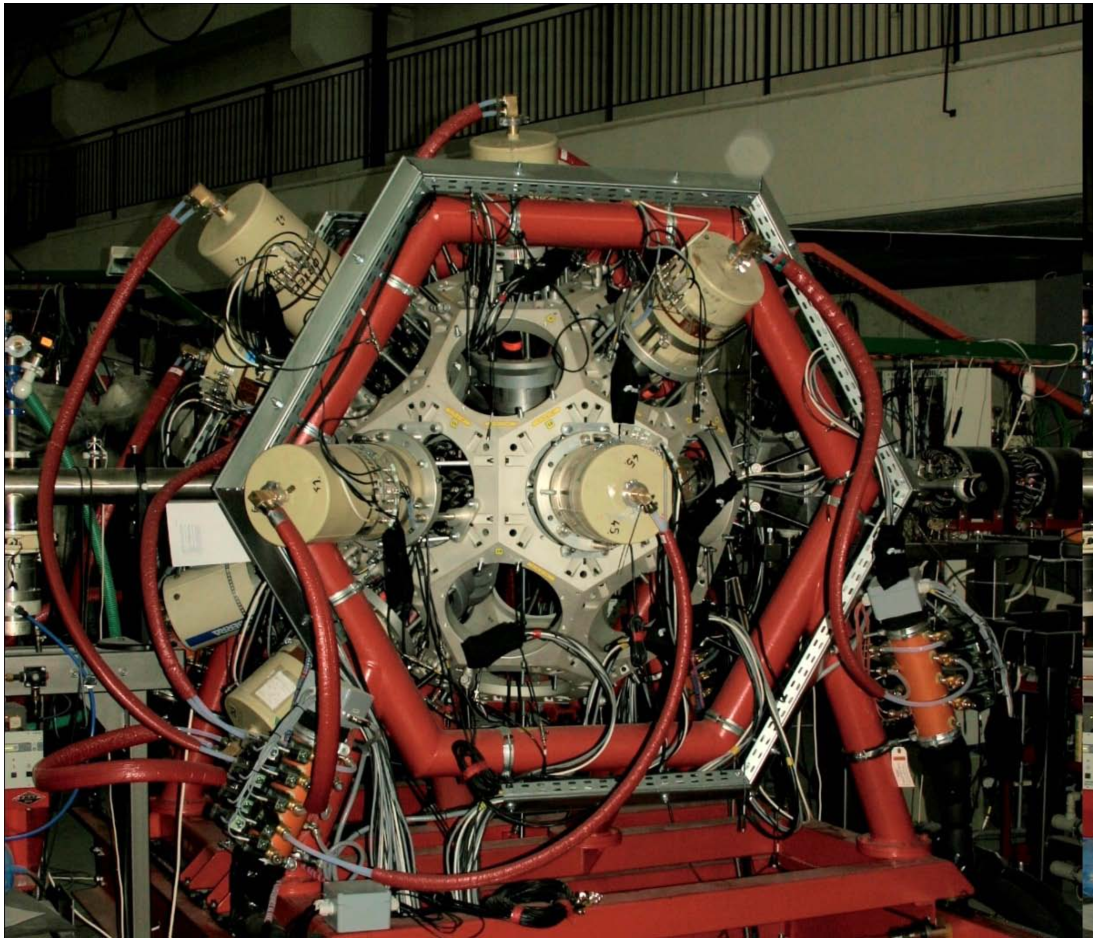
EAGLE 2011 - status report

central **E**uropean **A**rray for **G**amma **L**evels **E**valuation(EAGLE)



Julian Srebrny on behalf of the EAGLE collaboration,

EGAN 2011 - Padova, June 27, 2011

The most important events 2010/2011

1. The EAGLE collaboration has obtained at the end of 2009 a significant grant (about 600 kEUR) from the Polish Ministry of Science and Higher Education. This funding is provided for years 2010-2012 to support the project:
"Nuclear symmetries and their spontaneous breaking
- experiments on beams of the HIL UW cyclotron"
performed in the framework of the EAGLE- GAMMAPOOL Collaboration.

2. A very suitable candidate has been chosen as the responsible for maintenance of EAGLE Germanium detectors: PhMs Tomasz Abraham employed at HIL since July 2010.
He has received a supplementary training at the detector labs of the Institute of Nuclear Study in Swierk, the cyclotron laboratory of the University of Jyvaskyla and CANBERRA Lab.

3. The construction of the new LN_2 cooling system has been finished- March 2011
It has included: renovation of the LN_2 outer tank of 10 m^3 volume, construction of the vacuum LN_2 pipe about 50 m long, connecting the outer tank with EAGLE manifolds as well as the control system for LN_2 auto filling.

4. The new international Program Advisory Committee of the Heavy Ion Laboratory has been appointed (http://www.slcj.uw.edu.pl/en/59.html) - 2010.

5. 20 HPGe- phase I and 15 ACS will arrived at the end of this month in Warsaw from ORSAY. At the end 2011 additional 5 ACS will come from Jyvaskyla

6. **The EAGLE supporting frame and ion guide is working well.**

quite a few test experiments using EAGLE equipped in 12 HPGe ACS detectors of 20-35% efficiency were performed at HIL since October 2009

a) **COULEX of ^{94}Zr and ^{104}Pd by ^{20}Ne**

- **ancillary chamber 30 Si P-i-N diodes**

b) **DSAM picosecond lifetime measurement (test run for the chirality study) in ^{124}Cs**

c) **New conversion electron spectrometer with 12 Si detectors has been tested on ^{130m}Ba $K^{\pi} = 8^{-}$ isomer**

- **ancillary chamber 12 Si(Li) electron detectors**

d) **Complete + InComplete Fusion reaction mechanism study**

- **ancillary chamber Si-Ball 80% of 4Π**

^{122}Sn(^{20}Ne, α xn γ) ^{132,133}Ce E(^{20}Ne) = 141, 150 MeV

next talk Jan Mierzejewski

7. **17th Nuclear Physics Workshop "Marie & Pierre Curie was organized in Kazimierz Dolny (Poland) 22-26 September 2010.**

The main topics: ** Symmetry and symmetry breaking in nuclear physics **

two sessions arranged by the EAGLE collaboration: *"Chirality in Nuclei"* and *"Deformation, symmetries and Coulomb excitation"*

http://kft.umcs.lublin.pl/wfj/

Chiral symmetry braking

EXPECTED PROPERTIES IN LAB FRAME

Chiral partner bands

Two rotational bands with similar energy levels, same spins and parity.

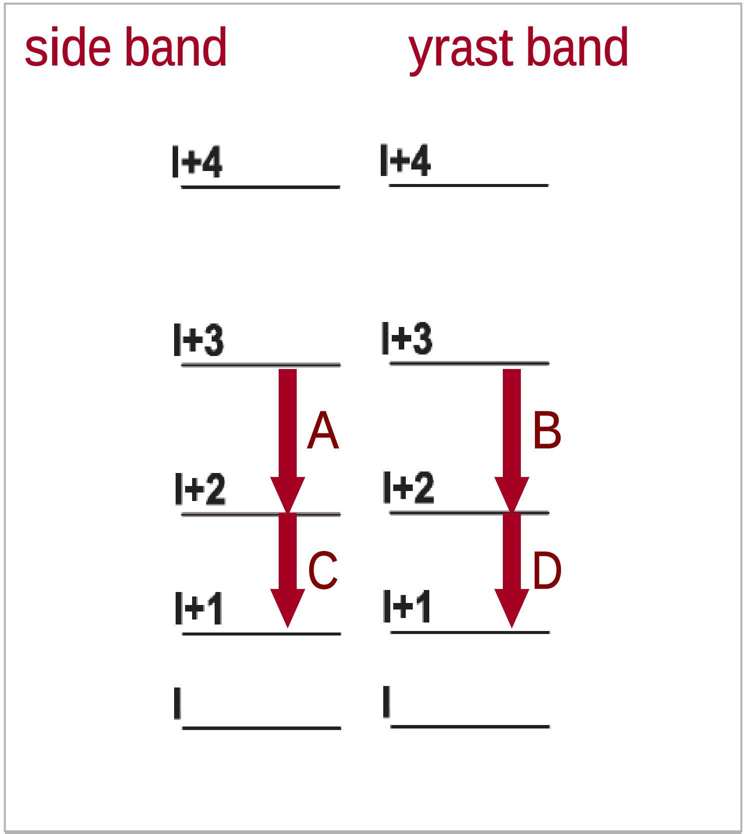
Similar electromagnetic properties

The same transition probabilities between corresponding levels

A=B

C=D

...



Chiral partner bands

Progress in analysis and interpretation of our previous chirality experiments on the beam of the Warsaw cyclotron - Warsaw, Lublin theoretical support

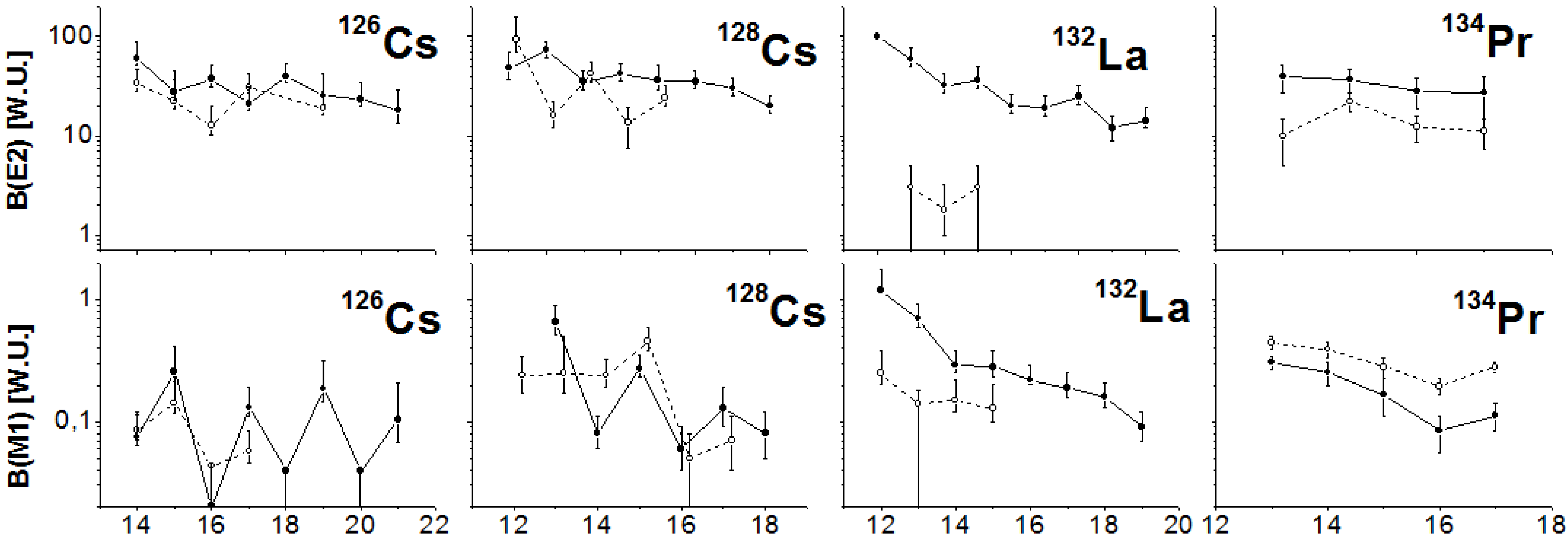
[1] Eur. Phys. J. A 42, 79–89 (2009)
Ch. Droste, S.G. Rohozinski, K. Starosta, L. Prochniak and E. Grodner
„Chiral bands in odd-odd nuclei with rigid or soft cores"
„ The feature pertinent to the model are the zero diagonal matrix elements

$$< R_r || \cos 3\gamma || R_r > = 0 \quad \rightarrow \quad < \gamma > = 30°$$

[2] submitted to EPJ A (2011)
S. G. Rohozinski, L. Prochniak, K. Starosta, Ch. Droste
.,Odd-odd nuclei as the core - particle - hole systems and chirality"

[3] submitted to Physics Letters (2011)
E. Grodner, I. Sankowska, T. Morek, S.G. Rohozinski, Ch. Droste, J. Srebrny, A.A. Pasternak, M. Kisielinski, M. Kowalczyk, J. Kownacki, J. Mierzejewski, A. Krol, K. Wrzosek
„Partner bands of 126Cs - first observation of chiral electromagnetic selection rules"

results of lifetime measurements by DSAM



reduced E2 (upper part) and M1(lower part) transition probabilities as a function of the initial spin value.

● *solid lines – yrast band* ○ *dotted lines - side band*

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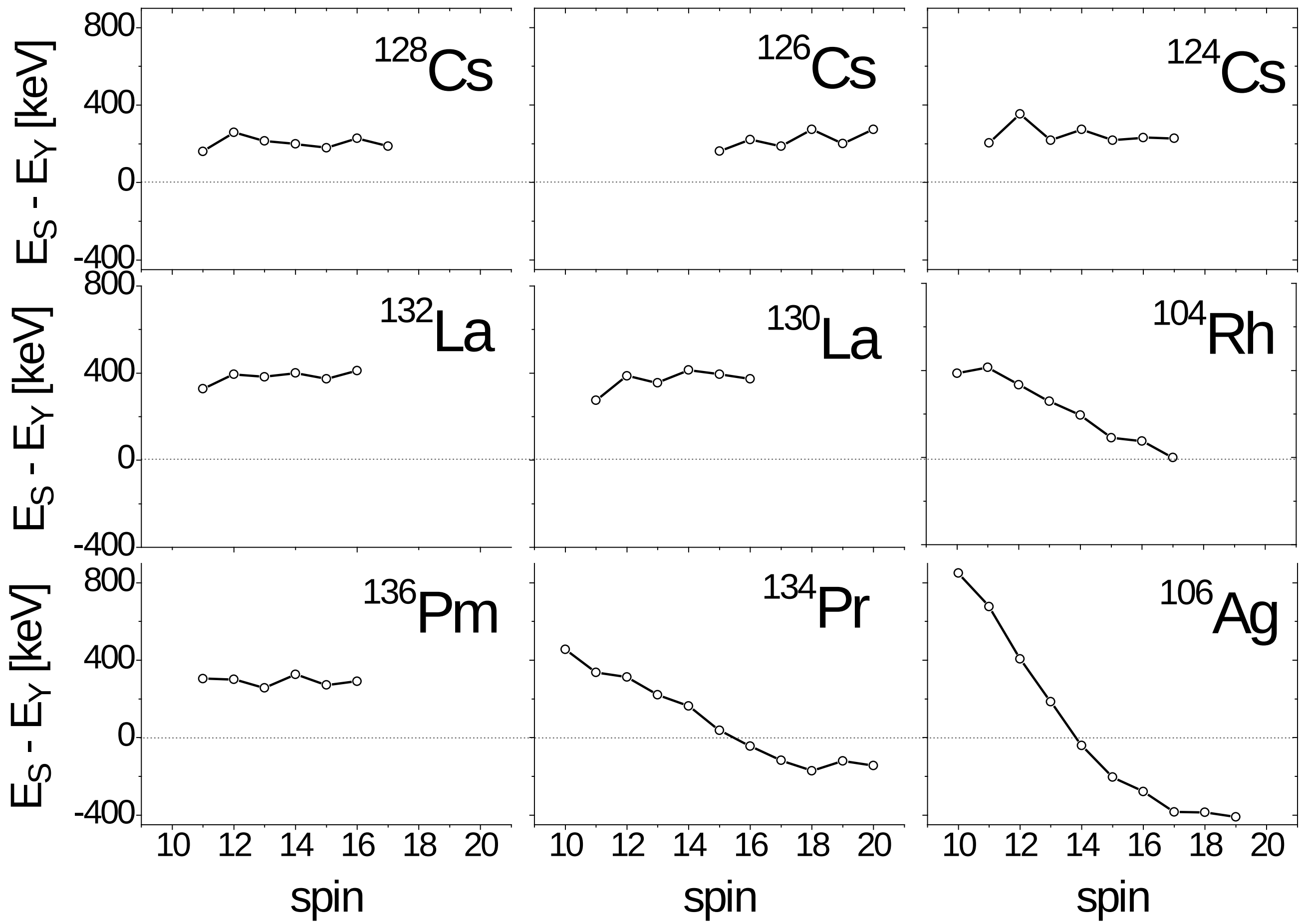
[1]E. Grodner, J. Srebrny, A. A. Pasternak, I. Zalewska, T. Morek, Ch. Droste, J. Mierzejewski, M. Kowalczyk, J. Kownacki, M. Kisieliński, S. G. Rohoziński, T. Koike, K. Starosta, A. Kordyasz, P. J. Napiorkowski, M. Wolińska-Cichocka, E. Ruchowska, W. Płóciennik, and J. Perkowski
128Cs as the Best Example Revealing Chiral Symmetry Breaking
Phys. Rev. Let. 97, 172501 (2006)

[2] E. Grodner, I. Sankowska, T. Morek, S.G. Rohozinski, Ch. Droste, J. Srebrny, A.A. Pasternak, M. Kisielinski, M. Kowalczyk, J. Kownacki, J. Mierzejewski, A. Krol, K. Wrzosek
Partner bands of 126Cs - first observation of chiral electromagnetic selection rules
Physics Letters B submitted.

Energy diference between side(Es) and yrast (Ey) chiral band levels



E. Grodner, ***Quest for the chiral symmetry breaking in atomic nuclei***
Acta Physica Polonica B39 (2008) 531

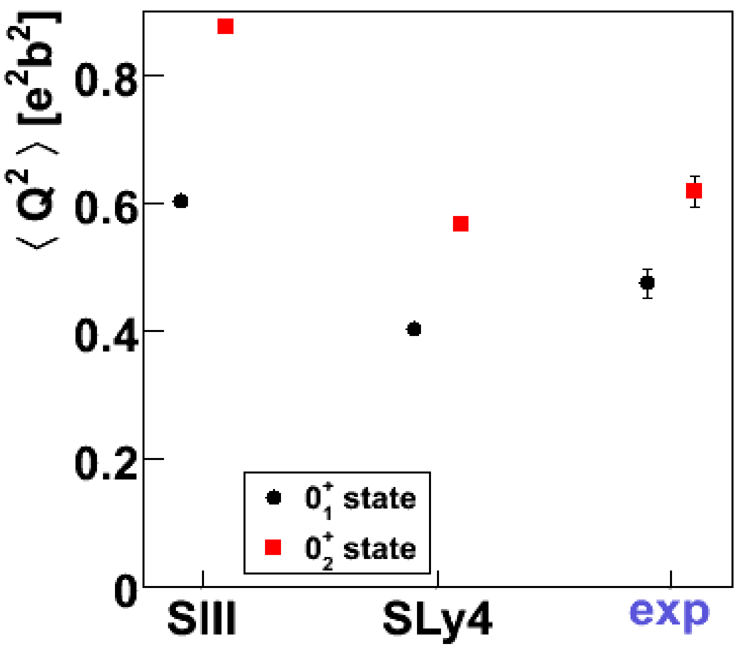
COULEX as a good test of microscopic theory

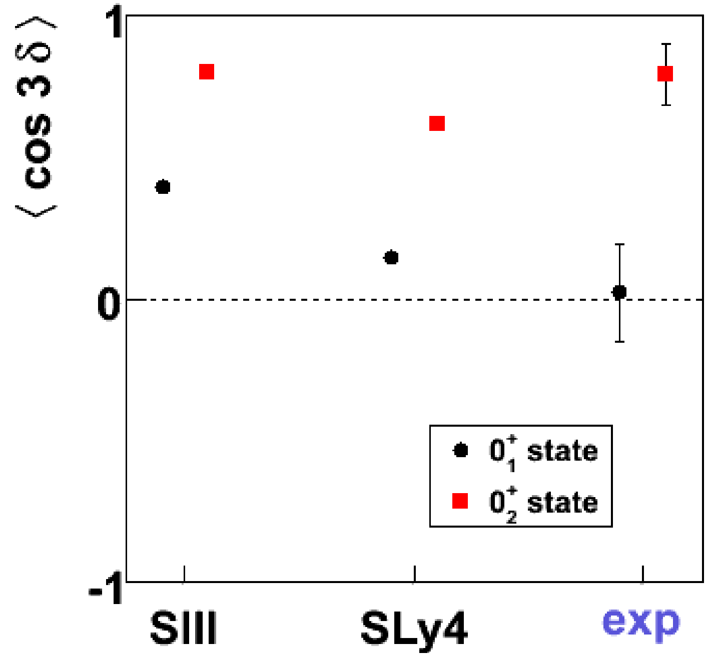
Katarzyna Wrzosek-Lipska – Kazimierz 2010

Quadrupole deformation parameters of ^{100}Mo: exp vs theory

General quadrupole collective Bohr Hamiltonian calculations

L. Próchniak Int. J. Mod. Phys. E19 (2010) 705,
L. Próchniak, S. G. Rohoziński, J. Phys. G: Nucl. Part. 36 (2009) 123101





triaxial

GBH calculations with the **SLy4** variant of Skyrme interaction indicate **better agreement** with experimentally obtained quadrupole deformation parameters.

K-isomers in even–even N=74 isotones.

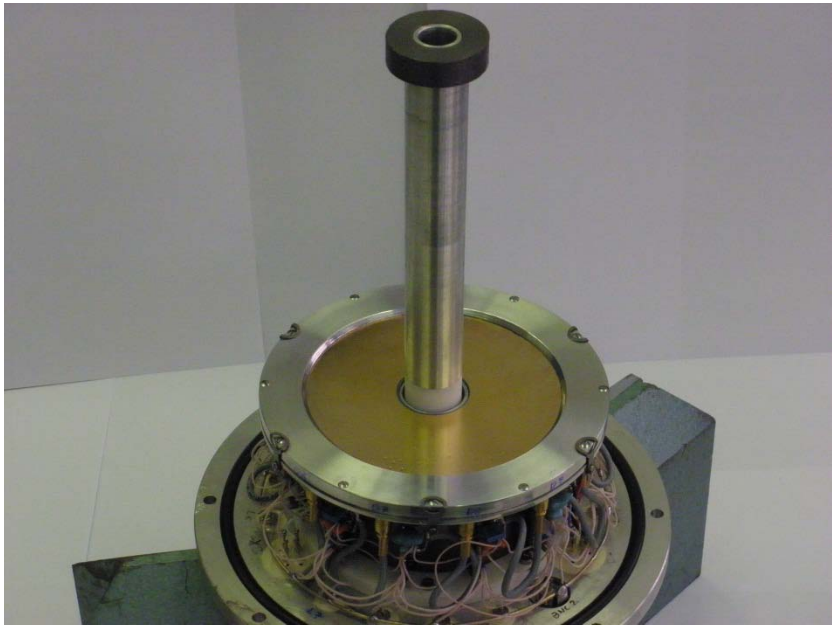
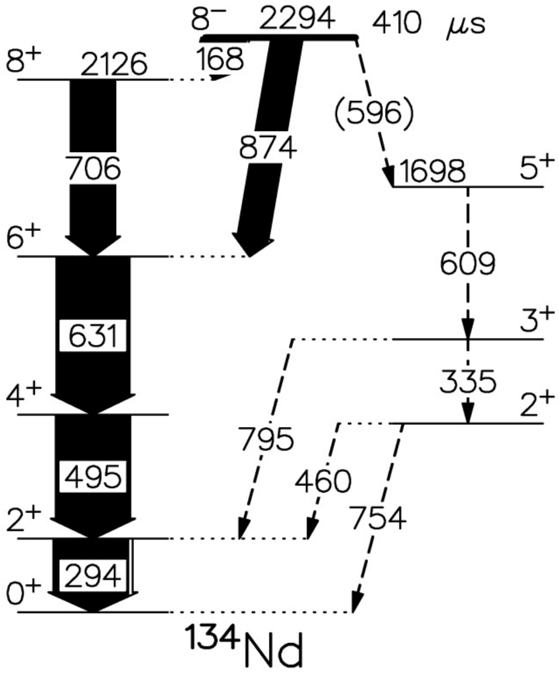


Figure 2. The detection part of the ICE spectrometer.
It is seen the new segmented detector Si(Li), electronic connections
and the lead absorber at the end of the aluminium tube used
for suppress the influence of gamma and X-rays generated in the target.

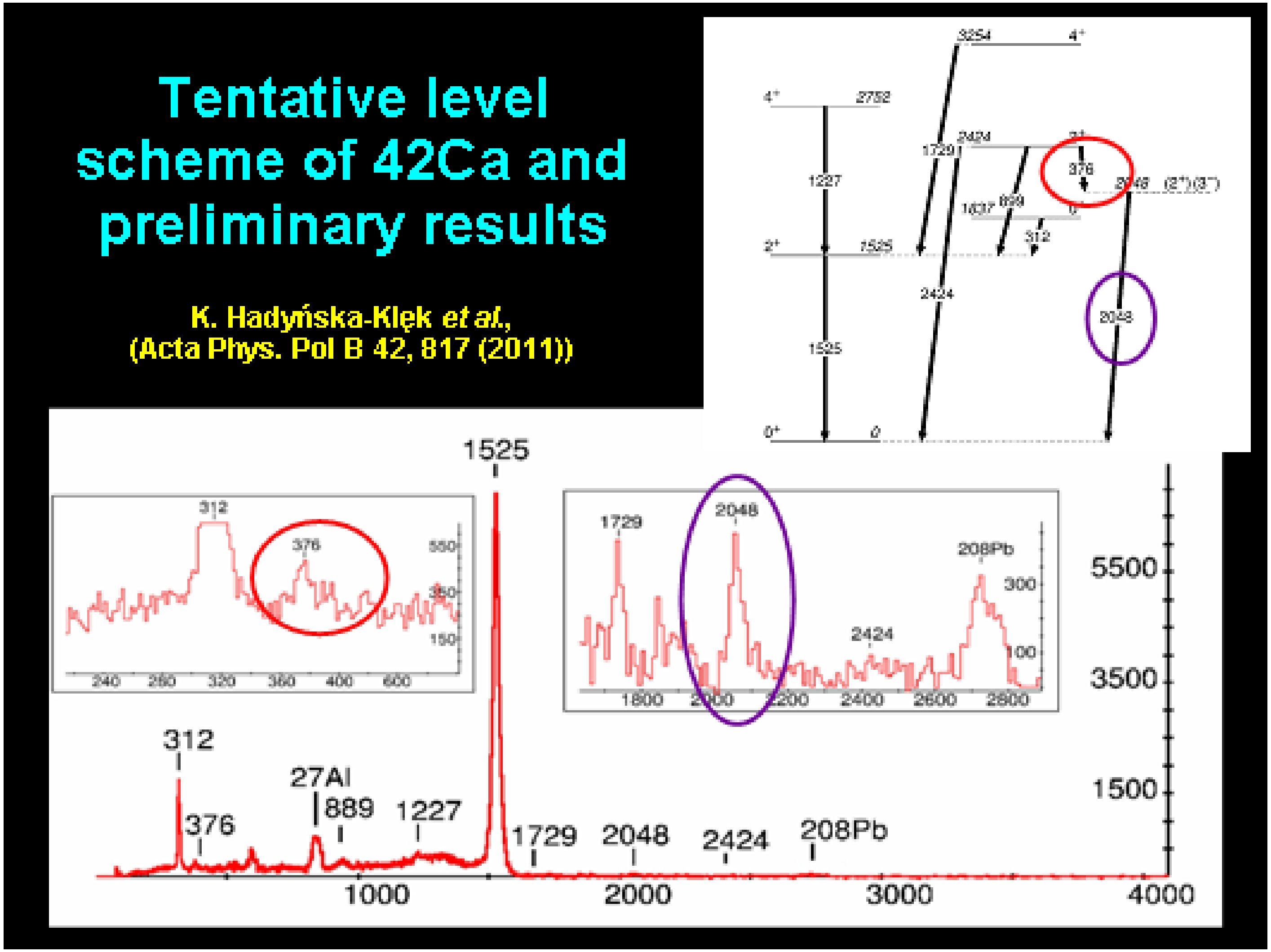


$^{16}O + ^{122}Te \rightarrow ^{134}Nd + 4n$ **$E(^{16}O) = 87$ MeV**

The first results from AGATA Demonstrator

experiment in HIL UW to establish a proper level scheme

posible B(E2) or B(E3) can be varied 10-100 times using various level scheme



SUMMARY

- **HIL UW is ready to mount Phase I - 70% HPGe + ACS detectors into EAGLE spectrometer**
- **Experiments on beam of U-200P cyclotron will start October 2011**
- **Test runs on small efficiency EAGLE shown that many projects can be succesfuly performed**
  - DSAM for chirality search in ^{124}Cs
  - COULEX on ^{94}Zr and ^{104}Pd
  - γ-band population in the decay of K-isomers by e-γ and γ – γ measurements
  - Complete + InComplete Fusion reaction mechanism
- **Strong theoretical support by Warsaw and Lublin team increase our understanding and interpretation of the experimental results**

EAGLE - 20-30 HpGe ACS,

U200P cyclotron energy 10 MeV x A ions from ^{10}B to ^{40}Ar, probably also ^{78}Kr

80% 4Π Si- Ball, Munich COULEX chamber, Łódź 12 Si(Li) electron spectrometer,

Koln - Bucharest PLUNGER, INNERBALL 60 BaF2 ,

- Shape dynamics and coexistence study by COULEX — P. Napiorkowski
- Chirality, a new dynamical parameter important to understand the structure of odd-odd nuclei — E. Grodner
- K-isomer electromagnetic excitation and decay: test of K-quantum number conservation weakening of the K-forbideness due to the triaxiality — J. Perkowski
- CF + ICF reaction mechanism, Entry state depopulation, multiplicity and sum energy, structures in the continuum, side-feeding model for DSAM — J. Mierzejewski
- Digital electronics — M. Kowalczyk

Collaboration members

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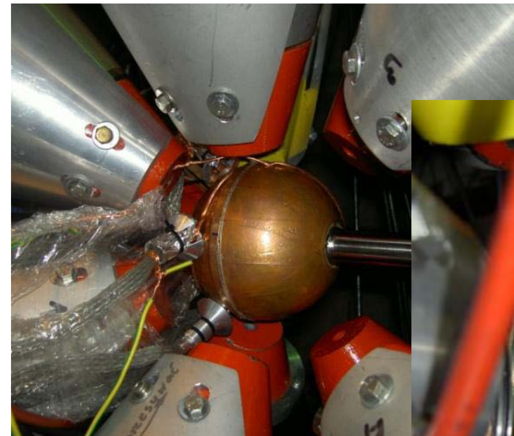
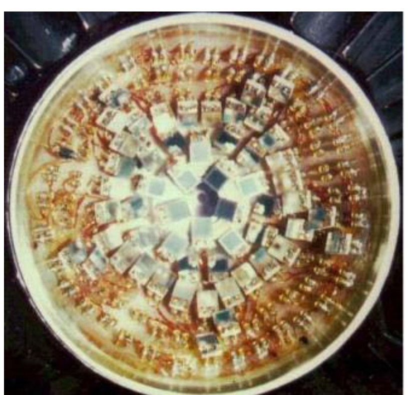
20 Institute of Nuclear Research (ATOMKI), Debrecen, Hungary

„Komora Monachijska”

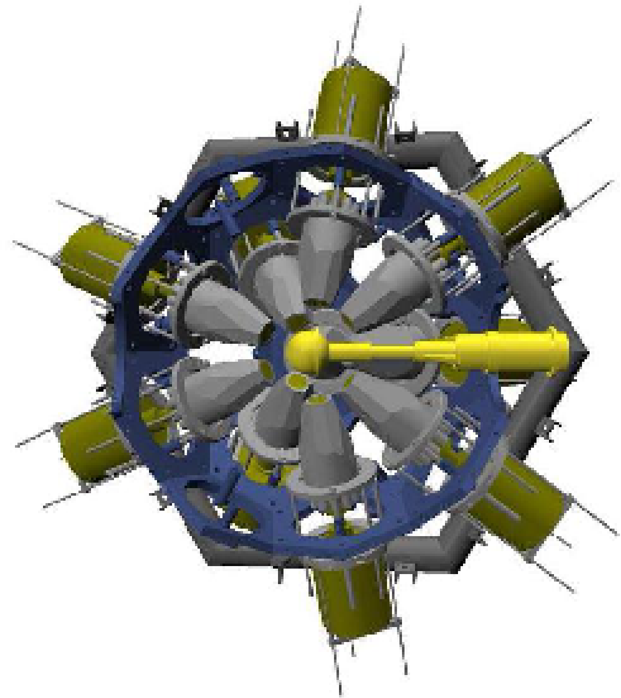


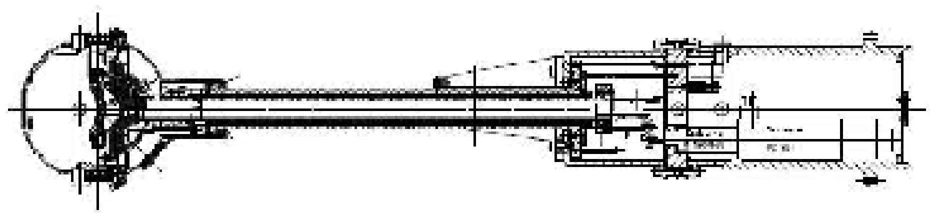
- tarczowa komora rozproszeń
- średnica 10 cm
- wewnątrz można umieścid do 110 P-i-N-diod ustawionych pod kątami wstecznymi (aktualnie używane 48)
- diody P-i-N o powierzchni 5x5 mm^2
- zakres kątów 110° ÷ 170°



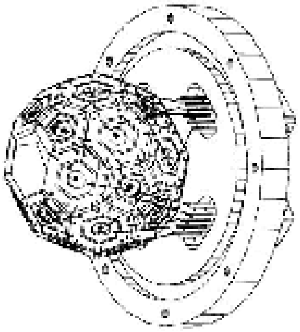
Plunger

- Stosowany do pomiaru pikosekundowych czasów życia metodą RDM
- Zapewnia równoległe ustawienie tarczy i stopera oraz regulację odległości między nimi

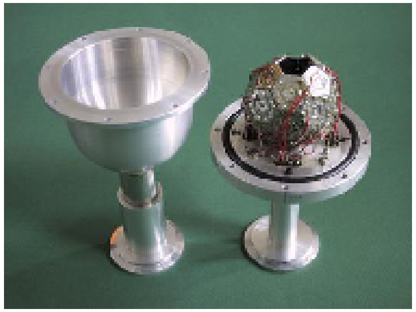


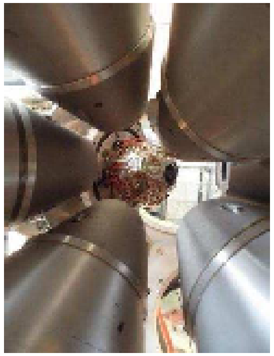


Silicon Ball



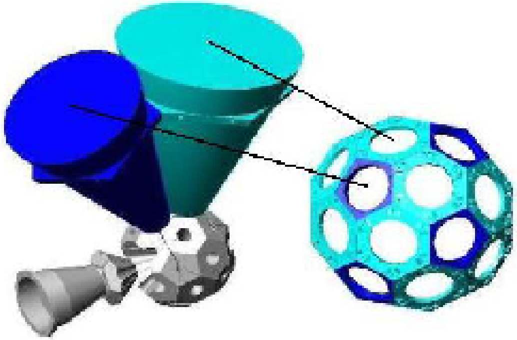
- Dwudziestościan ścięty o średnicy 5 cm
- 30 cienkich (100 μm) detektorów epitaksjalnych na grubej podkładce Si
- Wydajność ok. 90%
- Detektor cząstek naładowanych – rozróżnia protony od cząstek α
- Pracuje w temperaturze pokojowej
- Z_{Si} = 14, energia potrzebna do kreacji pary elektron dziura 3.7eV

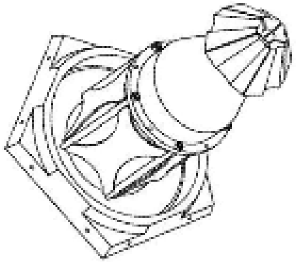


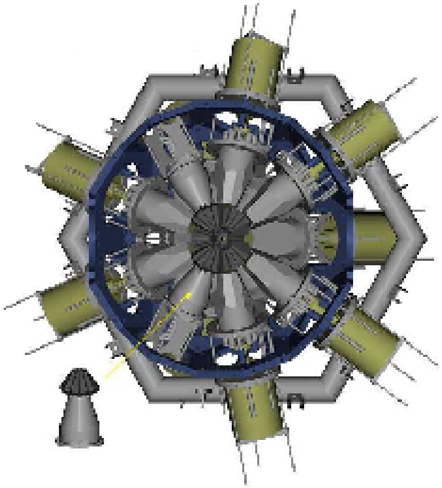


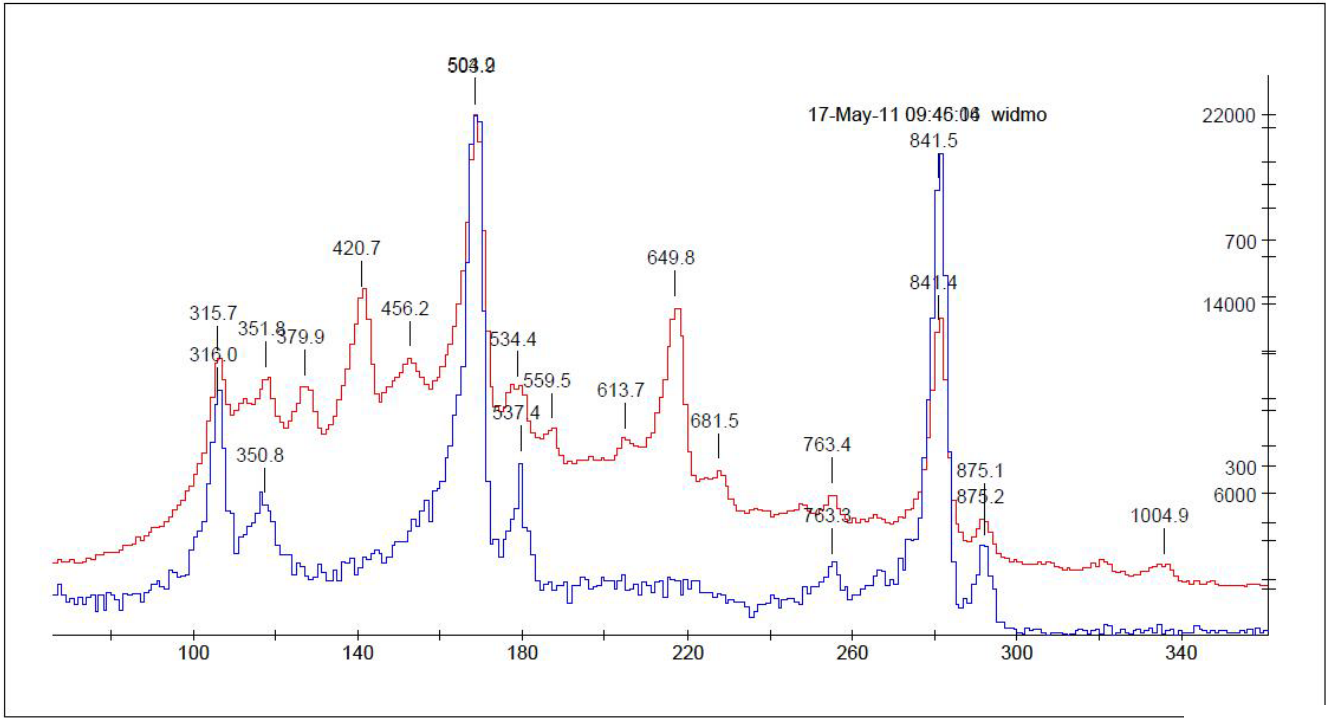
Filtry krotności BaF_2

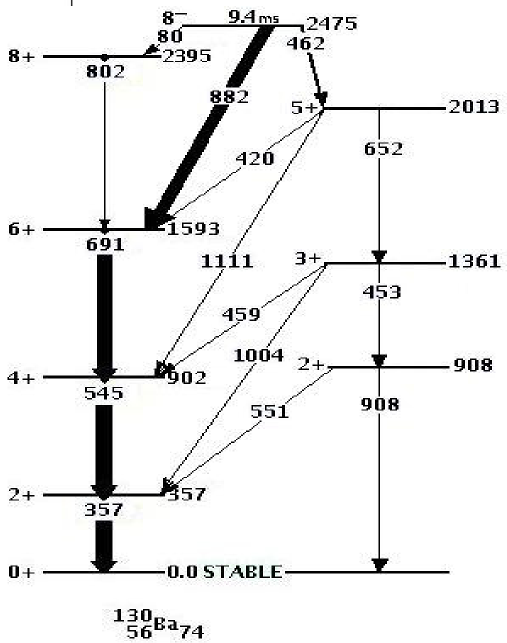
- Do badania jąder o dużej energii wzbudzenia (rzędu 10-20 MeV, duża gęstość poziomów)
- Badanie krotności i sumy energii kaskad promieniowania gamma
- Czas relaksacji szybka 0.6ns, wolna 620 ns
- Wymuszają geometrię układu











pełne widmo elektronów, elektrony w koincydencji z 691 keV

energia elektronów konwersji wewnętrznej

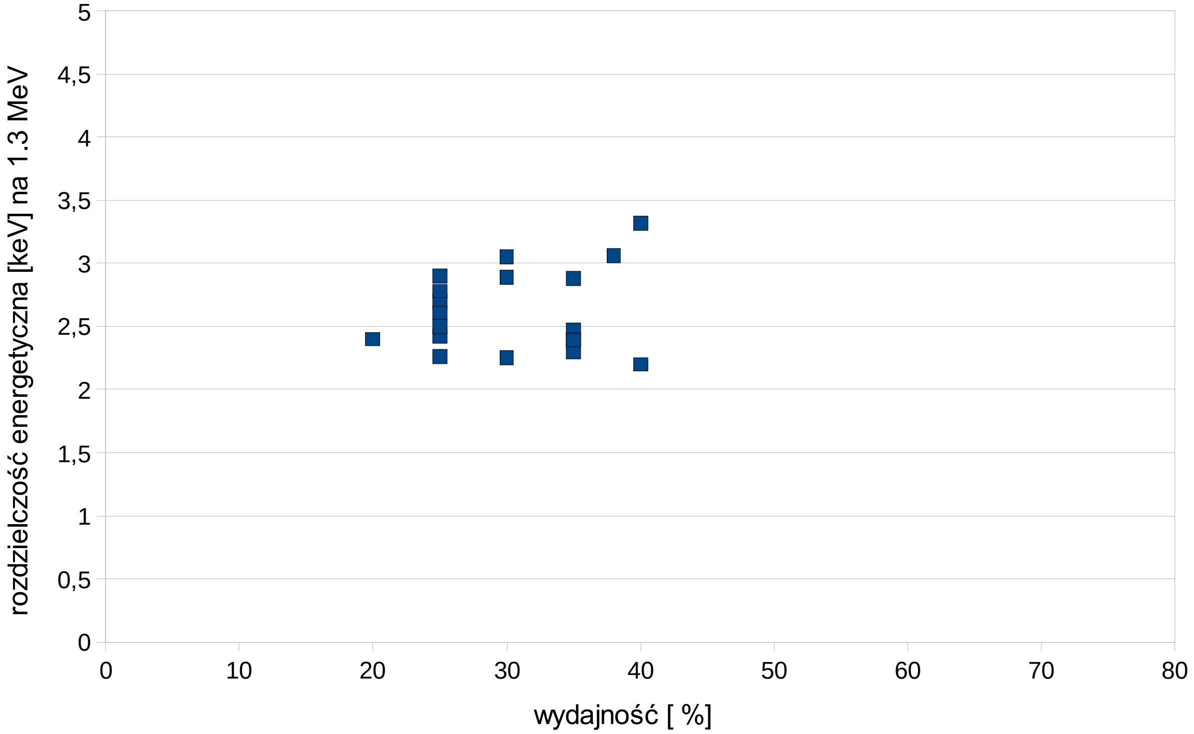
$$E_{en} = E\gamma - E_n$$

oznaczenie orbity elektronowej n = K,L,M,…..

E_K = 40 keV, E_L = 7 keV

nowe detektory Ge w liczbie 20 pozwolą zwiększyć wydajność:

- single   ok.. 4 razy
- double ok.. 10 razy



Scientific program of EAGLE campaign on beams of U200P cyclotron at Heavy Ion Laboratory, University of Warsaw

Julian Srebrny on behalf of the EAGLE collaboration

European GAMMAPOOL Workshop, Paris May 29, 2008