technology, Akademicheskaya St. 1, Kharkov, 61108, Ukraine — [5]INFN Roma Tor Vergata,Via della Ricerca Scientifica 1, 00133 Rome - Italy — [6]INFN sezione di Torino, Via P.Giuria 1, 10125 Torino Italia — [7]INFN - LNF,Via E. Fermi 40, 00044 Frascati (Roma) Italy — [8]Universita degli Studi di Messina, Via Consolato del Mare 41, 98121 Messina — [9]The University of Edinburgh, James Clerk Maxwell Building, Mayfield Road, Edinburgh EH9 3JZ UK — [10]Petersburg Nuclear Physics Institute, gatchina, Leningrad District, 188300 Russia — [11]Russian Academy of Sciences Institute for Nuclear Research, prospekt 60-letiya Oktyabrya 7a, Moscow 117312 Russia — [12]Institut für Physik, Klingelbergstrasse 82, CH-4056 Basel

Участники от Лаборатории мезонной физики:

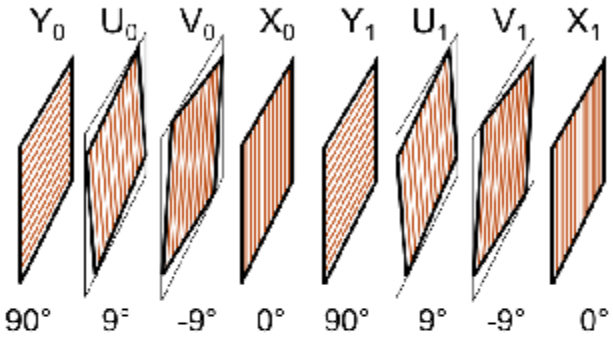
Д.Е. Баядилов, А.Б. Гриднев, И.В Лопатин, Д.В. Новинский, В.В. Сумачёв.

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

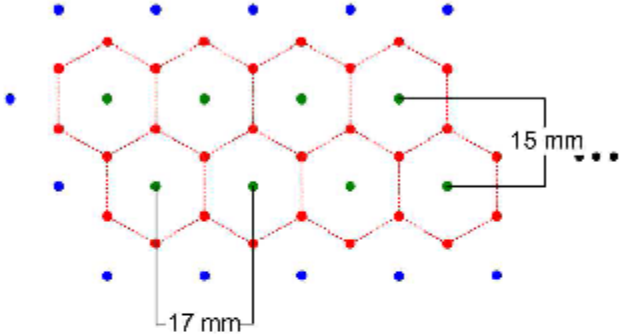


Driftkammer - Aufbau

8 Driftkammern mit je 2 Signaldrahtebenen



Senkrechter Schnitt durch eine Kammer



Spurrekonstruktion

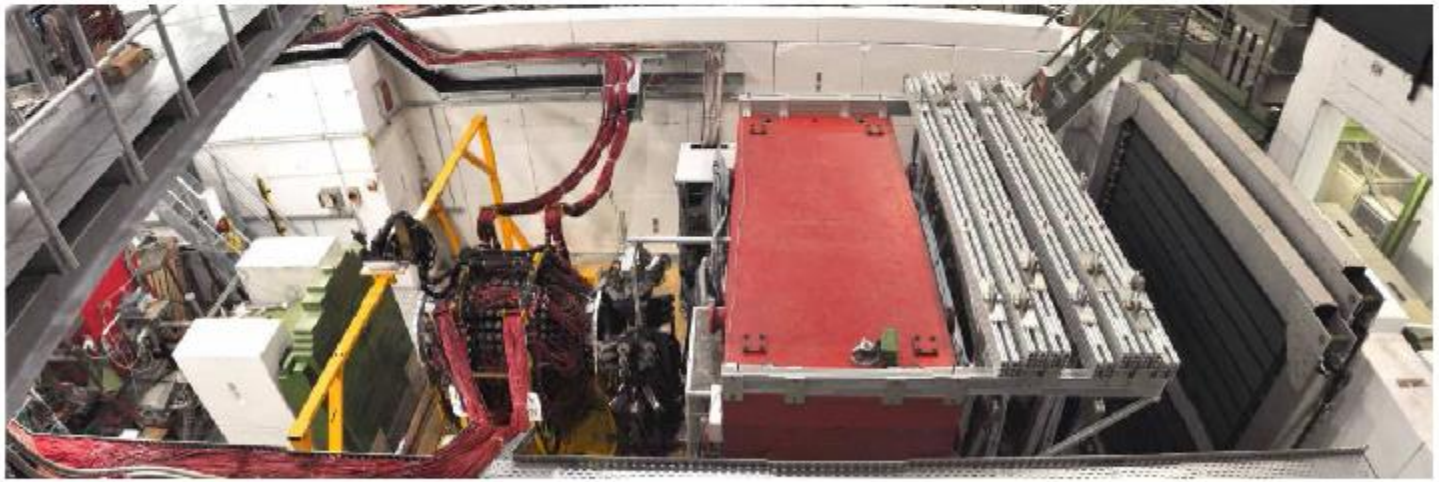
Bisher:
Position der Drähte als Hit-Position

Verbesserte Rekonstruktion:
Nutze Driftzeit zur Verbesserung der räumlichen Auflösung

Das BGO-OD Experiment

BGO-Open-Dipole Experiment am ELSA-Beschleuniger in Bonn:

- Systematische Untersuchung der Photoproduktion von Mesonen
- $\sim 4\pi$-Akzeptanz, hochsegmentierter BGO-Ball, Vorwärtsspektrometer mit offenem Dipolmagneten



Описанная выше экспериментальная установка идеально подходит для изучения много-частичных конечных состояний со смешанными зарядами. Надёжная идентификация частиц обеспечивается как в области малых углов, перекрываемой большим магнитным спектрометром, так и центральной области BGO-детектора. Особо следует отметить, что в переднем направлении вылета частиц высокое разрешение достигается для протонов с большими импульсами.
Кроме того, K^+- и K^--мезоны чётко идентифицируются, также одновременно, что очень важно для фоторождения φ-мезонов. Высокая эффективность регистрации нейтронов получается благодаря комбинации BGO-детектора и время-пролётного детектора. Особым достоинством является возможность использовать BGO-детектор при формировании триггера.

А.А. Кулбардис
В.С. Бекренев

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.

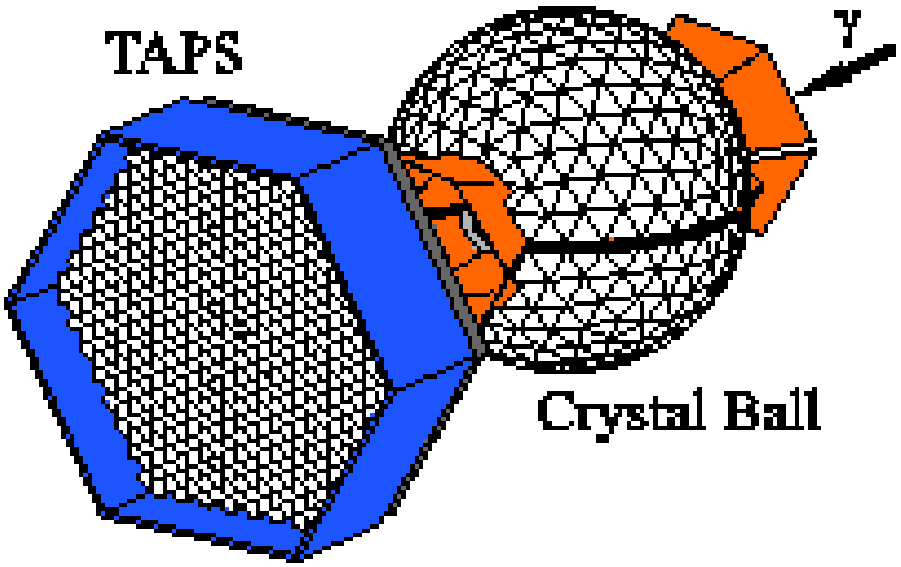


Fig. 1. The Crystal Ball/TAPS setup.

За 2014 год коллаборацией Crystal Ball опубликовано 11 статей с участием сотрудников ЛМФ.

ЛМФ 2014 (гамма-нуклон)

Photoproduction of π^0-mesons off neutrons in the nucleon resonance region

M. Dieterle[1], I. Keshelashvili[1], J. Ahrens[2], J.R.M. Annand[3], H.J. Arends[2], K. Bantawa[4], P.A. Bartolome[2], R. Beck[2,5], V. Bekrenev[6], A. Braghieri[7], D. Branford[8], W.J. Briscoe[9], J. Brudvik[10], S. Cherepnya[11], B. Demissie[9], E.J. Downie[2,3,9], P. Drexler[12], L.V. Fil'kov[11], A. Fix[13], D.I. Glazier[8], D. Hamilton[3], E. Heid[2], D. Hornidge[14], D. Howdle[3], G.M. Huber[15], I. Jaegle[1], O. Jahn[2], T.C. Jude[8], A. Käser[1], V.L. Kashevarov[2,11], R. Kondratiev[16], M. Korolija[17], S.P. Kruglov[6], B. Krusche[1], A. Kulbardis[6], V. Lisin[16], K. Livingston[3], I.J.D. MacGregor[3], Y. Maghrbi[1], J. Mancell[3], D.M. Manley[4], Z. Marinides[9], M. Martinez[2], J.C. McGeorge[3], E. McNicoll[3], D. Mekterovic[17], V. Metag[12], S. Micanovic[17], D.G. Middleton[14], A. Mushkarenkov[7], B.M.K. Nefkens[10], A. Nikolaev[2,5], R. Novotny[12], M. Oberle[1], M. Ostrick[2], B. Oussena[2,9], P. Pedroni[7], F. Pheron[1], A. Polonski[16], S.N. Prakhov[10], J. Robinson[3], G. Rosner[3], T. Rostomyan[1], S. Schumann[2,5], M.H. Sikora[8], D. Sober[18], A. Starostin[10], I. Supek[17], M. Thiel[2,12], A. Thomas[2], M. Unverzagt[2,5], D.P. Watts[8], D. Werthmüller[1], L. Witthauer[1]
(Crystal Ball/TAPS experiment at MAMI, the A2 Collaboration)

Precise angular distributions have been measured for the first time for the photoproduction of π^0-mesons off neutrons bound in the deuteron. The effects from nuclear Fermi motion have been eliminated by a complete kinematic reconstruction of the final state. The influence of final-state-interaction effects has been estimated by a comparison of the reaction cross section for quasi-free protons bound in the deuteron to the results for free protons and then applied as a correction to the quasi-free neutron data. The experiment was performed at the tagged photon facility of the Mainz Microtron MAMI with the Crystal Ball and TAPS detector setup for incident photon energies between 0.45 GeV and 1.4 GeV. The results are compared to the predictions from reaction models and partial-wave analyses based on data from other isospin channels. The model predictions show large discrepancies among each other and the present data will provide much tighter constraints. This is demonstrated by the results of a new analysis in the framework of the Bonn-Gatchina coupled-channel analysis which included the present data.

PACS numbers: 13.60.Le, 14.20.Gk, 14.40.Aq, 25.20.Lj

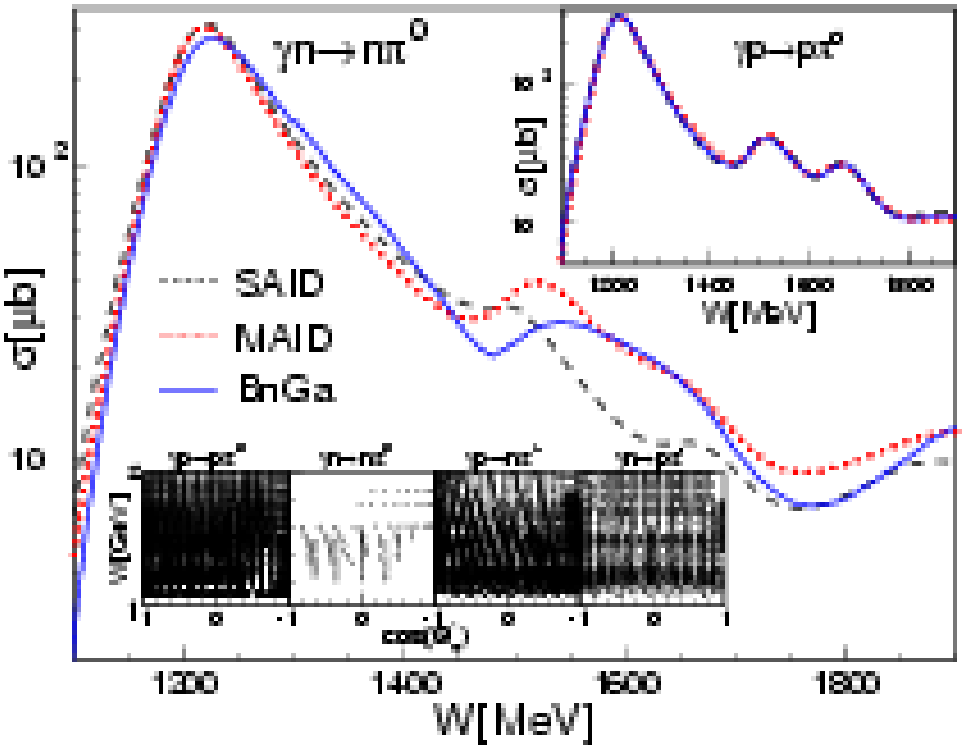


FIG. 1: Main plot: predicted total cross sections from SAID [4], MAID [6], and the BnGa analysis [25] for $\gamma n \to n\pi^0$. Insert, upper right corner: same analyses for $\gamma p \to p\pi^0$. Insert at bottom: previously available data base [28] (each point represents one measurement at W and $\cos(\Theta^*_{cm})$.

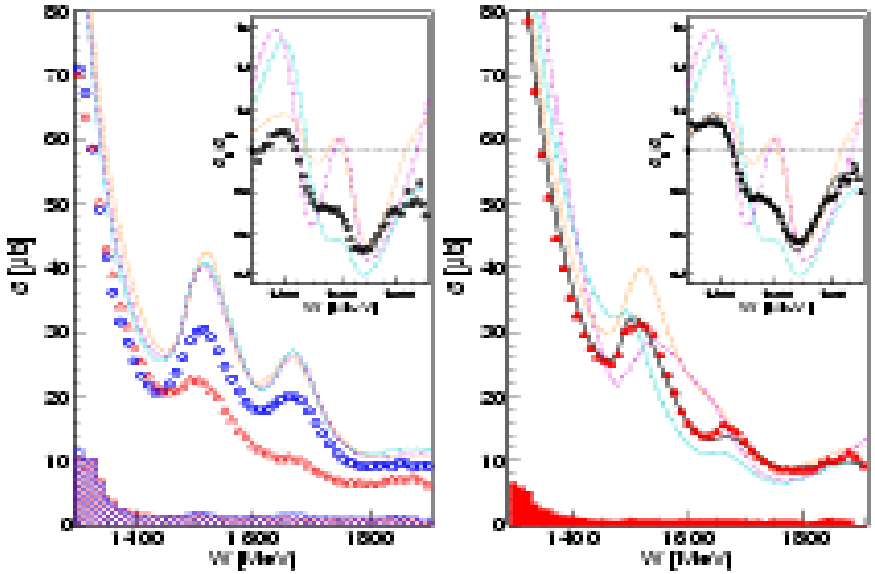


FIG. 2: Left-hand side: Total cross sections as functions of W for π^0 production on quasi-free protons (open, blue circles) and on quasi-free neutrons (open, red triangles). Curves: predictions for $\gamma p \to p\pi^0$ from the SAID multipole analysis [4] dashed (cyan) line, the MAID unitary isobar model [6] dotted (orange), the BnGa analysis [8, 25] dash-dotted (magenta). Histograms at bottom represent systematic uncertainties (blue: proton, red: neutron). The insert compares the neutron/proton cross section ratio to the model predictions (same notation for curves). Right-hand side: Total cross sections for $\gamma n \to n\pi^0$ (filled red triangles), i.e. quasi-free neutron data with FSI correction. Curves: predictions from same models as on left hand side, additionally (black solid) re-fit of BnGa model. Histogram at bottom: systematic uncertainty. Insert: ratio of corrected neutron cross section and SAID proton cross section.

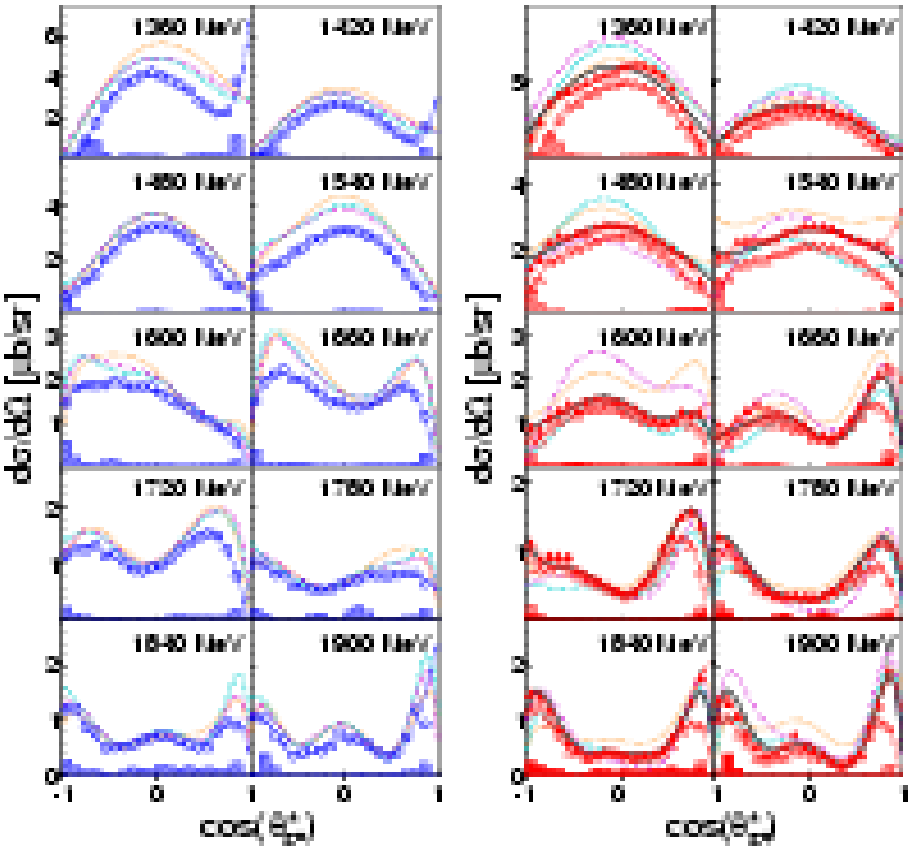


FIG. 3: Angular distributions for π^0-photoproduction on the quasi-free proton (left two rows) and the quasi-free neutron (right two rows, filled symbols: FSI corrected, open symbols, no correction). Dash-dotted blue and red curves: fits to data with Eq. 2. Same coding for model curves as in Fig. 2.

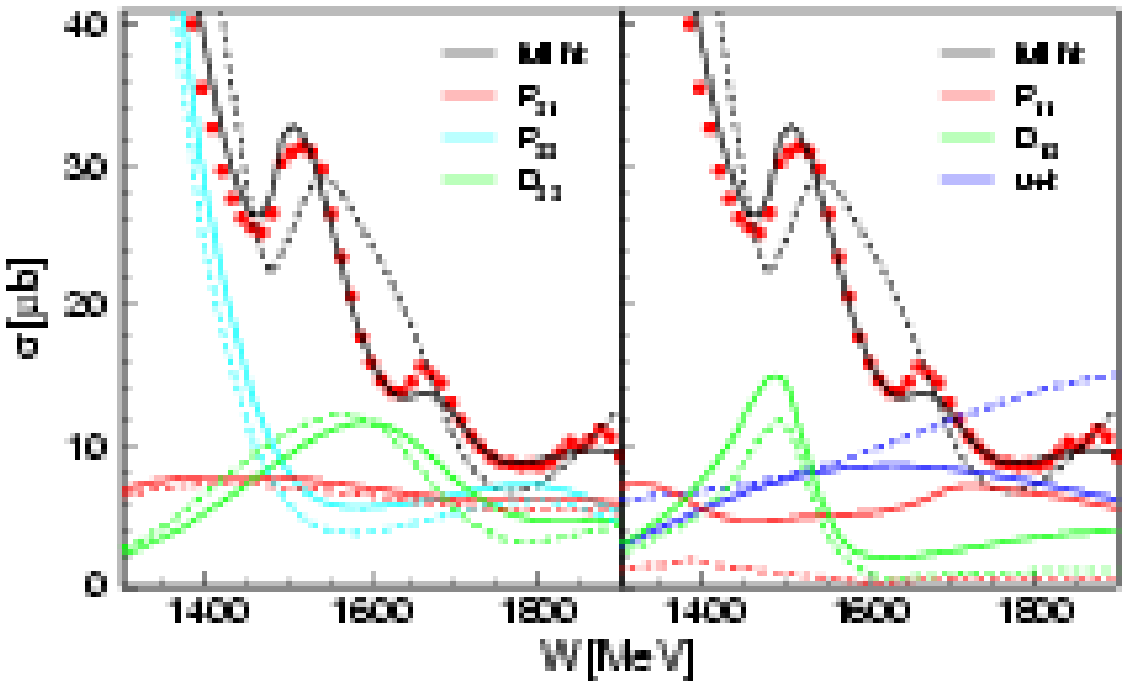


FIG. 4: Results of BnGa fit. (Red) points: total cross section data, dashed curves: previous BnGa results [25], solid curves: re-fit including present data. Left hand side: partial waves for Δ-resonances (red: P_{31}, light blue: P_{33}, green: D_{33}). Right hand side: N^* (red: P_{11}, green: D_{13}) and non-resonant background from $u-$ and t-channel (blue).

Планы на 2015 г.

Бонн, CB-ELSA:
Модернизация установки

Бонн, BGO-OD:
Доработка по предложению эксперимента
Участие в сменах

Майнц, CB-TAPS:
Участие в наборе статистики и обработке