UNIVERSITY OF WARSAW

HIL

Heavy Ion Laboratory at the University of Warsaw

PhD Opportunities

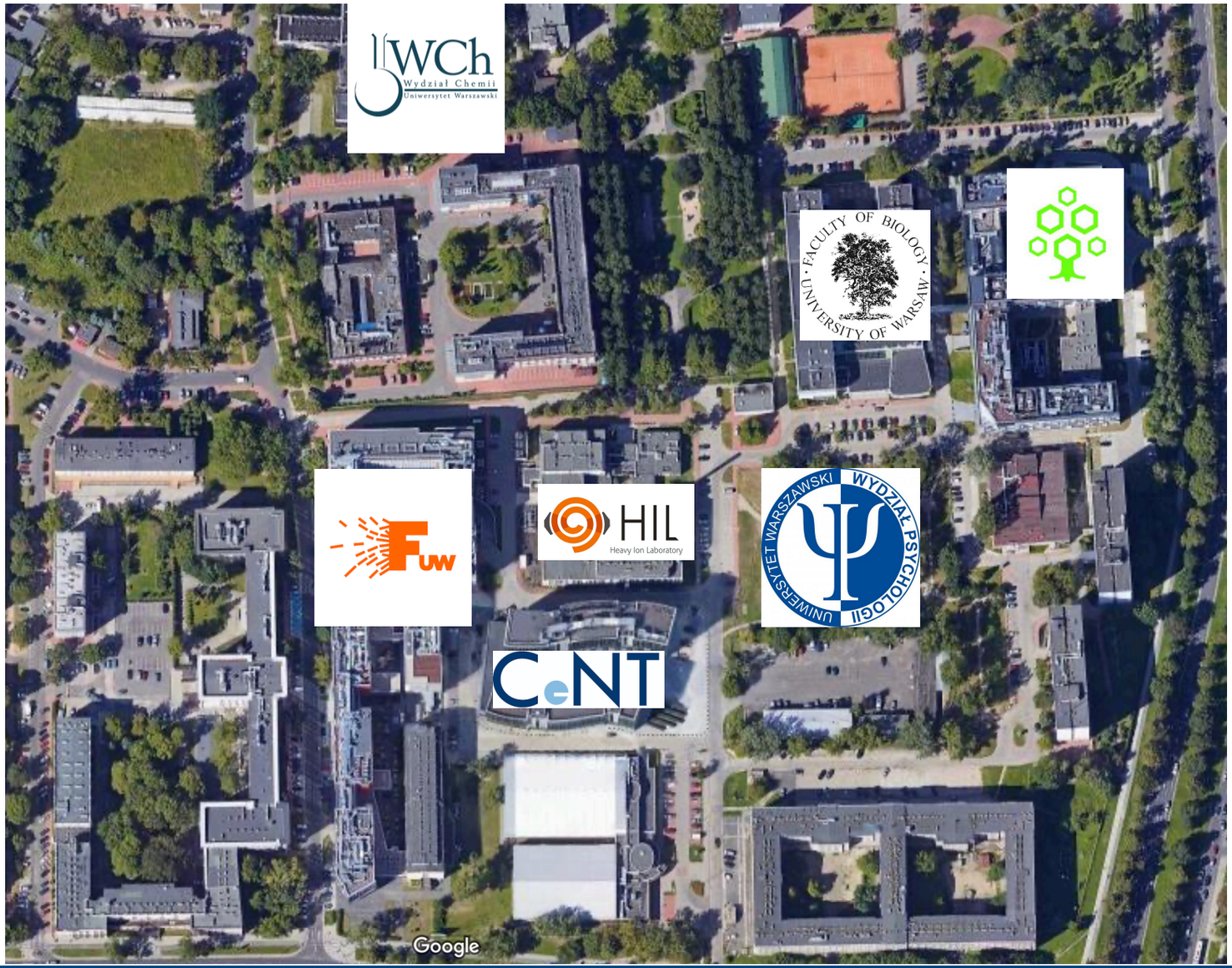
Paweł J. Napiorkowski

Heavy Ion Laboratory at University of Warsaw



- research unit of the University of Warsaw
- national level nuclear physics laboratory for fundamental research
- open for external users (~200/year)

Heavy Ion Laboratory at University of Warsaw



- research unit of the University of Warsaw
- national level nuclear physics laboratory for fundamental research
- open for external users (~200/year)



Senior researchers: 9
Researchers: 21
PhD Students: 3
Voluntary scientists: 3

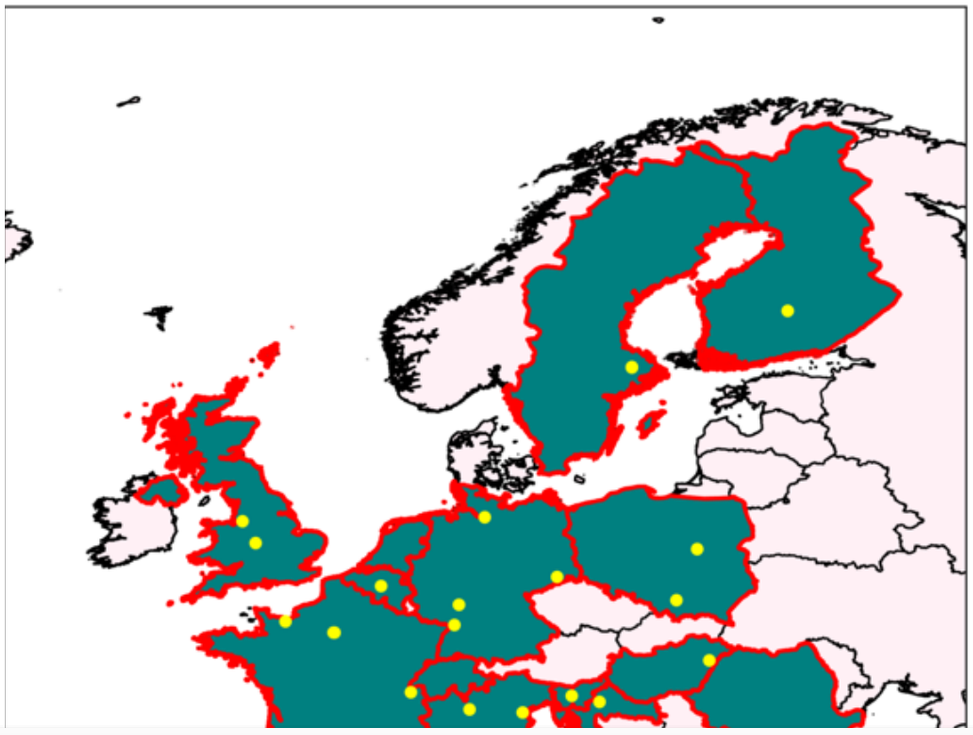
Engeneeres: 10
Technicians: 16
Administration: 10
Service: 10

Total: 76 + 6

EURO-LABS

2022-2026

- Consortium of 34 institutions
- 15 research infrastructures for low-energy nuclear physics
- NLC/SLCJ:
  1000 beam hours (4008 delivered)
  8 projects (18 done)
  40 users (76 paid out of 504)

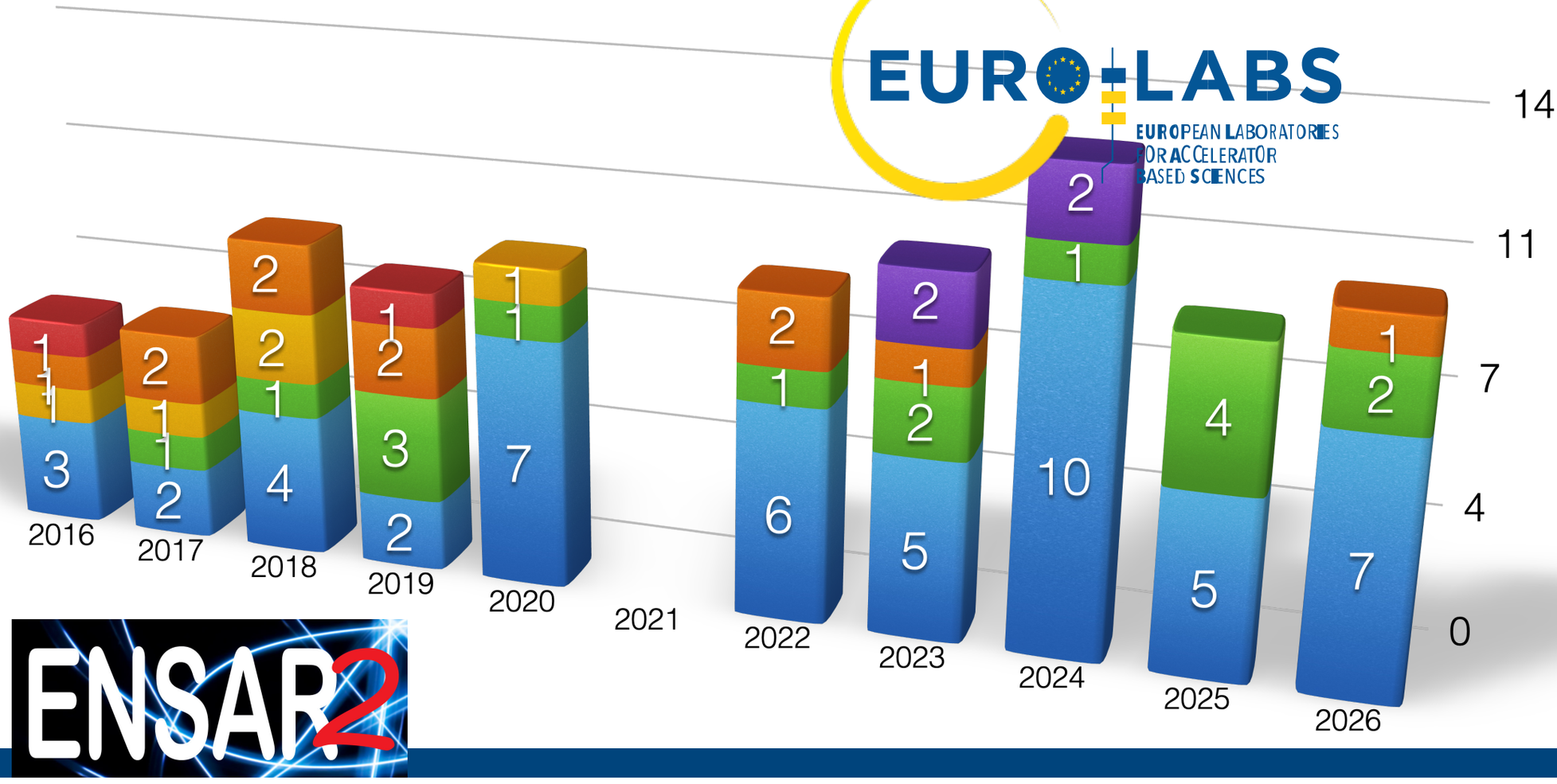


HADRON-2030

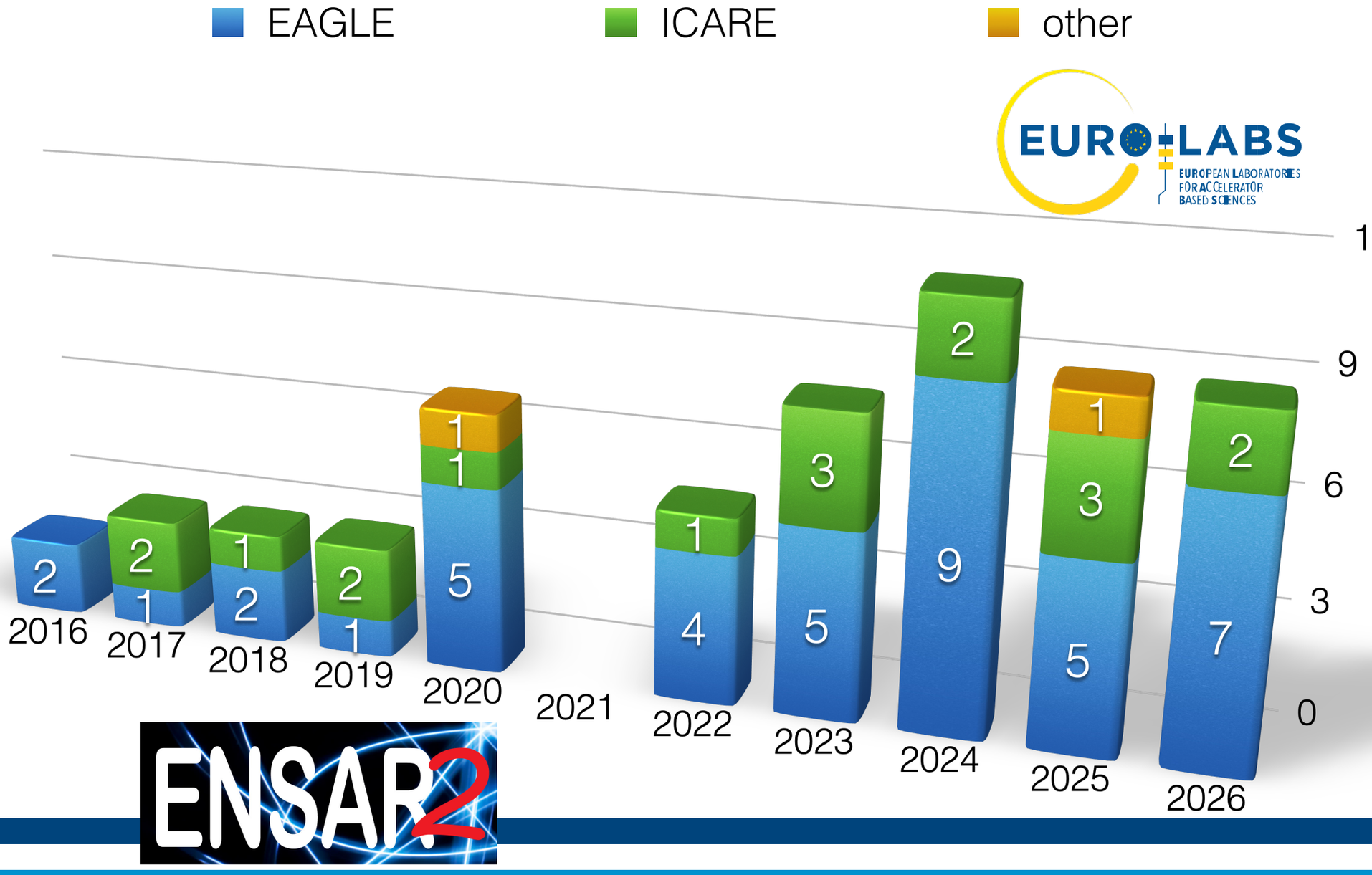
2026-2030

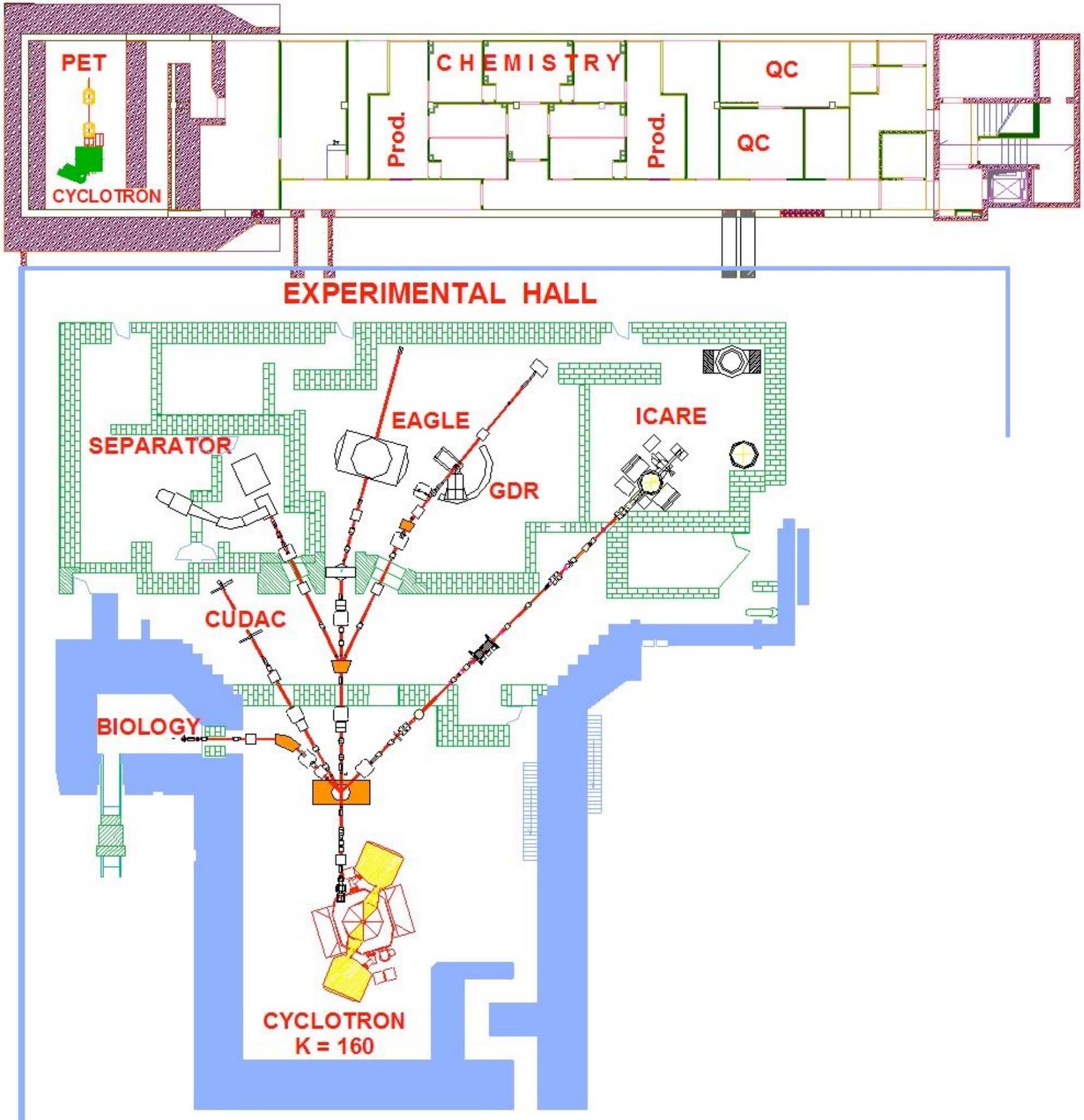
Research topics of projects proposed for HIL

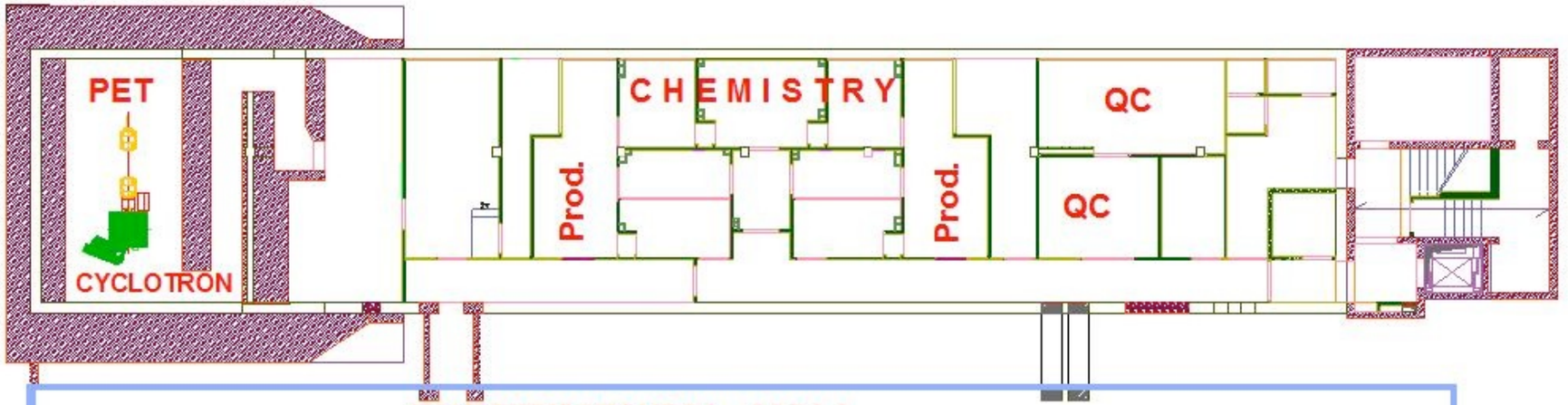
- Gamma Spectroscopy
- Isotopes for Medicine
- Radiobiology
- Nuclear Reactions
- Irradiations
- Other



International projects submitted to the HIL PAC




PET
CYCLOTRON
CHEMISTRY
Prod.
Prod.
QC
QC
EXPERIMENTAL HALL
SEPARATOR
EAGLE
GDR
ICARE
CUDAC
BIOLOGY
CYCLOTRON
K = 160





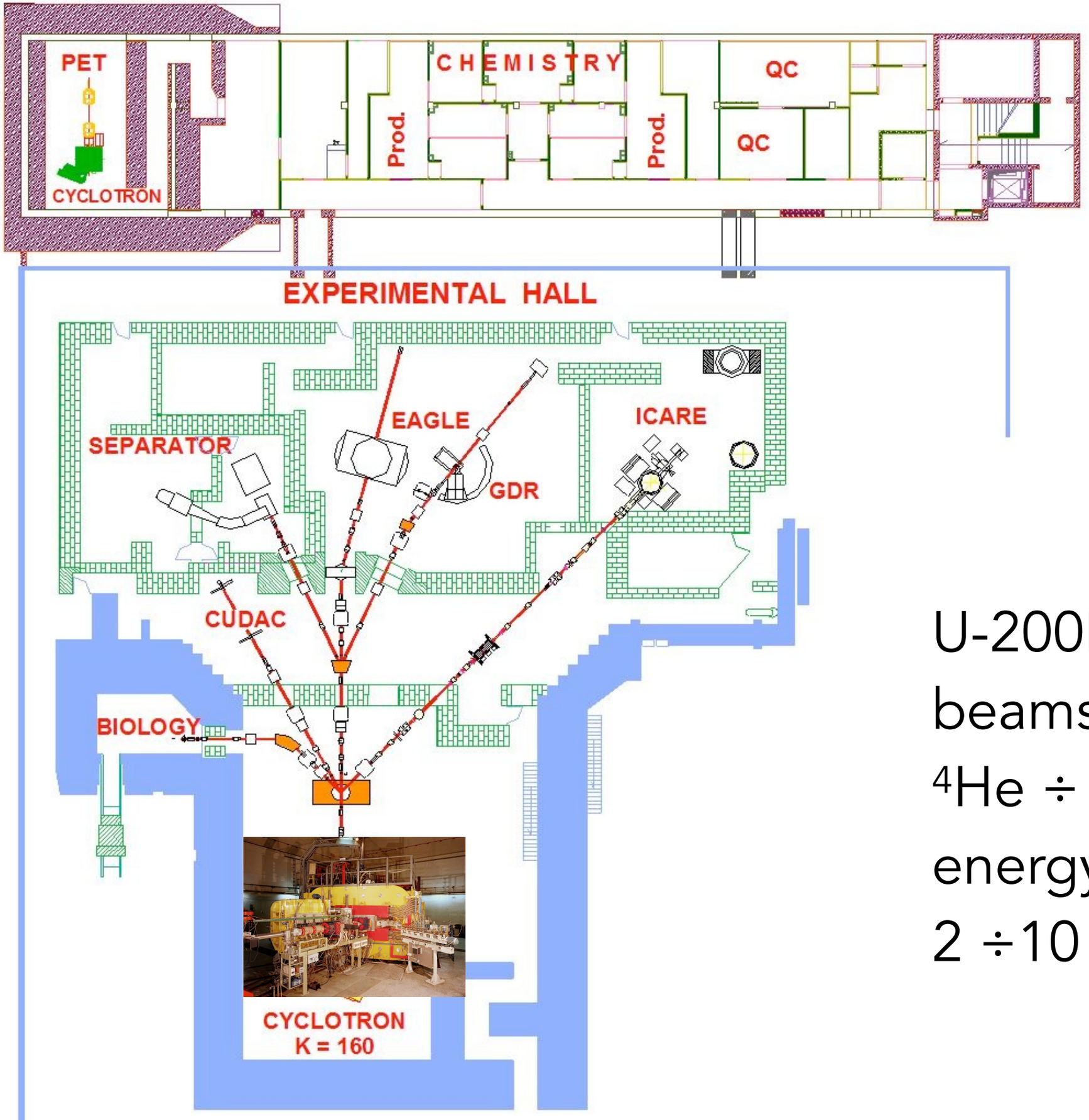
U-200P

beams:

$^{4}He \div {}^{40}Ar$

energy:

2 ÷10 MeV*A



U-200P

beams:

$^{4}He \div {}^{40}Ar$

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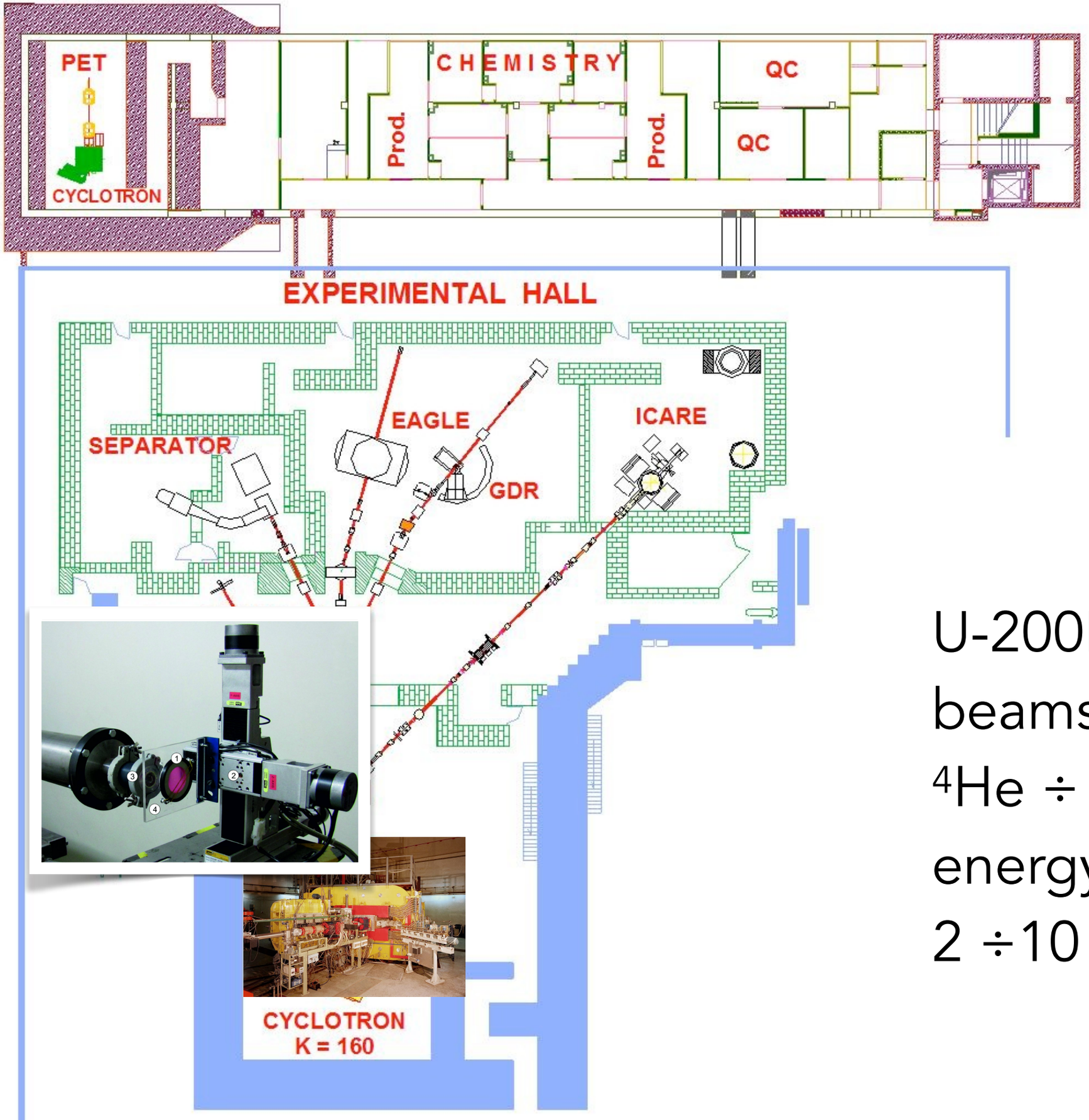
2 ÷10 MeV*A



U-200P

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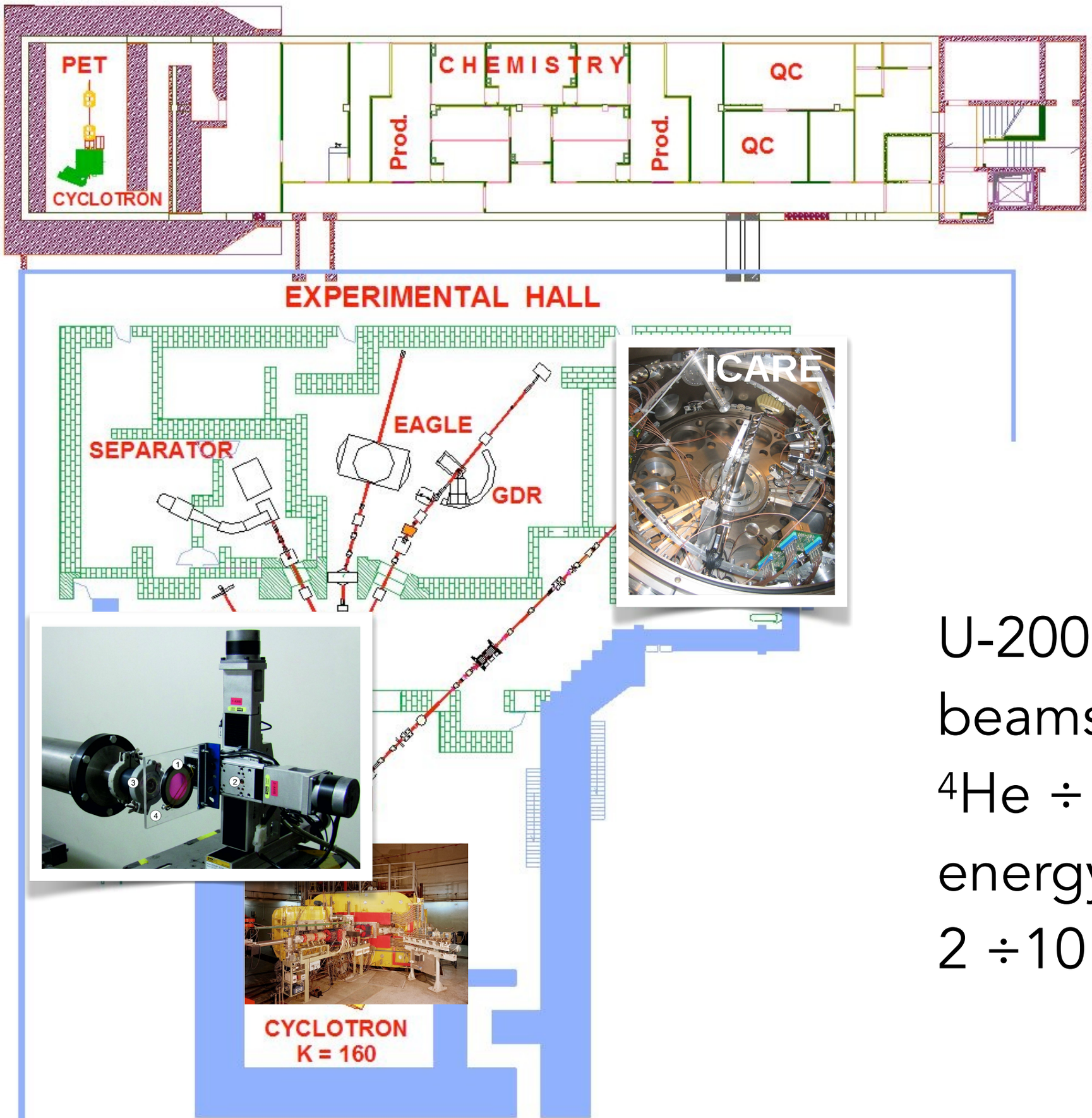

U-200P

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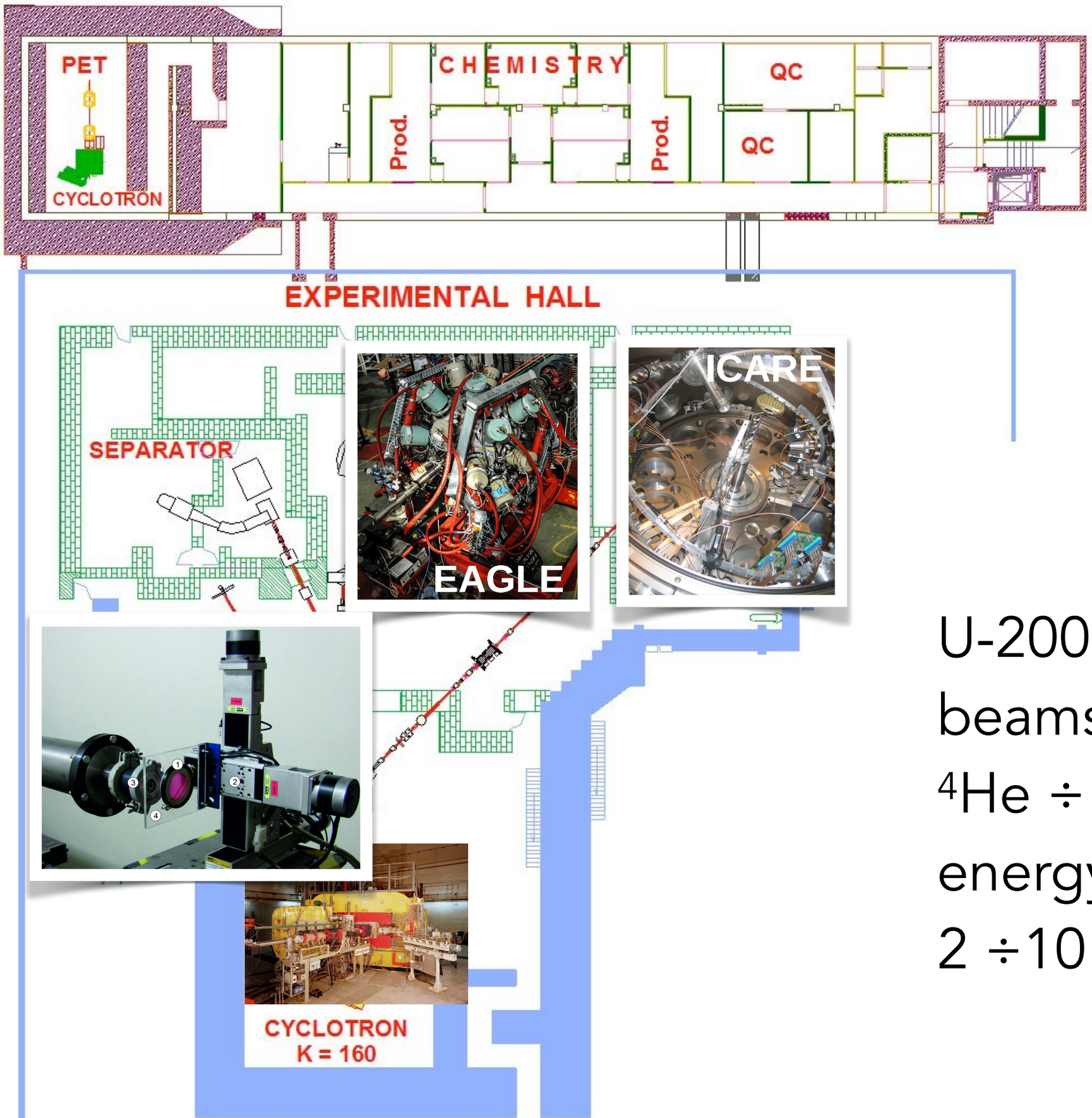


U-200P

beams:

$^{4}He \div {}^{40}Ar$

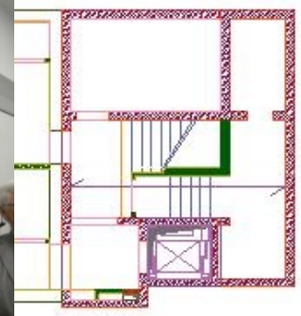
energy:

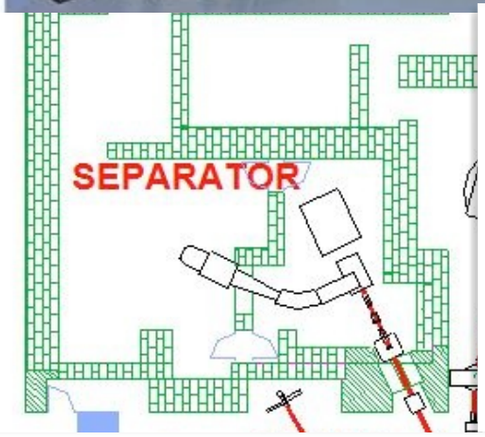
2 ÷10 MeV*A

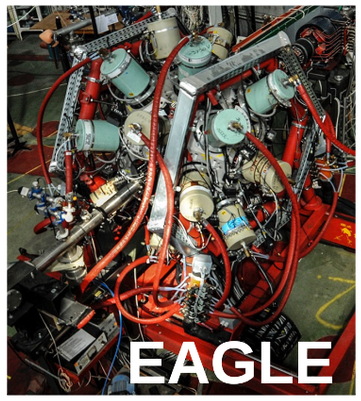
GE PetTrace
beams:
protons 16.5 MeV
deuterons 8 MeV



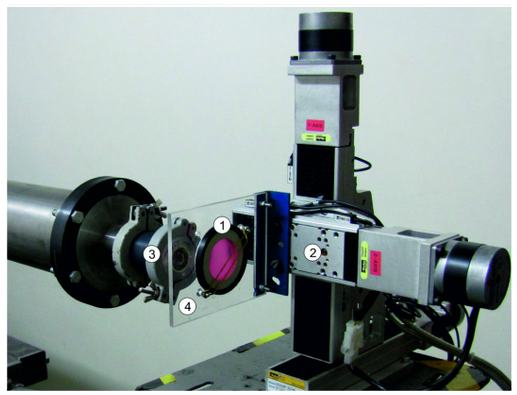


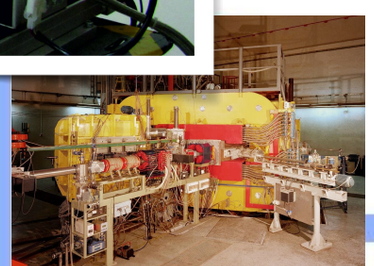










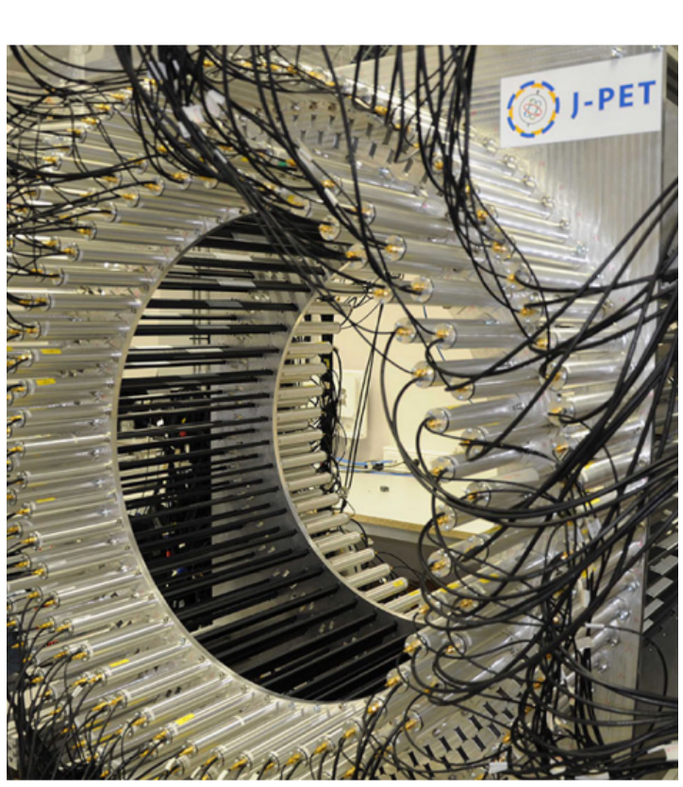


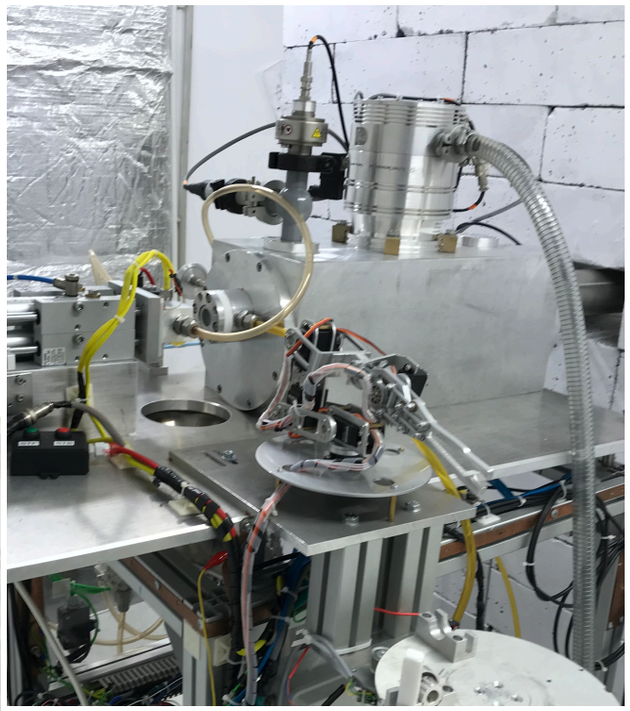
U-200P
beams:
$^{4}He \div {}^{40}Ar$
energy:
2 ÷10 MeV*A

Radiopharmaceuticals Production and Research Centre

- Experimental production of other medical isotopes is also being conducted.
  (eg. ^{43,44}Sc)

- HIL collaborates with Jagiellonian University to implement novel scanner J-PET (built by prof. P. Moskal team)
  HIL produces ^{43,44}Sc with PET-TRACE cyclotron using our original method.





Irradiation station for PET-TRACE cyclotron
(patent 227402)

K.Szkliniarz et al. Applied Radiation and Isotopes 118 (2016) 182–189
M.Sitarz et al. Applied Radiation and Isotopes 142 (2018) 104–112

EAGLE

central **E**uropean **A**rray for **G**amma **L**evels **E**valuations

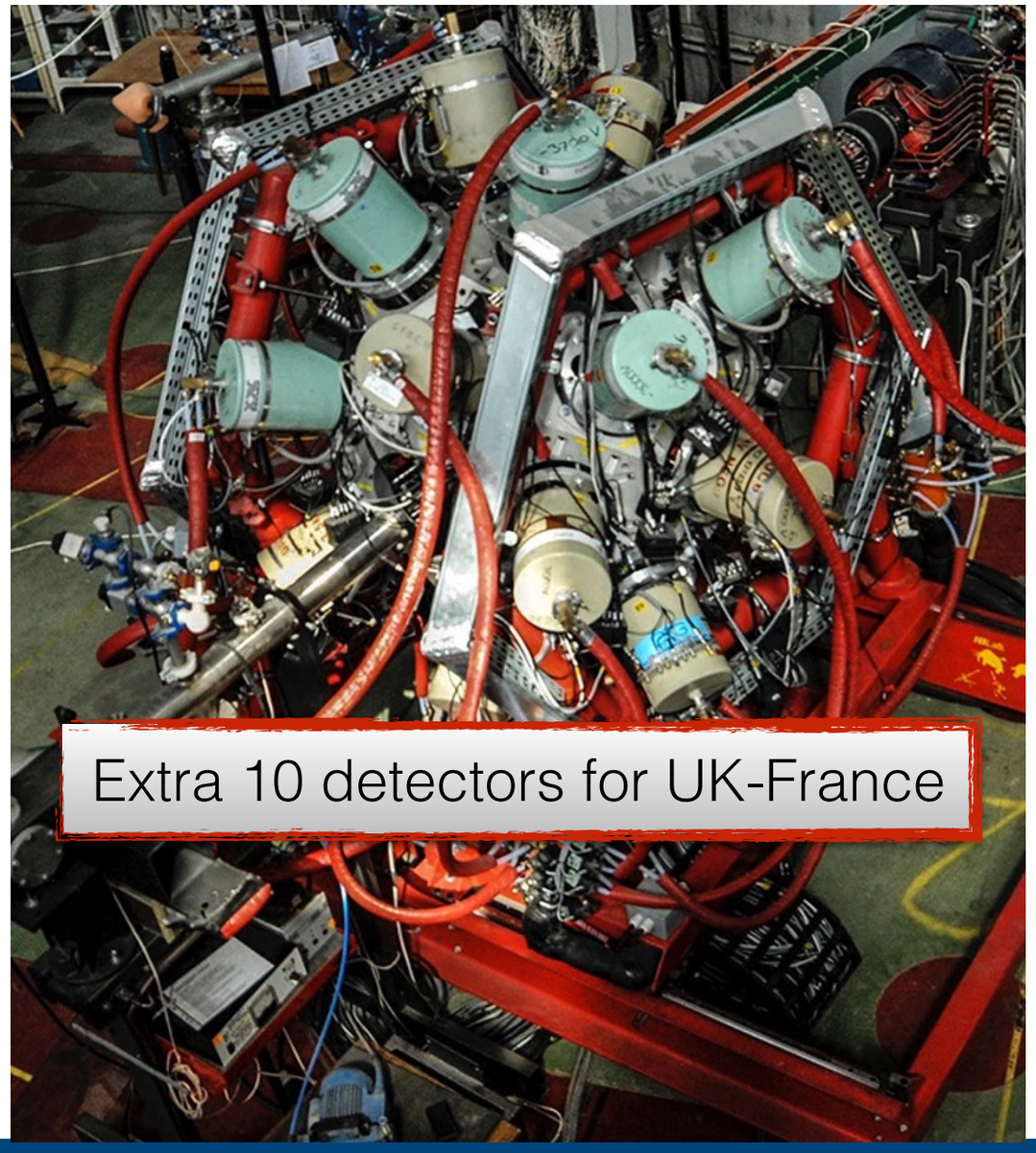
- multi-detector gamma-ray spectrometer

- up to 30 HPGe detectors with ACS

- employ 15 Phase-I EUROBALL detectors from Gammapool

- many ancillary detectors

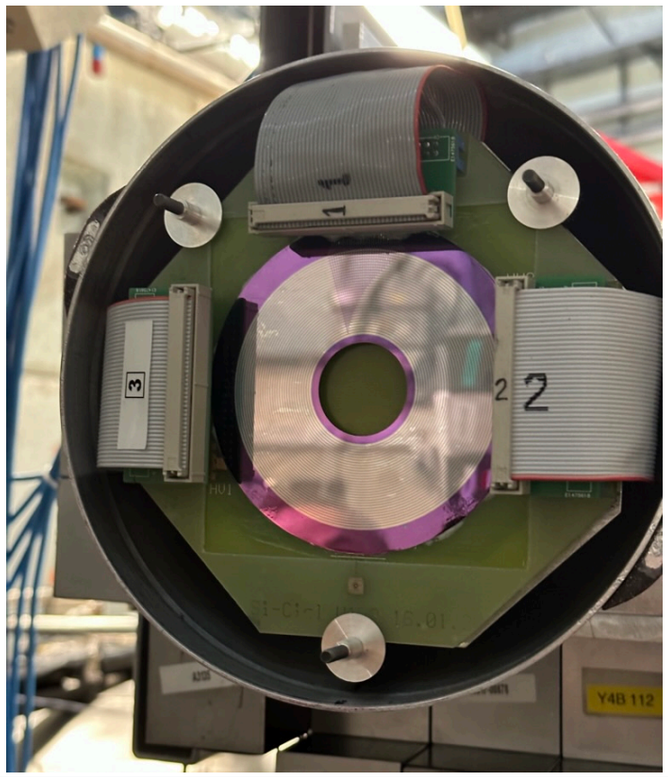
J. Mierzejewski et al., NIM A659 (2011)84



EAGLE

Scientific Program

- Study of non-spherical and non-axial shapes of nuclei by direct measurements of electromagnetic matrix elements using Coulomb excitation method



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Contents lists available at ScienceDirect

Physics Letters B

journal homepage: www.elsevier.com/locate/physletb

Letter

Deformation of the $0^+_{1,2}$ states in ^{110}Cd from low-energy Coulomb excitation

K. Wrzosek-Lipska [a,*], I. Z. Piętka [a], L. Próchniak [a], P. E. Garrett [b,c], M. Zielińska [d], T. Abraham [a], J. M. Allmond [e], F. L. Bello Garrote [f], H. Bidaman [b], V. Bildstein [b], S. Buck [b], C. Burbadge [b,1], M. Chiari [g], R. Coleman [b], G. Colombi [h,2], G. Colucci [a], A. Diaz Varela [b], D. T. Doherty [d,3], S. Dutt [i,j], B. Greaves [b], K. Hadyńska-Klęk [a], J. Heery [k], M. Hlebowicz [l], D. Hymers [b,4], J. Iwanicki [a], G. Jaworski [a], B. Jigmeddorj [b,5], D. Kalaydjieva [d,2], M. Kisieliński [a], M. Komorowska [a], N. Kopeć [a,6], M. Kowalczyk [a], J. Kowalska [a], K. Krutul-Bitowska [a], R. Kumar [i,1], A. Mai Quynh [m], N. Marchini [g], T. Marchlewski [a], K. R. Mashtakov [b], M. Matejska-Minda [a,n], C. Michelagnoli [h], A. Nannini [g], P. J. Napiorkowski [a], B. Olaizola [b,7], F. Oleszczuk [l], M. Palacz [a], E. Pasquali [o], E. E. Peters [p], M. Rocchini [b,g], E. Sahin [f], J. Samorajczyk-Pyśk [a], M. Saxena [a,q], A. Stolarz [a], J. Srebrny [a], A. Tucholski [a], A. Trzcińska [a], M. Venhart [r], J. L. Wood [s], S. W. Yates [p,t], T. Zidar [b]

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[e] *Physics Division, Oak Ridge National Laboratory, Oak Ridge, 37831, TN, USA*
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[i] *Inter-University Accelerator Centre, New Delhi, 110 067, India*
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[n] *Institute of Nuclear Physics, Polish Academy of Sciences, Cracow, PL-31-342, Poland*
[o] *Università degli Studi di Camerino, Dipartimento di Fisica, Camerino, I-62032, Italy*
[p] *Department of Chemistry, University of Kentucky, Lexington, 40506-0055, KY, USA*
[q] *Department of Physics and Astrophysics, University of Delhi, New Delhi, 110007, India*
[r] *Institute of Physics, Slovak Academy of Sciences, Bratislava, SK-84511, Slovakia*
[s] *School of Physics, Georgia Institute of Technology, Atlanta, 30332, GA, USA*
[t] *Department of Physics and Astronomy, University of Kentucky, Lexington, 40506-0055, KY, USA*

* Corresponding author.

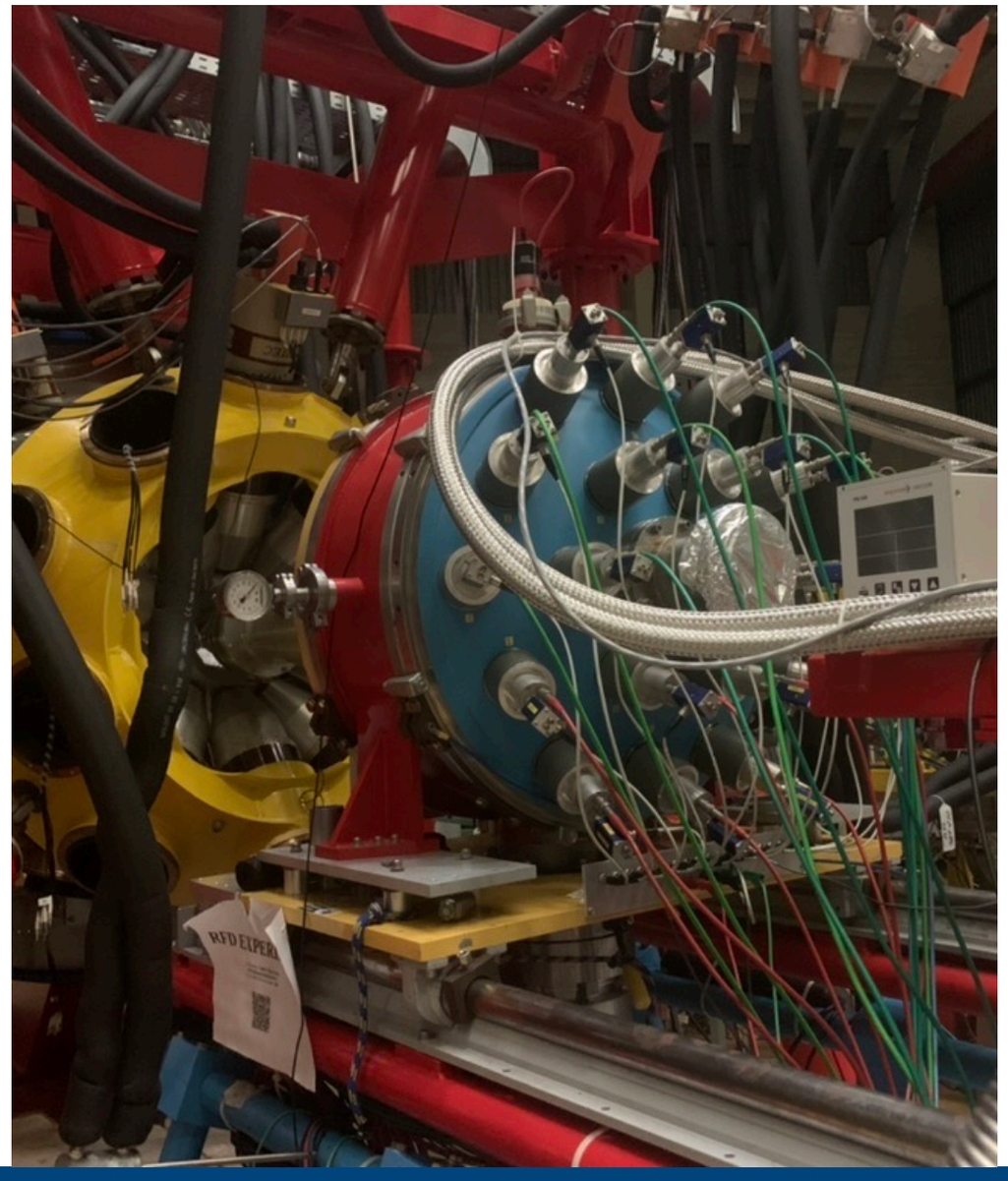
30 YEARS UNIVERSITY OF WARSAW | HIL

P.J.Napiorkowski

Next with EAGLE

- RFD for EAGLE investigation of collective bands in medium-light N~Z nuclei with masses A=40-70, situated in the nuclear chart above doubly magic ^{40}Ca and ^{56}Ni

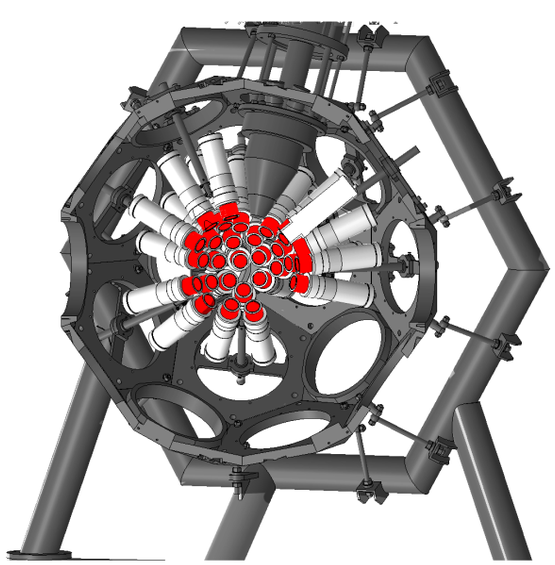
- study of nuclei from the Ac-Th region - the best-known examples of the reflection asymmetric nuclear shapes

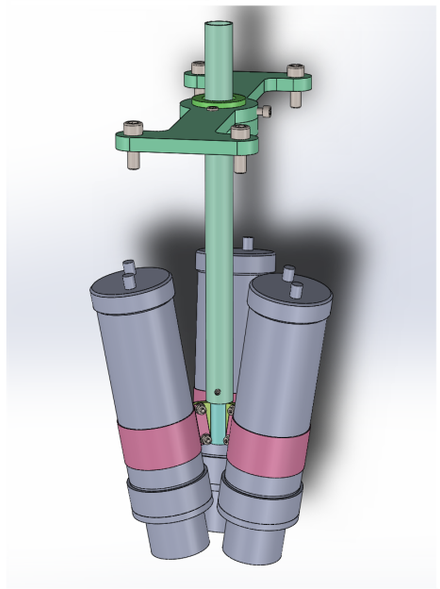


Next with EAGLE

- FLASH (Fast-Timing LaBr3 Array for Spectroscopy at HIL) campaign

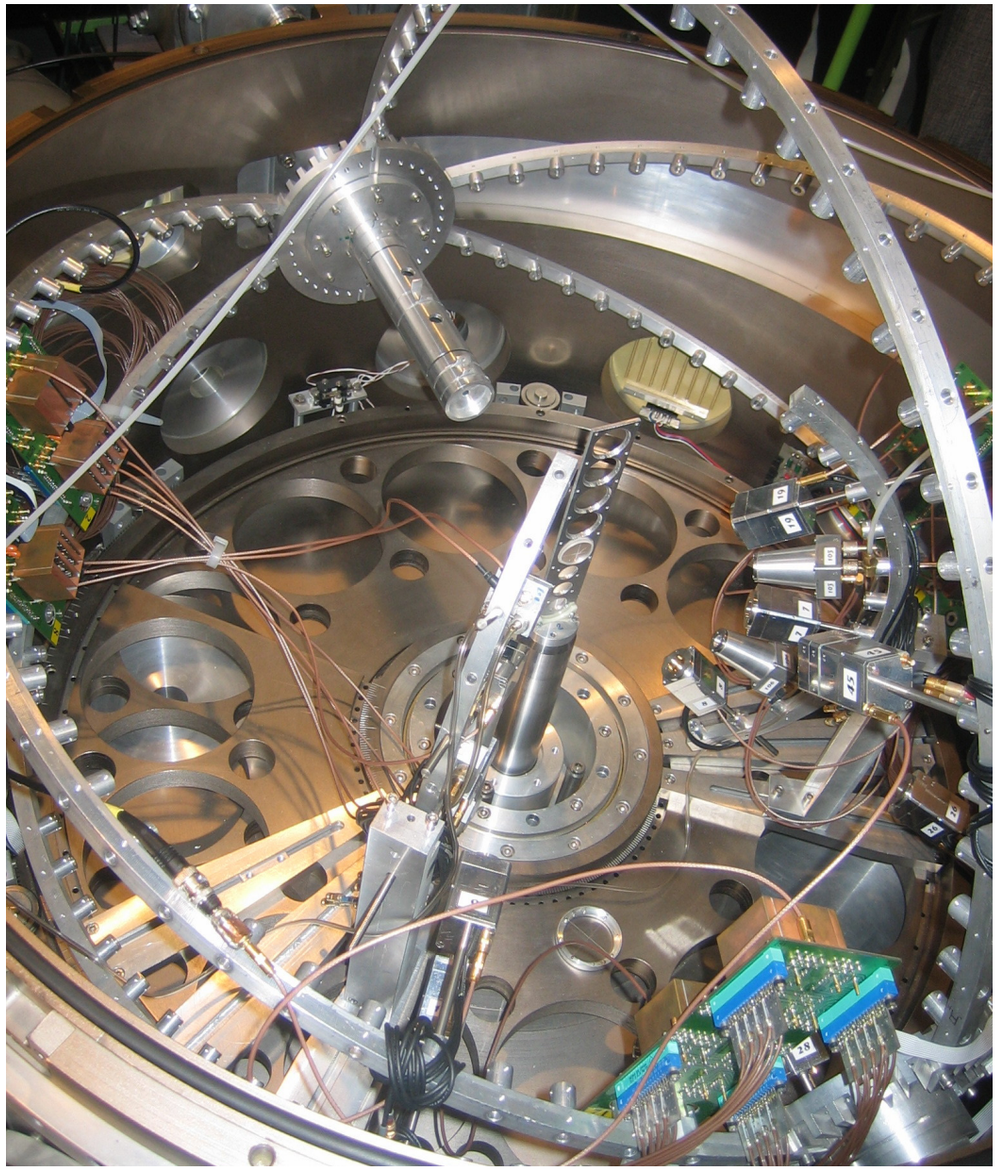
- investigation of short-range correlations in nuclei and α-clustering near the shell closure at N = 126





Nuclear Reaction Studies with ICARE

- ICARE Particle Spectroscopy Chamber from IReS Strasburg, France
  Form 2007 at HIL.



Nuclear Reaction Studies with ICARE

- ICARE Particle Spectroscopy Chamber from IReS Strasburg, France
  Form 2007 at HIL.
- Scientific program:
  - barrier distributions measurements

PHYSICAL REVIEW C **109**, 064625 (2024)

Dissipation by transfer and its influence on barrier distributions

G. Colucci,[1,*] E. Piasecki,[1] A. Trzcińska,[1] P. W. Wen,[2] V. Palmin,[3] and T. Abramova[3]
[1]*Heavy Ion Laboratory, University of Warsaw, 02-093 Warsaw, Poland*
[2]*China Institute of Atomic Energy, Xinzhen, Fangshan, Beijing 102413, China*
[3]*Moscow Institute of Physics and Technology, Moscow 117303, Russia*

(Received 21 February 2024; accepted 3 June 2024; published 27 June 2024)

The quasielastic barrier distribution (D_{qe}) of the $^{20}Ne + ^{208}Pb$ system exhibits a single broad structureless peak, unlike the results of coupled-channels calculations, including the strongest collective states of both projectile and target, which show a pronounced double-peaked structure. Separate measurements of the transfer strength, combined with the relatively small number of weak noncollective states in ^{208}Pb, suggested that the observed barrier smoothing in this system could be due to the influence of couplings to transfer reactions. The coupled reaction channels (CRC) calculations performed by explicitly coupling to the two strongest transfer partitions, one-neutron pickup and one-proton stripping, suggest that the cumulative effect of coupling to many relatively weak transfer channels is responsible for the barrier smoothing rather than a few strong transfer reactions. In this perspective, the four main transfer channels (one- and two-neutron pickup and one-proton and one-alpha stripping) of the $^{20}Ne + ^{208}Pb$ system were coupled to the collective excitations by employing an upgraded CCQEL code, where we introduced the dependence of the transfer coupling strength on the transferred particle and experimental Q-value distributions. Because of the availability of Q distributions measured at the two beam energies of 96 and 103 MeV, two sets of transfer coupling strength were determined for each transfer channel. The study with the upgraded code indicates transfers with negative ground-to-ground states Q value as the leading cause of the smearing of the barrier distribution. At the beam energy of 103 MeV, the smoothing of D_{qe} is influenced mainly by the one-neutron pickup. On the other hand, the one-neutron pickup and one-proton stripping transfers are dominant for the beam energy of 96 MeV. These results highlight the importance of the transfer coupling dependence on the experimental Q-value distribution and, consequently, on the dissipation of the projectile kinetic energy.

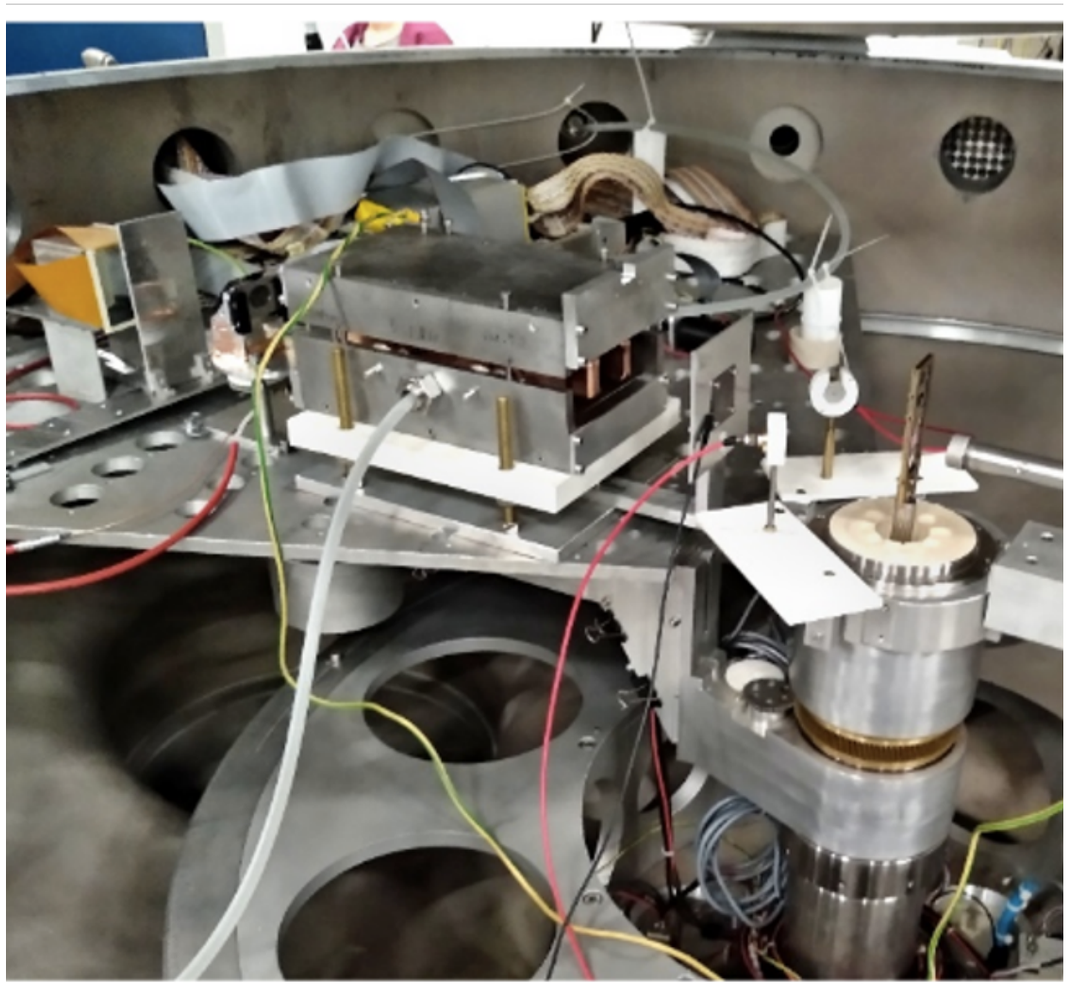
DOI: 10.1103/PhysRevC.109.064625

I. INTRODUCTION

behavior seems to result from dissipation: the partial conver-

What next with ICARE...

- Wien filter for ICARE
  (by A.Trzcińska, G.Colucci,
  E.Piasecki, M.Wolińska-Cichocka
  in collaboration with INFN
  Laboratori Nationale del Sud,
  Catania, Italy)



Radiobiology @ HIL

www.nature.com/scientificreports

scientific reports

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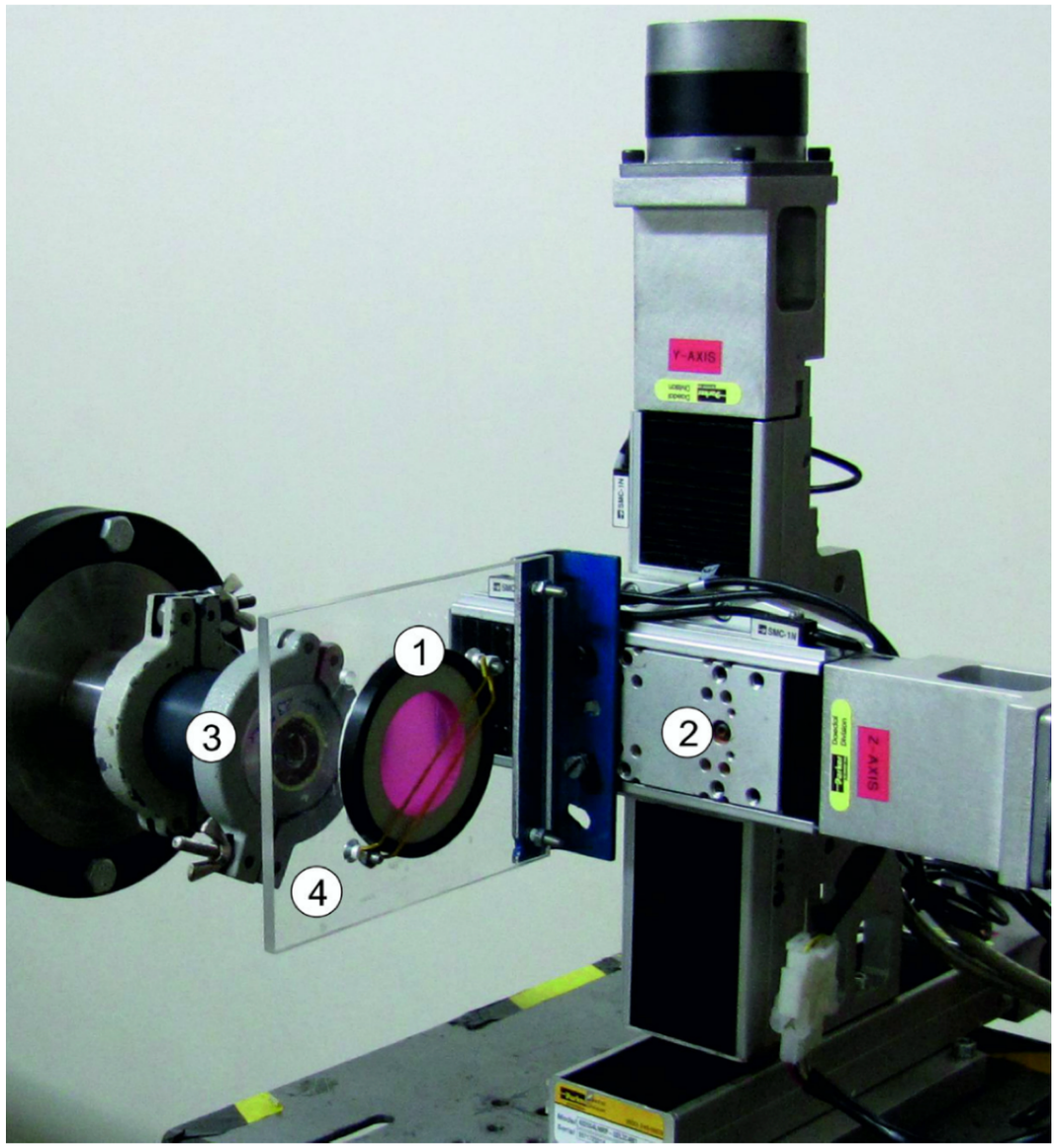
OPEN

Expression of DNA-damage response genes after exposure to high LET particles used in BNCT in glioblastoma cells with altered radiosensitivity

Martyna Araszkiewicz[1,2]✉, Agnieszka Korgul[1], Katarzyna Tymińska[2], Urszula Kaźmierczak[4], Kinga Dyka[1], Patrycja Chuchała[1], Renata Grzela[1], Patrycja Kamińska[1], Roman Kuczma[1], Bohdan Paterczyk[5], Anna Stankiewicz-Drogoń[1], Beata Wielgus-Kutrowska[1], Agata Kustra[3], Michał Fryc[3], Piotr Bednarczyk[3] & Kamila Maliszewska-Olejniczak[3]✉

DNA-dependent protein kinase catalytic subunit (DNA-PKcs) plays a central role in the repair of double-strand breaks (DSBs), but its deficiency alters the broader DNA damage response in glioblastoma cells exposed to α particle irradiation. Here, we investigated transcriptional changes in DNA repair pathways and cellular radiosensitivity in two isogenic glioblastoma cell lines differing in DNA-PKcs status: M059J (DNA-PKcs-deficient) and M059K (DNA-PKcs-proficient). Using pathway-focused qPCR, we profiled 30 genes involved in key DNA repair pathways and evaluated cell survival by clonogenic and MTT assays. M059J cells, despite DNA-PKcs deficiency, exhibited comparable survival fractions and higher metabolic activity than DNA-PKcs-proficient M059K cells following α particle irradiation. Irradiated M059J cells exhibited broad transcriptional upregulation of genes involved in double-strand break repair, single-strand break repair, mismatch repair, and nucleotide excision repair, reflecting compensatory activation of multiple repair mechanisms. In contrast, M059K cells displayed a restricted response, characterized primarily by strong *PRKDC* upregulation, the gene encoding DNA-PKcs. These findings highlight the pivotal role of DNA-PKcs status in shaping the DNA damage response and radiosensitivity of glioblastoma cells. Targeting compensatory repair pathways in DNA-PKcs-deficient tumors may offer novel strategies for radiosensitization in glioblastoma therapy.

Keywords Glioblastoma, DNA-PKcs, α particle irradiation, DNA damage response, Radiosensitivity



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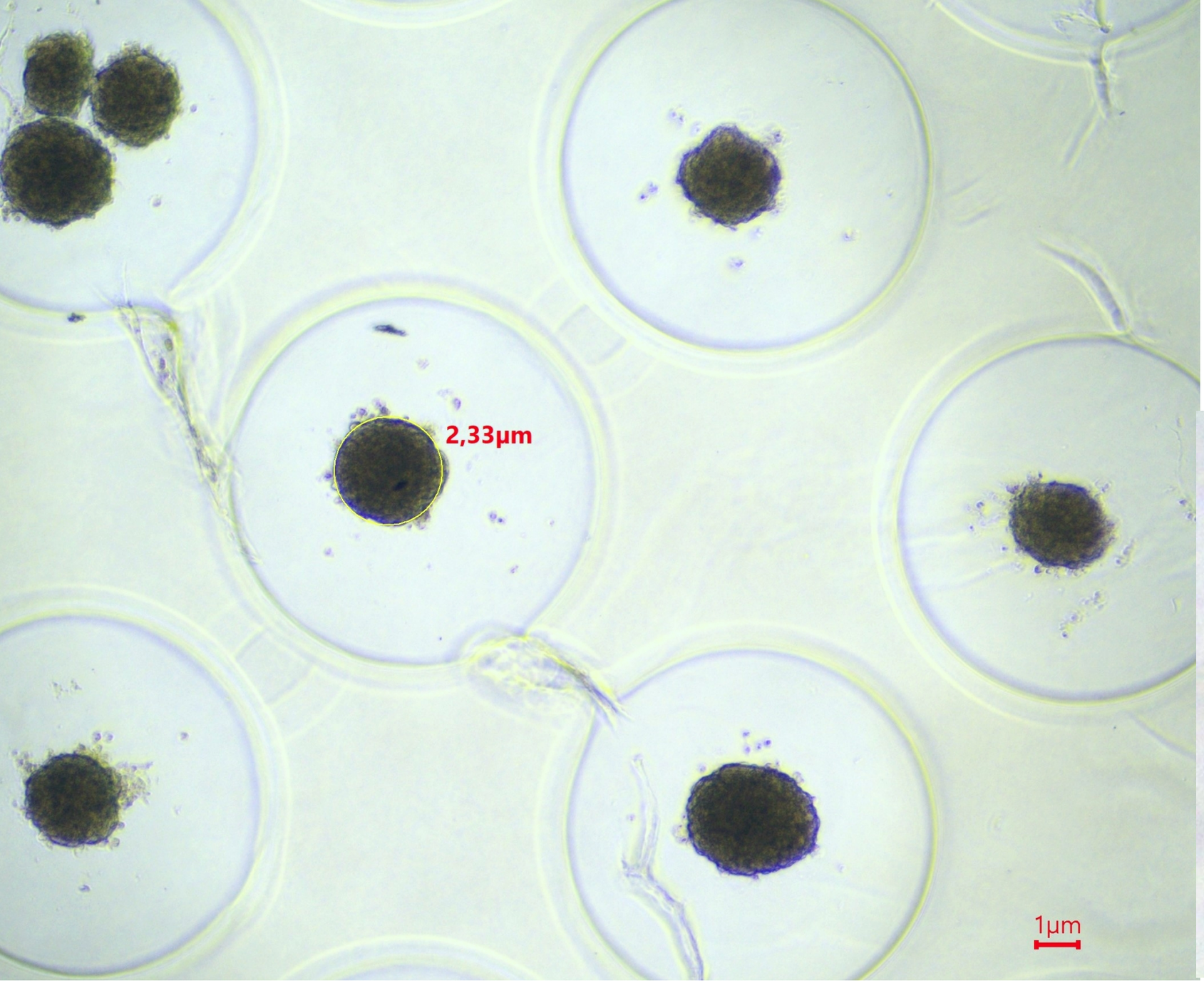
Radiobiology lab at HIL

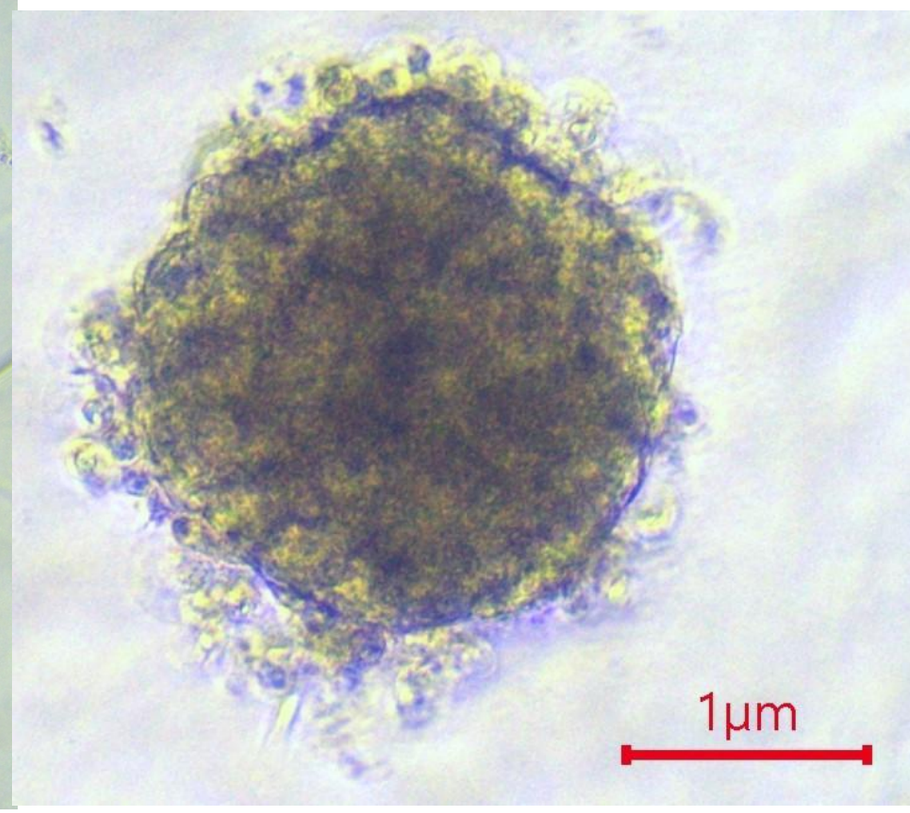


Courtesy of U.Kaźmierczak

Equipment:

- **Inverted microscope,**
- **Fluorescence microscope,**
- **Laminar chamber,**
- **Incubator (humid, CO_2),**
- **Refrigerator,**
- **Water Bath,**
- **Freezer (for −20˚C storage).**





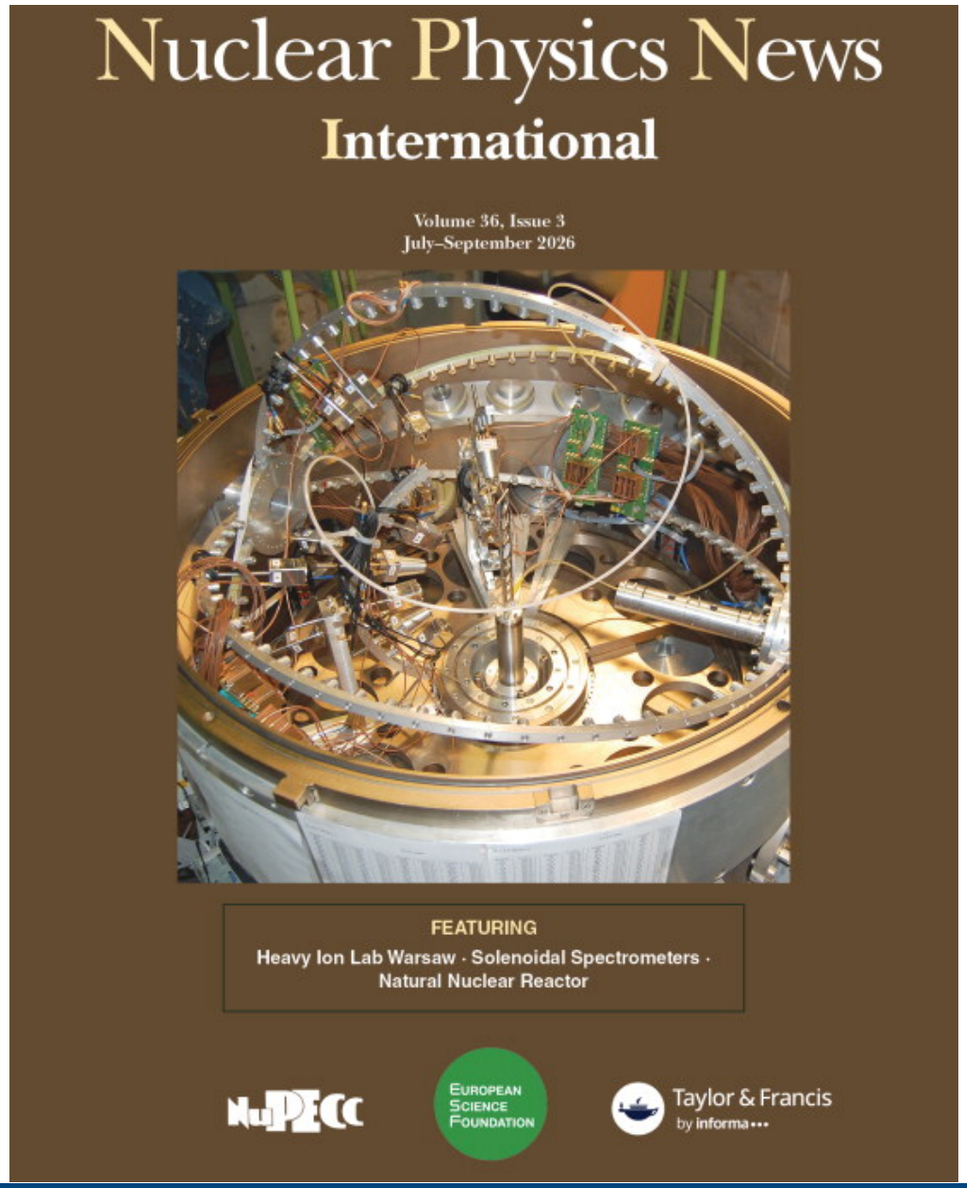
3D cell colonies: glioma M059K spheroids

Courtesy of U.Kaźmierczak

Summary

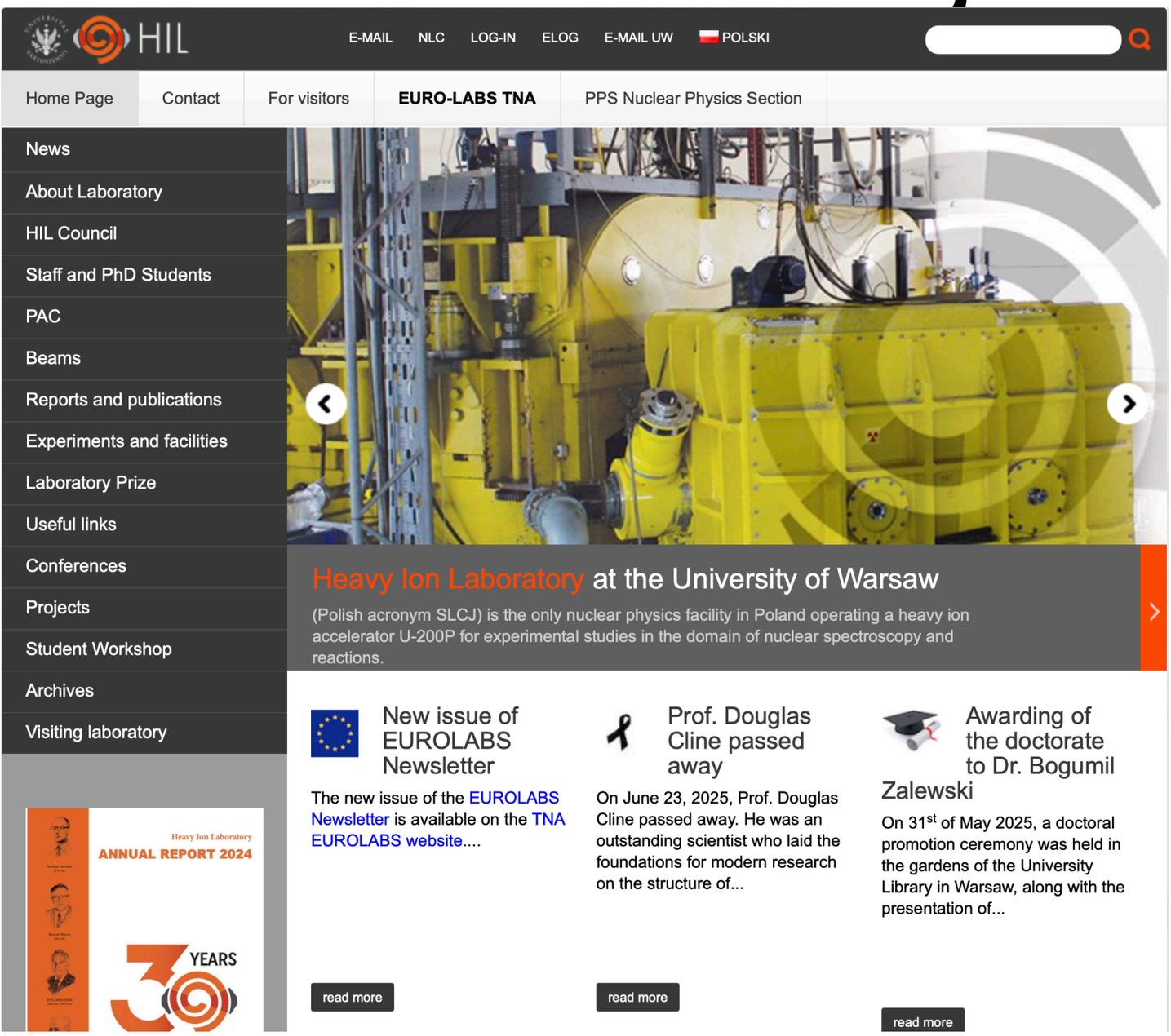
- **HIL is a European research facility**, open to broad international collaboration equipped with a wide range of experimental stations

- Our research focuses on **physics and chemistry,** with strong interdisciplinary connections to
- **biology**
- **medicine,**
- **detector development,**
- **electronics**
- **computer programming** for data acquisition and data analysis.



P.J.Napiorkowski https://www.tandfonline.com/doi/full/10.1080/10619127.2026.2694952

www.slcj.uw.edu.pl

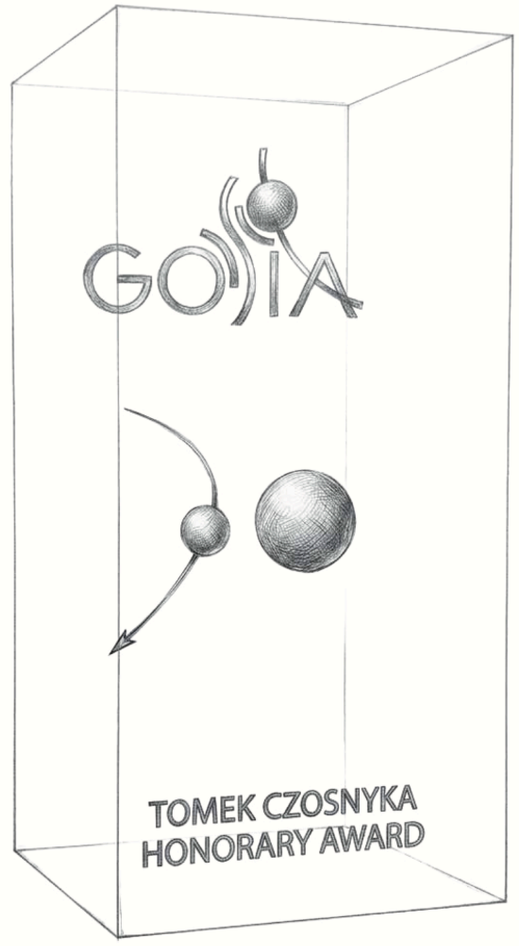




Tomasz Czosnyka
1952 - 2006

Heavy Ion Laboratory

ANNUAL REPORT 2025



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