



Adam Maj
IFJ PAN Krakow

IFJ PAN and ELI-NP: Ongoing and planned collaborations



MoU between IFJ PAN and ELI-NP was signed in 2014

Memorandum of Scientific Collaboration
on the implementation of the
Extreme Light Infrastructure – Nuclear Physics (ELI-NP) Project
between
“Horia Hulubei” National Institute of Physics and Nuclear
Engineering, Romania
and
Henryk Niewodniczanski Institute of Nuclear Physics Polish
Academy of Sciences (IFJ PAN), Poland

SIGNATURES

IFIN-HH/ELI-NP



Prof. Nicolae Victor Zamfir, Director

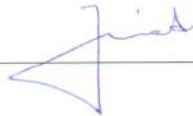


Dr Ovidiu Tesileanu MoU Responsible

30.04.2014

Date

IFJ PAN



The Henryk Niewodniczanski
INSTITUTE OF NUCLEAR PHYSICS
POLISH ACADEMY OF SCIENCES
ul. Radzikowskiego 152
31-342 KRAKÓW, POLAND

Prof. Marek Jezabek, Director General



Prof. Adam Maj MoU Responsible

5.5.2014

Date

3. Areas of cooperation

The undersigned parties agree to cooperate on research topics relevant for the ELI-NP project, for:

- developing the ELI-NP experimental areas;
- defining the experimental programme;
- developing instrumentation;
- training high-skilled human resources in the field;
- promoting ELI-NP as an international user facility.

The signatory parties can customize their relationship so that cooperation may include other areas found necessary for maximizing the success of ELI-NP implementation.

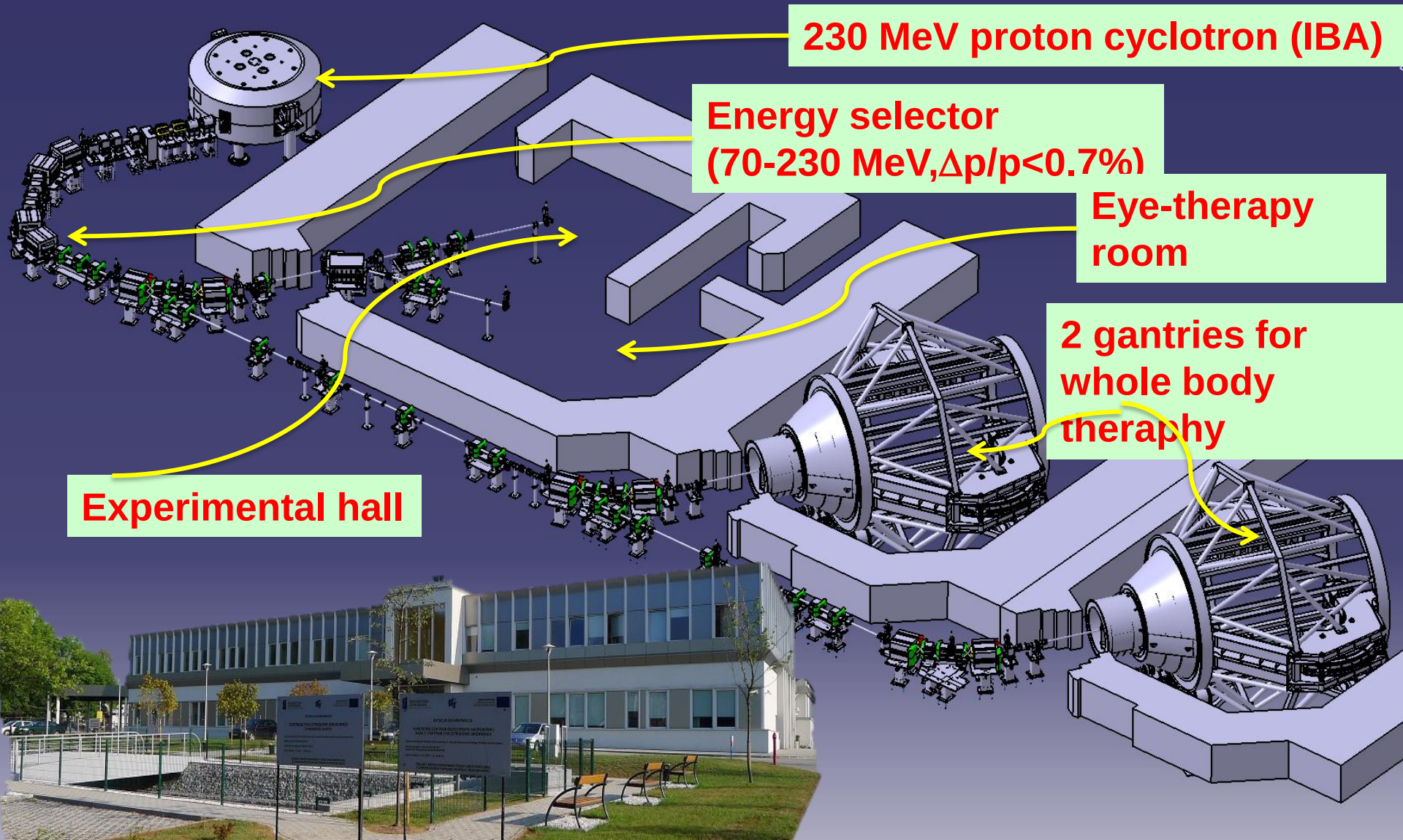
Research at CBB@IFJ-PAN:

**Areas of common interest
and instrumentation**



Cyclotron Center Bronowice

Institute of Nuclear Physics Polish Academy of Sciences Krakow, Poland



CCB - International Advisory Committee

- Faical Azaiez (IPN, Orsay, France)
- Angela Bracco (University of Milano and INFN, Italy)
- Bogdan Fornal (IFJ PAN, Kraków, Poland) - co-chair
- Zsolt Fulop (ATOMKI, Debrecen, Hungary)
- Muhsin Harakeh (KVI, Groningen, Netherlands) - chair
- Robert Janssens (Argonne National Laboratory, USA)
- Stanisław Kistryn (Jagiellonian University, Kraków, Poland)
- Marek Lewitowicz (GANIL, Caen, France)
- Adam Maj (IFJ PAN, Kraków, Poland)
- Krzysztof Rusek (Warsaw University, Poland)
- Hideyuki Sakai (RIKEN, Japan)
- Nicolae Victor Zamfir (IFIN-HH, Bucharest, Romania) (until 2022)
- Wiktor Zipper (University of Silesia, Katowice, Poland)

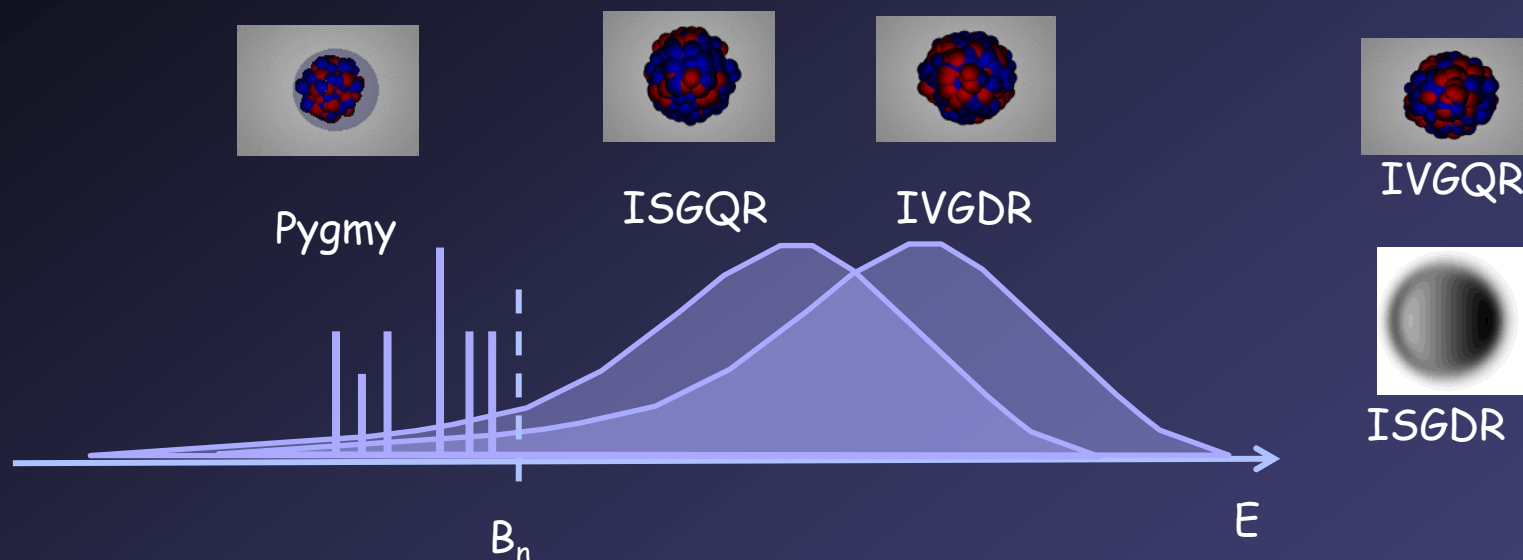
Since 2012 IAC meets once a year (end of August), evaluates submitted experimental proposals and give recommendations



Physics program recommended by IAC

- **Gamma decay from high-lying states and giant resonances excited via $(p,p'\gamma)$**
- **Study of M4 stretched configuration decay in light nuclei**
- Dynamics of few-nucleon systems
- Investigation of the mechanism of proton-induced fission and spallation
- Characterisation of novel detectors with high-energy protons
- Investigation of gamma emission in experimental modelling of hadron therapy

Collective excitations (excited by protons and gammas)



„pygmy“ states - PDR
(Pygmy Dipole Resonance)
- Soft Dipole Mode
- low-lying dipole strength

ISGQR
(Giant
Quadrupole
Resonance)

IVGDR
(Giant
Dipole
Resonance)

GR: - proton and neutron oscillations
- superposition of particle-hole excitations

GDR, GQR γ decay: $\sim 10^{-3} - 10^{-4}$

CCB: Large reaction chamber (with entrances for gamma detectors)



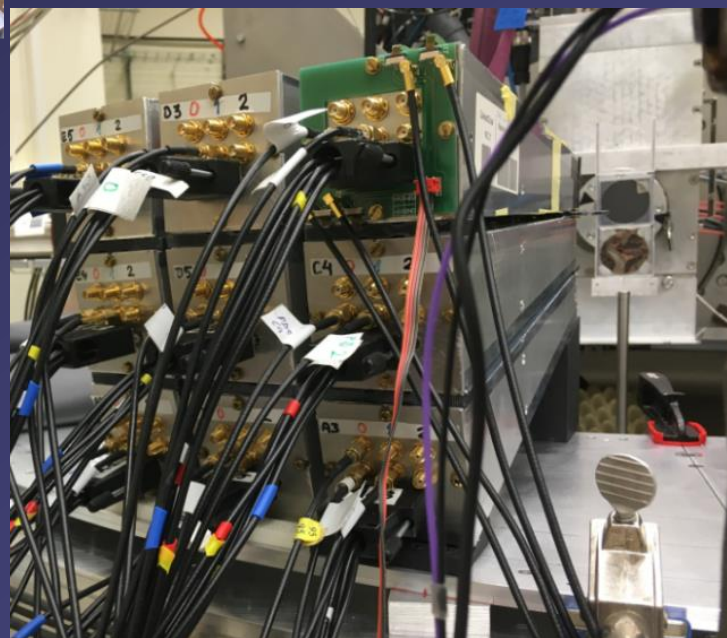
4 large volume LaBr_3 (3.5"x8") detectors and

2 **PARIS** clusters:
9 $\text{LaBr}_3 + \text{NaI}$
9 $\text{CeBr}_3 + \text{NaI}$
phoswiches



- KRATTA charge particle array (for protons up to 250 MeV)
 - Set of DSSSD for low energy charged particles
- inside the chamber - in the vacuum

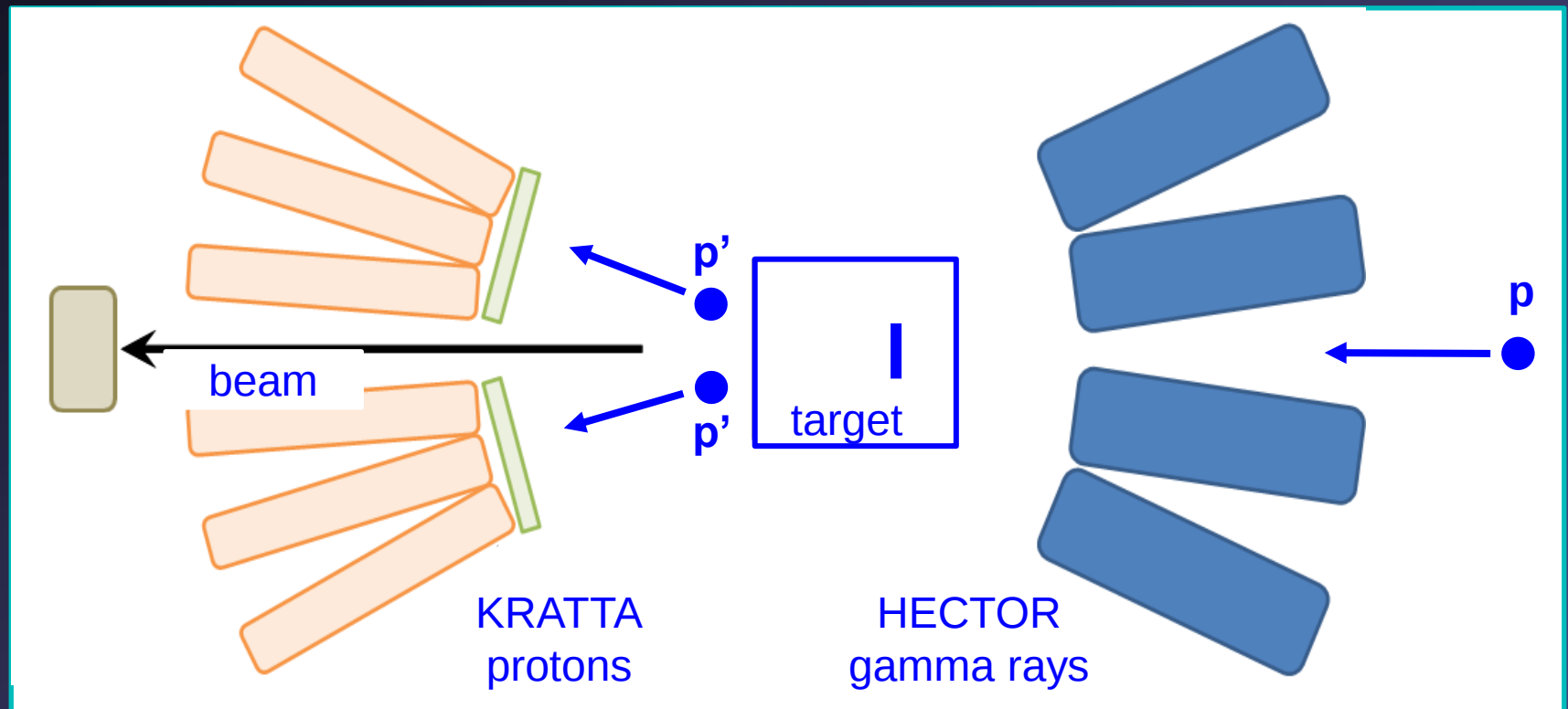
Gamma detectors (LaBr_3 , PARIS)
Outside the vacuum, mounted using holders / cylindrical pockets



Idea of the experiments at CCB with **protons**

proton beam from the CCB Krakow cyclotron used for medical treatment

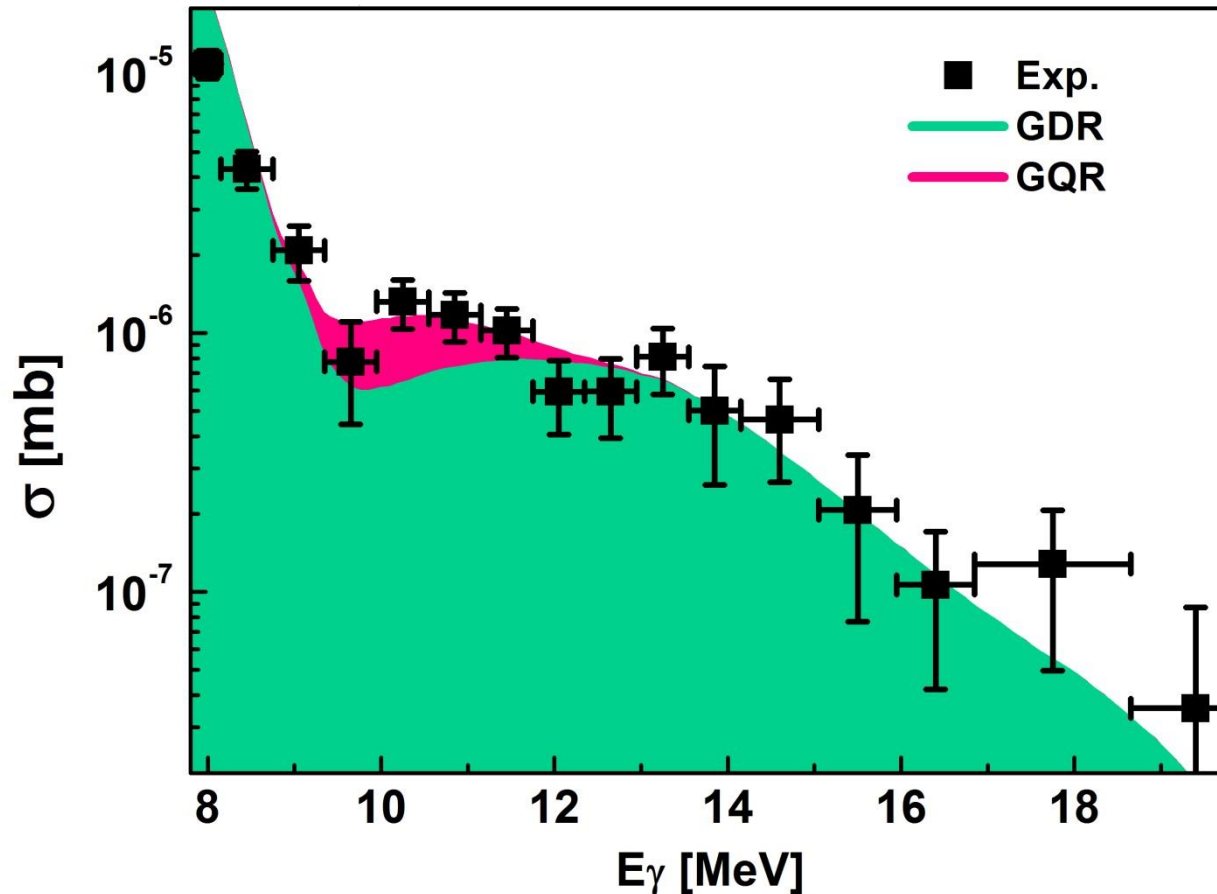
p @ 85 MeV on ^{208}Pb target 48 μm (54.5 mg/cm^2) thick



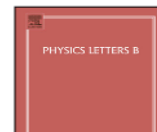
coincidence measurement of gamma rays and scattered protons

**γ decay to the ground state from the excitations above the neutron threshold
in the $^{208}\text{Pb}(p, p'\gamma)$ reaction at 85 MeV**

B. Wasilewska,¹ M. Kmiecik^{1,*} M. Ciemała,¹ A. Maj,¹ F. C. L. Crespi,^{2,3} A. Bracco,^{2,3} M. N. Harakeh,⁴ P. Bednarczyk,¹ S. Bottoni,^{2,3} S. Brambilla,³ F. Camera,^{2,3} I. Ciepał,¹ N. Cieplicka-Oryńczak,¹ M. Csátos,⁵ B. Fornal,¹ V. Gaudilla,⁶ J. Grębosz,¹ J. Isaak,⁷ Ł. W. Iskra,^{1,3} M. Jeżabek,¹ A. J. Krasznahorkay,⁵ S. Kihel,⁸ M. Krzysiek,¹ P. Lasko,¹ S. Leoni,^{2,3} M. Lewitowicz,⁹ J. Łukasik,¹ M. Matejska-Minda,¹ K. Mazurek,¹ P. J. Napiorkowski,¹⁰ W. Parol,¹ P. Pawłowski,¹ L. Q. Qi,¹¹ M. Saxena,¹⁰ Ch. Schmitt,⁸ Y. Sobolev,¹² B. Sowicki,¹ M. Stanoiu,¹³ A. Tamii,¹⁴ O. Wieland,³ and M. Ziębliński¹



**Papers from the
experiments
in CBB**



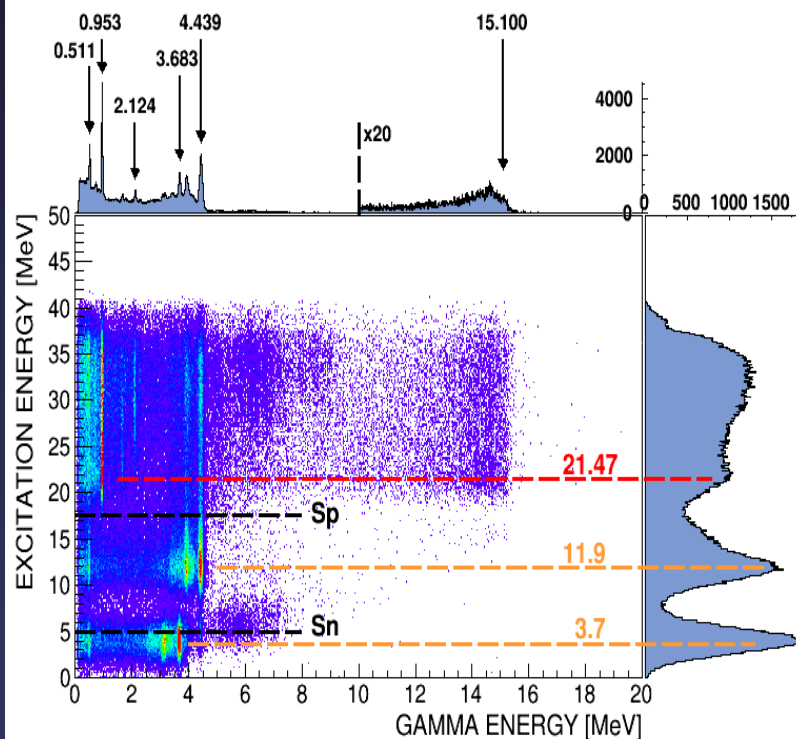
**^{13}C target made of 10 foils in separate frames,
total thickness 1 mg/cm²**

(Nicoleta Florea, Nicu Marginean IFIN-HH, Bucharest, Romania)



The decay of the 21.47-MeV stretched resonance in ^{13}C : A precise probe of the open nuclear quantum system description

N. Cieplicka-Oryńczak^{a,*}, Y. Jaganathan^{a,i}, B. Fornal^a, S. Leoni^b, M. Płoszajczak^c,
M. Ciemala^a, S. Ziliani^b, M. Kmiecik^a, A. Maj^a, J. Łukasik^a, P. Pawłowski^a, B. Sowicki^a,
B. Wasilewska^a, M. Ziębliński^a, P. Bednarczyk^a, C. Boiano^b, S. Bottoni^b, A. Bracco^b,
S. Brambilla^b, I. Burducea^e, F. Camera^b, I. Ciepał^a, C. Clisu^e, F.C.L. Crespi^b,
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Ł.W. Iskra^a, M. Krzysiek^a, P. Kulesa^f, N. Marginean^e, R. Marginean^e, I. Matea^g,
M. Matejska-Minda^a, K. Mazurek^a, B. Million^b, W. Parol^a, M. Sferrazza^h, L. Stan^e,
B. Włoch^a

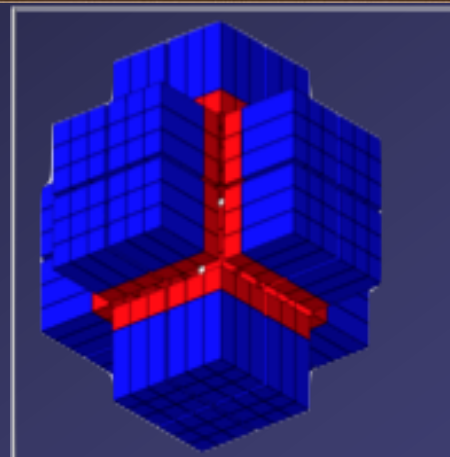
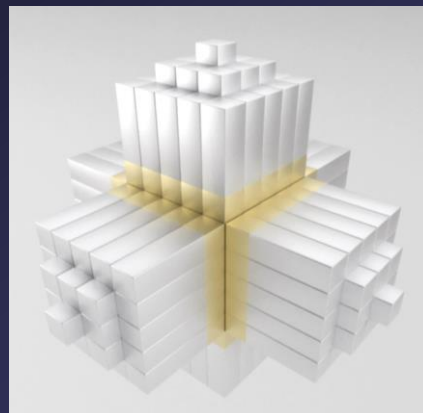
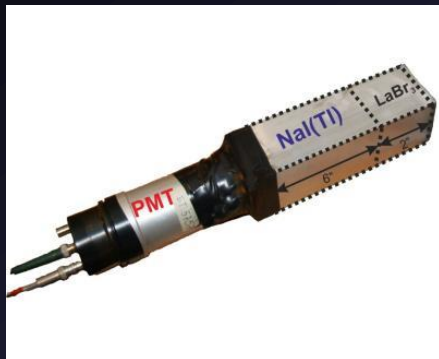


**Papers from the
experiments
in CBB**

PARIS array: clusters of 9 phoswich Labr3/CeBr3-NaI detectors



PHOTON ARRAY FOR STUDIES WITH RADIOACTIVE ION AND STABLE BEAMS



PARIS MoU:

IN2P3 (France),

COPIN (Poland),

GANIL/SPIRAL2 (France), INFN (Italy),

TIFR/BARC/VECC (India),

IFIN HH (Romania),

UK, Turkey,

GSI (Germany)

PARIS Steering Committee

(representing the parties in the PARIS MoU)

Marek Lewitowicz (GANIL, France) - Chair

Bogdan Fornal (COPIN, Poland) - Vice-Chair

Angela Bracco (INFN, Italy)

Wilton Catford (UK)

Oliver Dorvaux (IN2P3, France)

Sefa Ertuerk (Turkey)

Juergen Gerl (GSI/FAIR, Germany)

Vandana Nanal (India)

Mihai Stanoiu (Romania)

Adam Maj (Krakow)

PARIS Project Manager

Research at ELI-NP/IFIN-HH:

**Areas of common interest
and instrumentation**

Shape Coexistence at Zero Spin in ^{64}Ni Driven by the Monopole Tensor Interaction

N. Mărginean^{1,*}, D. Little,^{2,3} Y. Tsunoda,⁴ S. Leoni^{5,6,†}, R. V. F. Janssens^{2,3,‡}, B. Fornal^{7,§}, T. Otsuka^{8,9,10,||}, C. Michelagnoli,¹¹ L. Stan,¹ F. C. L. Crespi,^{5,6} C. Costache,¹ R. Lica,¹ M. Sferrazza,¹² A. Turturica,¹ A. D. Ayangeakaa,¹³ K. Auranen,^{14,¶} M. Barani,^{5,6,11} P. C. Bender,¹⁵ S. Bottoni,^{5,6} M. Boromiza,¹ A. Bracco,^{5,6} S. Călinescu,¹ C. M. Campbell,¹⁶ M. P. Carpenter,¹⁴ P. Chowdhury,¹⁵ M. Ciemała,⁷ N. Cieplicka-Oryńczak,⁷ D. Cline,¹⁷ C. Clisu,¹ H. L. Crawford,¹⁶ I. E. Dinescu,¹ J. Dudouet,¹⁸ D. Filipescu,¹ N. Florea,¹ A. M. Forney,¹⁹ S. Fracassetti,^{5,6,**} A. Gade,^{20,21} I. Gheorghe,¹ A. B. Hayes,²² I. Harca,¹ J. Henderson,²³ A. Ionescu,¹ Ł. W. Iskra,⁶ M. Jentschel,¹¹ F. Kandzia,¹¹ Y. H. Kim,¹¹ F. G. Kondev,¹⁴ G. Korschinek,²⁴ U. Köster,¹¹ Krishichayan,³ M. Krzysiek,⁷ T. Lauritsen,¹⁴ J. Li,^{14,††} R. Mărginean,¹ E. A. Mauger,²⁵ C. Mihai,¹ R. E. Mihai,¹ A. Mitu,¹ P. Mutti,¹¹ A. Negreț,¹ C. R. Niță,¹ A. Olăcel,¹ A. Oprea,¹ S. Pascu,¹ C. Petrone,¹ C. Porzio,^{5,6} D. Rhodes,^{20,21} D. Seweryniak,¹⁴ D. Schumann,²⁵ C. Sotty,¹ S. M. Stolze,¹⁴ R. Șuvăilă,¹ S. Toma,¹ S. Ujenuic,¹ W. B. Walters,¹⁹ C. Y. Wu,²³ J. Wu,¹⁴ S. Zhu,²² and S. Ziliani^{5,6}

Papers from the
experiments
in IFIN-HH

 PRL **118**, 162502 (2017)

PHYSICAL REVIEW LETTERS

 week ending
21 APRIL 2017


Multifaceted Quadruplet of Low-Lying Spin-Zero States in ^{66}Ni : Emergence of Shape Isomerism in Light Nuclei

S. Leoni,^{1,2,*} B. Fornal,³ N. Mărginean,⁴ M. Sferrazza,⁵ Y. Tsunoda,⁶ T. Otsuka,^{6,7,8,9} G. Bocchi,^{1,2} F. C. L. Crespi,^{1,2} A. Bracco,^{1,2} S. Aydin,¹⁰ M. Boromiza,^{4,11} D. Bucurescu,⁴ N. Cieplicka-Oryńczak,^{2,3} C. Costache,⁴ S. Călinescu,⁴ N. Florea,⁴ D. G. Ghiță,⁴ T. Glodariu,⁴ A. Ionescu,^{4,11} Ł. W. Iskra,³ M. Krzysiek,³ R. Mărginean,⁴ C. Mihai,⁴ R. E. Mihai,⁴ A. Mitu,⁴ A. Negreț,⁴ C. R. Niță,⁴ A. Olăcel,⁴ A. Oprea,⁴ S. Pascu,⁴ P. Petkov,⁴ C. Petrone,⁴ G. Porzio,^{1,2} A. Șerban,^{4,11} C. Sotty,⁴ L. Stan,⁴ I. Știru,⁴ L. Stroe,⁴ R. Șuvăilă,⁴ S. Toma,⁴ A. Turturica,⁴ S. Ujenuic,⁴ and C. A. Ur¹²

Vol. 50 (2019)

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No 3

PHOTONEUTRON CROSS-SECTION MEASUREMENTS FOR ^{165}Ho BY THE DIRECT NEUTRON-MULTIPLICITY SORTING AT NEWSUBARU*

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D.M. FILIPESCU^{b,d}, T. RENSTRÖM^e, G.M. TVETEN^e, S. BELYSHEV^f,
K. STOPANI^g, H. WANG^h, G. FAN^h, Y.-W. LUIⁱ, D. SYMOCHKO^j,
S. GORIELY^k, A.-C. LARSEN^e, S. SIEM^e, V. VARLAMOV^g,
B. ISHKHANOV^g, T. ARI-IZUMI^c, S. MIYAMOTO^l

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“Horia Hulubei” National Institute for Physics and Nuclear Engineering
077125 Măgurele, Romania

IFIN-HH

Proposal for the TANDEM accelerator
Eligant Rosphere Campaign of experiments 2022

Search for pygmy dipole strength in $^{58,60}\text{Ni}$ at finite temperature

A. Bracco¹, G. Benzoni¹, S. Bottoni¹, S. Brambilla¹, F. Camera¹, F. Crespi¹, E. Gamba¹,
S. Leoni¹, B. Million¹, O. Wieland
M. Ciemala², M. Kmiecik², A. Maj²,
N. Marginean³, D. Filipescu³, N. Florea³, C. Miha³, P.-A. Söderström³ et al.
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⁴ Lomonosov Moscow State University, Moscow, Russia

Study of the isospin symmetry in ^{72}Kr at low temperature

A. Bracco¹, G. Benzoni¹, S. Bottoni¹, S. Brambilla¹, F. Camera¹, F. Crespi¹, E. Gamba¹,
S. Leoni¹, B. Million¹, O. Wieland
M. Ciemala², M. Kmiecik², A. Maj²,
N. Marginean³, D. Filipescu³, N. Florea³, C. Miha³, P.-A. Söderström³ et al.
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² IFJ-PAN, Krakow, Poland

³ Horia Hulubei National Institute for Physics and Nuclear Engineering (IFIN-HH), Măgurele, Romania
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Understanding the nature of 0^+ states in ^{114}Sn

B. Fornal¹, N. Cieplicka-Orynczak¹, L. Iskra¹, M. Ciemala¹,
S. Leoni², A. Bracco², G. Bottoni², G. Benzoni², F. Camera², F. Crespi², M. Sferrazza³,
C. Michelagnoli⁴, G. Colombi^{4,1}
N. Marginean⁵, C. Mihai⁵, M. Boromiza⁵, C. Clisu-Stan⁵, C. Costache⁵, D. Filipescu⁵, N. Florea⁵,
I. Gheorghe⁵, A. Ionescu⁵, R. Lică⁵, R. Marginean⁵, R.E. Mihai⁵, C. Neacșu⁵, A. Negreș⁵, C.R. Niță⁵,
A. Olăcel-Coman⁵, S. Pascu⁵, L. Stan⁵, C. Sotty⁵, A. Turturică⁵, S. Ujeniuc⁵,
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⁶ University of Tokyo, Tokyo, Japan

Spokespersons: B. Fornal, S. Leoni, N. Marginean

Proposals for the
experiments in IFIN-HH:
Performed in 2022

Low-spin spectroscopy of ^{118}Sn with different probes

B. Fornal¹, M. Ciemala¹, P. Bednarczyk¹, N. Cieplicka-Orynczak¹, L. Iskra¹, M. Kmiecik¹, A. Maj¹,
M. Matejska-Minda¹, S. Leoni^{2,3}, F. Crespi^{2,3}, A. Bracco^{2,3}, G. Benzon³, G. Bottoni^{2,3}, F. Camera^{2,3}, G. Ciconali^{2,3}, G. Corbari^{2,3},
B. Million³, O. Wieland³, N. Mărginean⁴, C. Mihai⁴, M. Boromiza⁴, C. Clisu-Stan⁴, C. Costache⁴, N. Florea⁴, D. Filipescu⁴, I. Gheorghe⁴,
R. Lica⁴, R. Mărginean⁴, R.E. Mihai⁴, C. Neacșu⁴, C.R. Niță⁴, A. Olăcel-Coman⁴, L. Stan⁴,
C. Sotty⁴, A. Turturică⁴, S. Ujenuic⁴,
M. Sferrazza⁵,
C. Michelagnoli⁶, G. Colombi^{6,2,3}, L. Domenichetti⁶,
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⁷ University of Tokyo, Tokyo, Japan

Spokespersons: B. Fornal, S. Leoni, N. Mărginean

Lifetime measurements in ^{84}Se to probe shape coexistence at N=50

M. Sferrazza¹, S. Bottoni², S. Leoni², B. Fornal³,
A. Bracco², G. Benzon², F. Camera², F. Crespi², C. Porzio², L. Iskra³, N. Cieplicka³,
N. Mărginean⁴, C. Mihai⁴, R. Borcea⁴, M. Boromiza⁴, S. Călinescu⁴, R. Mărginean⁴, R.E. Mihai⁴, C. Neacșu⁴,
D. Filipescu⁴, N. Florea⁴, I. Gheorghe⁴, A. Ionescu⁴, C. Clisu-Stan⁴, C. Costache⁴,
A. Negreț⁴, C.R. Niță⁴, A. Olăcel-Coman⁴, S. Pascu⁴, C. Petrone⁴, L. Stan⁴, C. Sotty⁴, A. Turturică⁴,
G. Turturică⁴, S. Toma⁴, S. Ujenuic⁴,
T. Otsuka⁵, Y. Tsunoda⁵,
C. Michelagnoli⁷, G. Colombi^{7,2}

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⁴ Horia Hulubei National Institute for Physics and Nuclear Engineering, Măgurele, Romania

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⁷ Institut Laue-Langevin (ILL), France

Gamma strength function measurements in $^{112,114}\text{Sn}$

P.-A. Söderström¹, M. Markova², R. Borcea³, M. Cucuic¹, A. Kuşoğlu¹, A.-C. Larsen²,
C. Mihai³, H. Pai¹, D. Testov¹, F. Camera⁴, M. Ciemala⁵, F. C. L. Crespi⁴, A. Giaz⁴,
L. Guardo⁶, J. Isaak⁷, M. Kmiecik⁵, D. Lattuada⁶, A. Maj⁵, B. Million⁴,
P. von Neumann-Cosel⁷, O. Wieland⁴

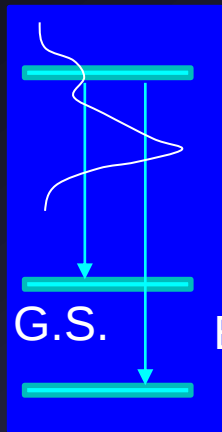
1. ELI-NP, Romania, 2. University of Oslo, Norway, 3. IFIN-HH, Romania,
4. INFN Milano and University of Milano, Italy, 5. IFJ PAN, Poland,
6. LNS Catania, Italy, 7. TU Darmstadt, Germany,

**Proposals for the
experiments in IFIN-HH:
To be performed in 2023**

IFJ PAN participations in the ELI-NP Working Group ELI-GANT

- Physics Cases

Measurement of the absolute values of $B(E1)$ and $B(M1)$ for $E^* \geq E_B$
Measurement of the absolute values of the neutron and γ branching ratio



Theory



PDR $\Rightarrow$ single-particle (non-collective) excitations
PDR $\Rightarrow$ collective states with mixed isoscalar/isovector

Experiments now



Experiments cannot pin down PDR microscopic structure

Experiments @ELI-NP



- Very similar γ -decays branch are measured in nearby nuclei provide indication of a PDR collective character



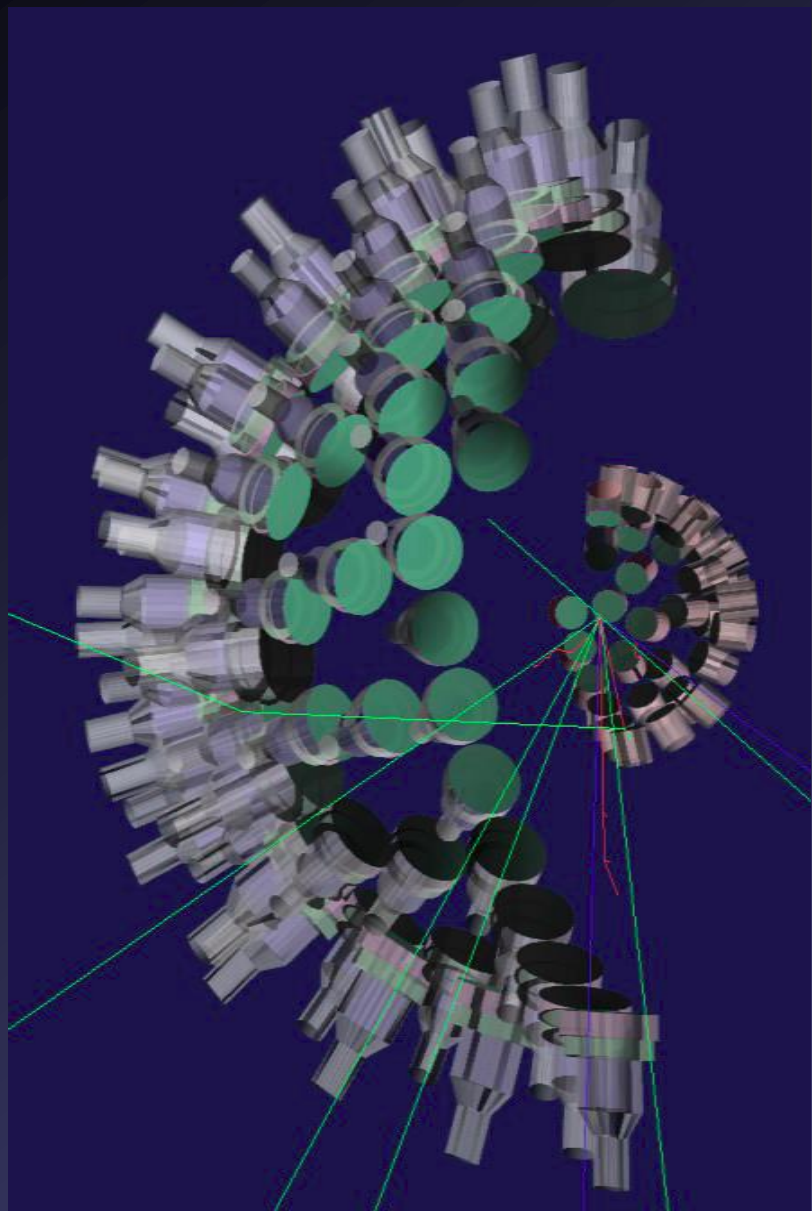
- EOS and neutron skin
Tunes theories for PDR in the r -process nucleosynthesis.



Polarization provides a very clean identification of E1/M1 decay as a function of E^*

IFJ PAN participation in the ELI-NP Working Group ELI-GANT

Experimental setup



15 $\text{LaBr}_3:\text{Ce}$ 3"x3" detectors

15 CeBr_3 3"x3" detectors

- Frontal and side absorbers

25 BC501A liquid scintillators

25 Lithium Glass scintillators

- Analog electronics

- Fast setup, cross checks, simple controls

- Some choices has to be done

- Digital electronics

- Fully funded – based on Caen 14 bits digitizers

- Measurements and test have to be done

**Research at CBB@IFJ-PAN
and ELI-NP/HH:**

**Perspective for increasing
common interest
and instrumentation**

- Common projects for exploration of the same nuclei for comparative studies of nuclear resonances (GDR, PDR) both with protons (CCB) and gammas (ELI-NP)
- Exchange and construction of novel instrumentation: Detectors (gamma, neutrons), electronics, ACQs,...
- Theoretical interpretations of nuclear resonances
- Common proposals for ELI-NP, CCB Krakow and elsewhere
- Participation in EU Project (*good examples: ENSAR2, EURO-LABS*)
- Exchange of students and post-doc's (*good example – dr. Mateusz Krzysiek*)



Participants of the collaborating teams

IFJ PAN:

B. Fornal, N. Cieplicka-Oryńczak, Ł. Iskra, M. Krzysiek,
M. Ciemała, M. Kmiecik, A. Maj
et al.

ELI-NP/IFIN-HH:

N. Marginean, C. Ur, D. Balabanski, M. Stanoiu, C. Mihai,
P.-A. Sodestroem, D. Filipescu, R. Marginean, O. Tesileanu
et al.