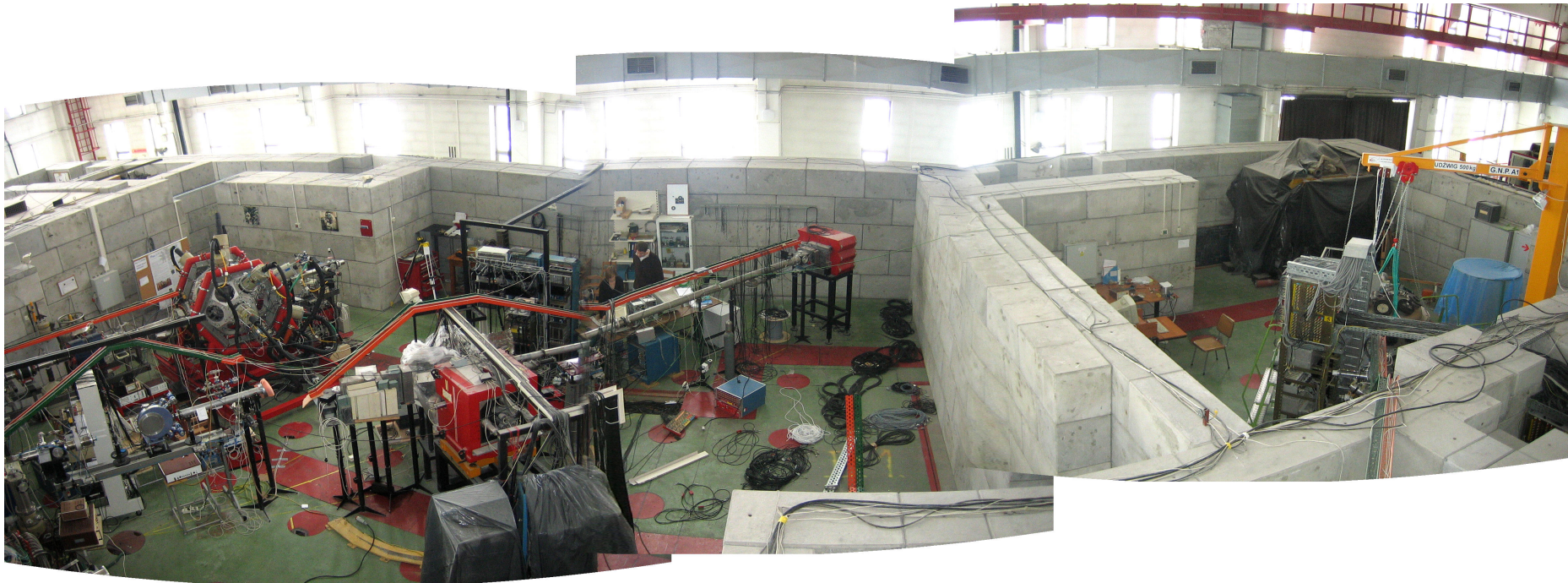
Heavy Ion Laboratory, University of Warsaw

an overview

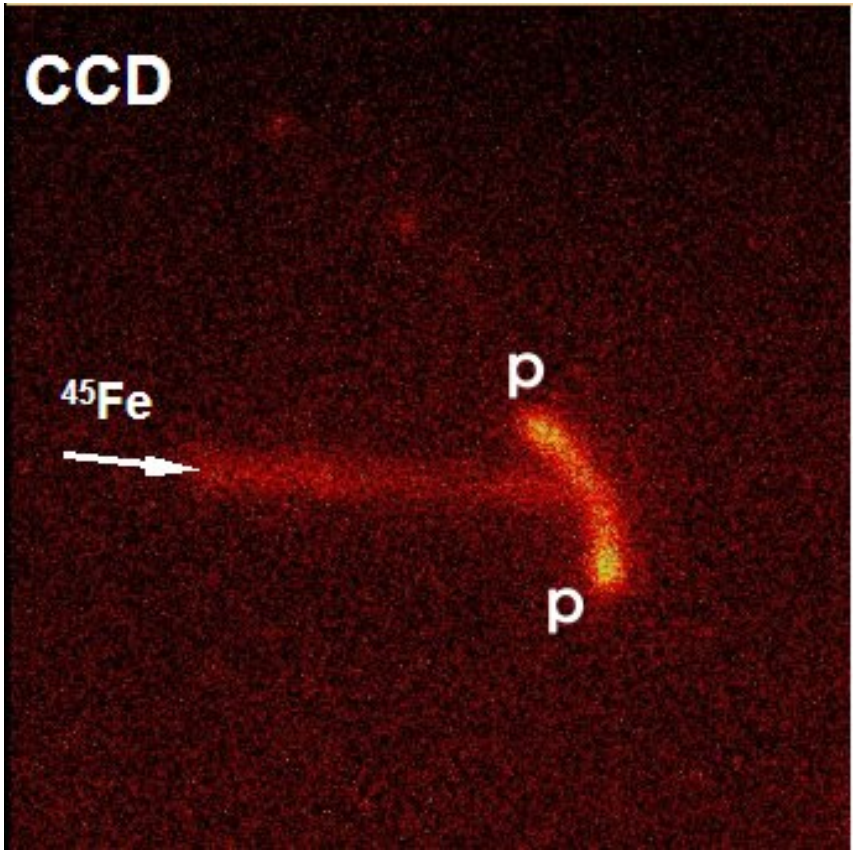
Krzysztof Rusek



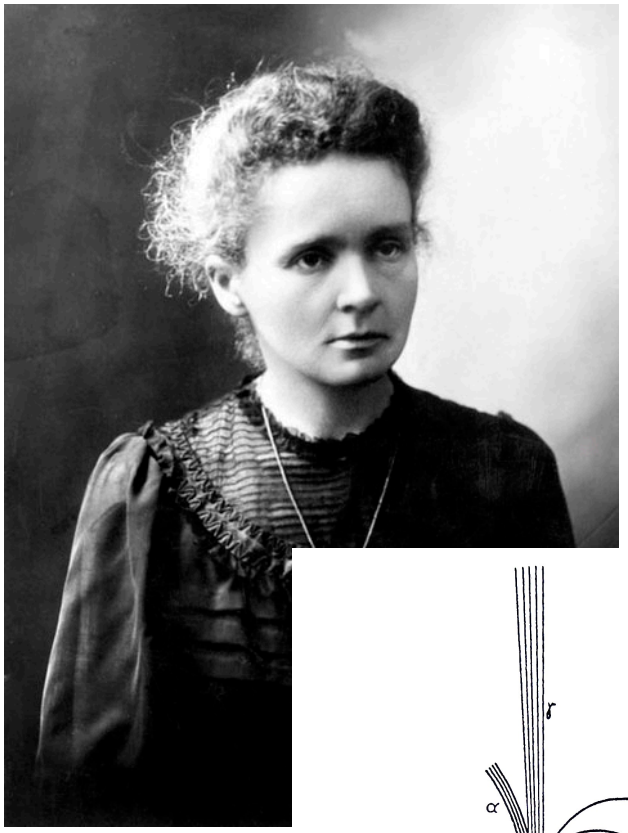
Heavy Ion Laboratory, University of Warsaw :

- National nuclear physics laboratory open for external users
- Recognized in Europe
- Involved in teaching
- developing medical applications

Radioactivity



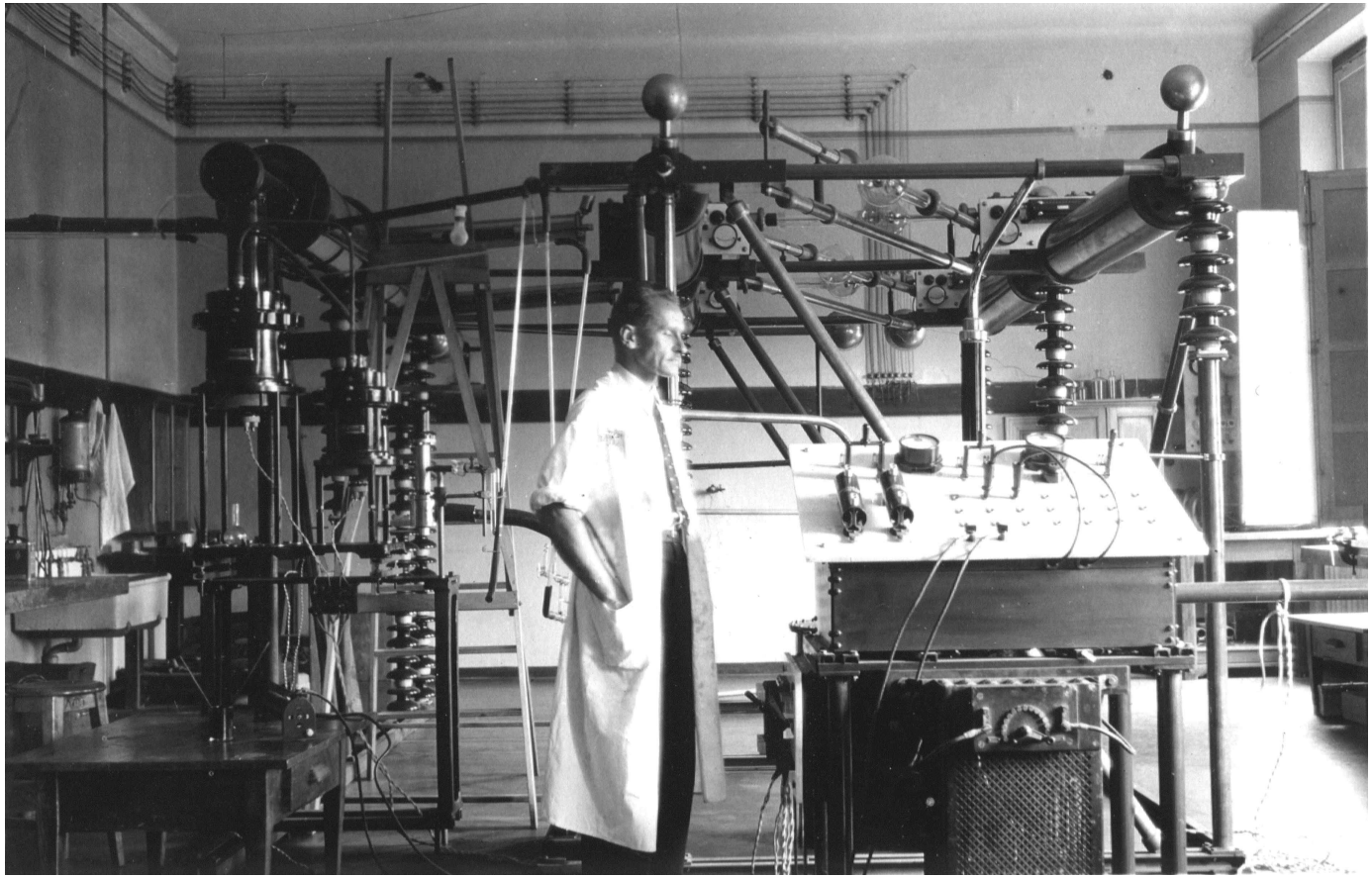
M. Pfützner et al.



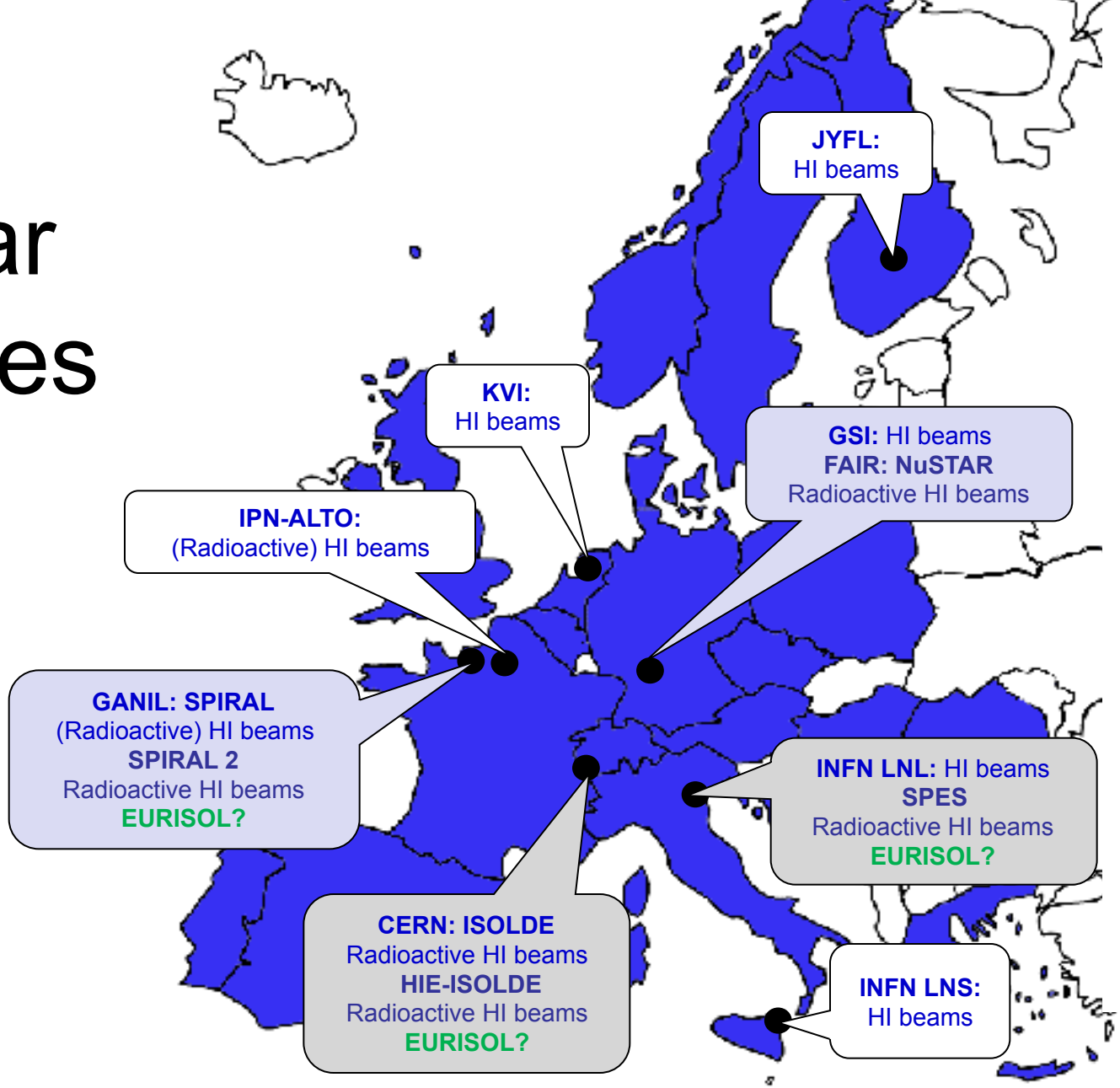
First Nuclear Physics Lab in Poland

Hoża 69, prof. A. Sołtan (1937)

deuterons 0.4 MeV, I up to 200 μA

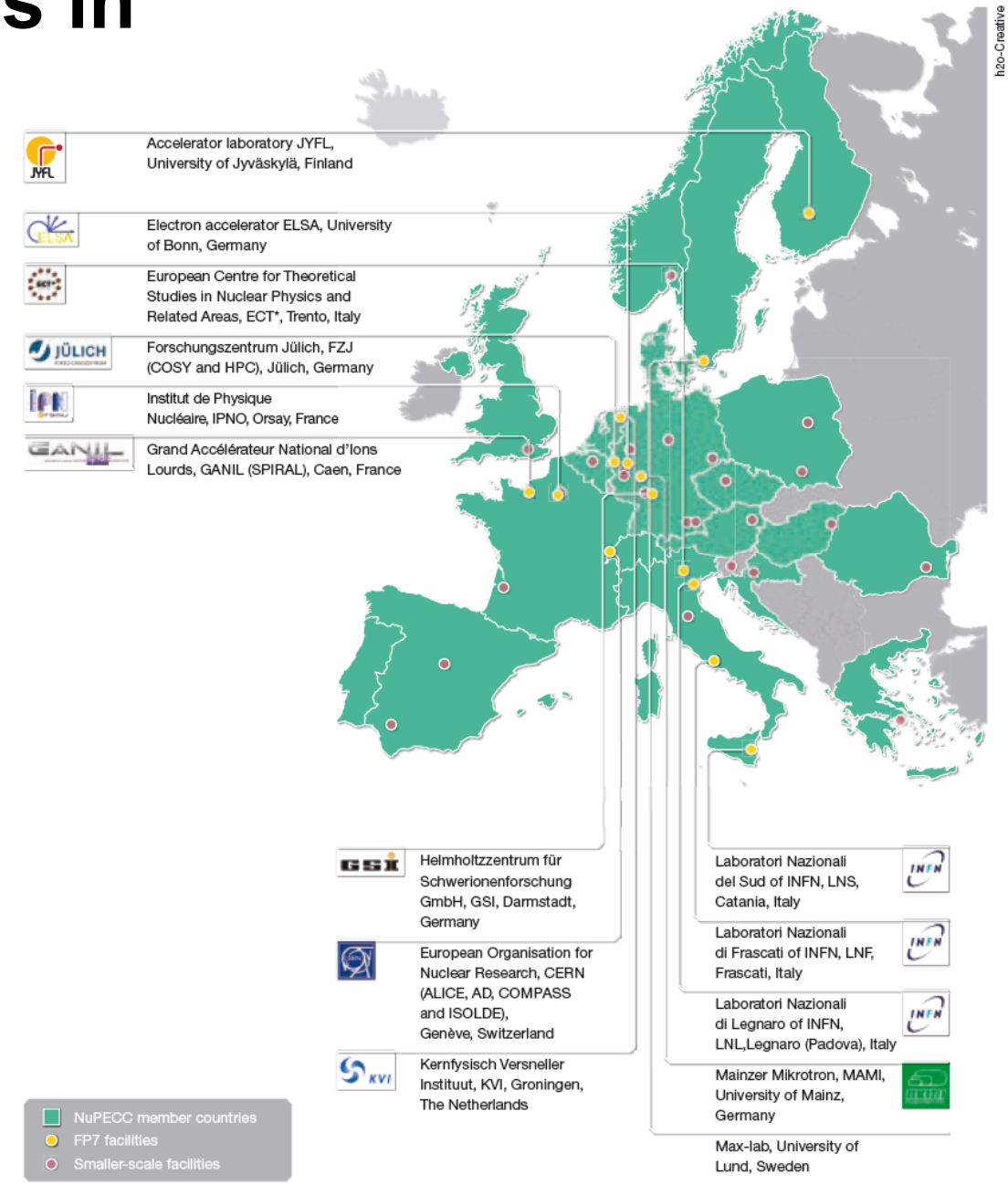


Large Nuclear Facilities



Nuclear facilities in Europe:

NuPECC Long Range Plan



Nuclear Facilities in Poland

Szczecin

HIL

ŚLCJ

Warszawa

Lodz

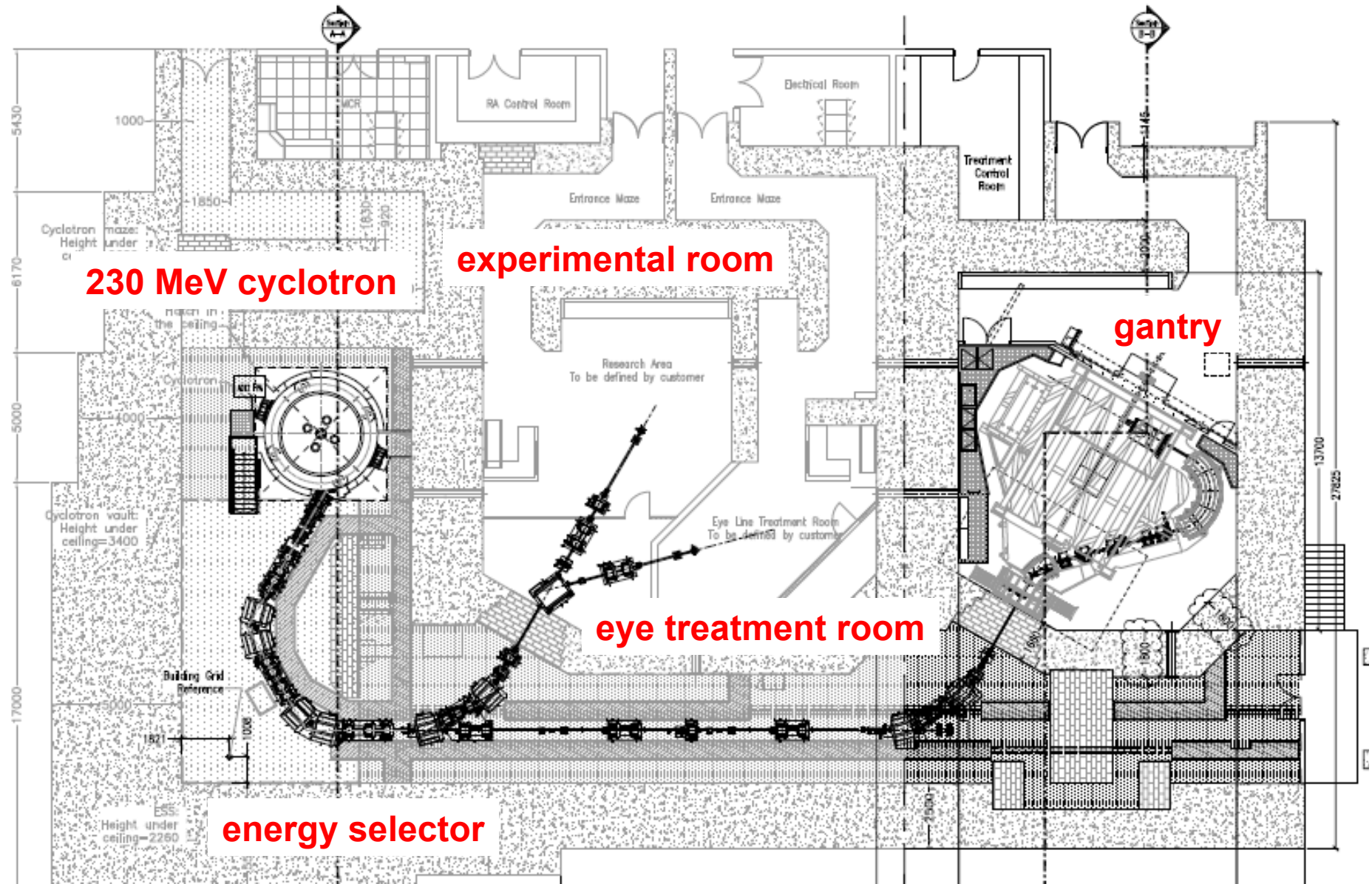
Katowice

Lublin

Kraków

Cyclotron Centre Bronowice

What is foreseen in NCRH – CCB?




11 May 2012
iba
Krakow – Proton Therapy Center

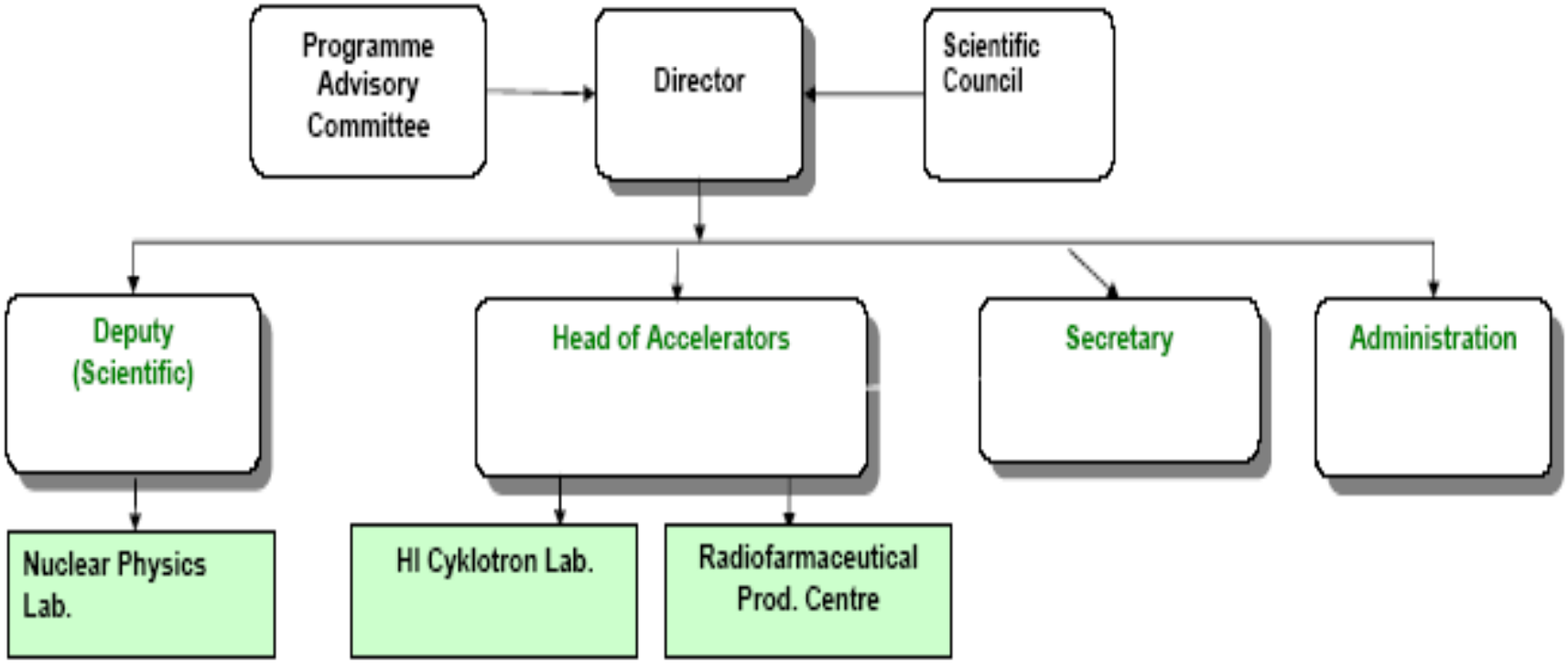
ELBRUS at Szczecin Univ.

Science Campus Ochota

First oncological hospital in Poland

29.05.1932

Heavy Ion Laboratory UW - a national lab.



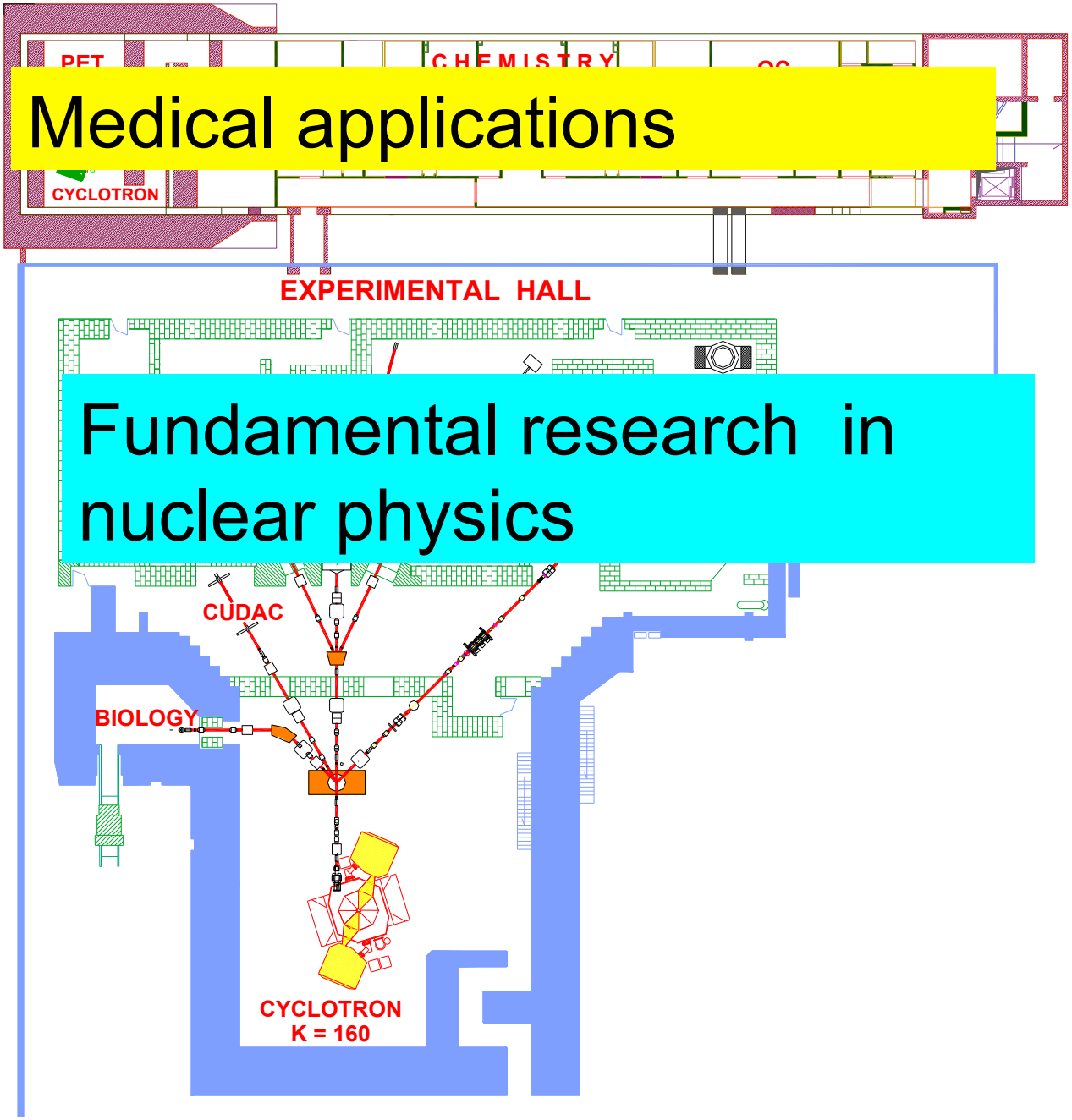
Staff

Scientists – 13
PhD students – 7
Technicians – 35
Administration - 8

HIL

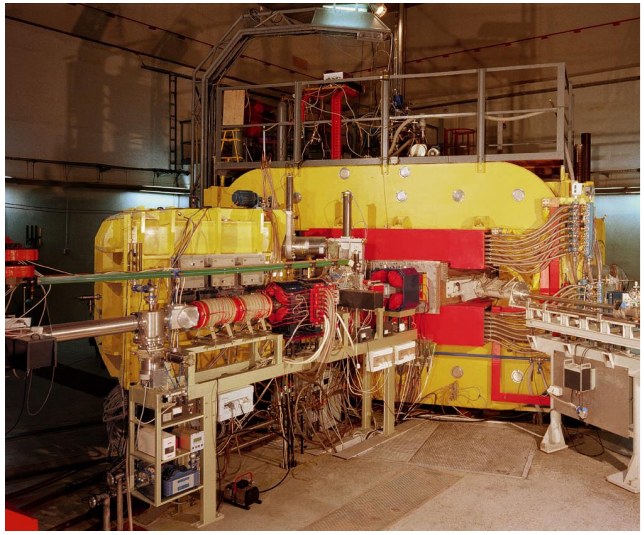
ŚLCJ

Medical applications

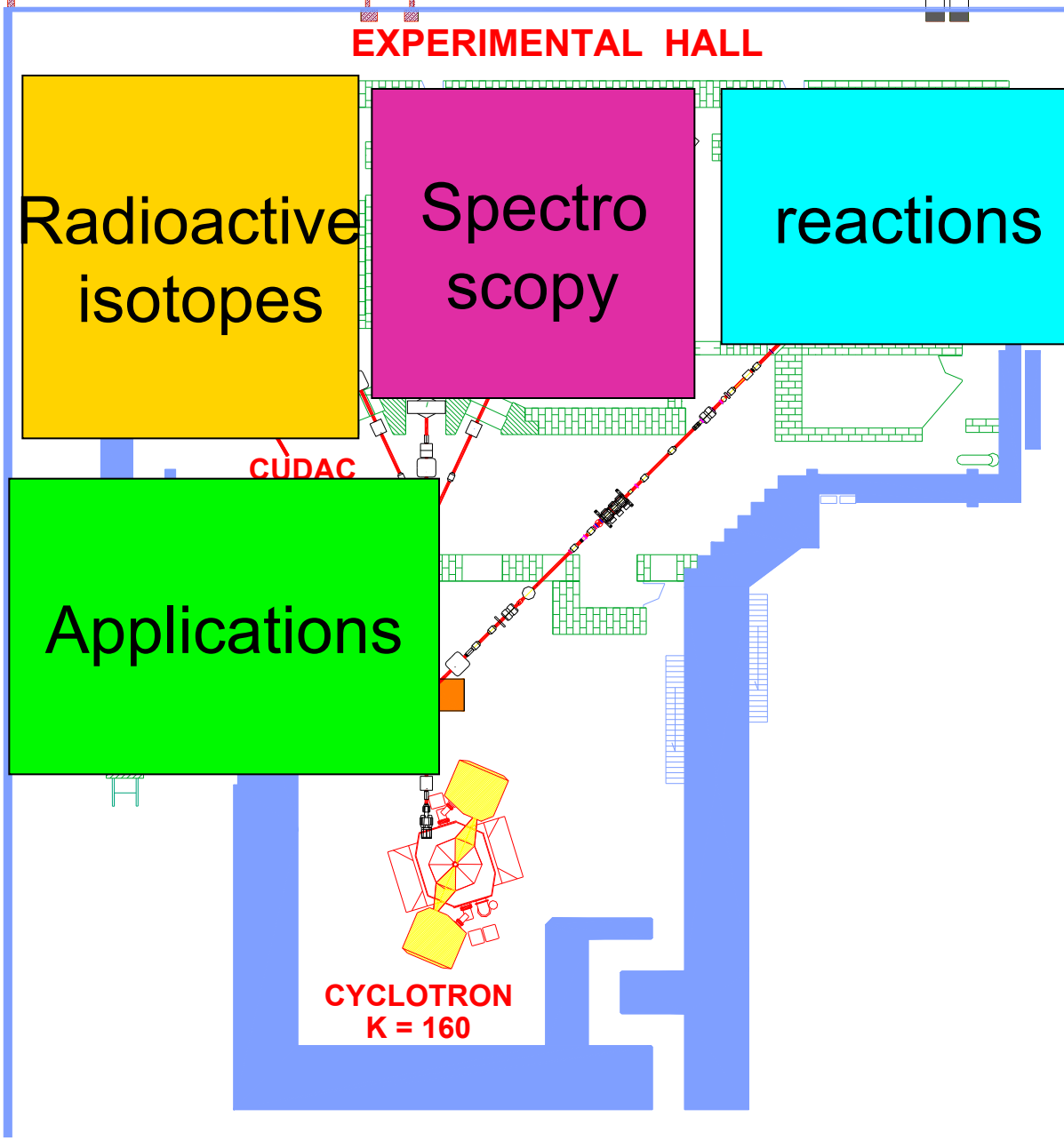


Fundamental research in nuclear physics

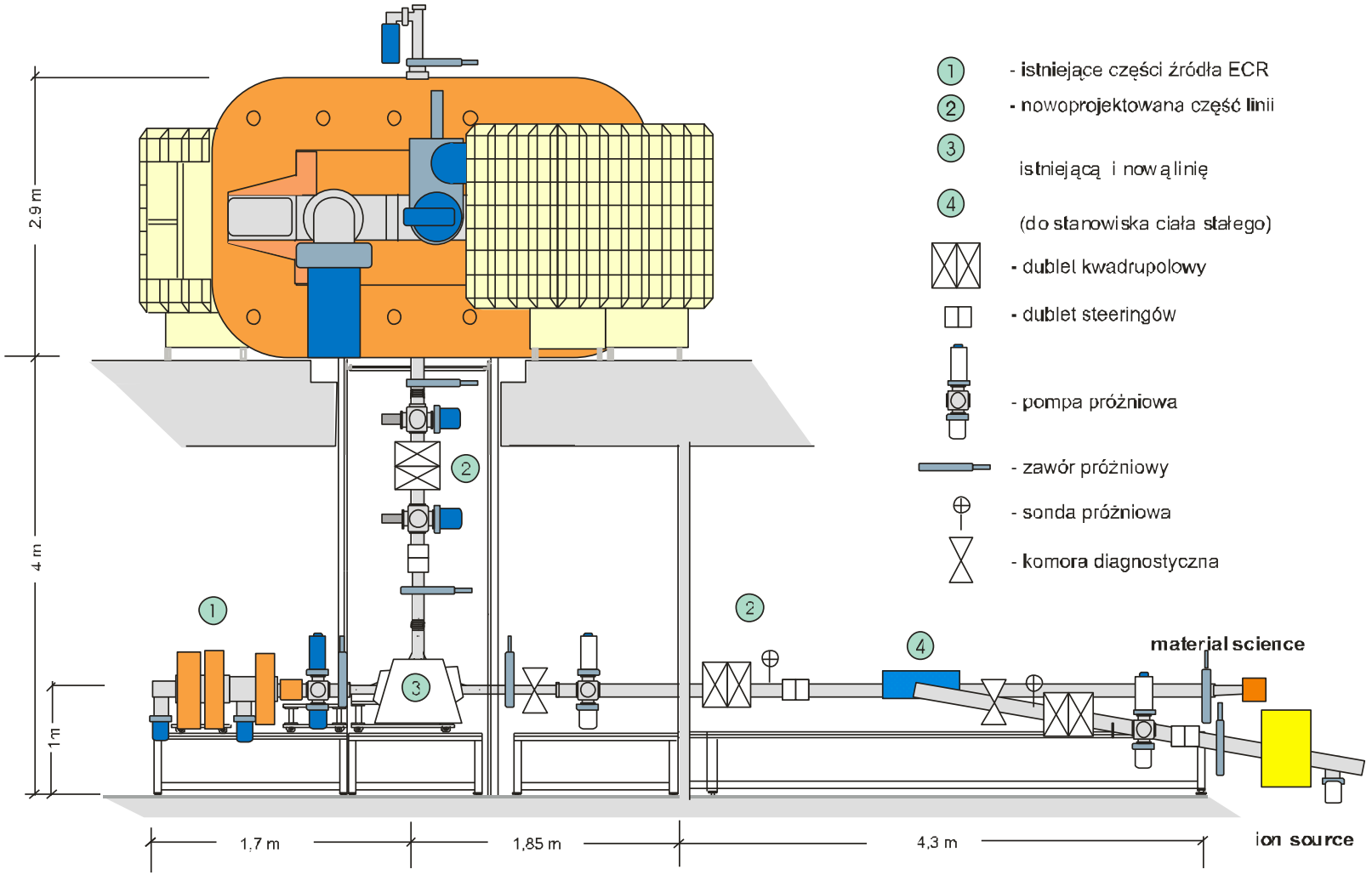
HIL ŚLCJ



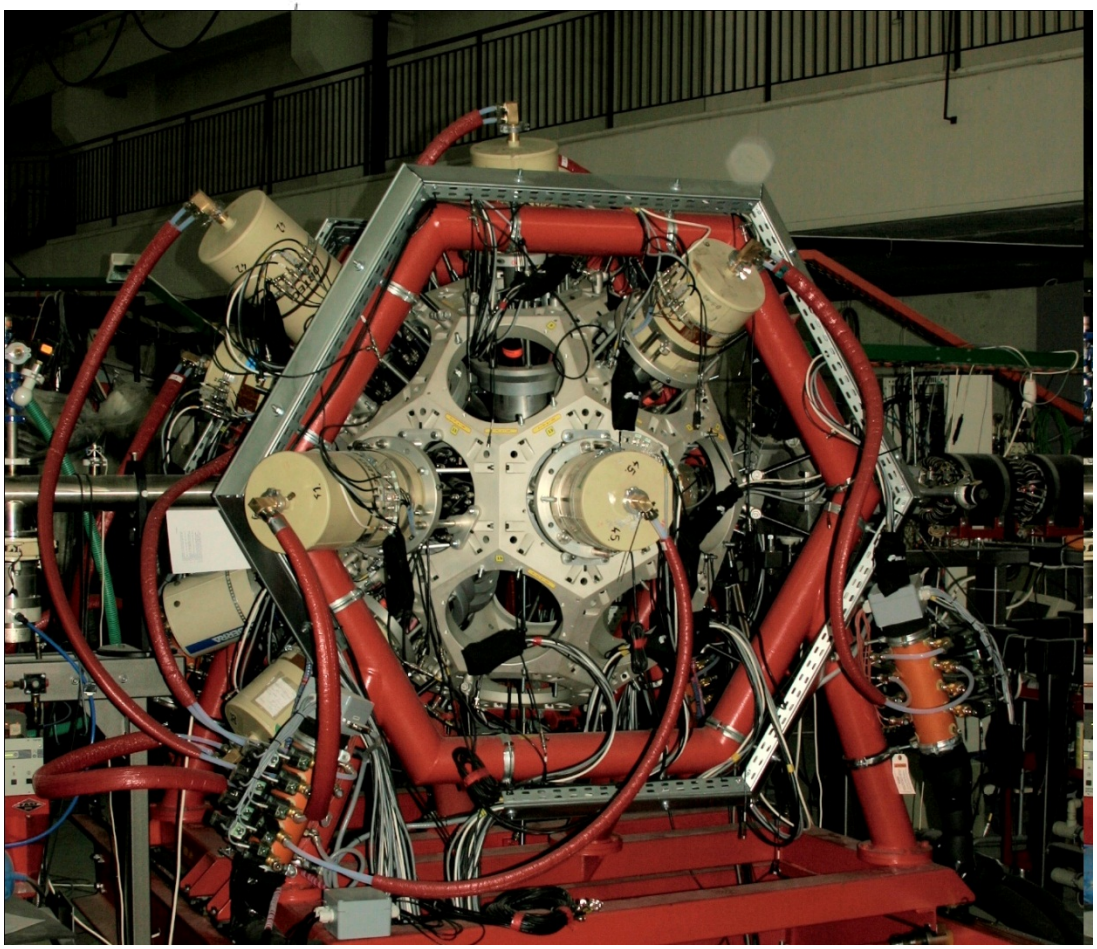
Energies 2 ÷10 MeV/A



Cyclotron U-200 and ion sources



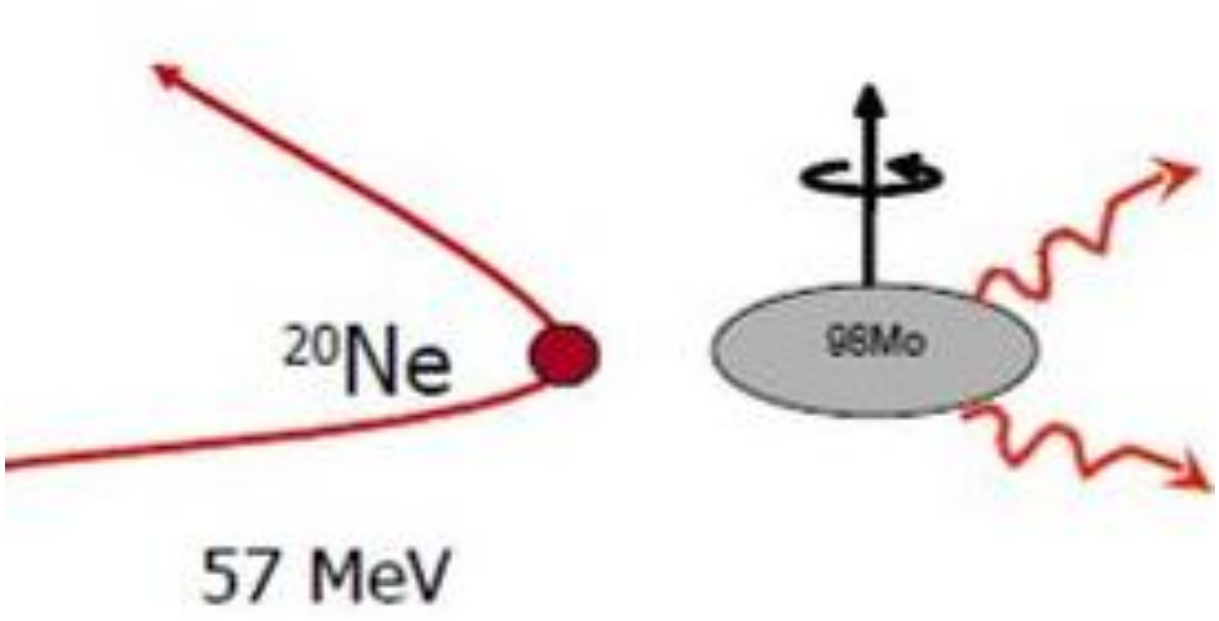
EAGLE γ - spectrometer



- up to 30 HP Ge detectors coupled to:
  - Internal conversion electron spectrometer
  - Scattering chamber with charged particles detectors

Electromagnetic properties of nuclei

(dr P. Napiorkowski, dr J. Srebrny…)



GOSIA Code

- Standard tool for Coulomb excitation data analysis
- Used worldwide, maintained and developed at HIL
- GOSIA Workshop – organised at HIL in April 2008

ISOLDE (MINIBALL), CERN:
J. Cederkäll, A. Ekström – ^{108,110}Sn, ^{108}In
J. Iwanicki - ^{88}Kr, ^{92}Kr
A. Hurst - ^{70}Se
I. Stefanescu – ^{68}Cu, ^{70}Cu
J. Van de Walle – ^{74}Zn
E. Clément – ^{96}Sr
A. Petts, N. Bree - ^{182,184,186,188}Hg

GANIL (EXOGAM), FRANCE:
E. Bouchez – ^{76}Kr
E. Clément – $^{74, 76}$Kr
M. Zielińska – ^{44}Ar

JAEA, TOKAI, JAPAN:
M. Koizumi - ^{66}Zn, ^{68}Zn
T. Hayakawa – ^{78}Se
A. Osa - ^{84}Kr
Y. Toh – ^{70}Ge
M. Zielińska – ^{96,98}Mo

JYVASKYLA, FINLAND
F. Becker – ^{78}Kr
M. Hackstein – ^{128}Xe

ANL (Gammasphere), USA
A.Hayes – ^{178}Hf

HIL Warsaw., Poland
J. Iwanicki– ^{165}Ho
M. Zielińska – ^{96,98}Mo
K. Wrzosek-Lipska - ^{100}Mo

Upcoming experiments – GOSIA used for simulations

ISOLDE (MINIBALL), CERN:
B. Bastin – ^{198,202}Po
M.Scheck – ^{220,222}Rn, ^{222,224}Ra

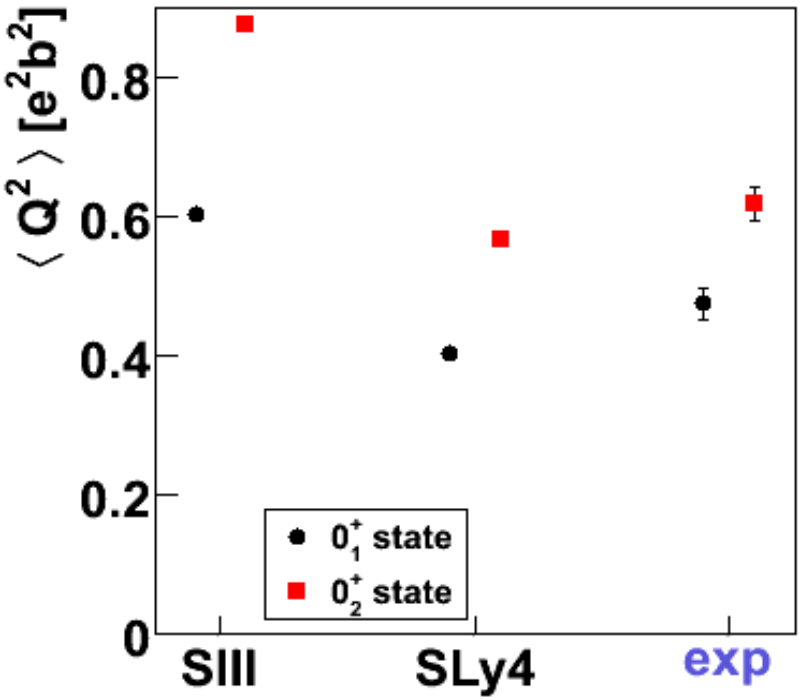
HIL WARSAW, POLAND
M.Scheck – ^{94}Zr (Mar 2010)
M. Zielińska – ^{104}Pd (May 2010)

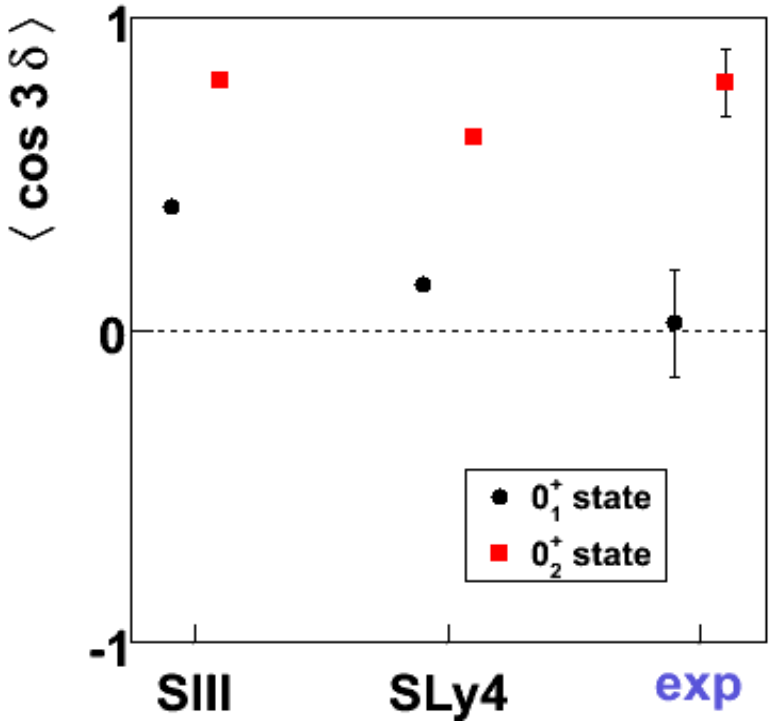
Deformation of ^{100}Mo g.s. and 0+ exc. state

Theory:

L. Próchniak Int. J. Mod. Phys. E19 (2010) 705,

L. Próchniak, S. G. Rohoziński, J. Phys. G: Nucl. Part. 36 (2009) 123101

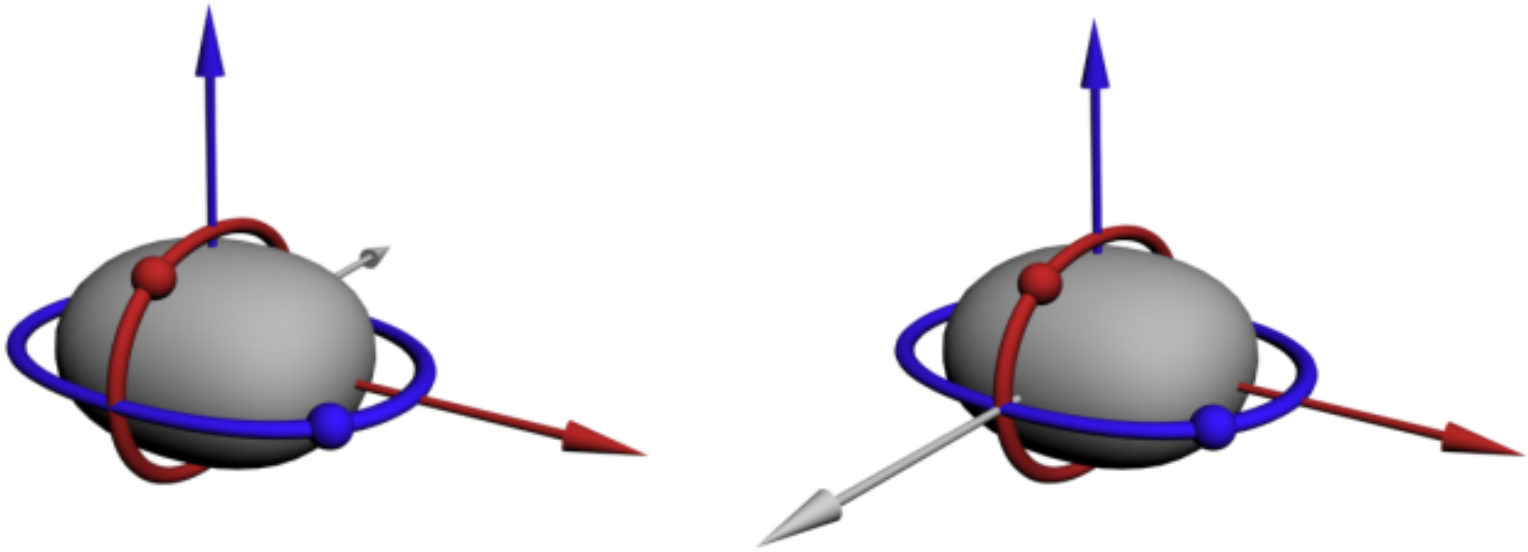




triaxial

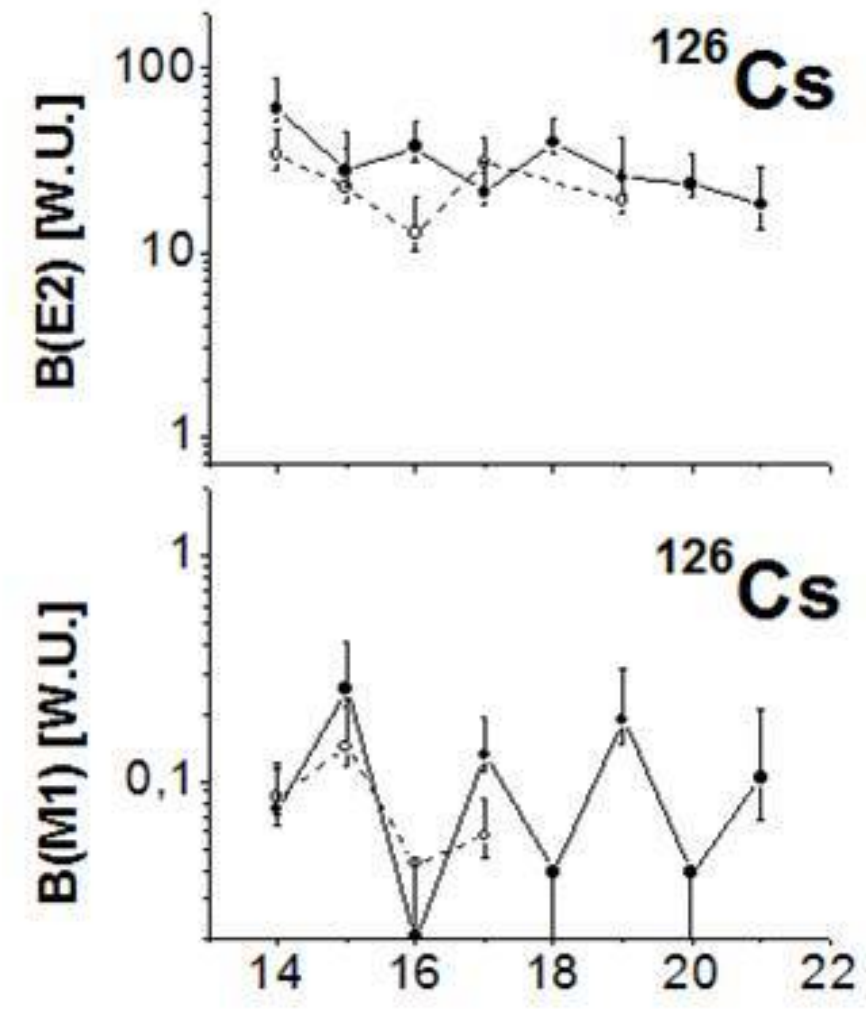
Symmetries and nuclear structure

(Dr J. Srebrny, dr E.Grodner…)



Studies of identical bands in A~130 nuclei

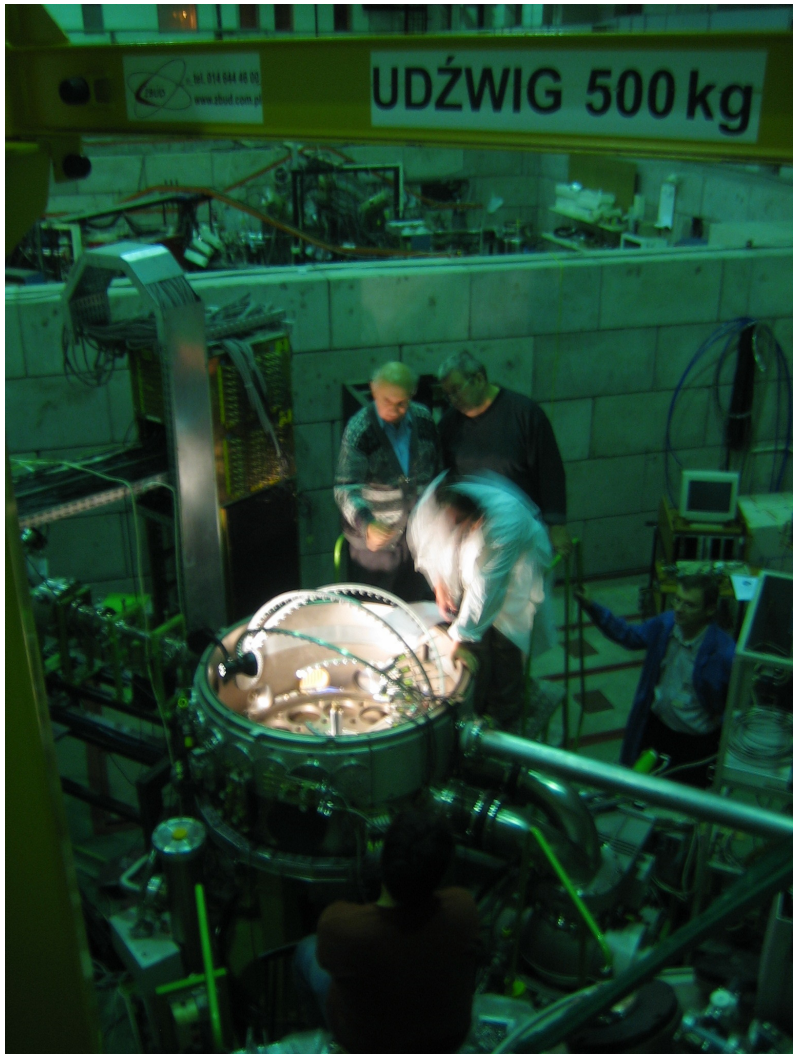
Results:

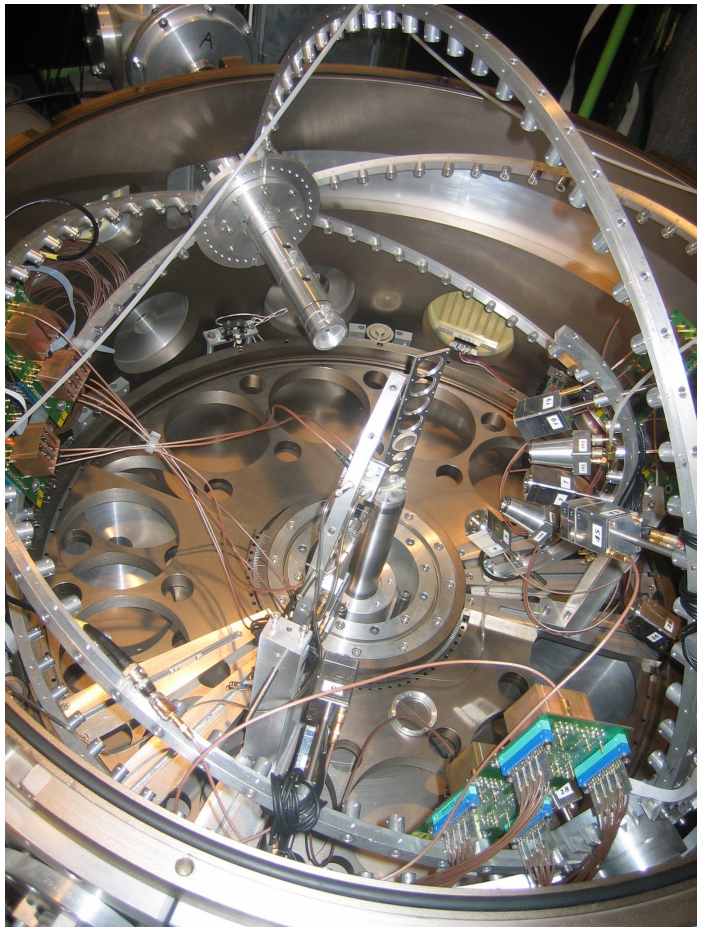


Solid curve – g.s. band

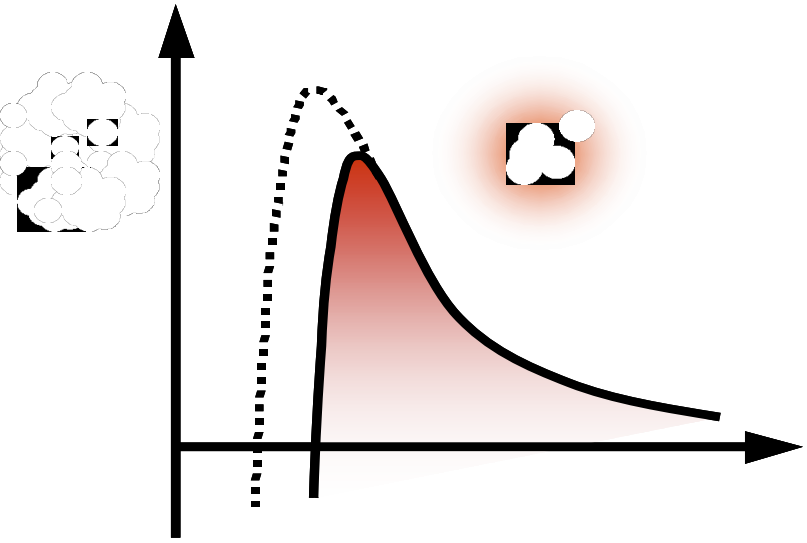
Dashed curve – side band

ICARE large scattering chamber

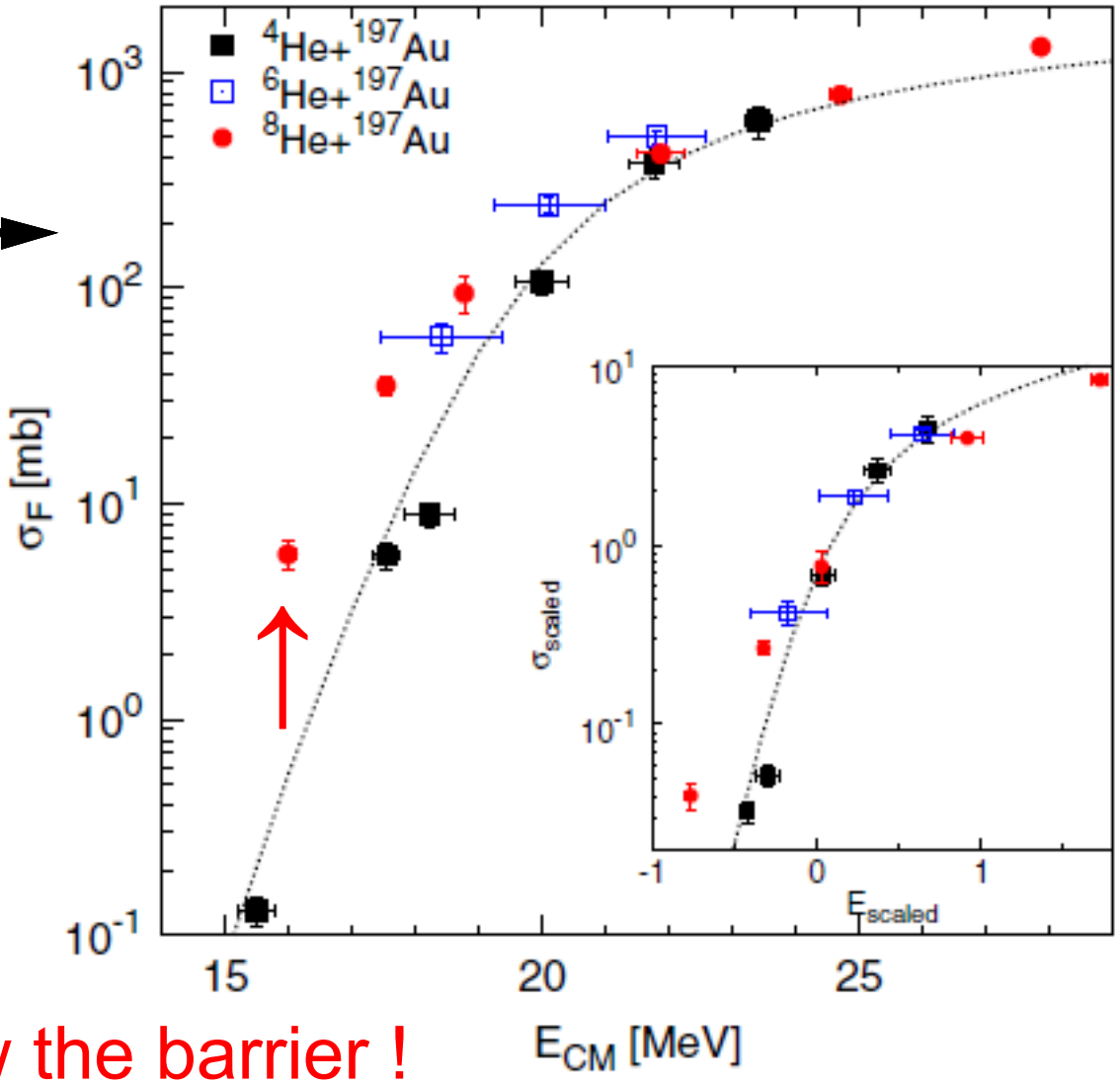




Tunneling



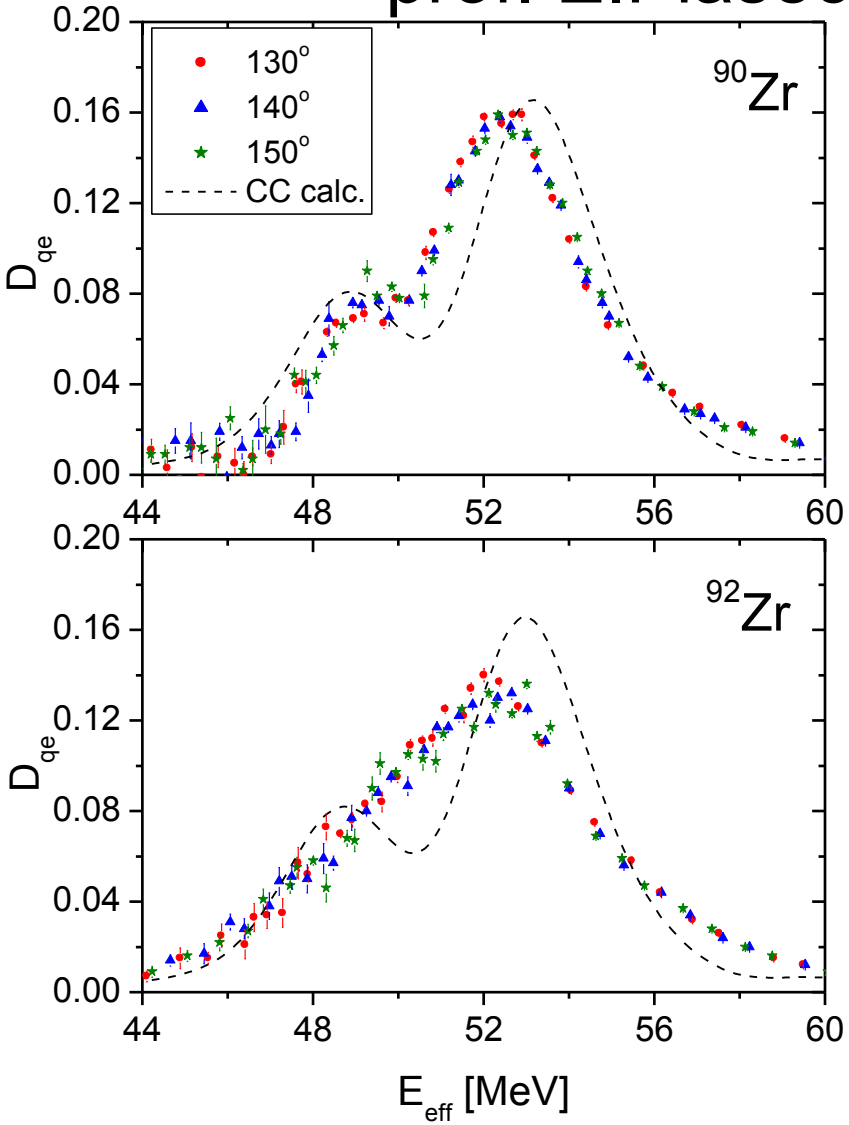
A. Lemasson et al. PRL 103 (2009) 2327701



Enhancement below the barrier !

Coulomb barrier distribution

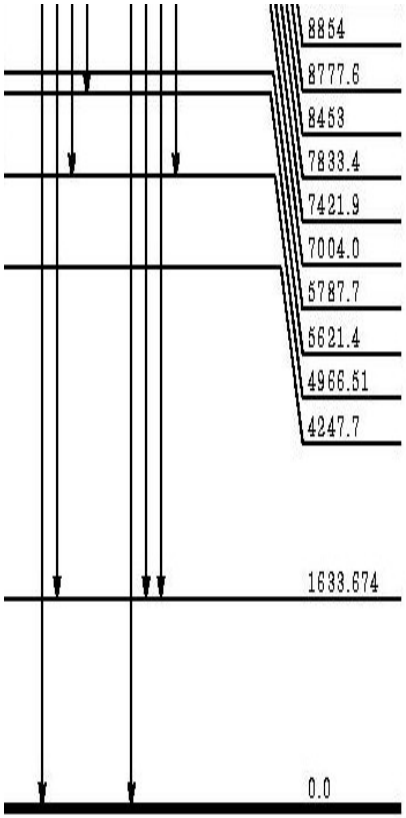
prof. E.Piasecki, dr A. Trzcinska



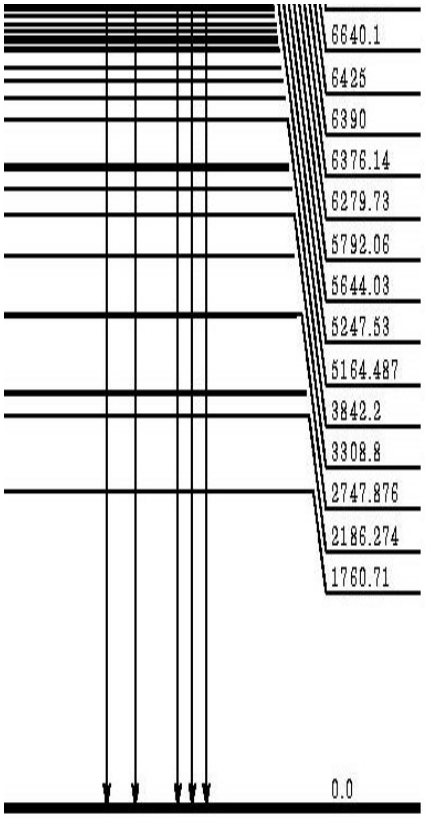
Exp: ^{20}Ne + Zr

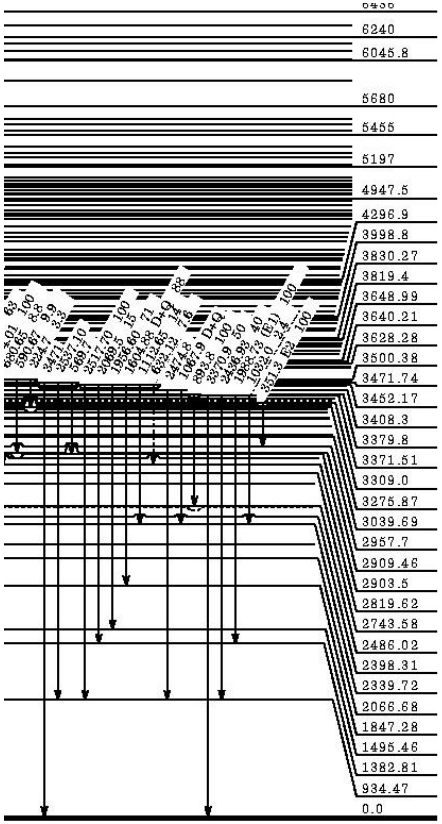
E. Piasecki i in., PR C80 (2009) 054613

Structure dependence



+





^{20}Ne **^{90}Zr** **^{92}Zr**

α-structure of light nuclei

$^{16}O = {}^{12}C + \alpha$

M.C. Morais, R. Lichtenthäler / Nuclear Physics A 857 (2011) 1–8

Table 2
Alpha spectroscopic factors for $^{16}O_{gs}$.

Work	Reaction	S_α
This work	$^{12}C(^{16}O,^{12}C)^{16}O$	1.45–1.58
Refs. [22,23]	$^{12}C(^{6}Li, d)^{16}O$	7.6–10
Ref. [24]	$^{12}C(^{7}Li, t)^{16}O$	0.38
Ref. [25]	$^{12}C(^{6}Li, d)^{16}O$	0.34
Ref. [26]	$^{16}O \rightarrow \alpha + {}^{12}C$	5.41
Refs. [9,19]	$^{12}C(^{16}O,^{12}C)^{16}O$	1.0–2.0

Experyments in HIL – A. Pakou et al. Uniwersytet Ioannina, Grecja

N. Burtebayev, University of Almaty, Kazakhstan

Interaction of exotic nuclei

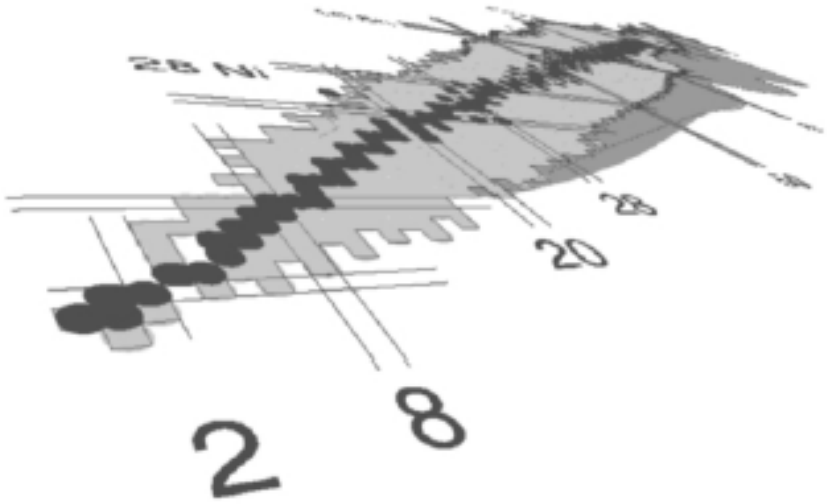
New „magic” numbers

Nuclear halo

Three body forces

Clustering

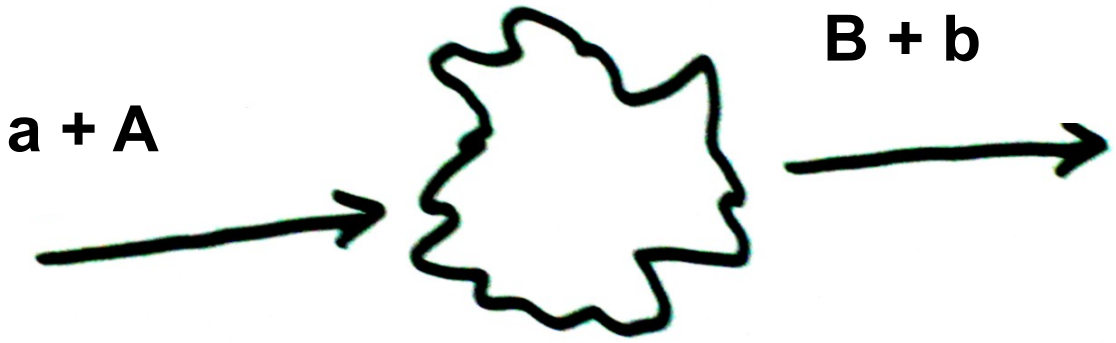
etc.



What about en effective optical potential??

Interaction of exotic nuclei

prof. Adam Rudchik, IBJ UAN Kiev



Probability: optical potential a + A

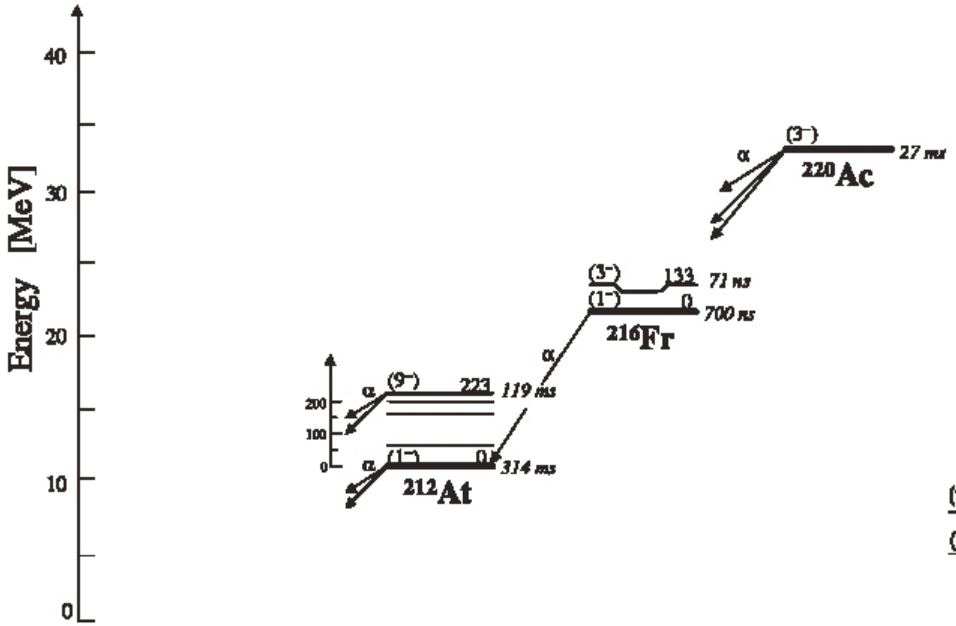
+ structure

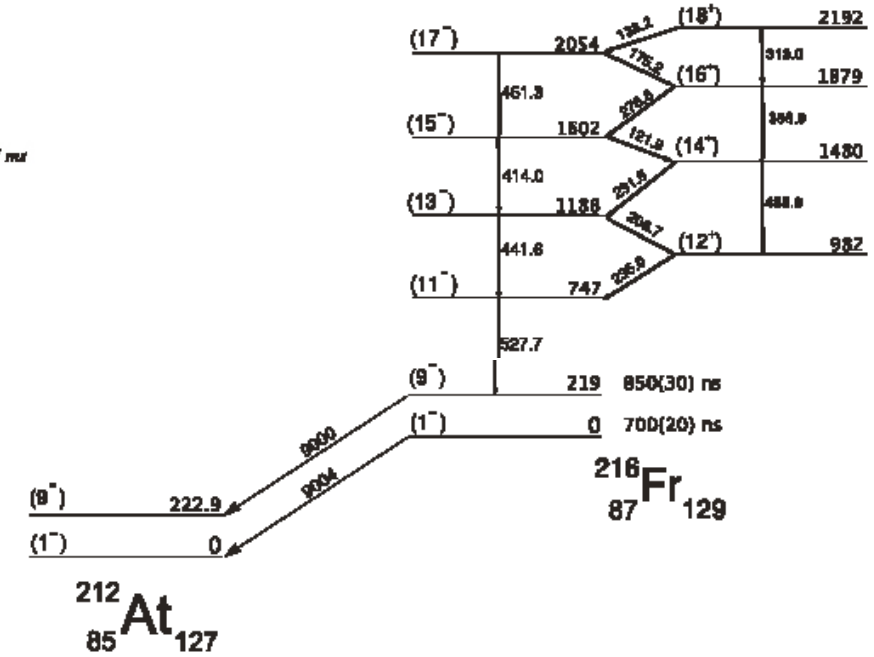
+ opt. potential b + B

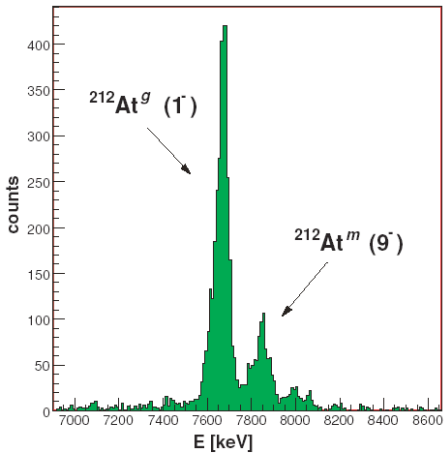
IGISOL – magnetic spectrometer

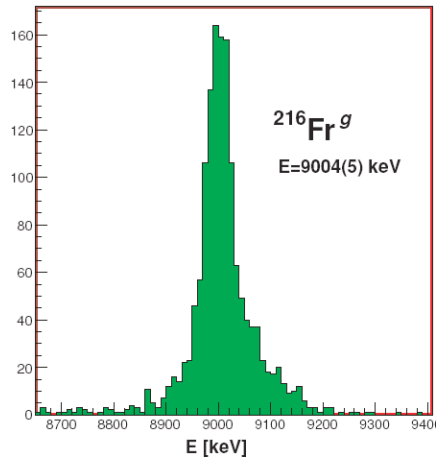
- Trans – lead nuclear isomers investigated by isotope separation on – line

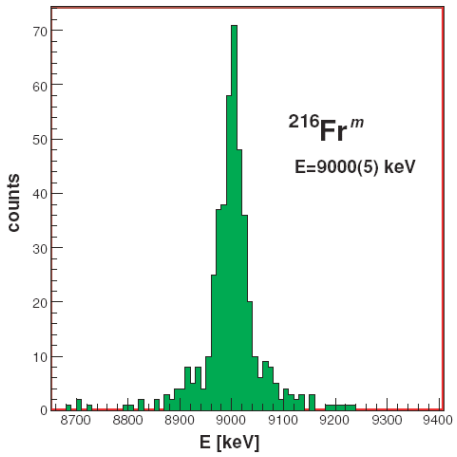
J. Kurcewicz et al. Phys. Rev. C76(2007)054320

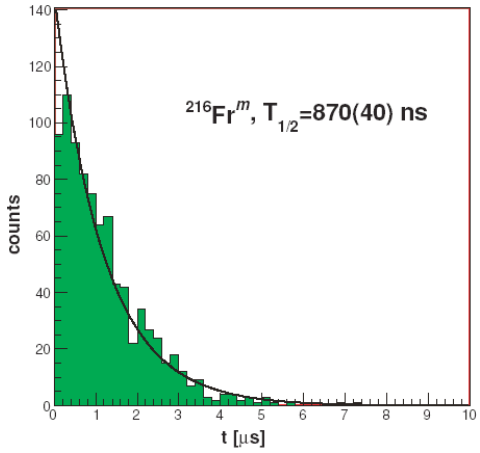




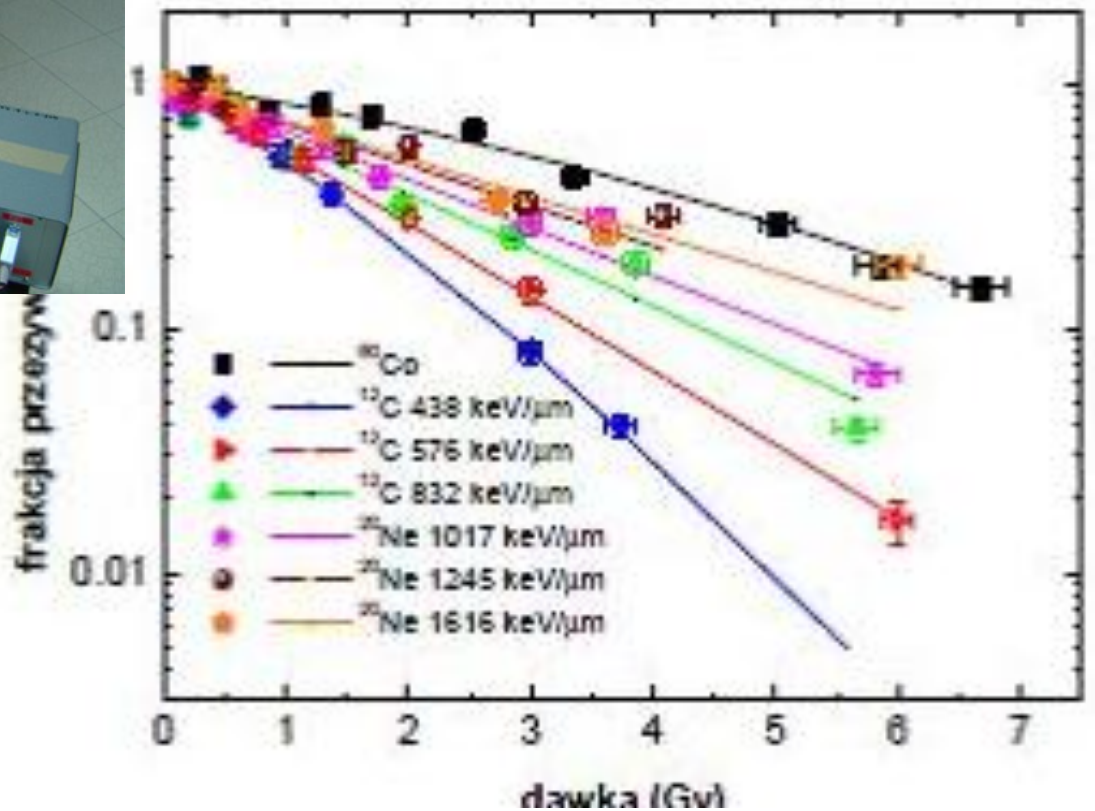




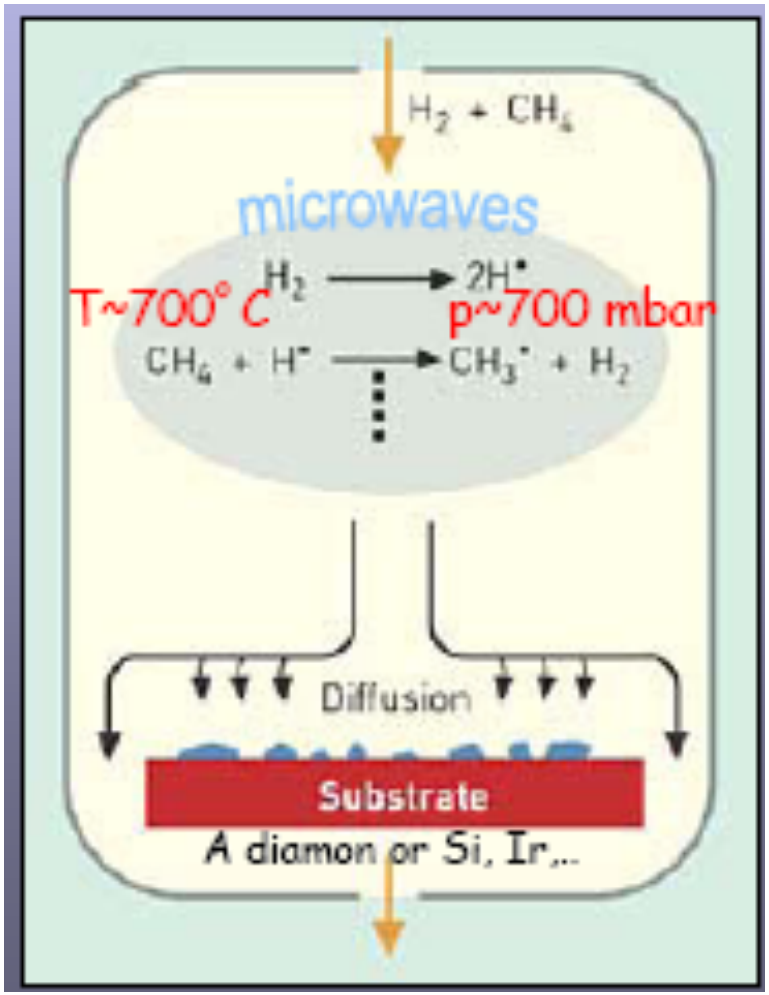




Survival of irradiated cells
(dr z. Szeflinski…)

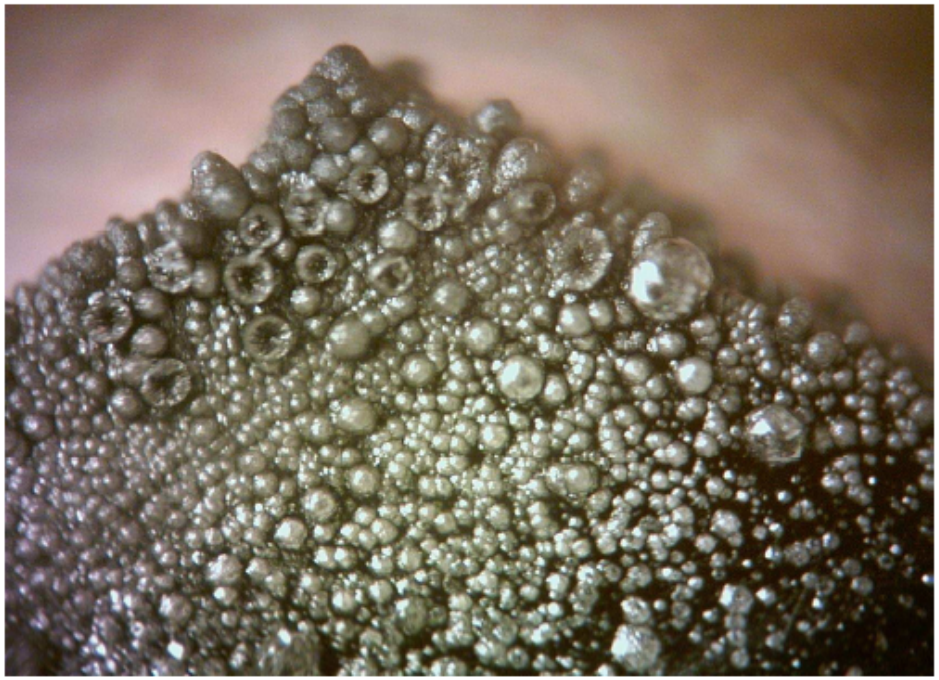


Detector laboratory



prof. A. Kordyasz

Diamond detectors

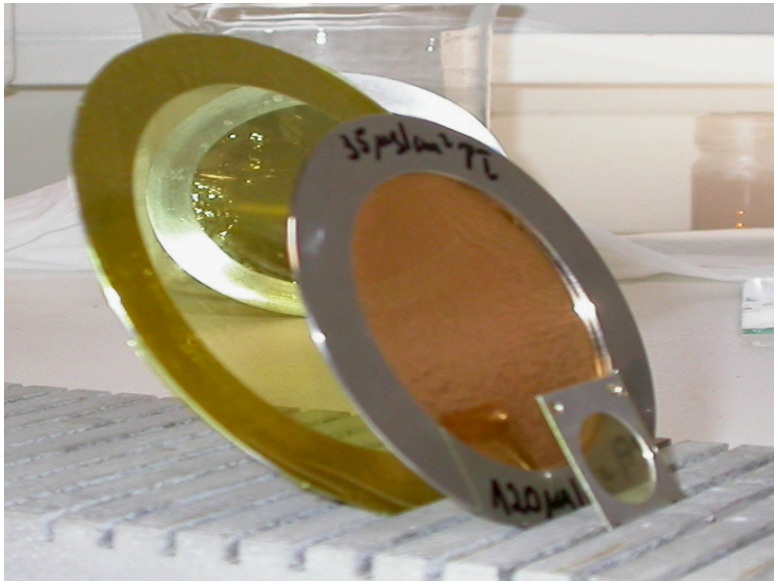


Target laboratory

dr Anna Stolarz

Head of ***International Nuclear Target Development Society***

www.intds.org



polyimide $(C^{22}H^{10}N^{2}O^{4})^{n}$

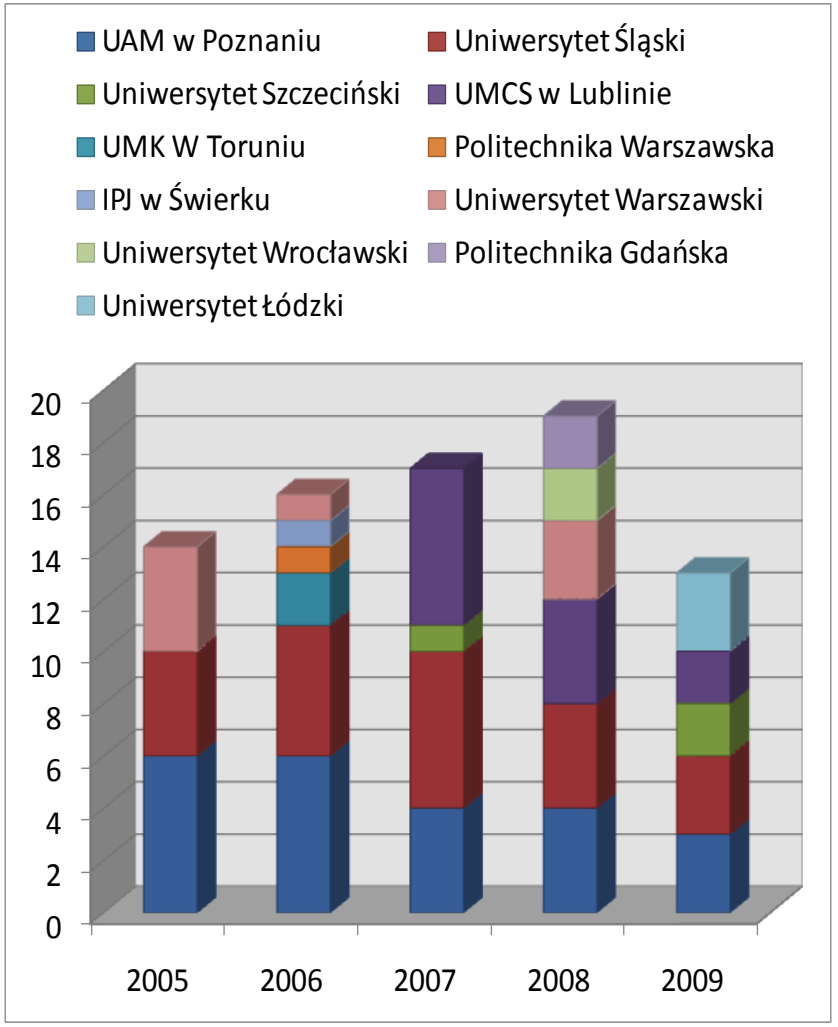
Perfect mechanical properties, high chemical resistance, low radiadion damage

Education

One-week workshop for undergrad. students

Środowiskowe Laboratorium Ciężkich Jonów, Uniwersytet Warszawski.

***Warszawa,* 20 - 25 April 2009 r.**



International student workshop

Partners:

- University of Warsaw, Poland
- University of Huelva, Spain
- University of Sofia, Bulgaria
- Akdeniz University, Antalya, Turkey

Participants 2010

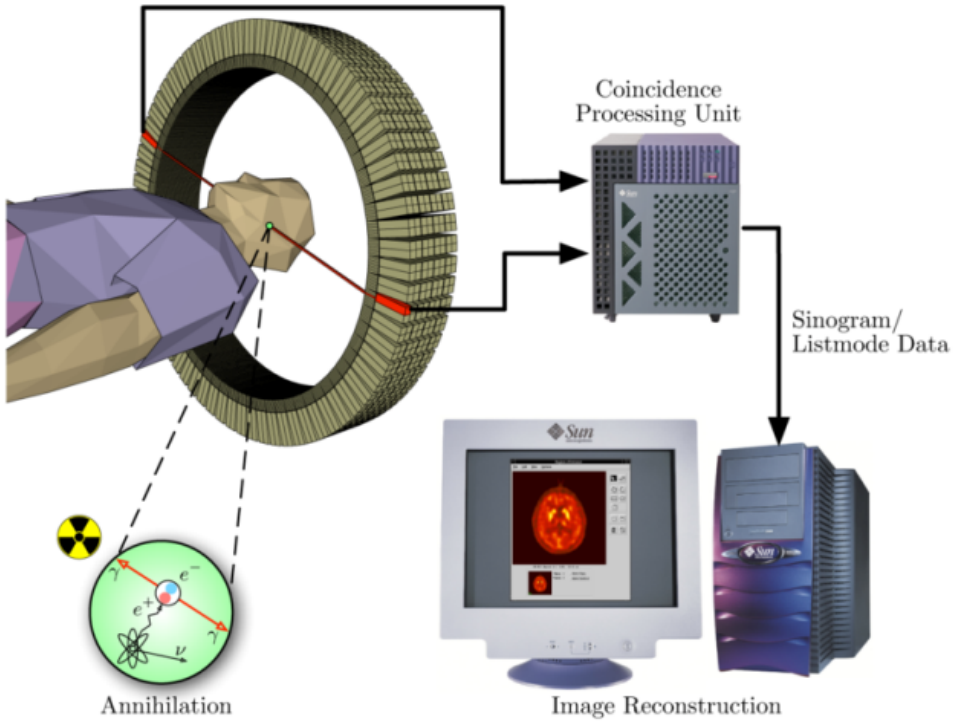
International Workshop
on Acceleration and Applications
of Heavy Ions

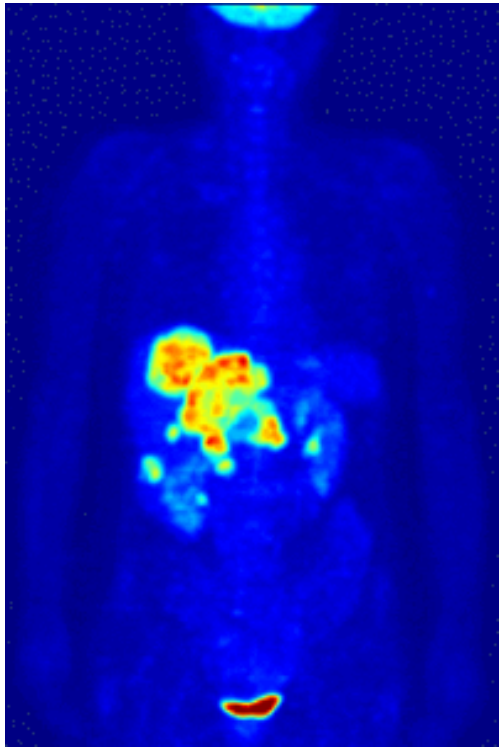
Participants

International Workshop
on Acceleration and Applications
of Heavy Ions

Positron-Emitting Tomography

- During 80 and 90s mostly a research tool
- Since 2000: standard technique in large hospital in EU/US for diagnosis of cancer





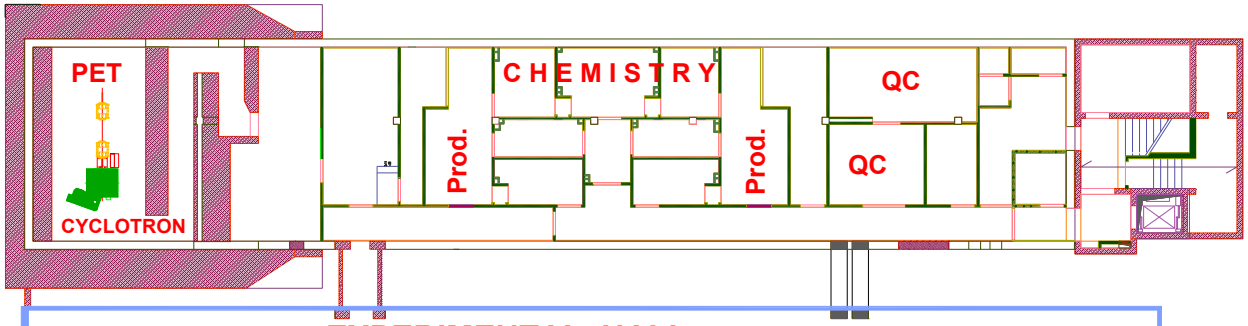
Isotopes

Nuclid	$T_{1/2}$ (min)	E_{max} (MeV)	Range y (mm)	Target	Reaction
^{18}F	109,7	0,635	0,2	^{18}O water Ne gas	$^{18}O(p,n)^{18}F$ $^{20}Ne(d,\alpha)^{18}F$
^{11}C	20,4	0,96	0,4	N_2 - gas	$^{14}N(p,\alpha)^{11}C$
^{13}N	9,96	1,72	0,8	^{16}O water	$^{16}O(p,\alpha)^{13}N$ $^{12}C(d,n)^{13}N$
^{15}O	2,07	1,19	0,5	N_2 - gas	$^{14}N(d,n)^{15}O$
^{68}Ga	68,3	1,9	1,2		Generator (from ^{68}Ge)

Radiopharmaceutical research and production centre

p / d cyklotron
16/8 MeV
(General Electric)

> 75 μA p
> 60 μA d



Opening ceremony, 15.05.2012

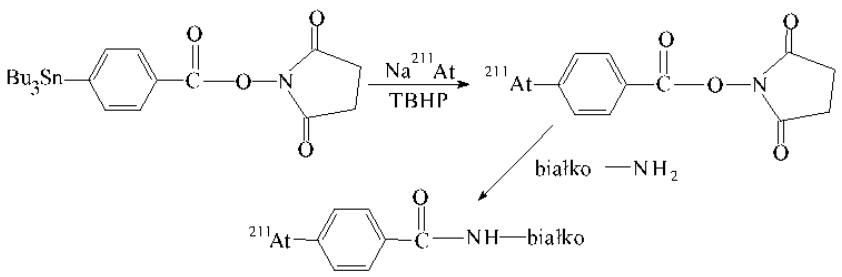
Therapy using α-emitters
(prof. J. Jastrzębski, dr J. Choinski…)

- α's strongly interact with matter
- Have short range – do not kill healthy cells
- Perfect theraphy for small cancers

α

^{211}At, ^{225}Ac, ^{212,213}Bi, ^{223,224}Ra, ^{212}Pb, ^{226}Th

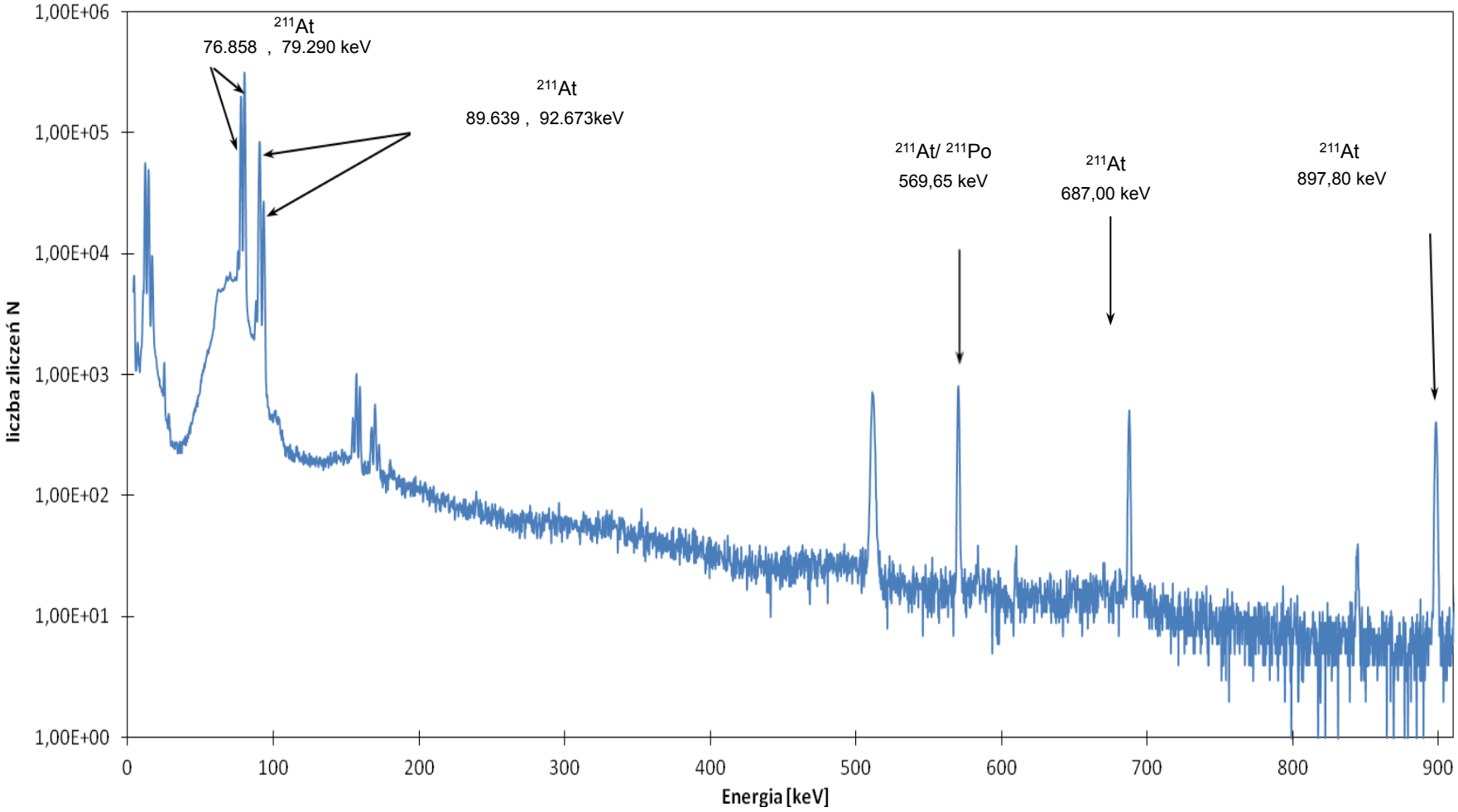
isotope production



drug

chemistry

Gamma spectrum from α irradiated Bi target



Summary

Heavy Ion Laboratory, University of Warsaw :

- National nuclear physics laboratory open for external users
- Recognized in Europe
- Involved in teaching
- developing medical applications