LHC upgrade, accelerator R&D

ReCFA 2012

Restricted European Committee for Future Accelerators

Sławomir Wronka, 11.05.12r

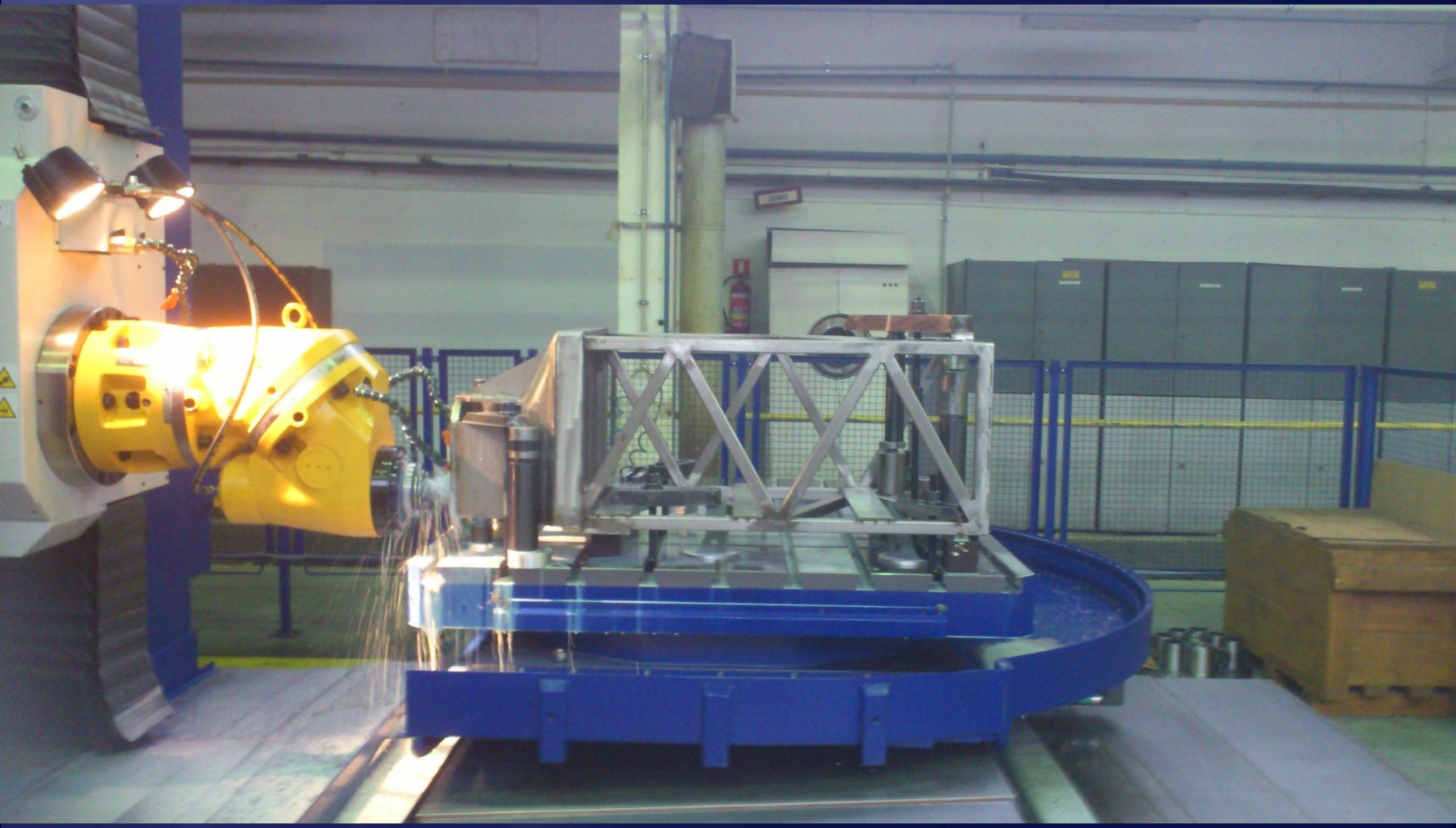
Main accelerator laboratories in Poland

- **Cracow**
  - AGH University of Science and Technology
  - IFJ Institute of Nuclear Physics Polish Academy of Sciences
  - PK University of Technology
  - UJ Jagiellonian University
- **Warsaw**
  - NCBJ National Centre for Nuclear Research
  - PW University of Technology
  - UW Warsaw University
- **Wrocław**
  - PWr University of Technology

LHC upgrade

Infrastructure for accelerator production at NCBJ

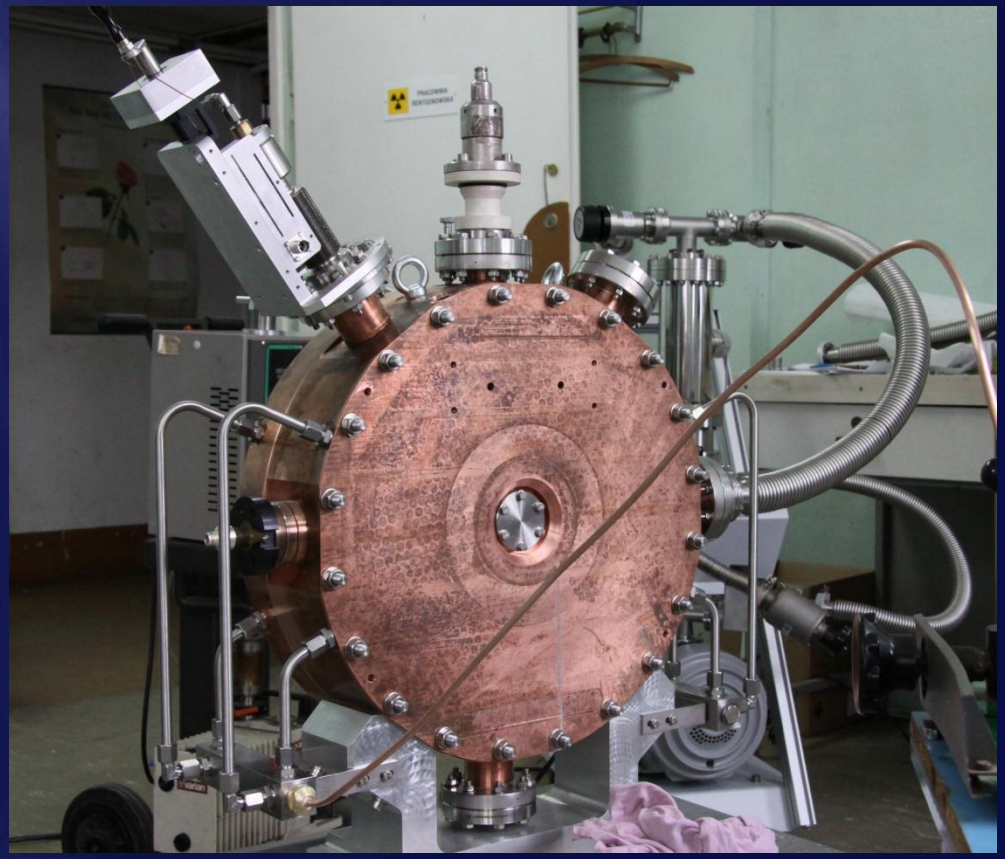

NC 3015 S

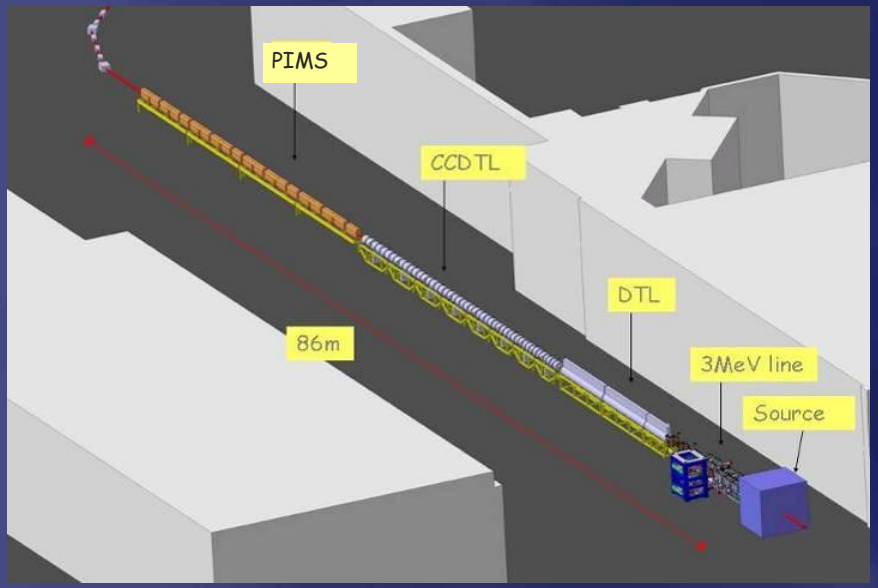


LHC upgrade

Machines, technology, personnel

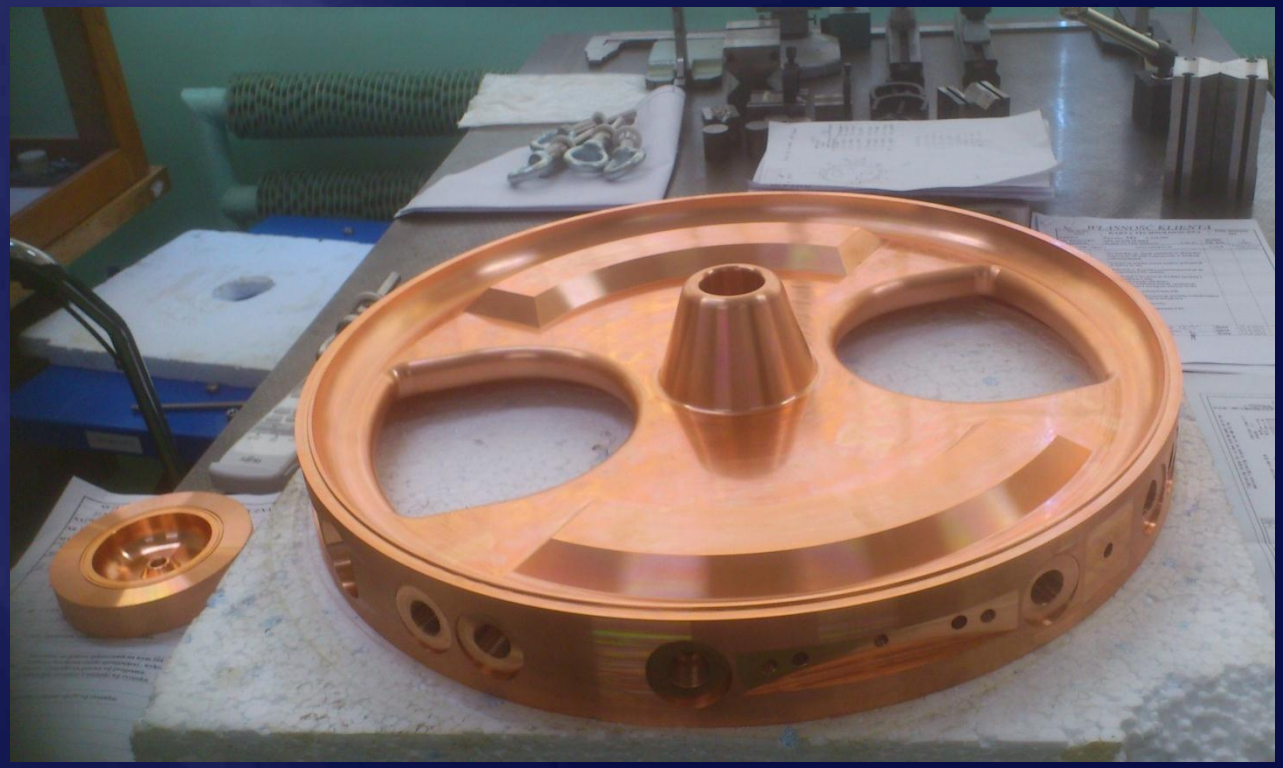
Buncher cavity for Linac4





LHC upgrade –
PIMS structure production for Linac4

- 352 MHz
- 102 -160 MeV
- 4MV/m
- ~18m long part



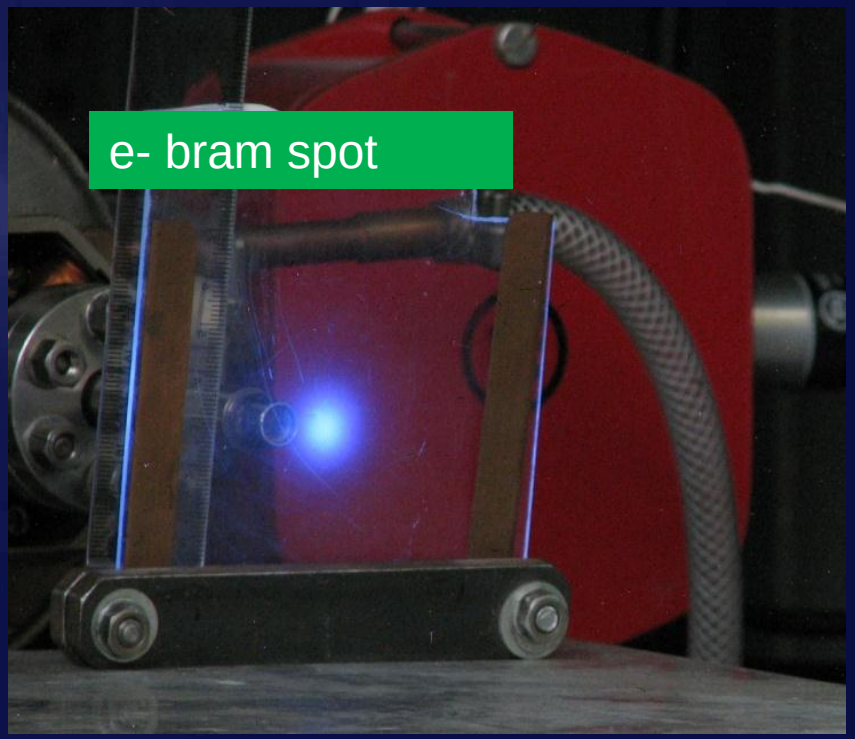
LHC upgrade - IFJ

- Design and construction of movable measuring equipment and accessories to test the electrical circuits of all superconducting magnets in the LHC.
- Programming of the Electrical Quality Assurance equipment
- Cold and warm measurements of LHC superconducting magnets

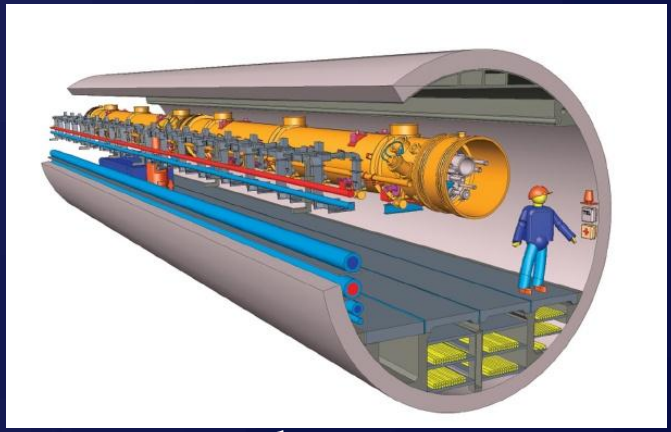
LHC upgrade

Radiation damage studies (PK, NCBJ)

Dedicated infrastructure for high doses irradiations in cryogenic environment.



XFEL

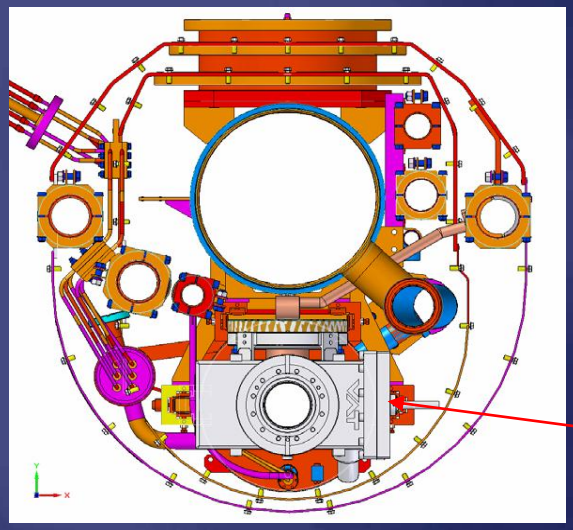


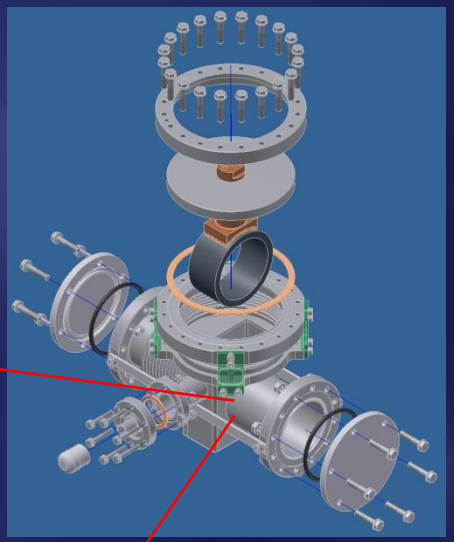
- Acceptance tests of superconducting magnets, cavities and cryo-modules

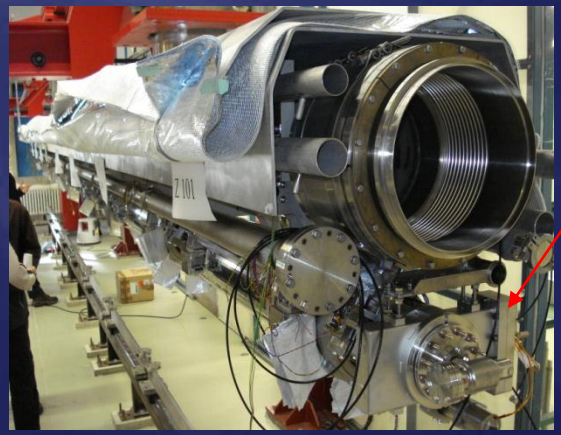
Group of experienced and skilled experts

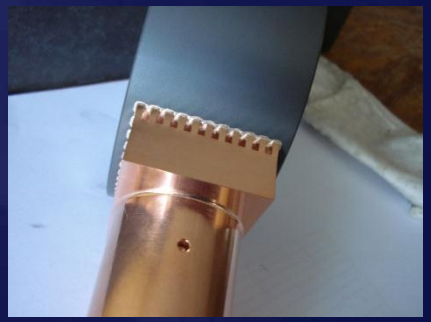
- Software development of the XFEL test stands
- Cryogenics
- Higher Order Mode (HOM) dumping system
  - HOM Couplers and Pick-ups;
  - Beam Line HOM Absorbers (BLA) for travelling HOMs

HOM couplers & absorbers



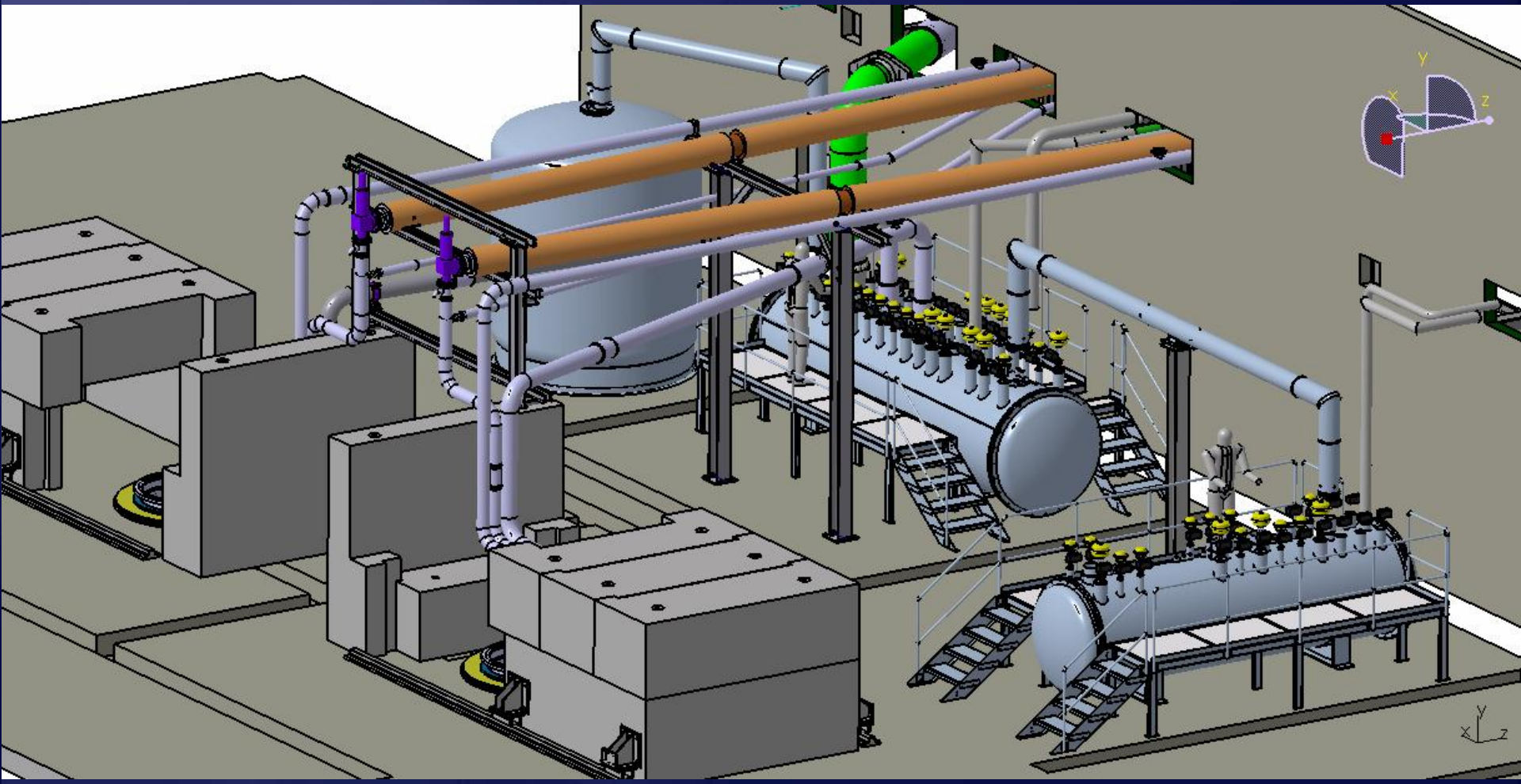






Courtesy: E.Plawski, NCBJ

Wroclaw University IKC to XFEL



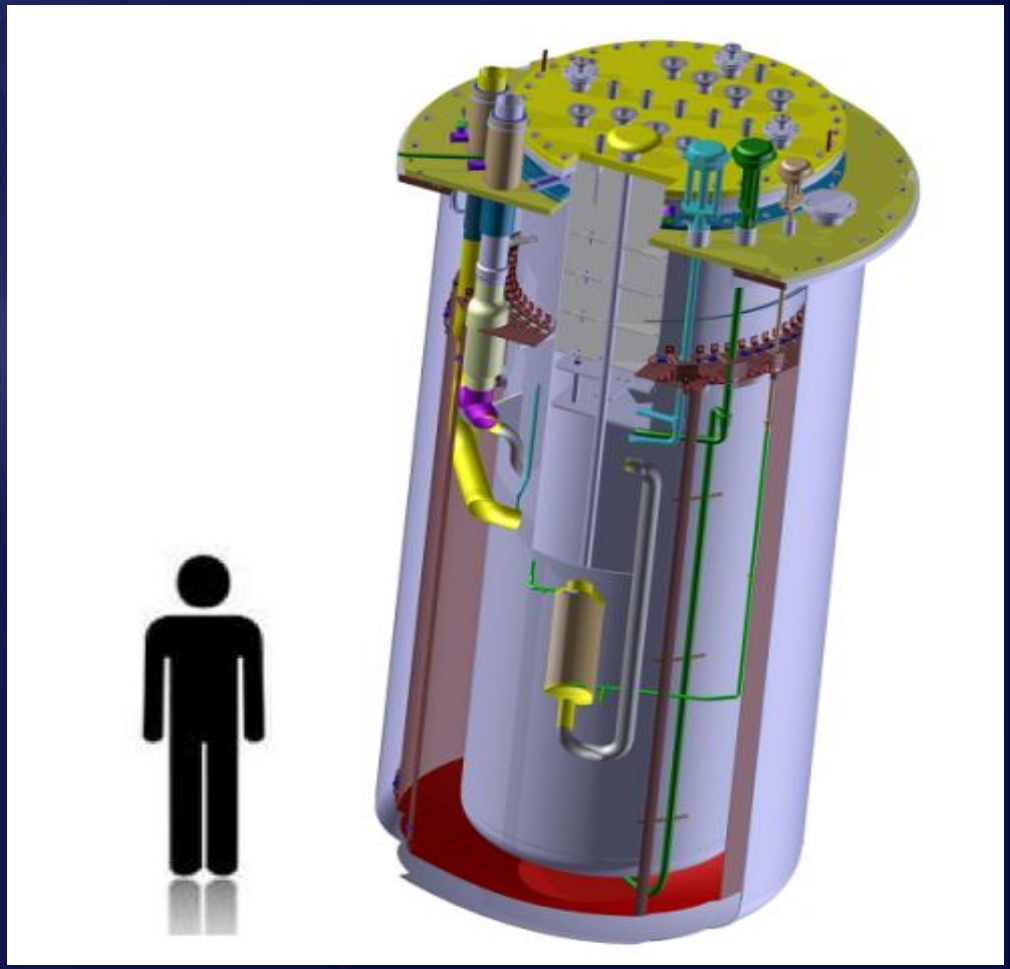
Courtesy: prof. M.Chorowski, WUT

WROCŁAWSKI PARK TECHNOLOGICZNY

XATC

KrioSystem

- Cryostat 3D model
- Cryostat equipment:
  - Control and JT valves
  - Supercritical helium heat exchanger
  - Coper theramal radiation shield
  - Process pipes and supports
  - Instrumentation
  - Insert for cavities instalation
- Crysotat vessel production follow AD2000 code



Courtesy: prof. M.Chorowski, WUT

XATC cryostats – WUT IKC to XFEL

XATC1 LHe vessel

XATC1 Vacuum Vessel

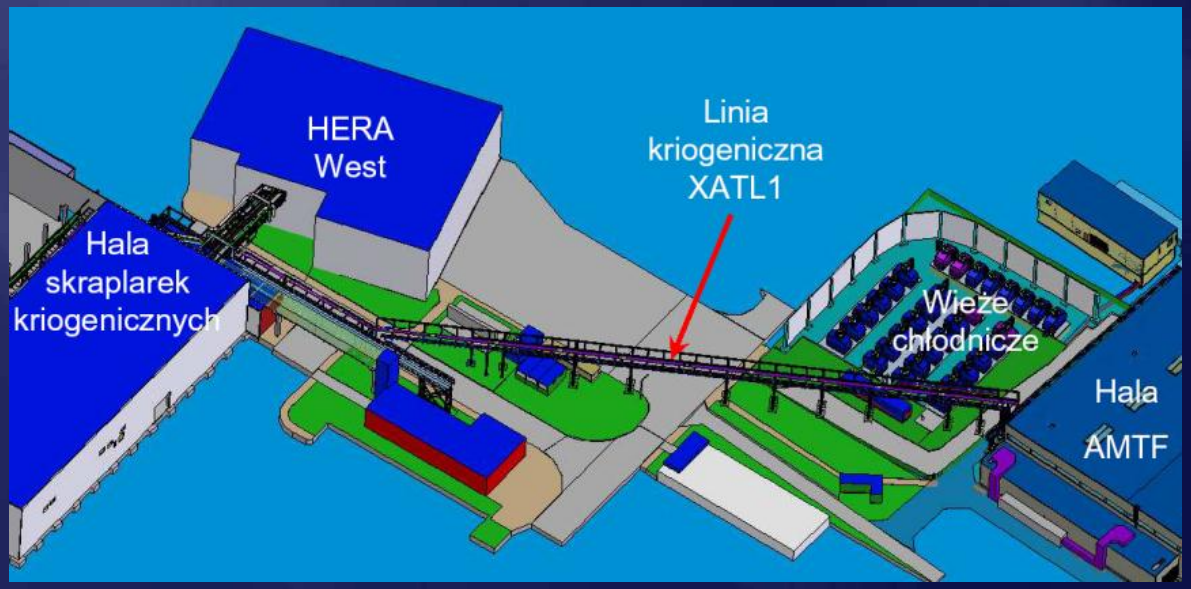
Courtesy: prof. M.Chorowski, WUT

Wroclaw University of Technology IKC to XFEL – transfer line

XATL1

Liquid helium multichannel transfer line

- lenght over 167 m with 4,5 K (-268° C)
- four transfer lines closed in vaccum shield

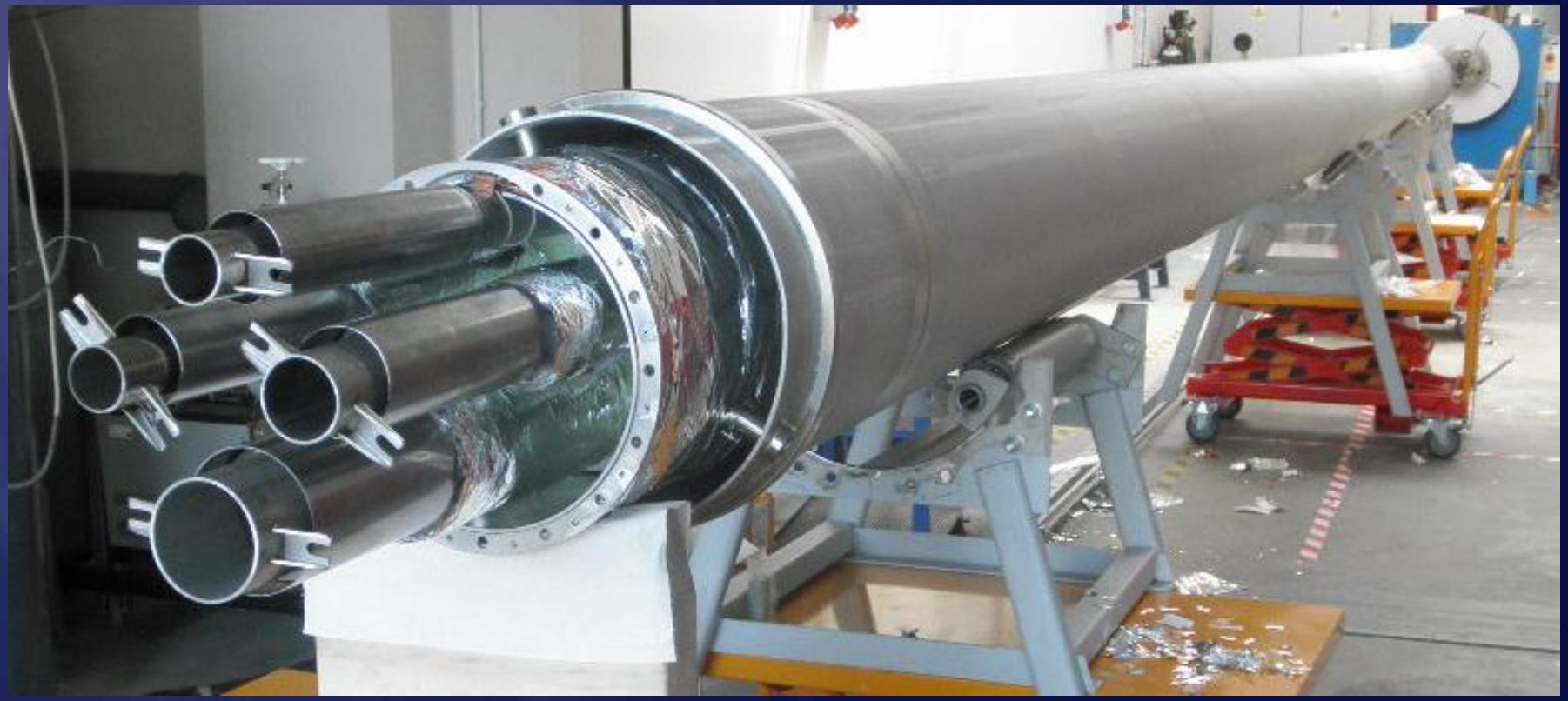


WROCŁAWSKI PARK TECHNOLOGICZNY

KrioSystem

XATL1 production process

Complete linear module

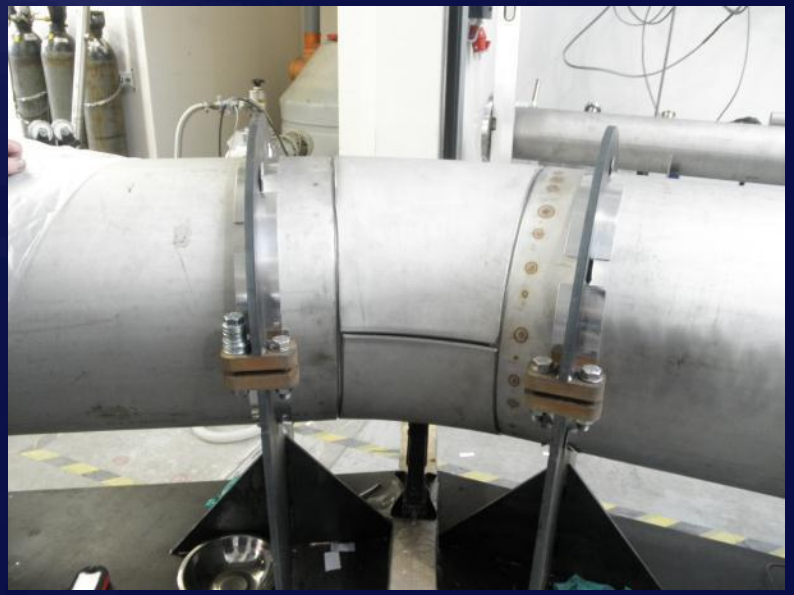


WROCŁAWSKI PARK TECHNOLOGICZNY

KrioSystem

XATL1 production

Welding works with fix supports and vacuum shield closing



WROCŁAWSKI PARK TECHNOLOGICZNY

KrioSystem

XATL1 installation

- Installation on the bridge with height around 10 m
- Special tents for protection against weather conditions
- Precise positioning of modules against each other
- Difficult welding position and small welding space

Summary of Wrocław University of Technology accelerator activities

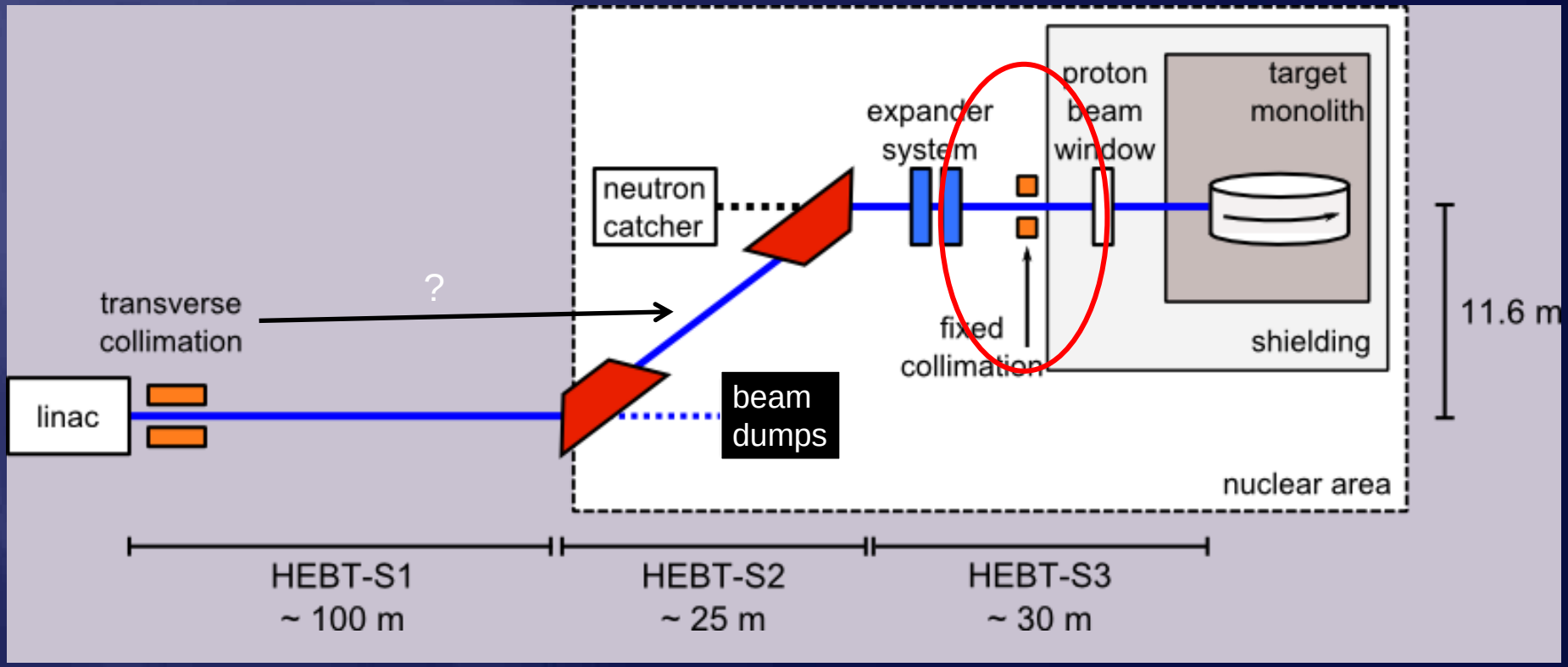
Installation	Activity	Remarks
LHC, CERN, Geneva	Update uf the LHC cryogenic system risk analysis	Modelling of the LHC failures, design recommendations
FAIR, GSI, Darmstadt	Design and productionof SIS 100 and SFRS local cryogenics	In frame of Polish IKC to FAIR
XFEL, DESY, Hamburg	Design and production of AMTF cryoline and cryostats	In frame of Polish IKC to XFEL

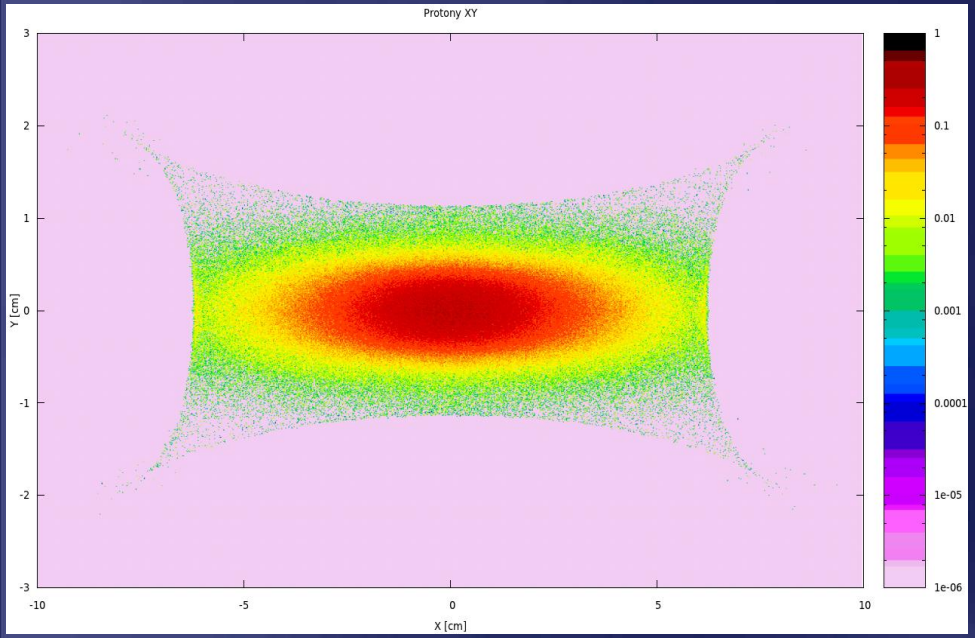
Courtesy: prof. M.Chorowski, WUT

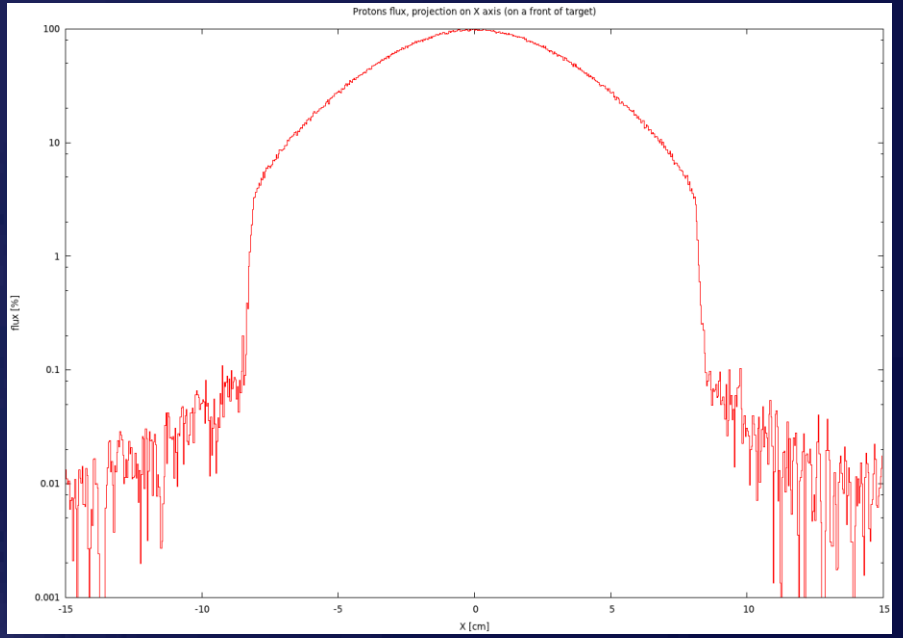
ESS

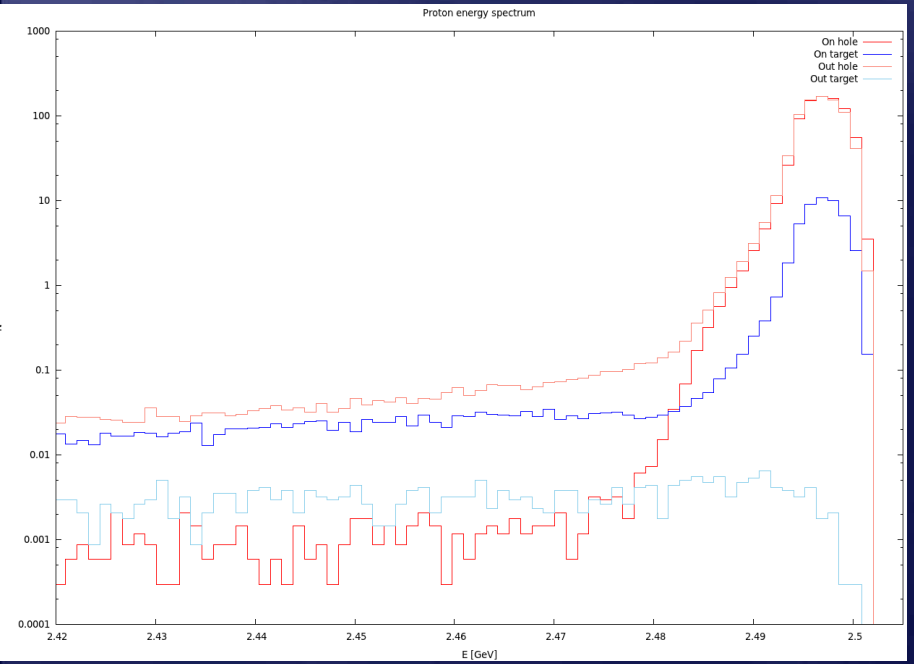
- 2,5 GeV proton beam, few MW beam power
- Polish group – 5 people
- Calculations:
  - RF
  - Radiation shielding
  - Beam dynamics
  - Collimation
- Financing by ESS & grants (yearly contracts)

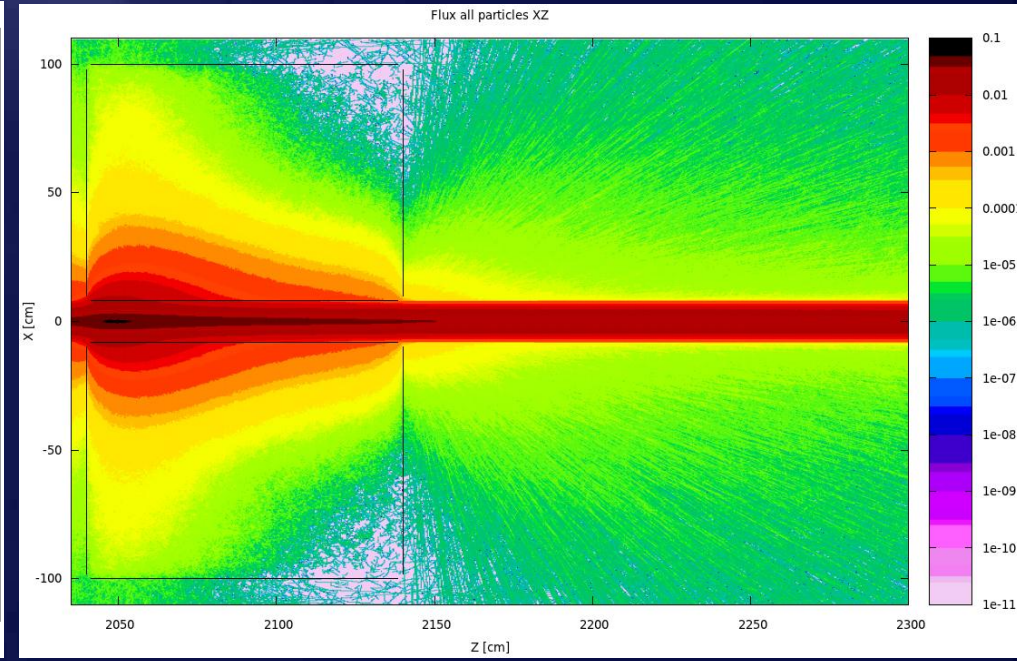
Schematic layout of HEBT




Protony XY
Y [cm]
X [cm]


Protons flux, projection on X axis (on a front of target)
flux [%]
X [cm]


Proton energy spectrum
On hole
On target
Out hole
Out target
E [GeV]


Flux all particles XZ
X [cm]
Z [cm]

GBAR Gravitational Behaviour of Antihydrogen at Rest

Swansea University
School of Physical Sciences

CSNSM

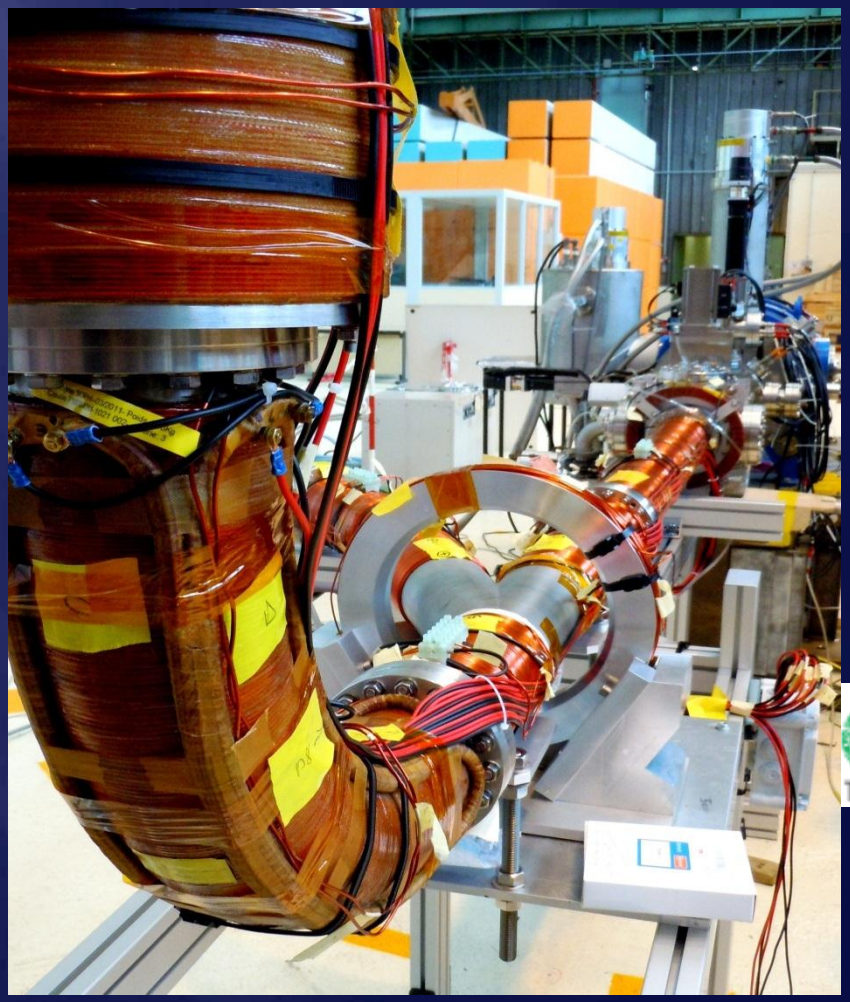
東京大学
THE UNIVERSITY OF TOKYO

IPCMS

NEUTRONS FOR SCIENCE
Institut Laue-Langevin

UPPSALA UNIVERSITET

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich



Irfu

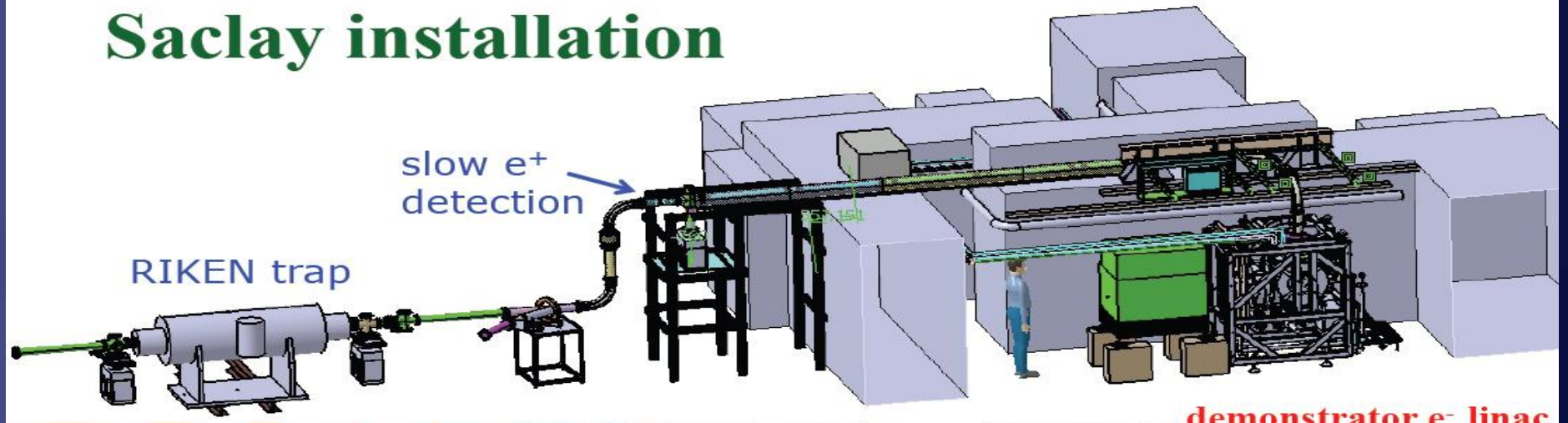
P.N.Lebedev Physical Institute of the Russian Academy of Science

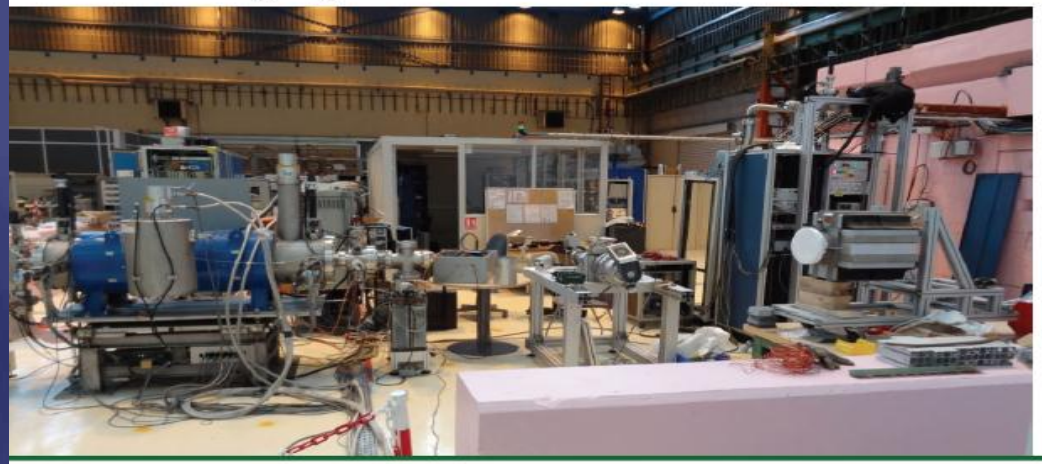
JG|U
JOHANNES GUTENBERG UNIVERSITÄT MAINZ

東京理科大学
Tokyo University of Science

RIKEN

Saclay installation





P. Pérez – CERN-SPSC– 25/10/2011

- Existing linac upgrade, 4 people (MoU + grant)
- Unique positron decelerator design, accelerator delivery

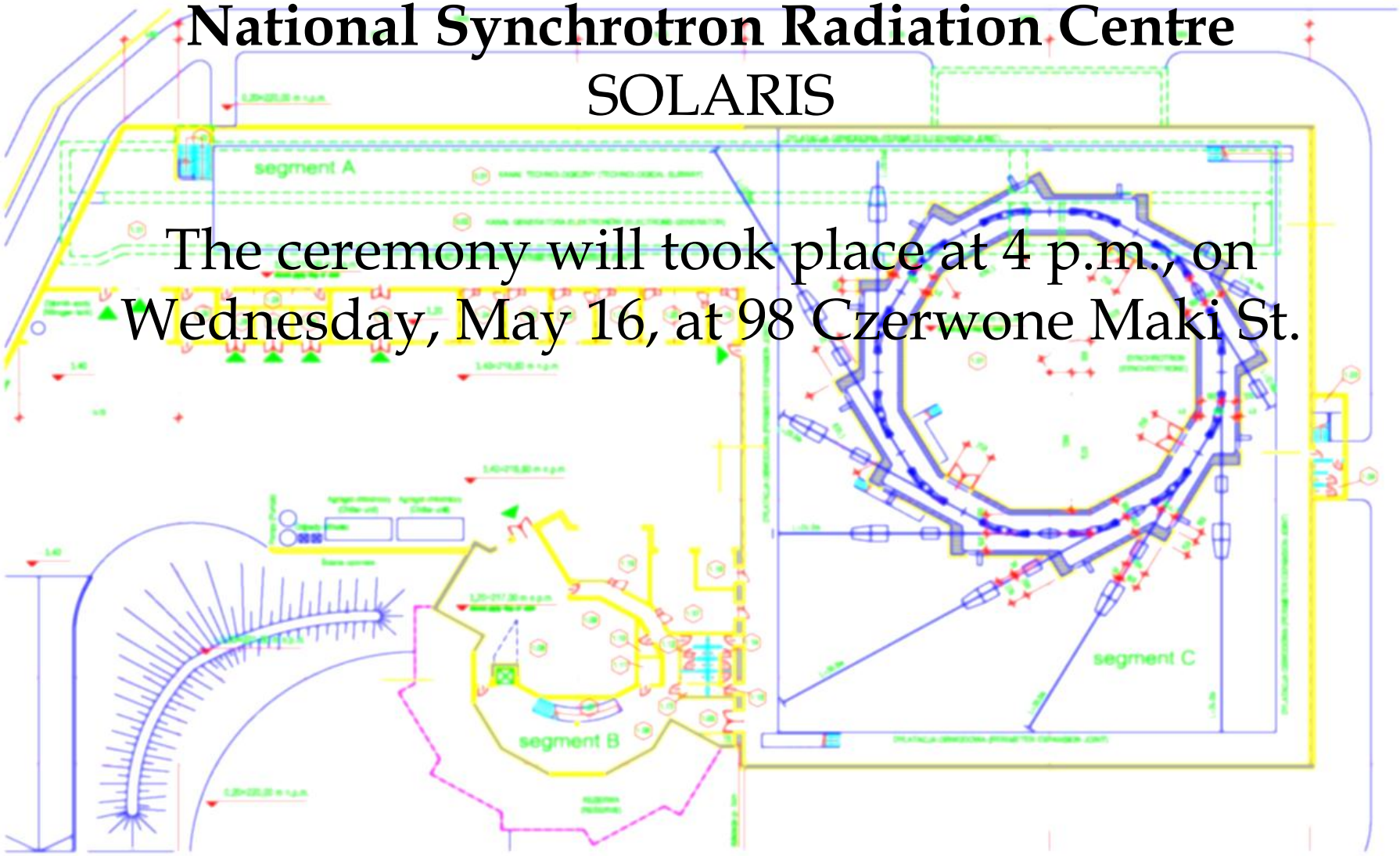
SOLARIS
NATIONAL SYNCHROTRON RADIATION CENTRE

National Synchrotron Radiation Centre

- Linac 0.7 GeV
- Storage ring, 96m circumference, 1.5 GeV
- 143Mzł, beam starts in 2014
- EU Structural Funds Operational Programme Innovative Economy

JAGIELLONIAN UNIVERSITY IN KRAKOW

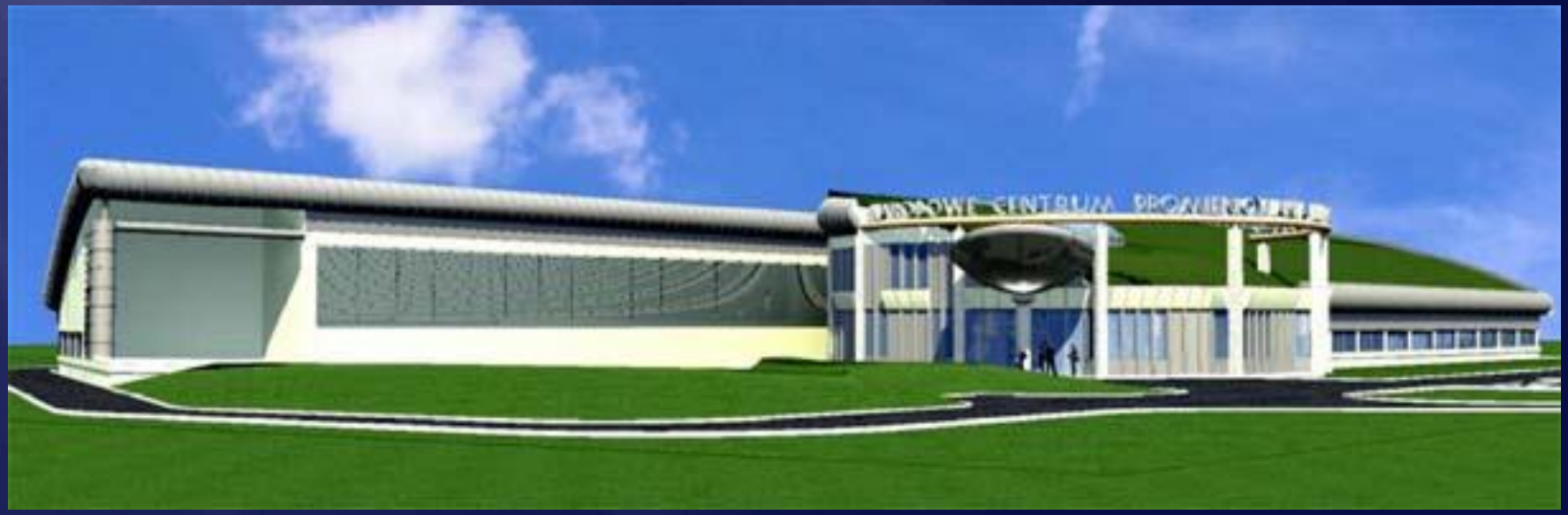
Foundation stone ceremony for **National Synchrotron Radiation Centre** SOLARIS



The ceremony will took place at 4 p.m., on Wednesday, May 16, at 98 Czerwone Maki St.

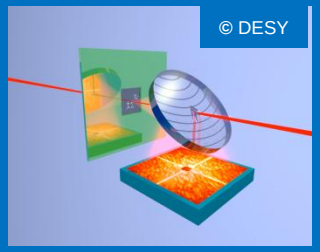
National Synchrotron Radiation Centre

http://synchrotron.pl/

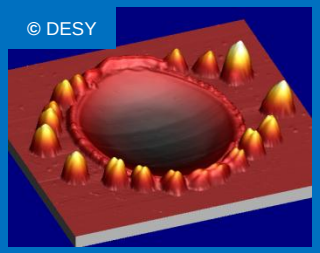


Free Electron Laser @ Świerk

4th generation light source driven by electron accelerator

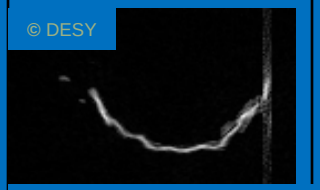


3D-imaging:
molecules
& nano-
structures



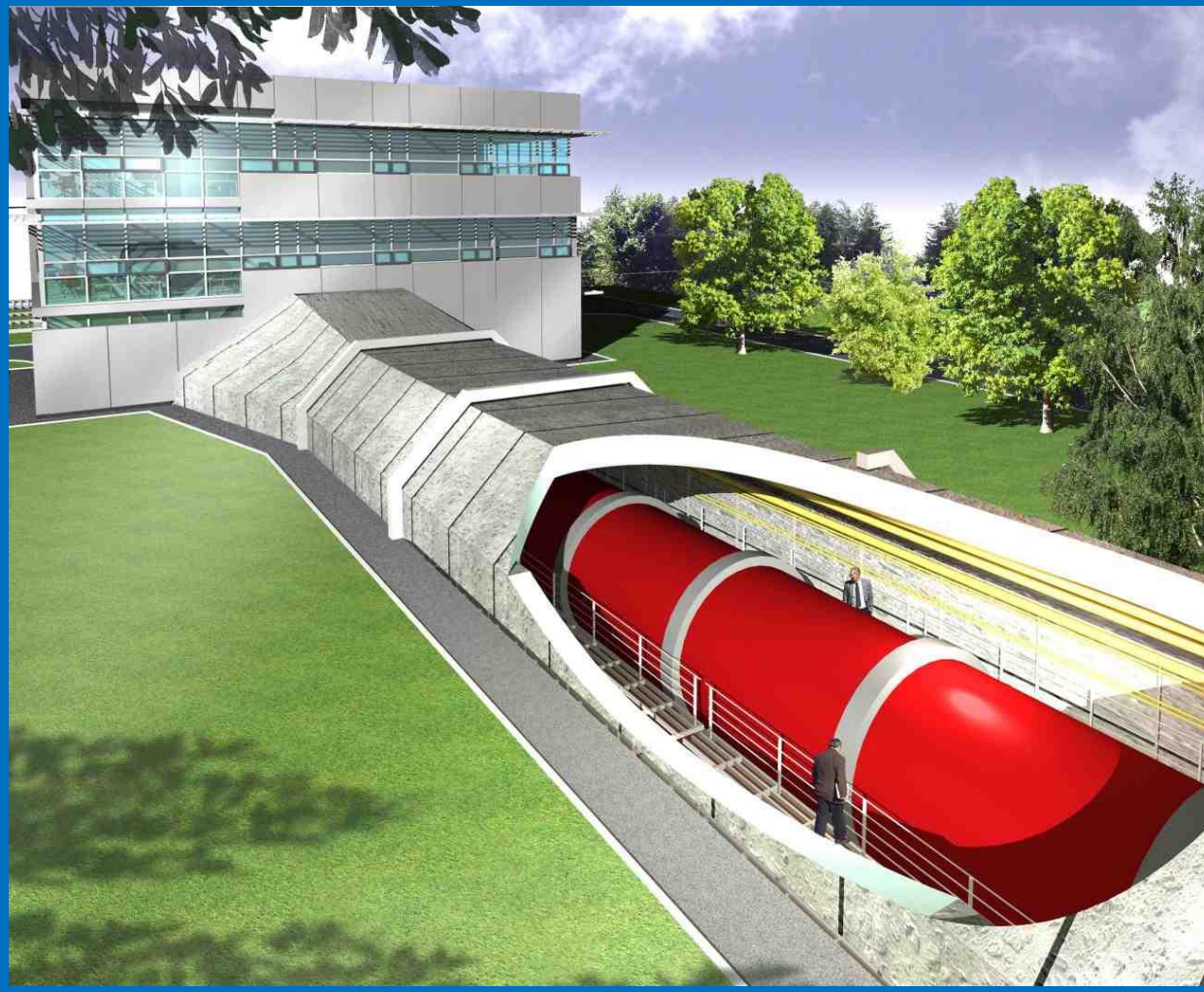
Material studies:
dense plasma properties

Novel technologies:
surface modification



Spiroplasma melliferus

Live sciences:
biological cell imaging



Continuous e^- beam E= **600 MeV**
Radiation wavelength: **UV → 9 nm, THz**
Pulse length: **< 100 fs**

Beam power (peak): **0.22 GW**
Length: up to **400 m**
Cost: **100 M€**

www.polfel.pl

National Center for Hadron Radiotherapy

PL | EN HOME NEWS PARTNERS NEWSLETTER LINKS CONTACT

National Consortium for Hadron Radiotherapy

13 September 2006 document establishing the National Consortium for Hadron Radiotherapy signed.

Members of the consortium , coordinated by the Institute of Nuclear Physics PAN, are 10 major Polish scientific and medical institutions.

2 August 2010 - ceremonial signing of an agreement for the supply of cyclotron Proteus C-235 with the technical infrastructure to create a National Center for Hadron Radiotherapy

Projects

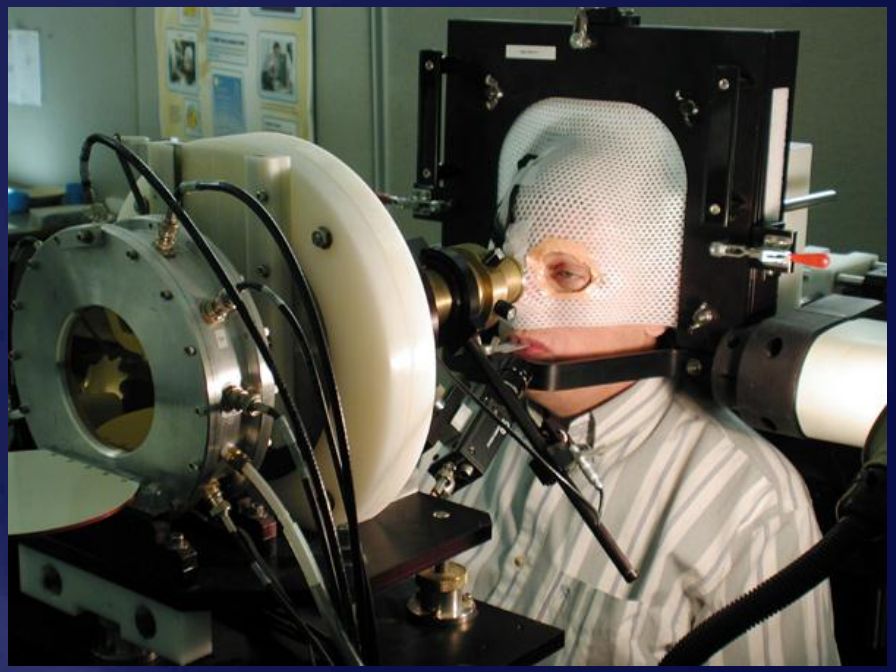
EU Structural Project: "National Center for Hadron Radiotherapy - Phase II: Cyclotron Center Bronowice - Gantry Room"

EU Structural Project: "National Center for Hadron Radiotherapy - Phase I: Cyclotron Center Bronowice"

Internal Project: Proton Radiotherapy of

http://www.krakow-poland.com/blog/2011/03/Hadrone-Therapy-Launched

- Proton Radiotherapy of Eye Melanoma
  - cyclotron AIC-144,
  - proton beam 60 MeV



- National Centre for Hadron Radiotherapy - cyklotron Proteus C-235 under construction

Accelerator infrastructures

- **Cracow:** neutron generator 14 MeV, 60 MeV cyclotron, 250 MeV cyclotron under construction, 2.5 MeV VdG high stability
- **Warsaw:** p cyclotron 25 MeV, cyclotron 200 MeV – heavy ion laboratory, nuclear reactor MARIA 30MW, VdG 2 MeV, ion implanters, electronics & LLRF laboratory.
  - Production unit for electron linacs – ~100 people (design office, workshop)
    - Vacuum & RF technology
    - Electron linacs 4-20 MeV available for detector tests (space missions equipment) or other irradiations
- **Wrocław:** cryogenics laboratory & production, technology transfer

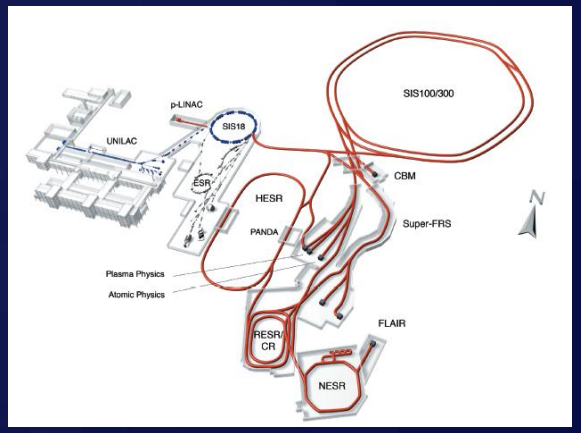
Summary

- Many activities in accelerator field for HEP is currently going on
- A lot of experience has been accumulated
- Groups of experts are able to perform calculations, modeling, design, production of many accelerator components as well as a delivery, assembly and starting up on-site
- Unique technology and expertise in accelerator production in Poland allow for participation in currently built and future facilities.

Summary

- Thanks to the close cooperation with industry the production capabilities include: warm cavities and whole accelerating structures, electron guns (SC gun studies), RF chains, warm magnets (solenoids, dipoles, quadrupoles), beam lines, advanced mechanics, cryogenics components, electronics & LLRF systems.
- R&D connected strongly to existing technology and production facilities (in-kind contributions).

Not all topics have been covered in this talk:



- ITER
- Wendelstain 7-X stellarator
- FAIR
- Advanced electronics for HEP accelerators
- LLRF details
- Beam instrumentation
- EuroNu - A High Intensity Neutrino Oscillation Facility in Europe
  (mechanical calculations & design,
  http://pc13.mech.pk.edu.pl/EUROnu).

Thank you