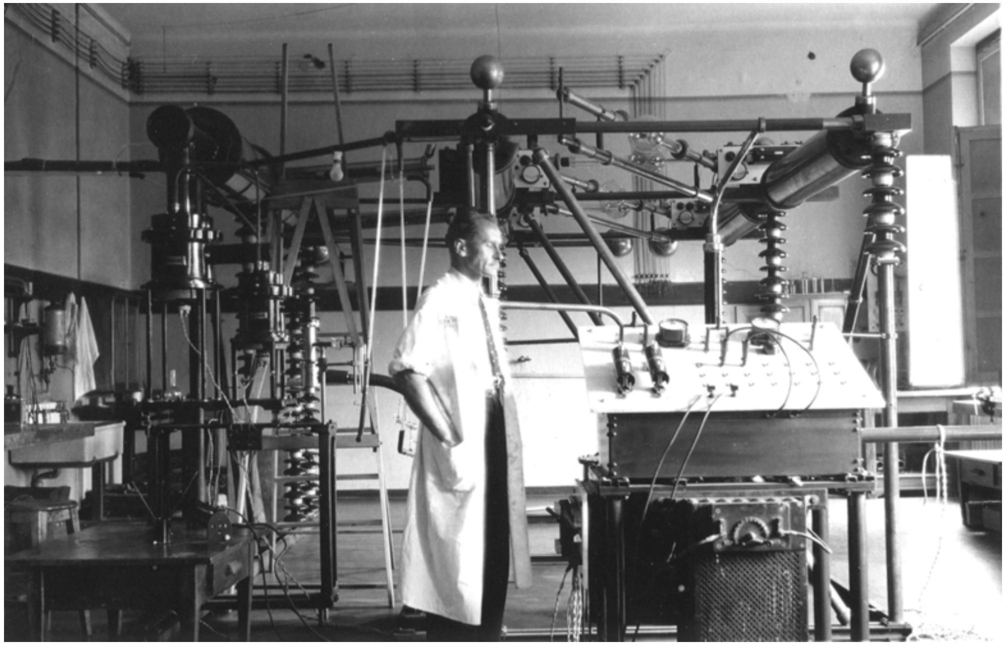
Heavy Ion Laboratory, University of Warsaw

Krzysztof Rusek

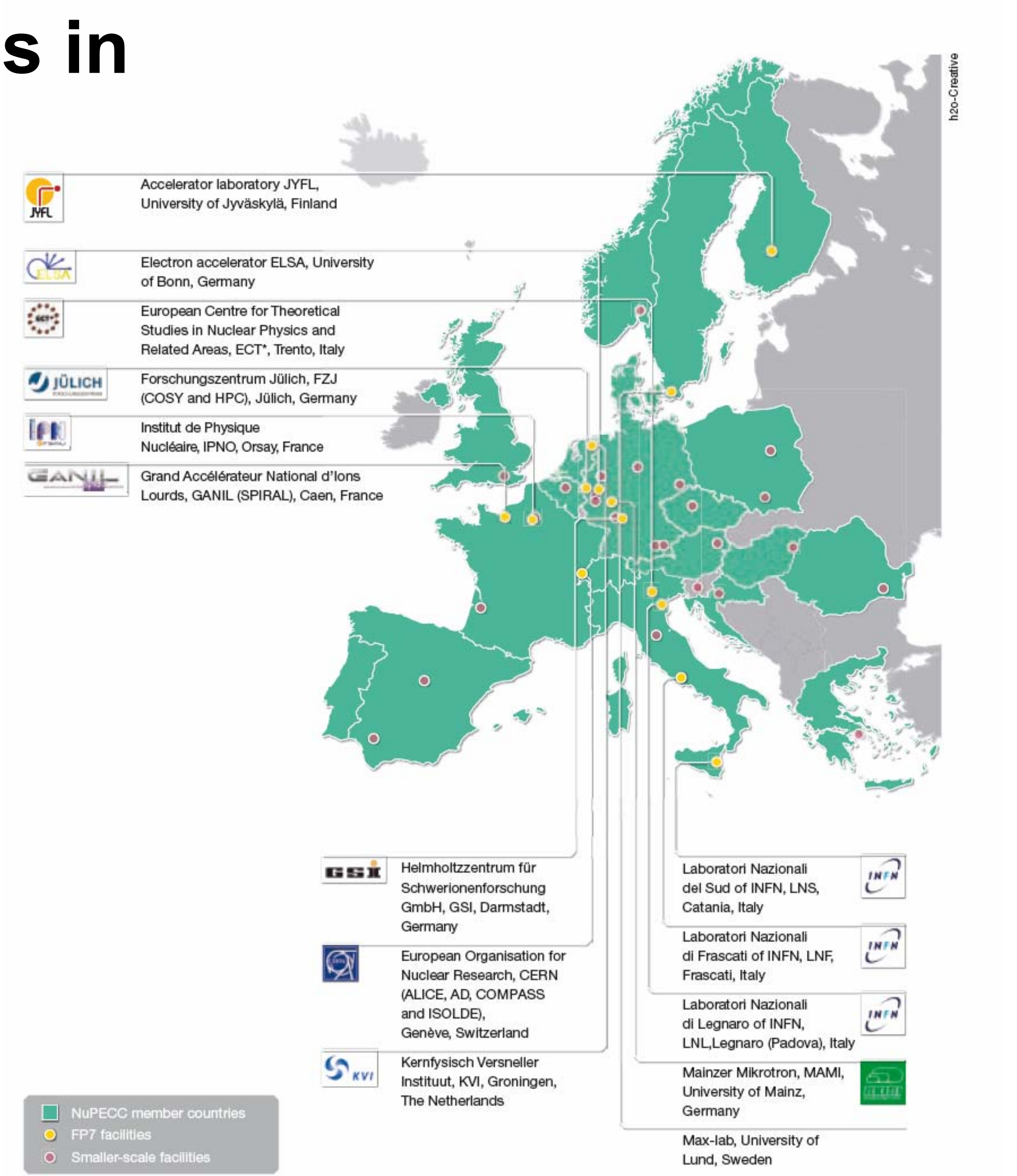
First Nuclear Physics Lab in Poland

Hoża 69, prof. A. Sołtan (1937)

deuterons 0.4 MeV, I up to 200 μA



Nuclear facilities in Europe:



NuPECC Long Range Plan

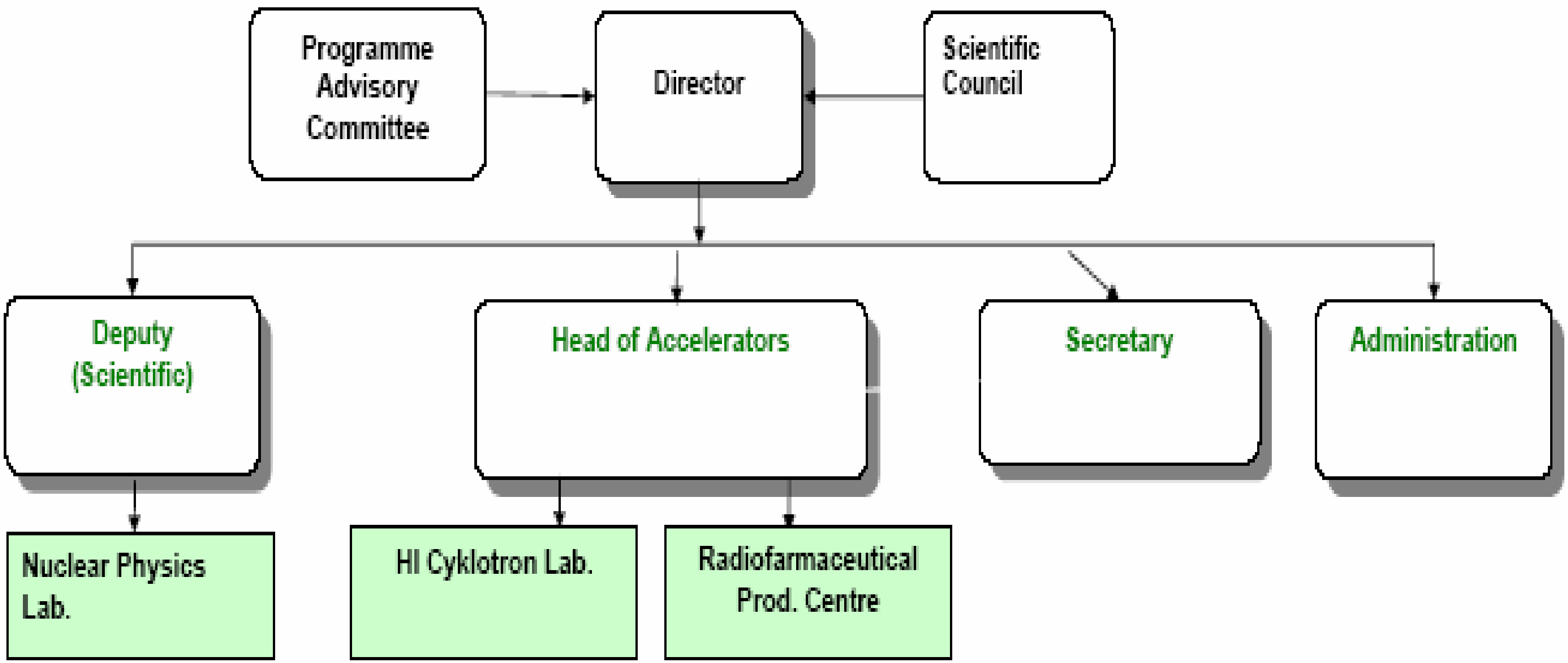
Nuclear Facilities in Poland

Campus Ochota

First oncological hospital in Poland

29.05.1932

Heavy Ion Laboratory UW



Staff

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

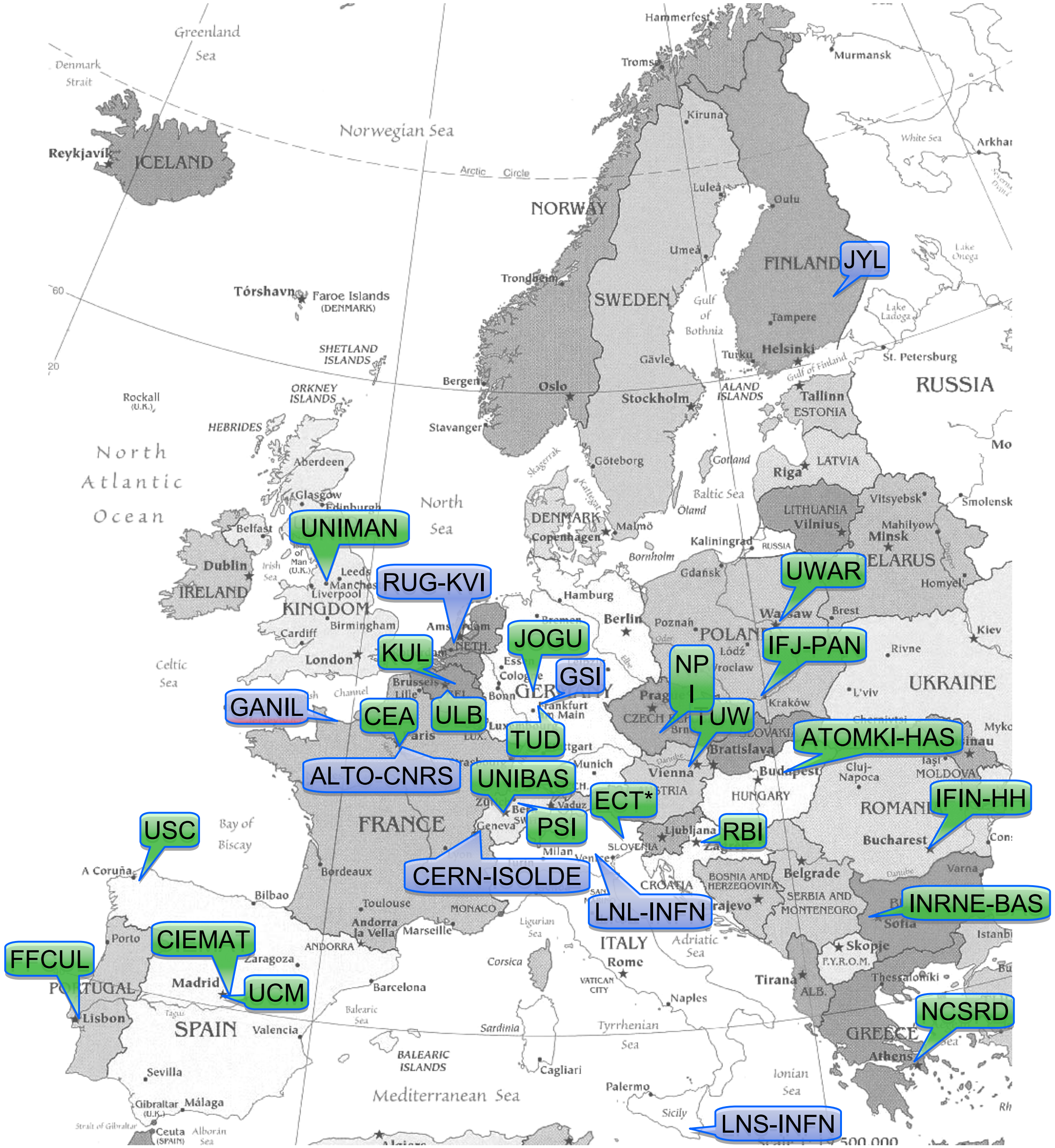
EU-FP7 funded Integrating Activity

"European Nuclear Science and Applications Research"

(ENSAR)

ENSAR is the Integrating Activity of Nuclear Scientists from almost all European countries performing research in three of the major subfields of Nuclear Physics: Nuclear Structure, Nuclear Astrophysics and Applications of Nuclear Science. It proposes an optimised ensemble of Networking (NAs), Transnational Access and Joint Research Activities (JRAs), which will ensure qualitative and quantitative improvement of the access provided by the current seven infrastructures, which are at the core of this proposal. The novel and innovative developments that will be achieved by the RTD activities will also assure state-of-the-art technology needed for the new large-scale projects.

Partners



7 TNA Facilities

29 beneficiaries

18 countries

Joint Research Activities in ENSAR

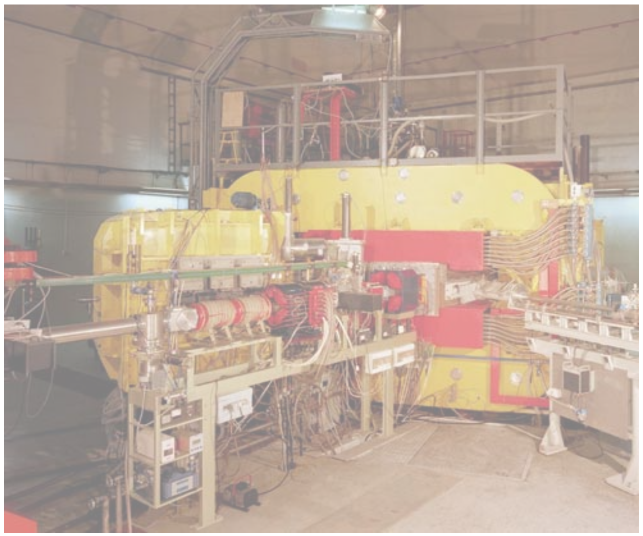
The JRAs deal with all aspects of experimental activities from sources and targets, to detectors, simulations of experimental set-ups, data analysis and development of adequate theoretical tools

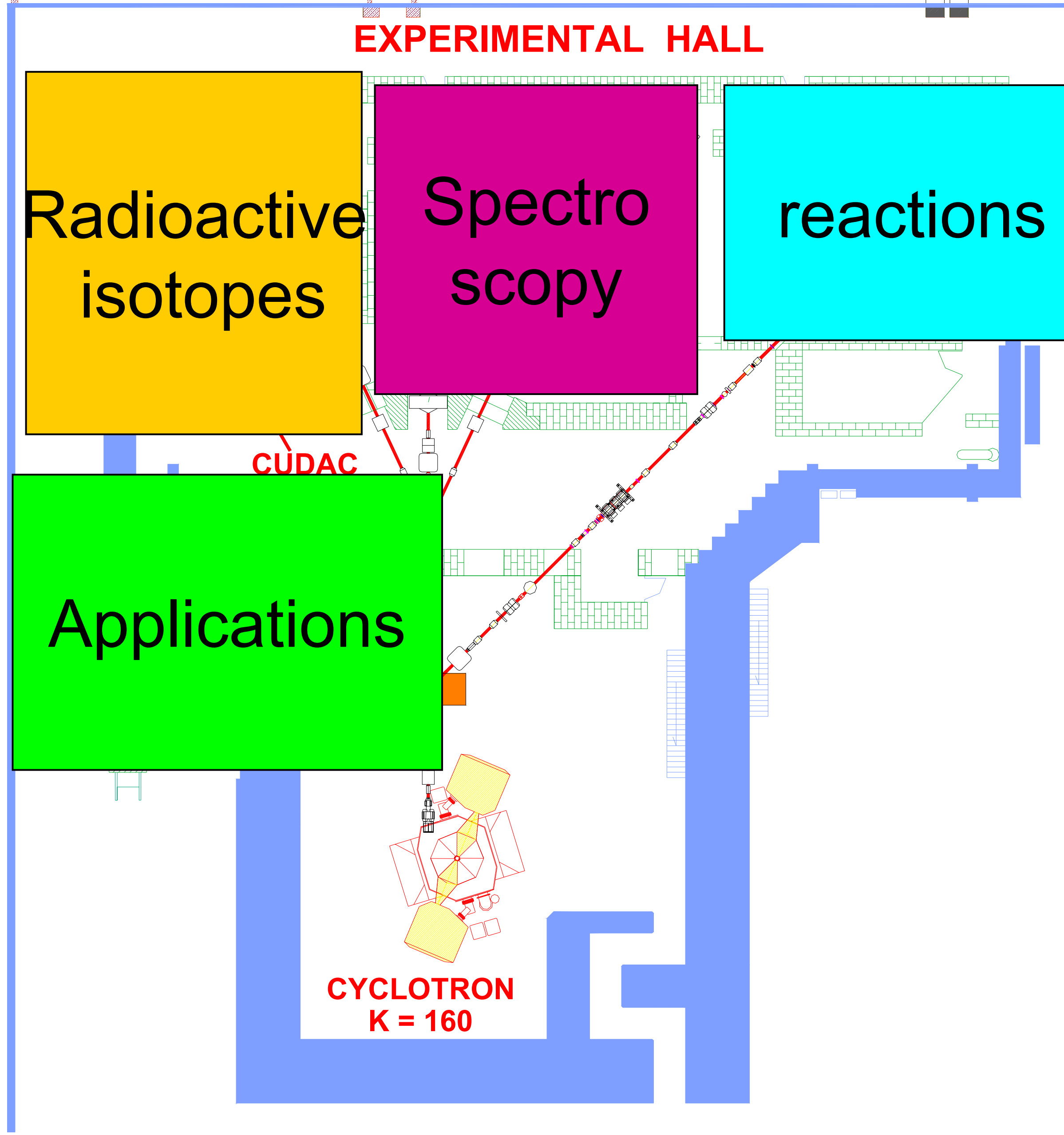
- **JRA01** ***ARES*** ***(Advanced Research on Ecr ion Sources)***
- **JRA02** ***ActILab*** ***(Actinide ISOL target R&D Laboratory)***
- **JRA03** ***PREMAS*** ***(Low-energy beam PREparation, MAnipulation & Spectroscopy)***
- **JRA04** ***INDESYS*** ***(INnovative solutions for nuclear physics DEtector SYStems: "From basic R&D to applications for the society")***
- **JRA05** ***SiNuRSE*** ***(Simulations for Nuclear Reactions and Structure in Europe)***
- **JRA06** ***EWIRA*** ***(East West Integrated Research Activities)***
  - create a niche for the small(er) laboratories from Central and South-Eastern Europe and bring them to a level comparable to that of the existing Western European laboratories
- **JRA07** ***THEXO*** ***(THeoretical tools in support of infrastructures)***

EC Funded Projects in Nuclear Physics

Project	Type	EC funding (M€)	FP
HadronPhysics: Study of Strongly Interacting Matter	Integrating Activity	17,4	FP6
EURONS: EUROpean Nuclear Structure Integrated Infrastructure Initiative	Integrating Activity	14,1	FP6
HadronPhysics2: Study of Strongly Interacting Matter	Integrating Activity	10,0	FP7
EURISOL DS: EURopean Isotope Separation On-Line Radioactive Ion Beam Facility	Design Study	9,2	FP6
DIRACsecondary-Beams: Internal Target experiments at the International Accelerator Facility	Design Study	9,0	FP6
DIRAC-PHASE-1: Construction stage 1 of the International Accelerator Facility	Construction	10,4	FP6
FAIR: Facility for Antiproton and Ion Research	Construction - Preparatory Phase	4,9	FP7
SPIRAL2PP: SPIRAL2 Preparatory Phase	Construction - Preparatory Phase	3,9	FP7
NUPNET: ERANET for Nuclear Physics Infrastructures	ERANET	1,3	FP7

HIL ŚLCJ





Energies 2 ÷10 MeV/A

Ions ^{10}B ÷ ^{40}Ar

Nuclear reactions

- Interaction of exotic nuclei

- Tunneling through the barrier

Interaction of exotic nuclei

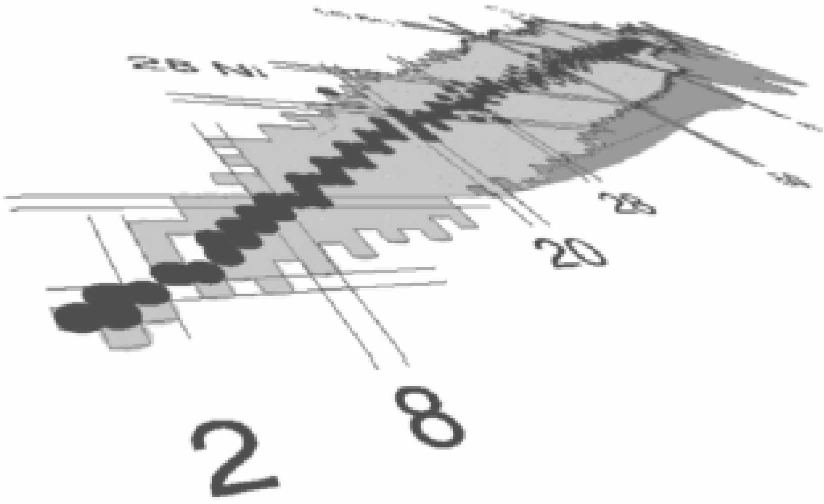
New „magic” numbers

Nuclear halo

Three body forces

Clustering

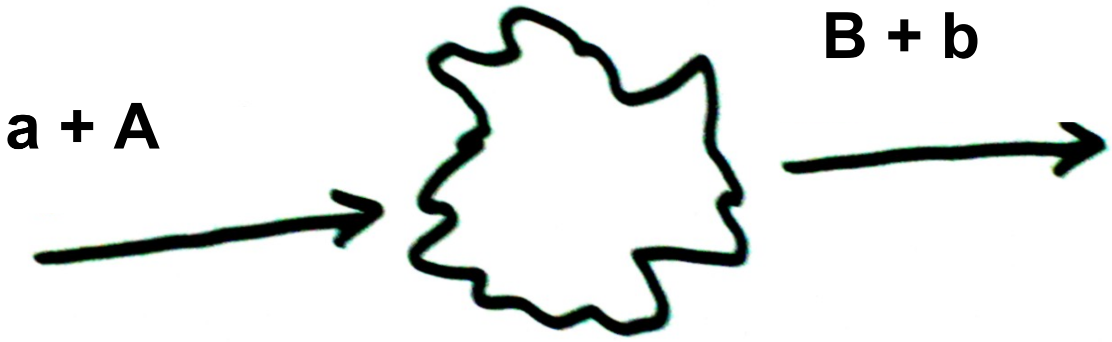
etc.



What about en effective optical potential??

Interaction of exotic nuclei

prof. Adam Rudchik, IBJ UAN Kiev

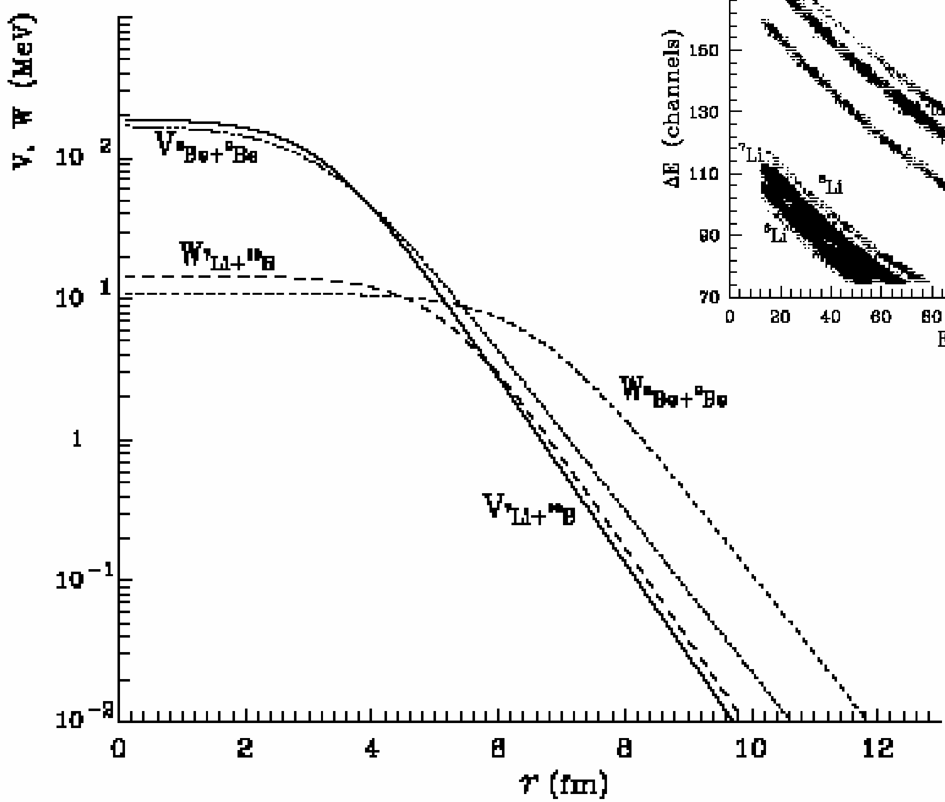


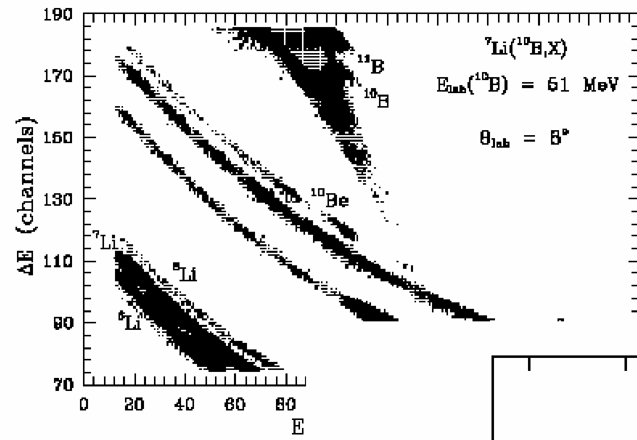
Probability: optical potential a + A

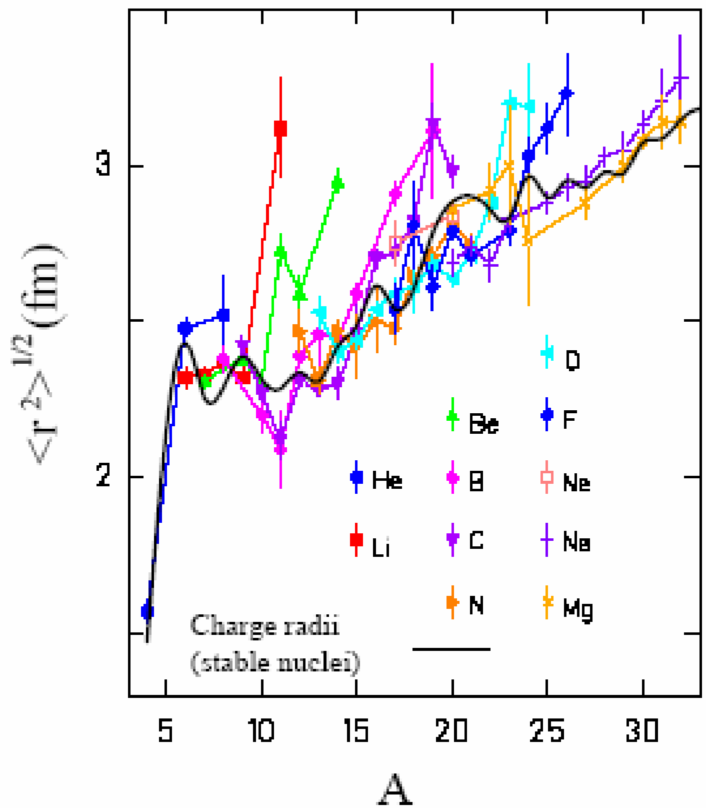
+ structure

+ opt. potential b + B

$^{10}B + {}^{7}Li \rightarrow {}^{8}Be + {}^{9}Be$

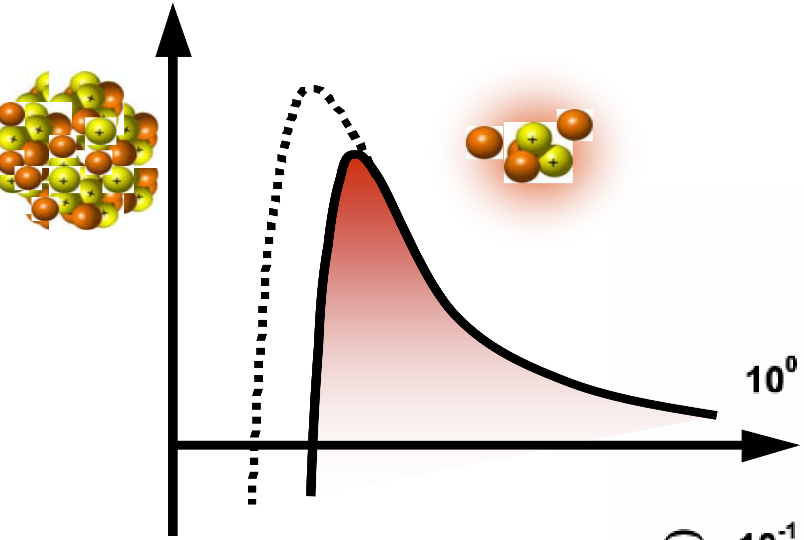


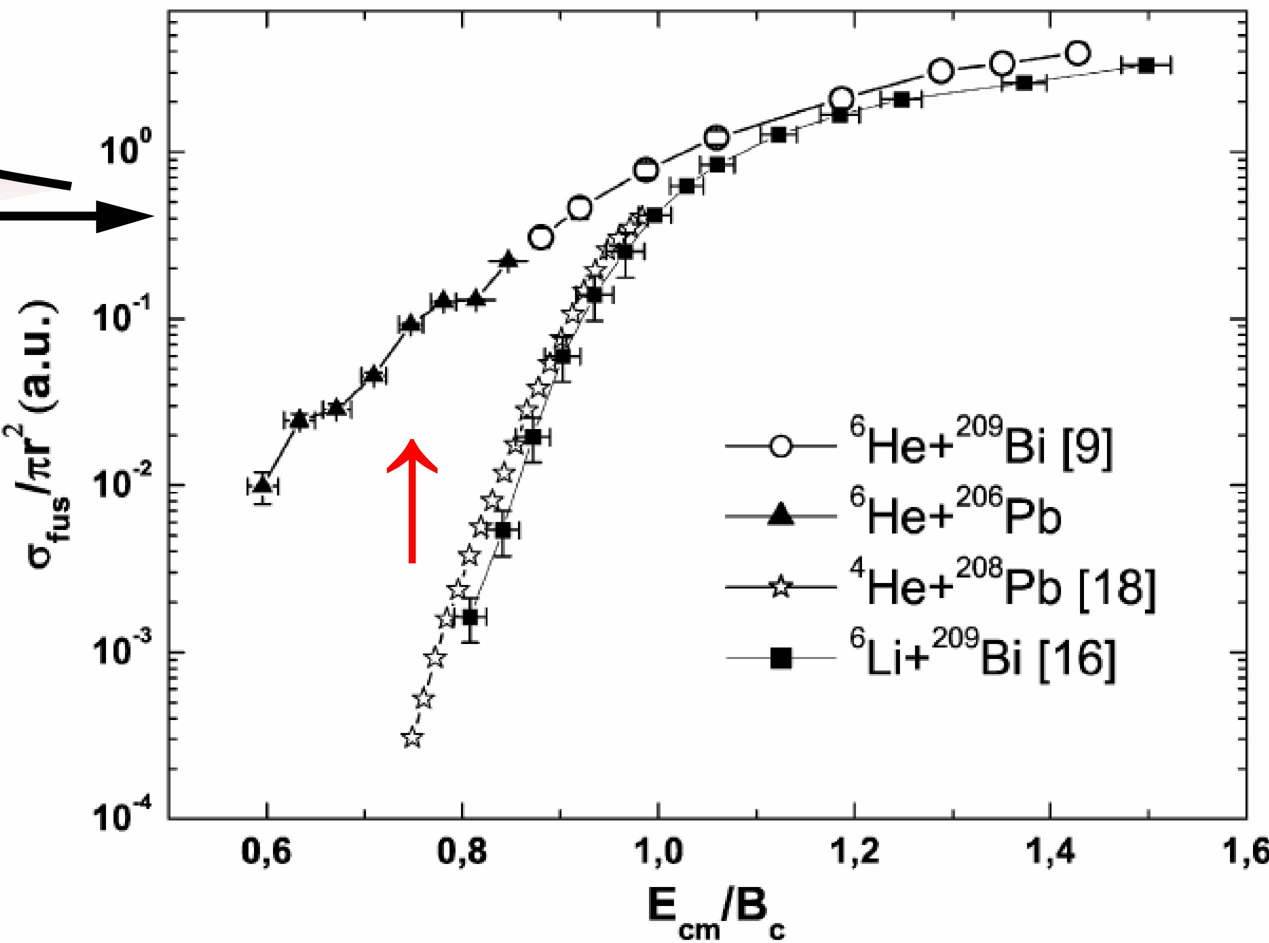




A.T. Rudchik i in. , PRC 79 (2009) 054609

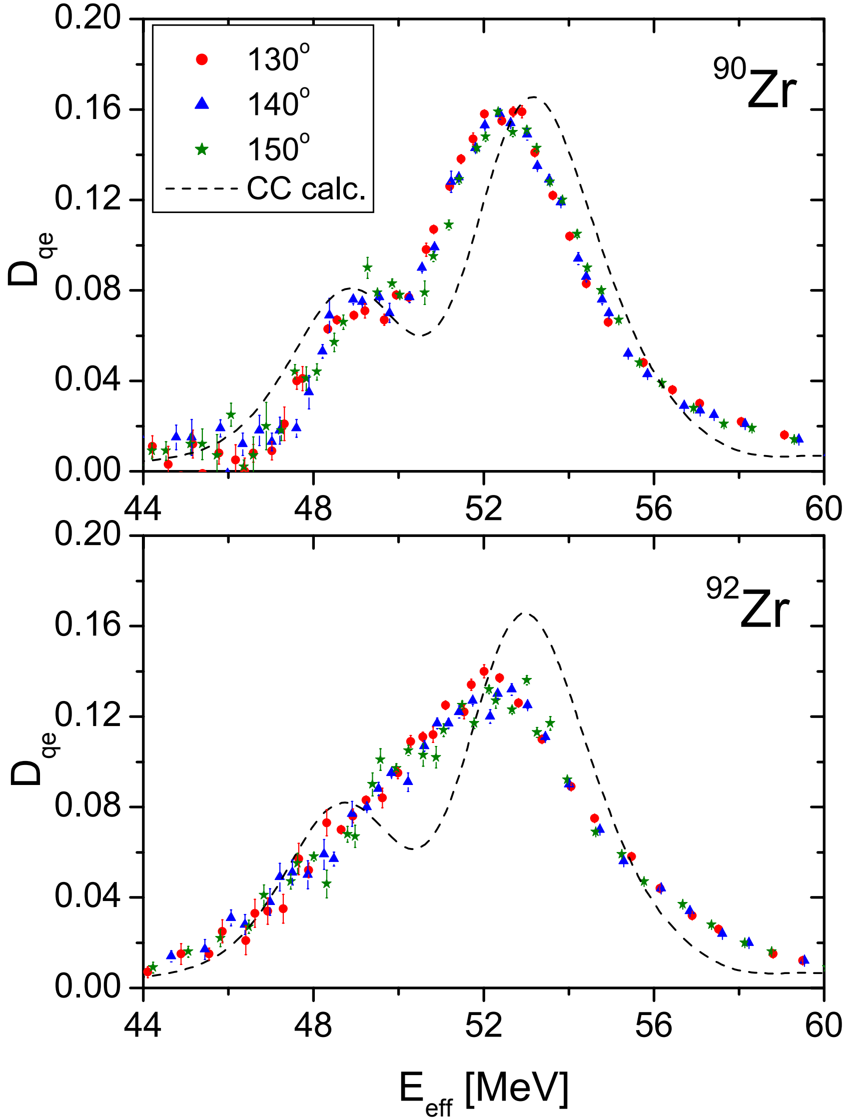
Tunneling





Enhencement below the barrier !

Barrier distribution

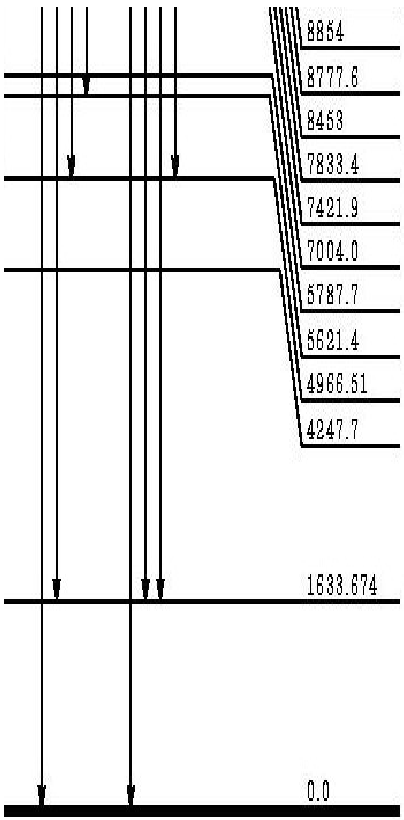


Exp: ^{20}Ne + Zr

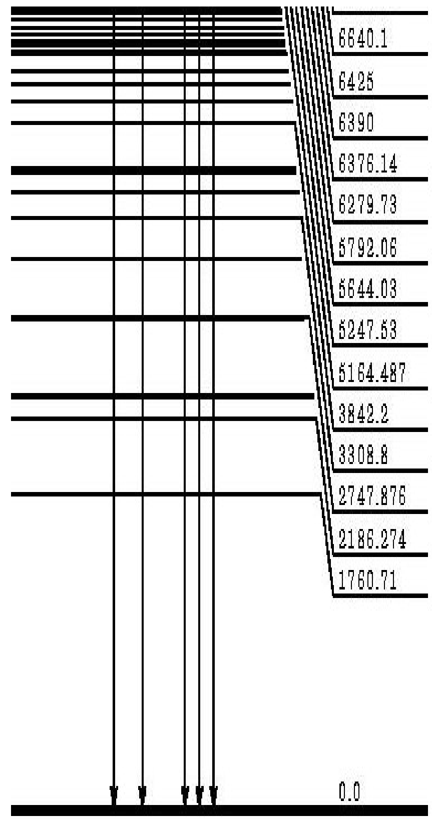
Depends on the Zr structure!

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

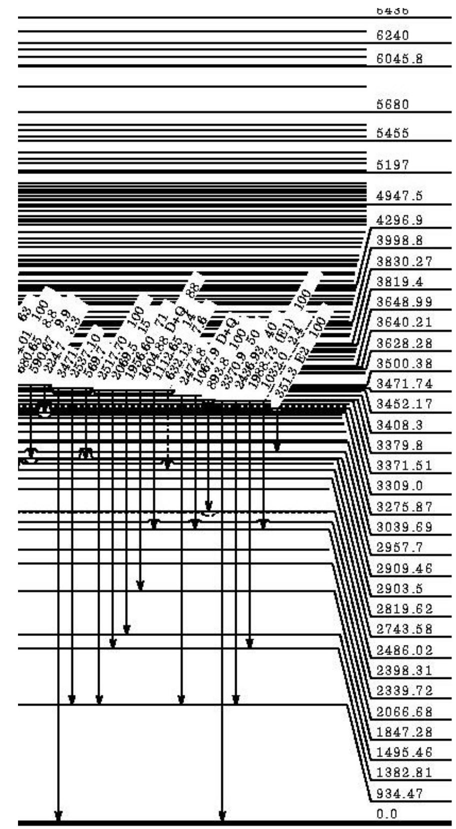
Structure dependence



^{20}Ne



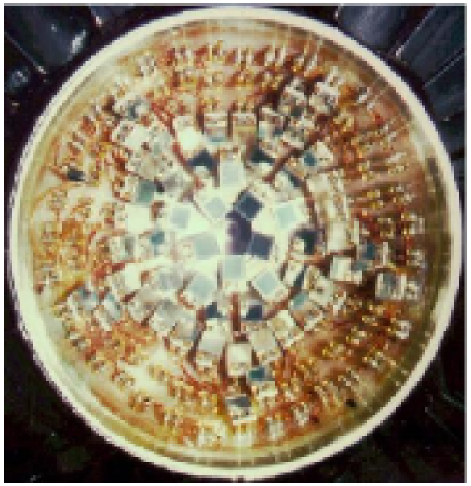
^{90}Zr

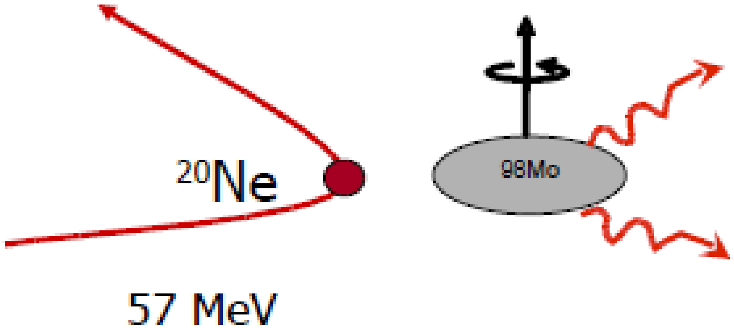


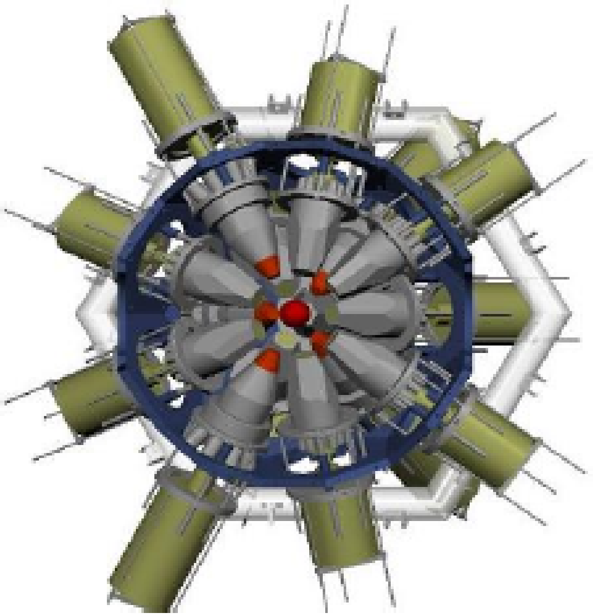
^{92}Zr

Spectroscopy:

Low-energy Coulomb excitation







- A complete set of E2 matrix elements, including relative signs, between Coulomb excited states can be extracted.

- If it is rich and precise enough, quadrupole deformation parameters $\langle Q^2 \rangle$ and $\langle Q^3 \cos 3\delta \rangle$ can be derived for each state individually, using the Quadrupole Sum Rules method.

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

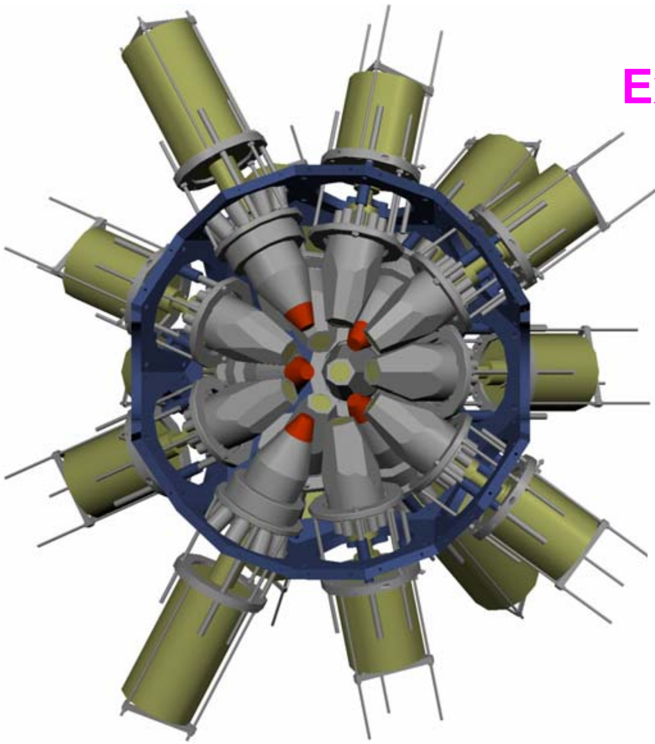
ANL (Gammasphere), USA
A.Hayes – ^{178}Hf

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)

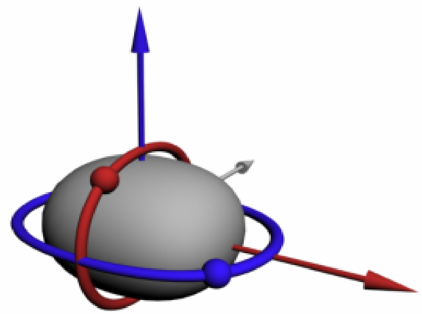


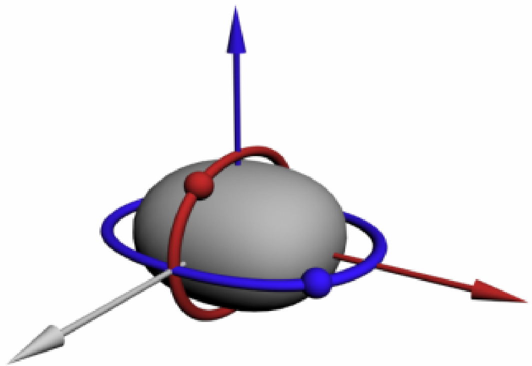
Experimental study of the nuclear chirality

three perpedicular angular momenta can form

right- or left-handed systems

for A ≈ 130 triaxial core, proton particle, neutron hole





search for such subsystems in atomic nuclei

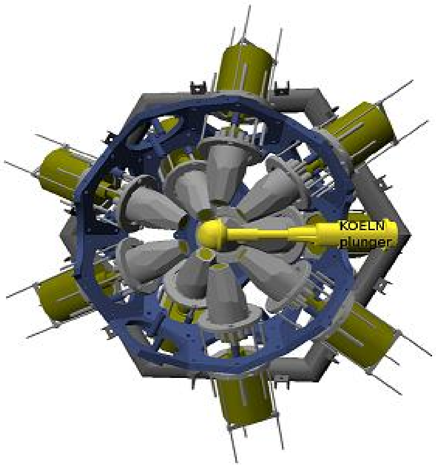
about 15 cases in odd-odd nuclei can indicate such features:

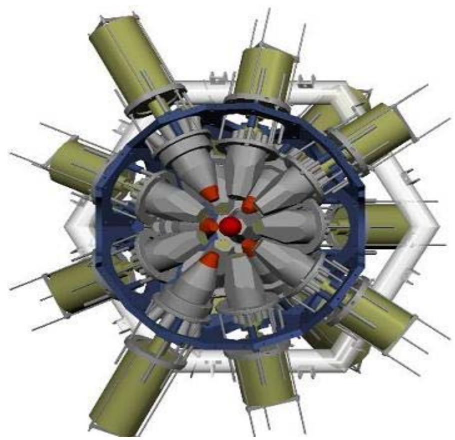
two partner bands: levels with the same I^{π} and nearly the same energy

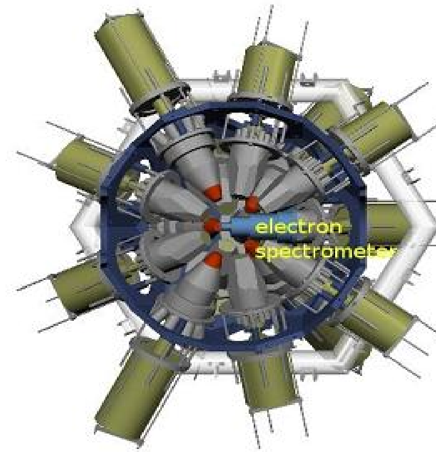
EAGLE

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

J. Mierzejewski, H. Mierzejewski, J. Kownacki, M. Kowalczyk, M. Kisieliński, J.Srebrny *et al*



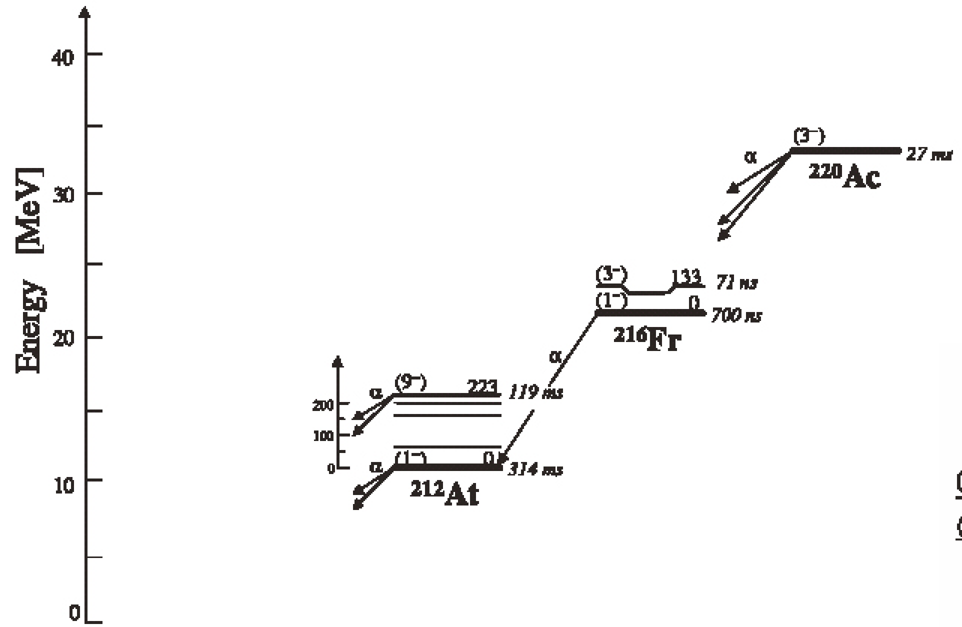


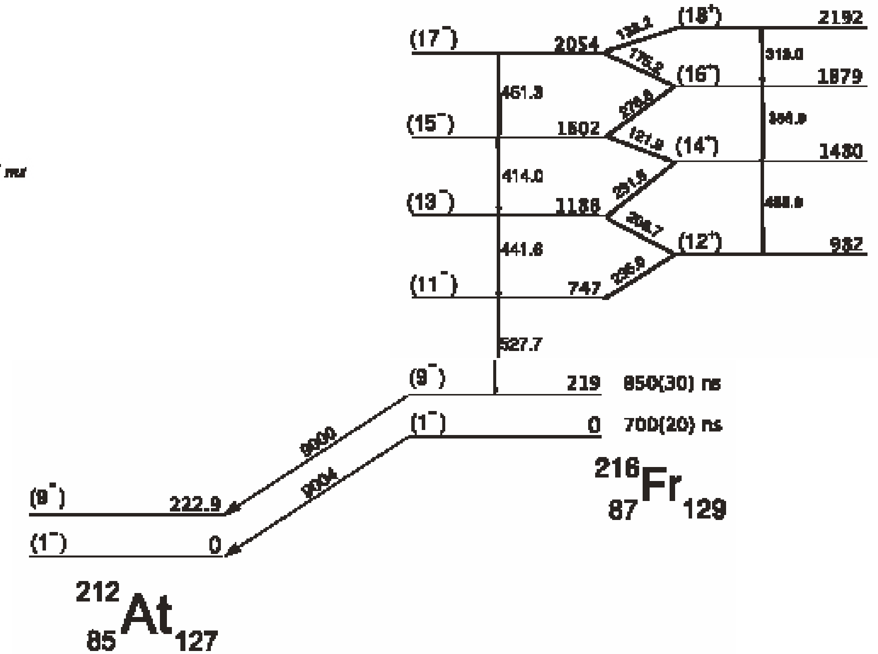


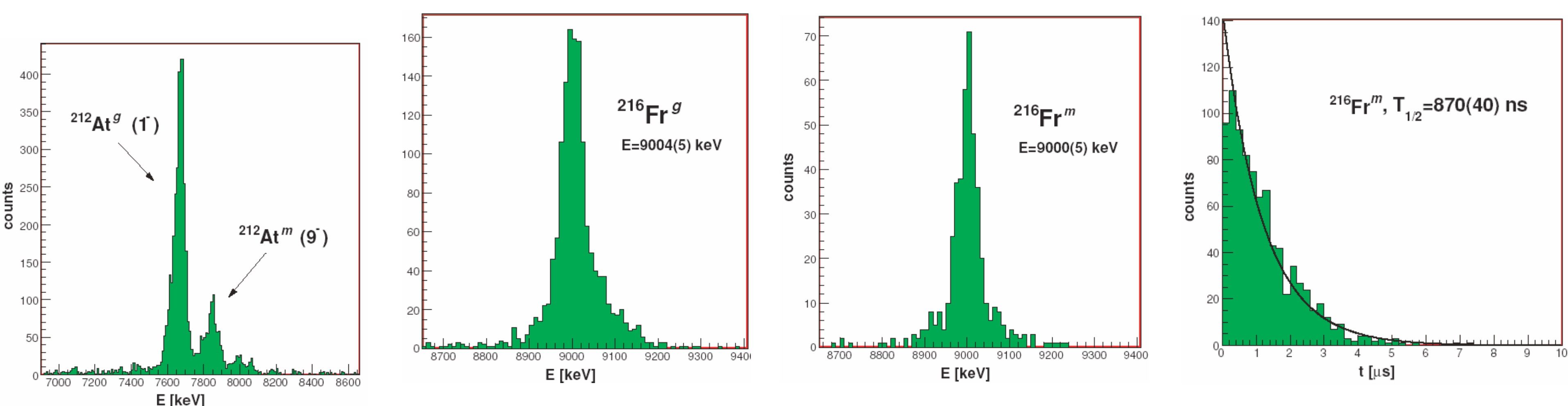
- new gamma spectrometer at the **Heavy Ion Laboratory in Warsaw**
- up to 30 gamma detectors coupled to:
  - internal conversion electron spectrometer
  - scattering chamber of 5 cm radius, containing 110 Si detectors
  - Silicon Ball - compact chamber with 30 Si detectors
  - multiplicity filter (60 BaF_2)
  - Köln-Bucharest plunger

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

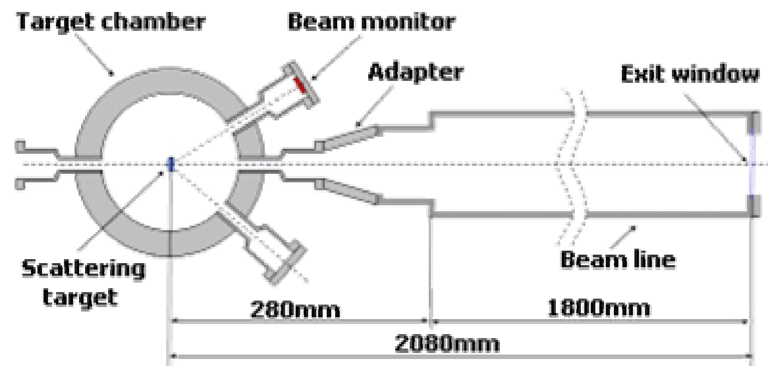
J. Kurcewicz et al.   Phys. Rev. C76(2007)054320

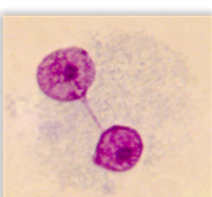


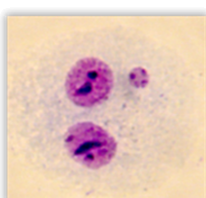


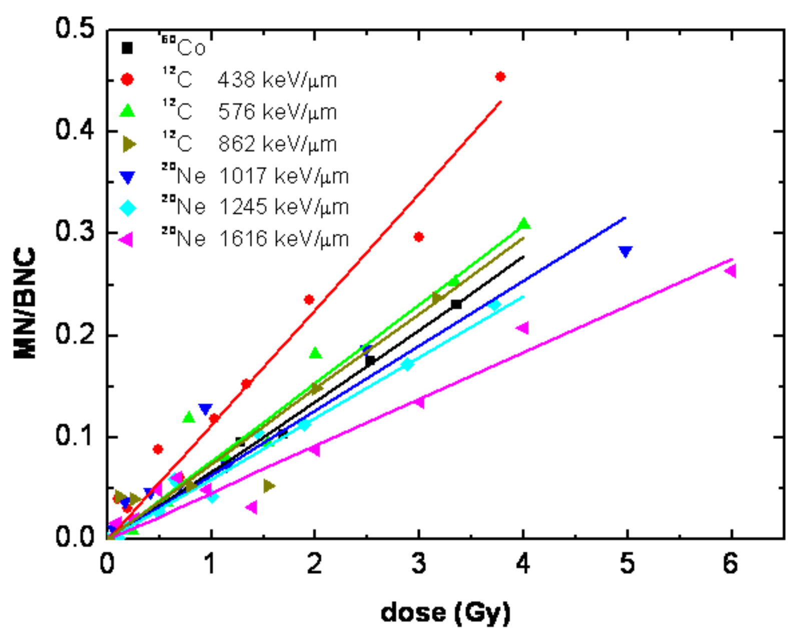


Applications: biology, survival of irradiated cells

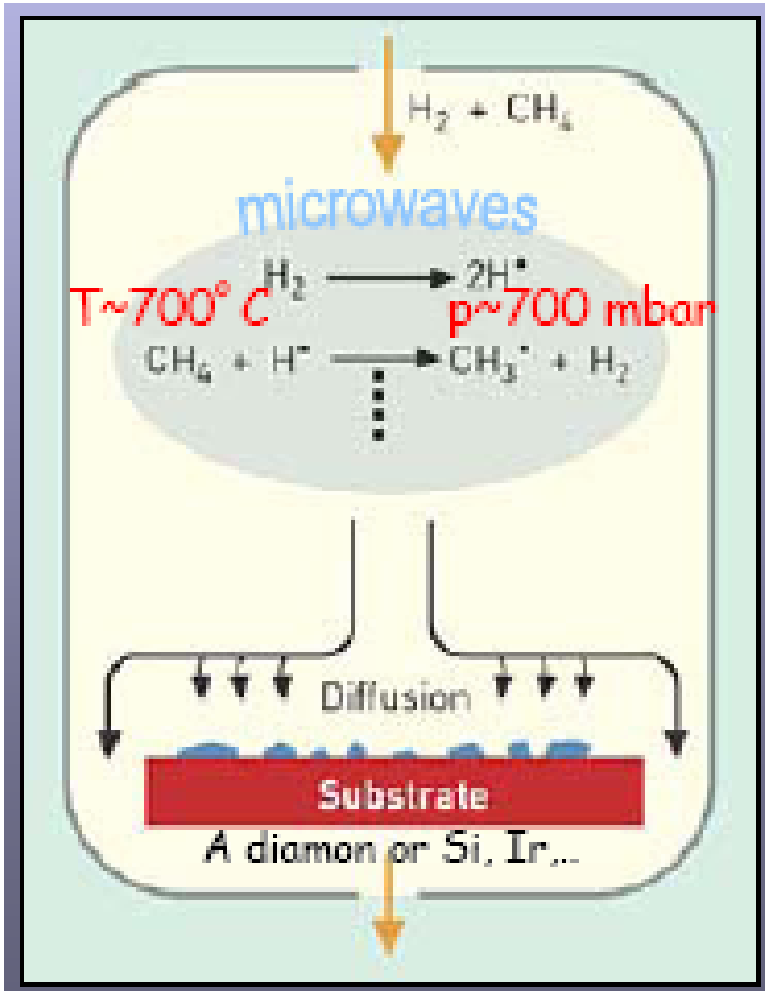






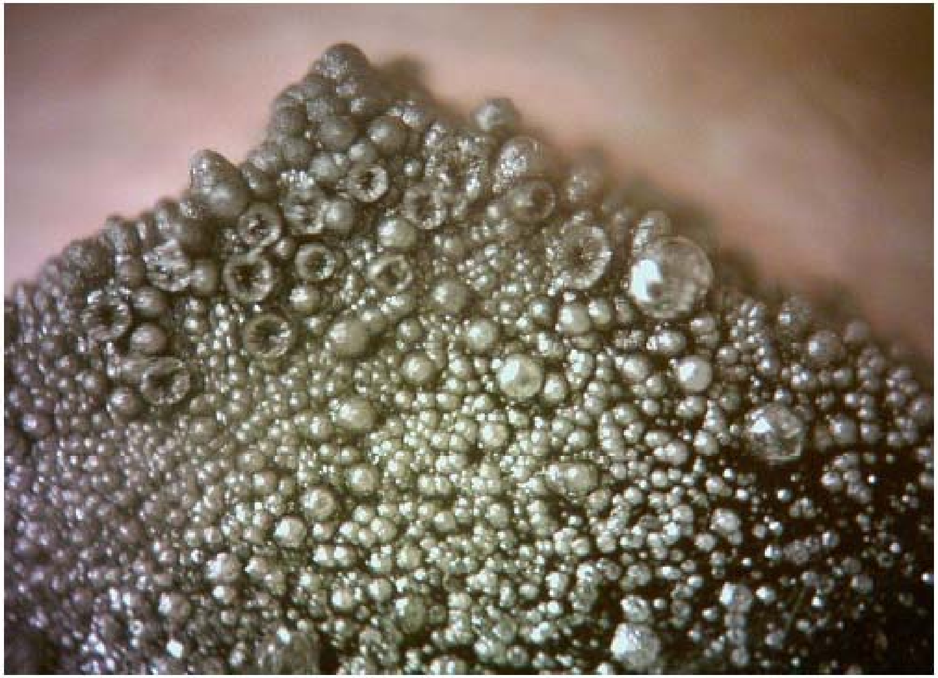


Detector laboratory



prof. A. Kordyasz

Diamond detectors

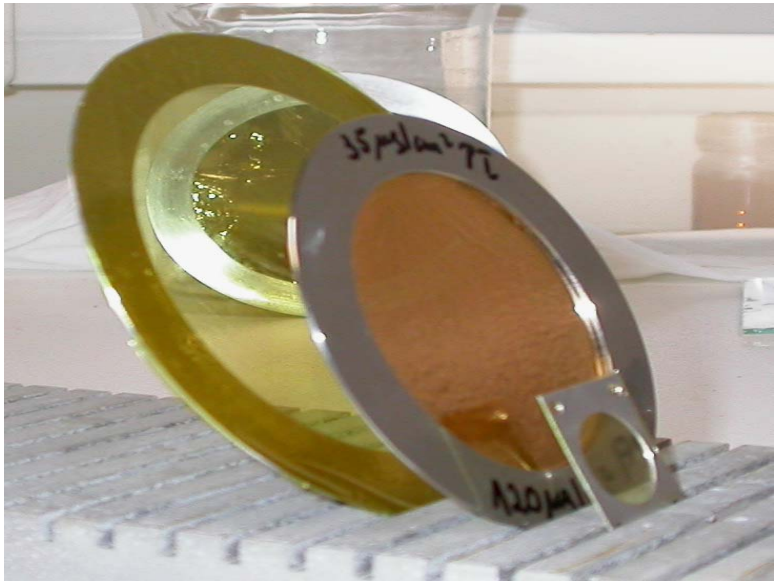


Target laboratory

dr Anna Stolarz

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

www.intds.org



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

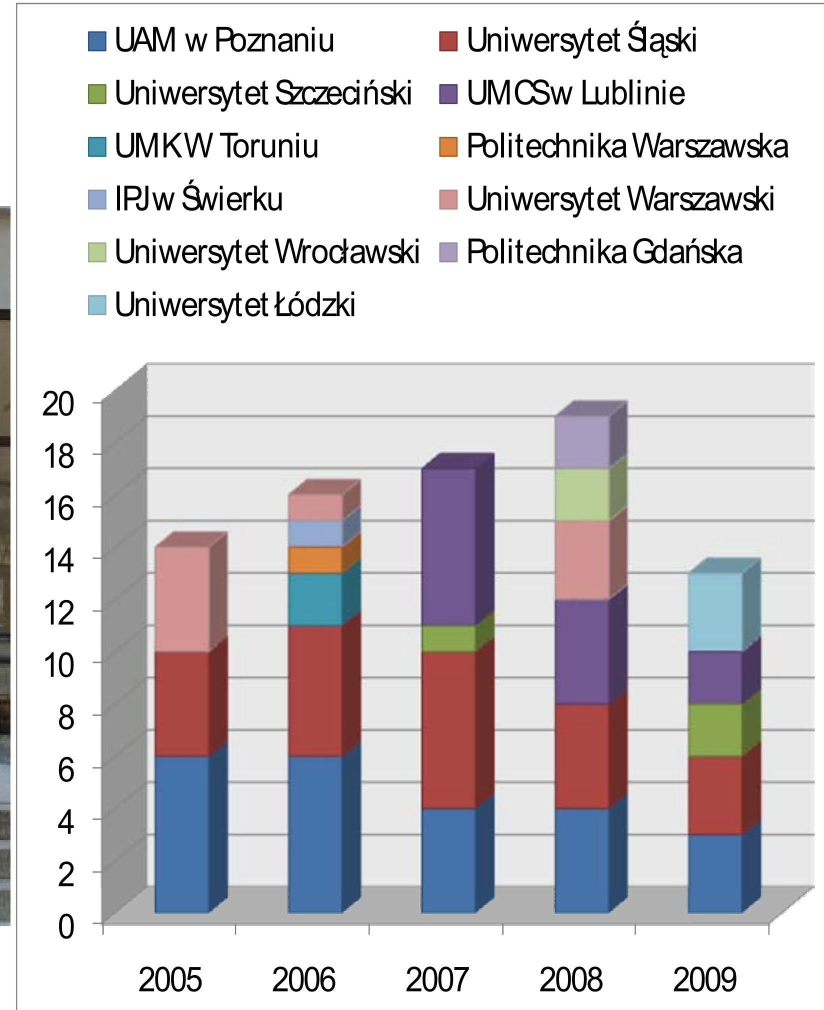
Perfect mechanical properties, high chemical resistance, low radiadion damage

Education

One-week workshop for undergrad. students

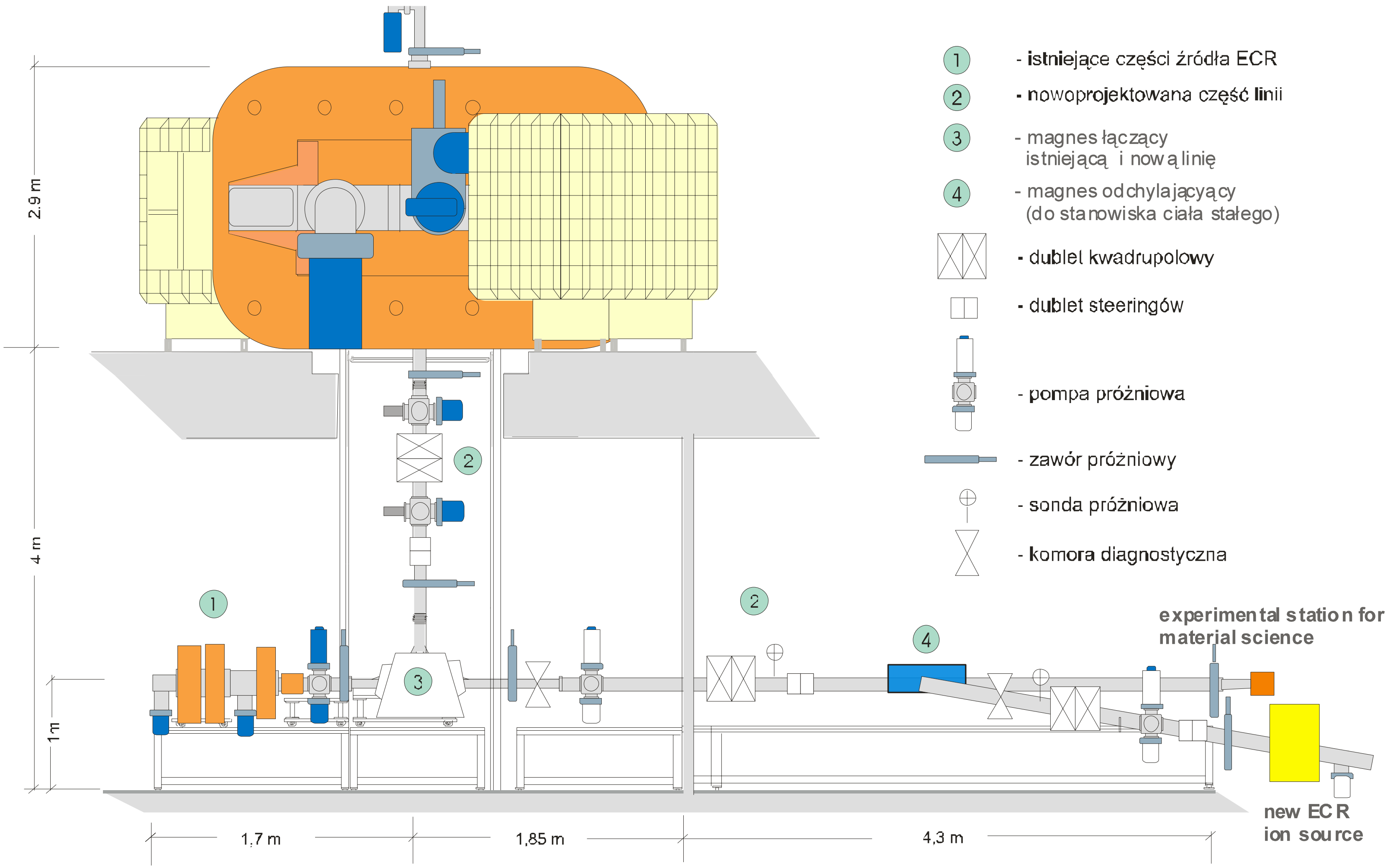
Środowiskowe Laboratorium Ciężkich Jonów, Uniwersytet Warszawski.

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



ECR source, ready in May 2010

SUPERNANOGAN – PANTECHNIK

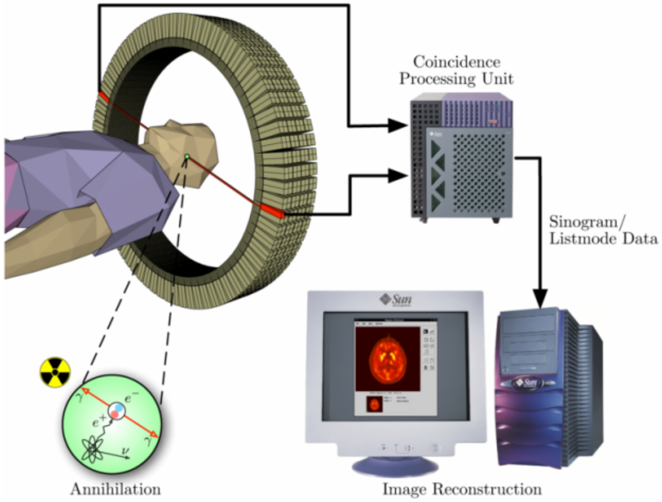


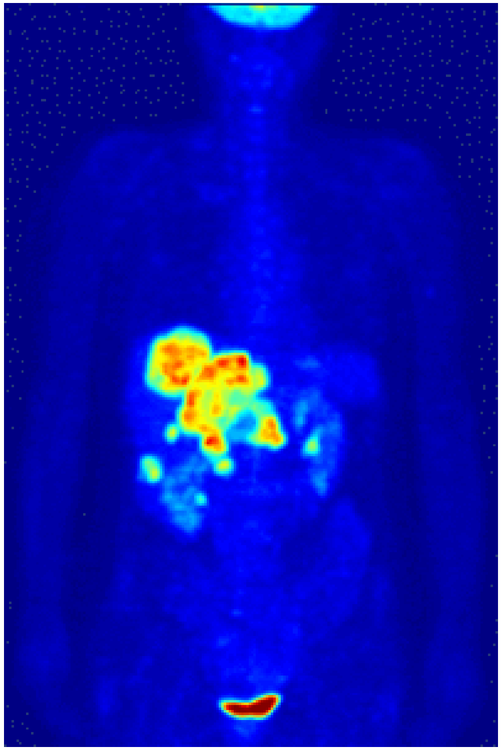
Old source

New source

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



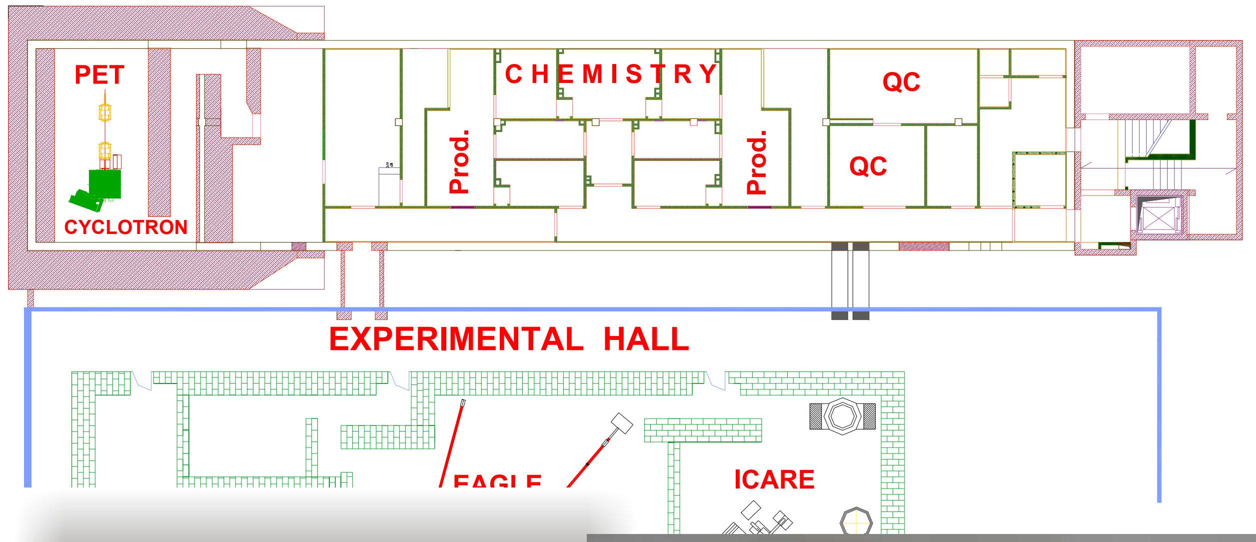


Radiofarmaceutical Prod. & Res. Centre

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

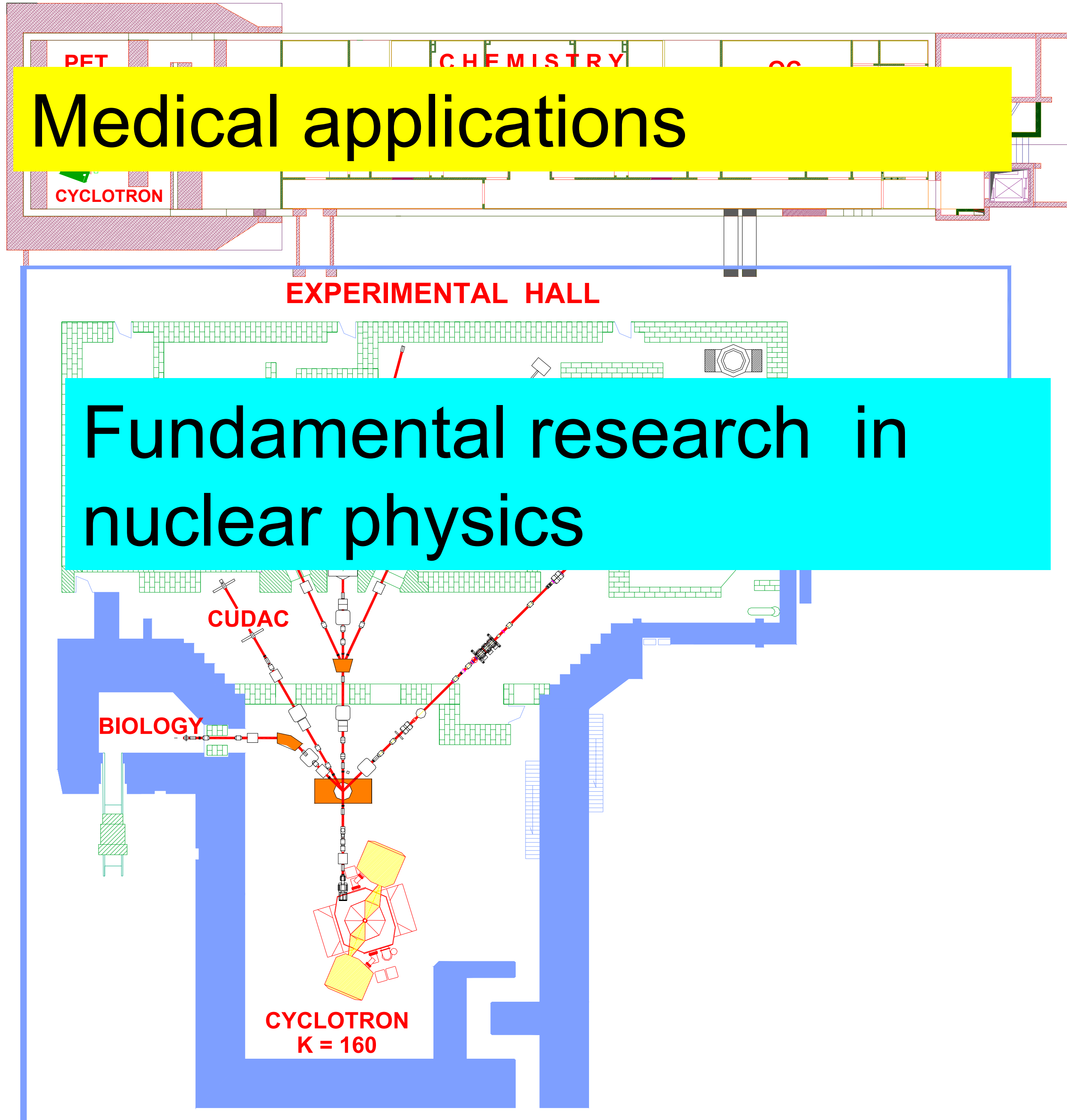
> 75 μA p
> 60 μA d

Ready in autumn 2011



Medical applications

Fundamental research in nuclear physics



Nuclear Cogeneration towards nuclear - coal synergy

Assoc. Prof. Ludwik Pieńkowski

Applications of High Temperature Nuclear Reactor in industry:

coal → gas, petrol. ……

Collaboration with AGH Cracow

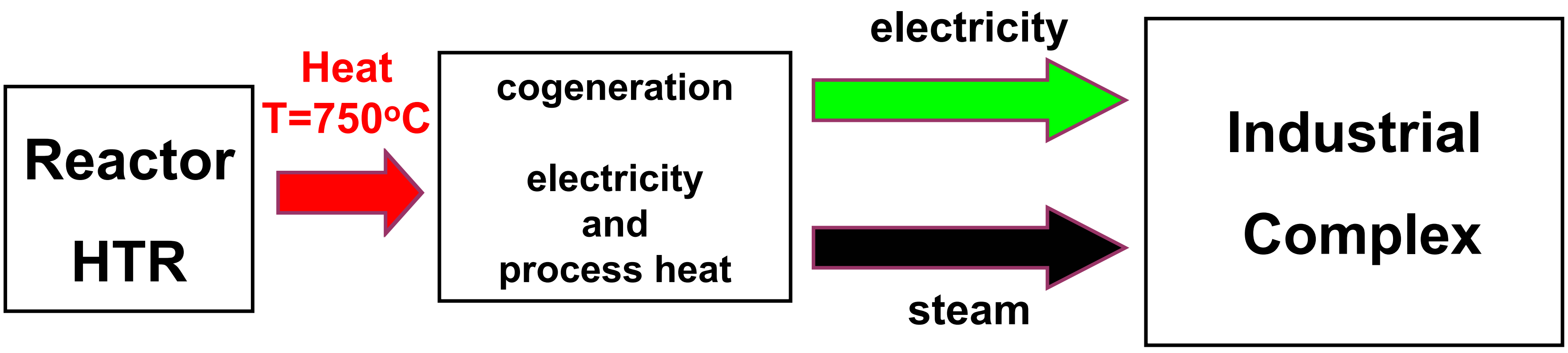
SEVENTH FRAMEWORK PROGRAMME
EURATOM

High Temperature Reactor Technology Network

eurOpairs

End-User Requirements fOr industrial Process heat Applications with Innovative nuclear Reactors for Sustainable energy supply

European programme launched in September 2009



Future

Thank you!