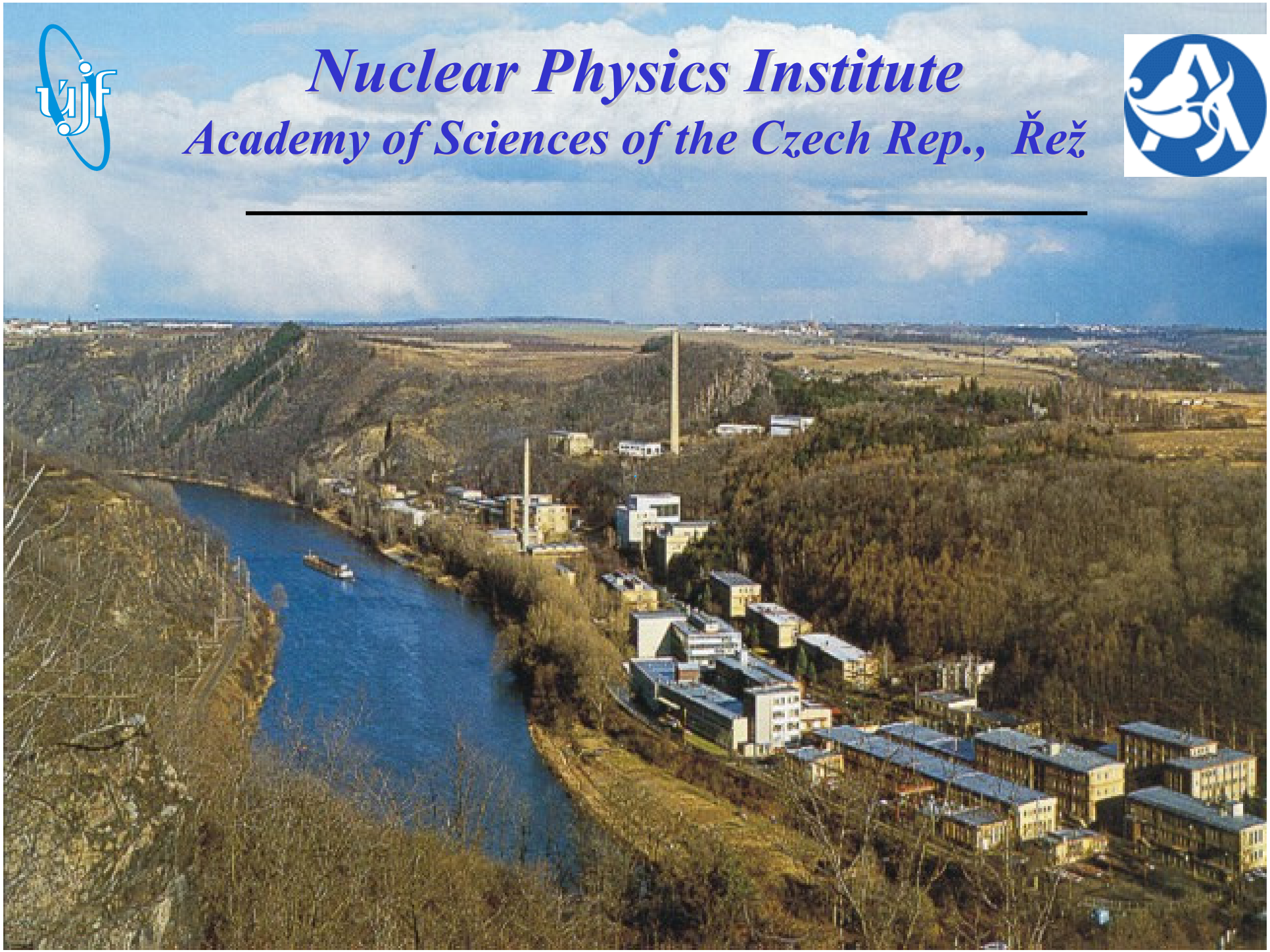
Nuclear Physics Institute

Academy of Sciences of the Czech Rep., Řež



Nuclear Physics Institute ASCR

major Czech institution in nuclear physics field

~ 200 employees ~ 70 scientists

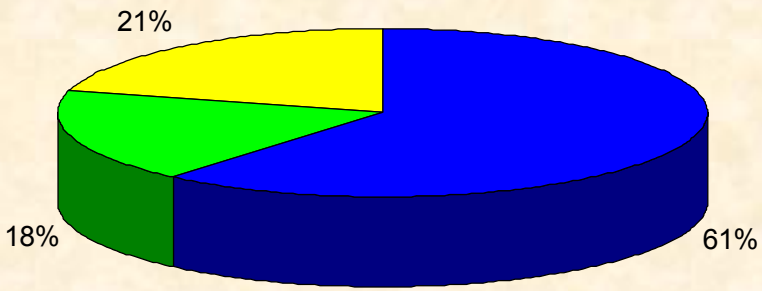
mission

- basis research in nuclear physics and related disciplines
- use of nuclear physics methods in interdisciplinary scientific and research areas

Nuclear Physics Institute ASCR

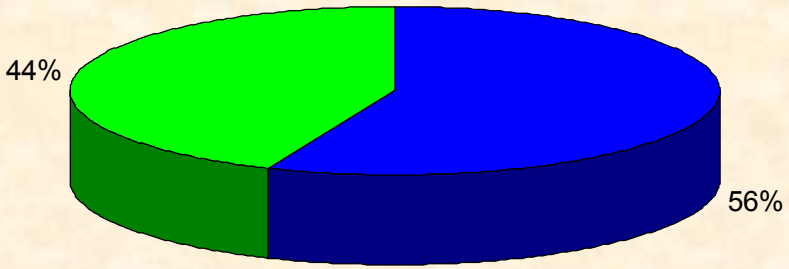
Financing Scheme - 2003

SOURCES 141,2 mil CZK / 4,5 mil EUR



- institutional ASCR 86,2 mil CZK / 2,8 mil EUR
- grants 25,4 mil CZK / 0,8 mil EUR
- commercial activities 29,6 mil CZK / 0,9 mil EUR

EXPENSES 136,5 mil CZK / 4,4 mil EUR



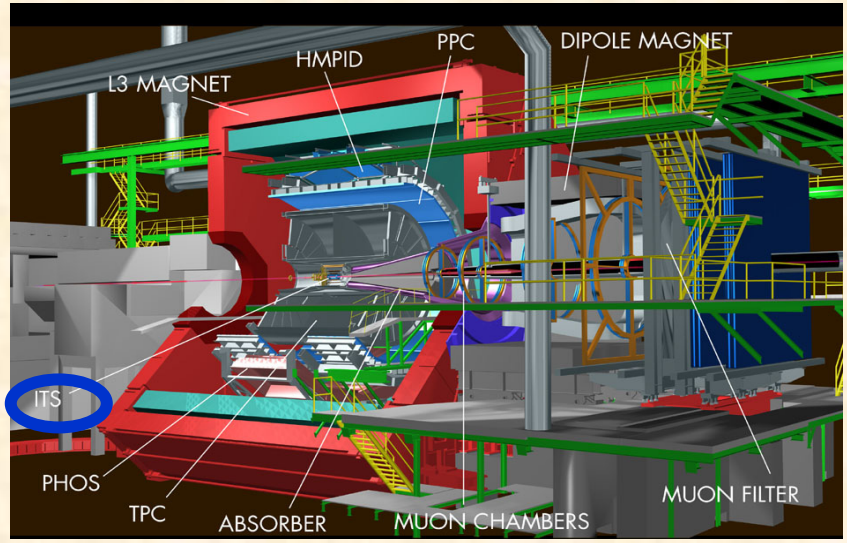
- personnel 76,8 mil CZK / 2,5 mil EUR
- material 59,7 mil CZK / 1,9 mil EUR

Nuclear Physics Institute ASCR

basic research

- **study of bulk strongly interacting matter in heavy ion collisions**
- **nuclei far from the stability**
- **nuclear astrophysics**
- **neutrino mass from electron spectroscopy**
- **theoretical physics**
- **mathematical physics**

ALICE (A Large Ion Collider Experiment)@CERN



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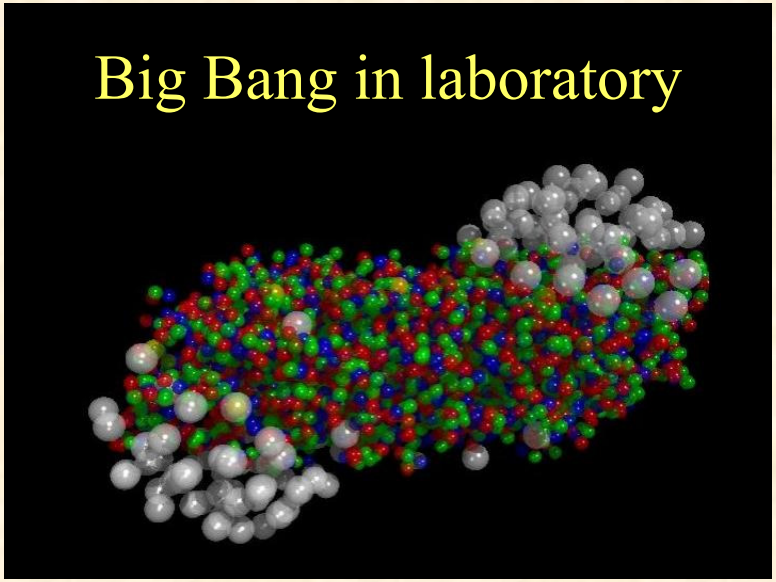
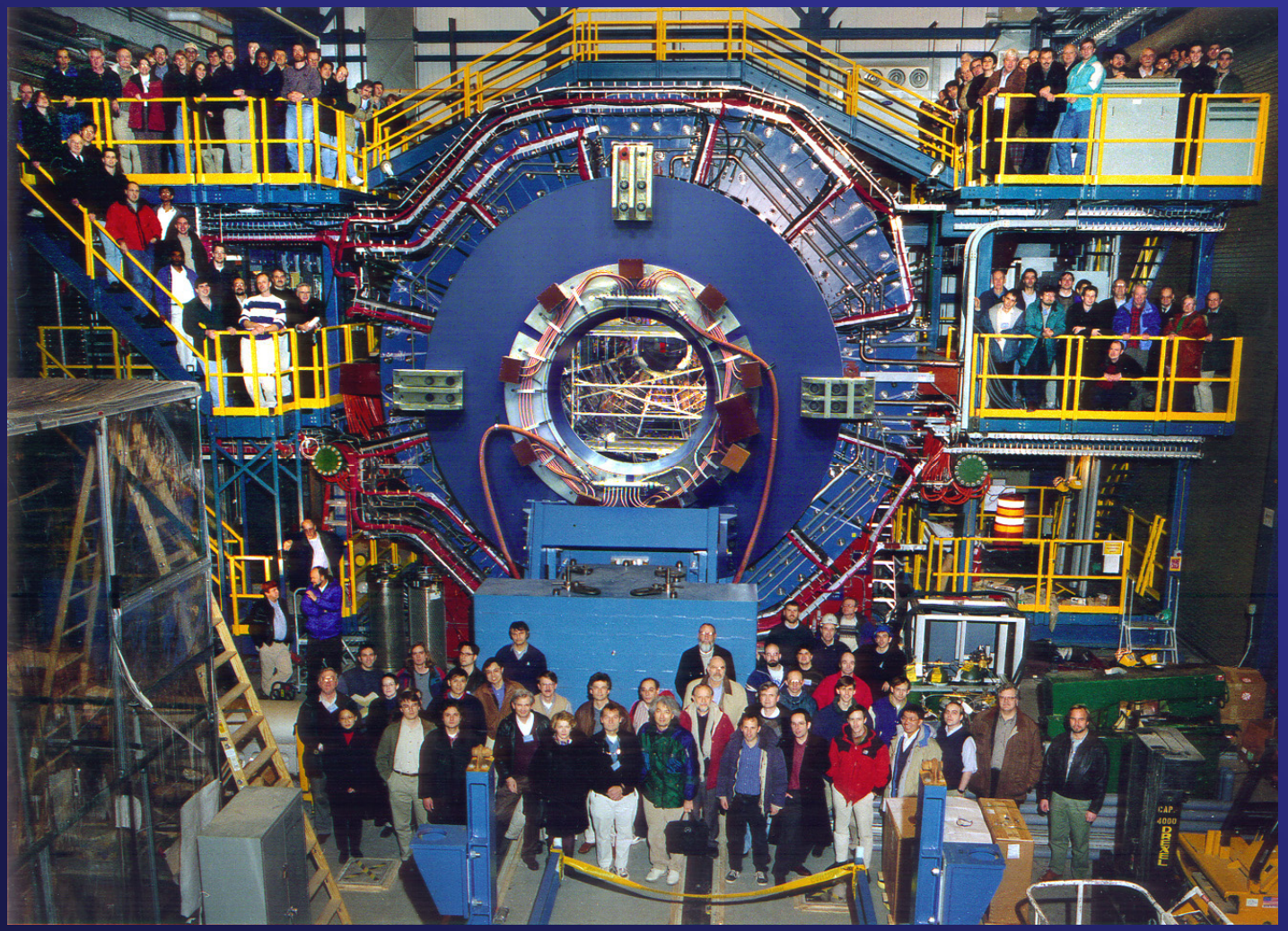


NPI Řež participation:

- Inner Tracking System
- GRID

LHC accelerator in CERN, 2007
quark-gluon plasma

Solenoidal Tracker At RHIC

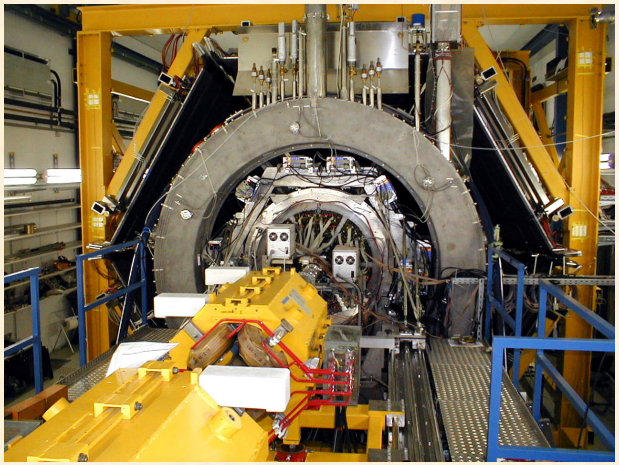


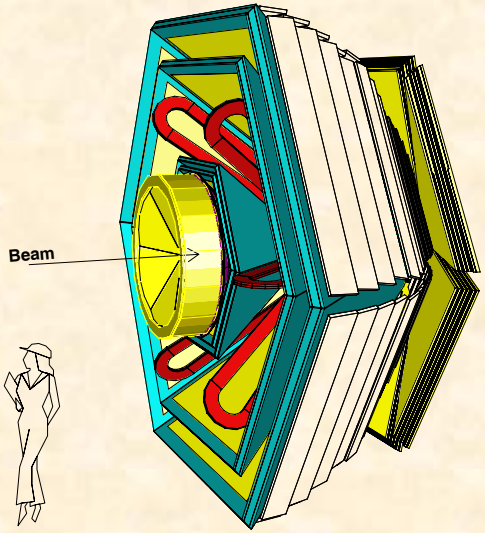
27.2.2003

STAR

BROOKHAVEN NATIONAL LABORATORY

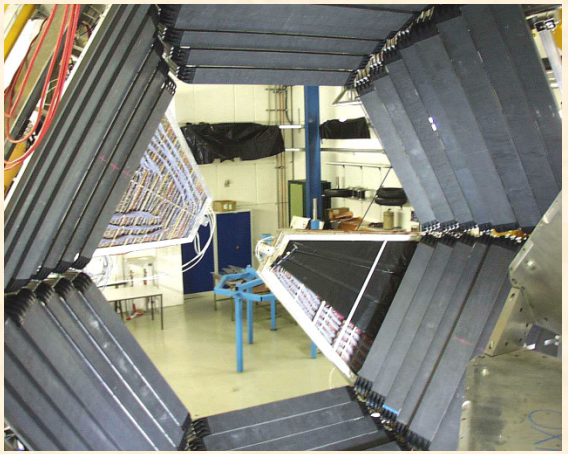
Dilepton pair spectrometer at GSI





NPI Řež participation

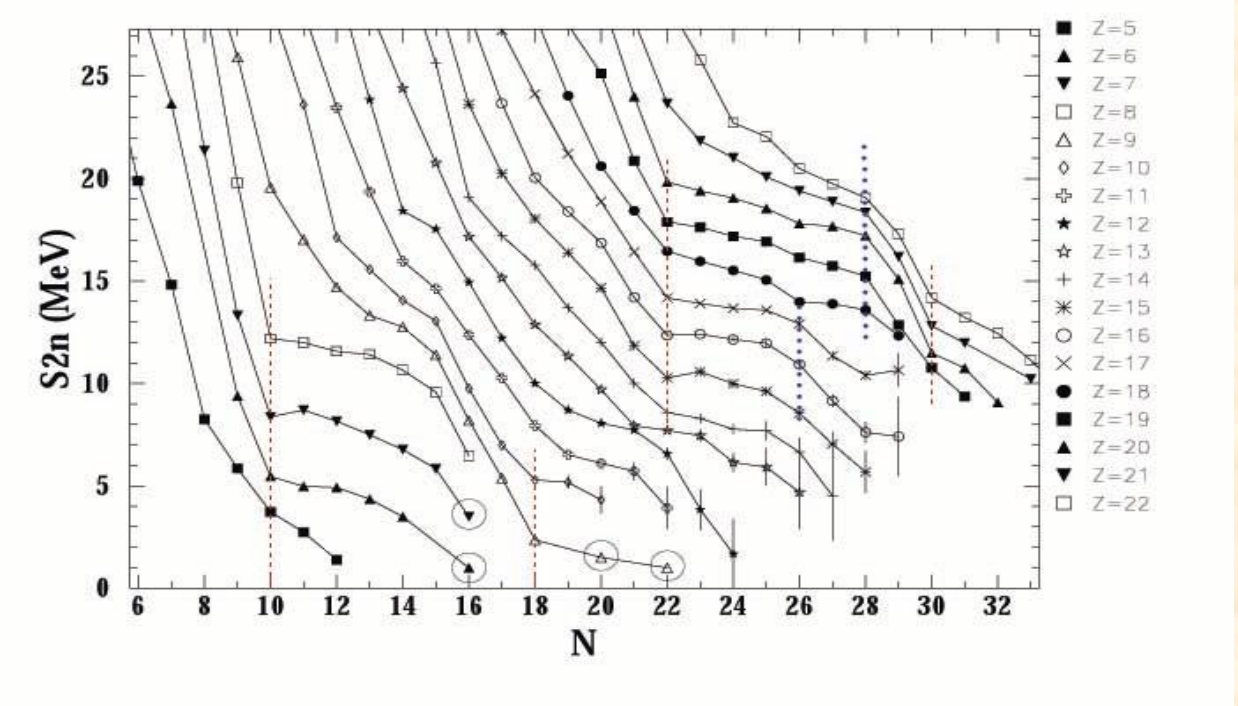
TOF – Time-of-Flight wall



nuclei far from the line of stability

collaborations at GANIL , JINR Dubna and ISOLDE CERN

exotic neutron rich nuclei with N~ 12 - 30



precision electron spectroscopy

KATRIN

(KArlsruhe TRItium Neutrino experiment)

endpoint region of tritium beta-spectrum

sensitivity to the upper limit of neutrino mass below 0.3 eV

integral electron spectrometer of 10 m diameter and 20 m length with a gaseous tritium source

NPI Řež responsible for the task CALIBRATION

Electrostatic spectrometer ESA 12

- **energy range 0 eV - 20 keV**
- **instrumental resolution 0.8 – 200 eV**
- **FWHM 1.0 eV**

theory

nuclear physics

- non-nucleonic degrees of freedom in nuclei
- relativistic description of light nuclei
- hypernuclei
- exotic atoms
- algebraic models of nuclear structure

hadron physics

- phases of deconfined QCD
- electroproduction of strangeness
- effective chiral models

mathematical physics

nuclear astrophysics

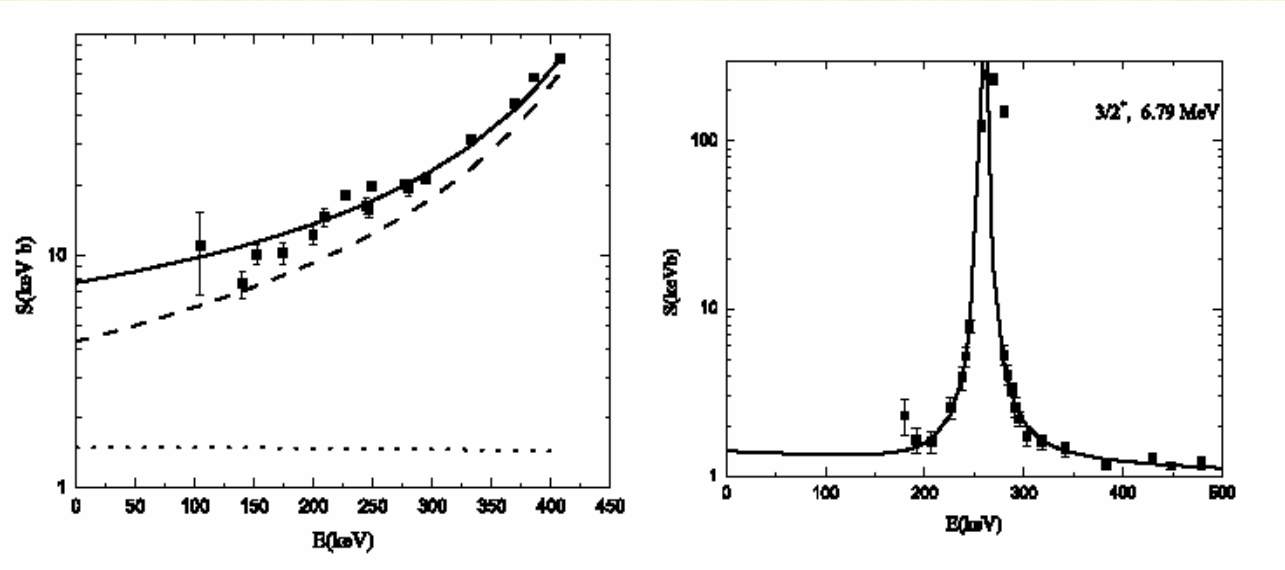
Texas A&M University, INFN Catania

Asymptotic Normalization Coefficient (ANC) method

direct part of (p,γ) ⟵ **(^{3}He,d), etc.**

Achromatic magneto-optical system for spectroscopy of nuclear reaction products

^{13}C(p,γ)^{14}N **^{14}N(p,γ)^{15}O**



Nuclear Physics Institute ASCR

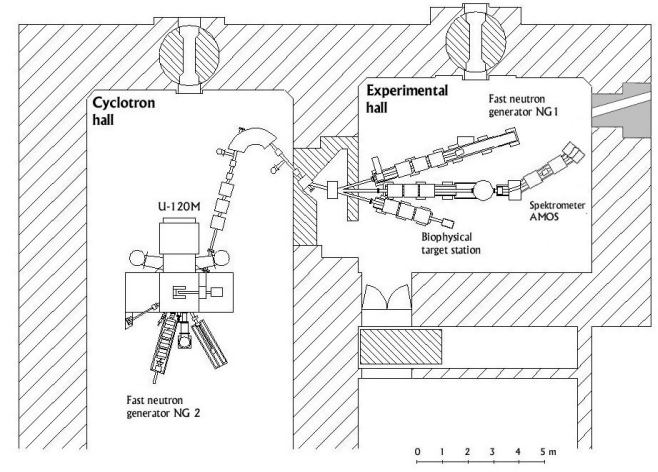
home facilities and equipment

- **cyclotron U 120-M**
- **fast-neutron generators**
- **VdG electrostatic accelerator**
- **microtron MT25**
- **neutron diffractometers (**at reactor LVR-15, NRI Řež plc)
- **radiopharmaceutical and radiochemical laboratories**

maintenance and future development essential

cyclotron - essential elements replaced
microtron – modernization going on
new tandem electrostatic accelerator

cyclotron accelerator U-120M



accelerated ions	energy [MeV]	extracted currents [μA]
H^-	10 - 38	15 - 35
H^+	10 - 38	3
d^+	10 - 20	3
$^3He^{2+}$	17 - 53	3
$^4He^{2+}$	20 - 40	3

Radiopharmaceutical R&D and production

production

- **18F fluordeoxyglucose** (FDG) for positron emision tomography (PET),
- **81Rb/81Kr** generator for lungs ventilation diagnostic

R&D

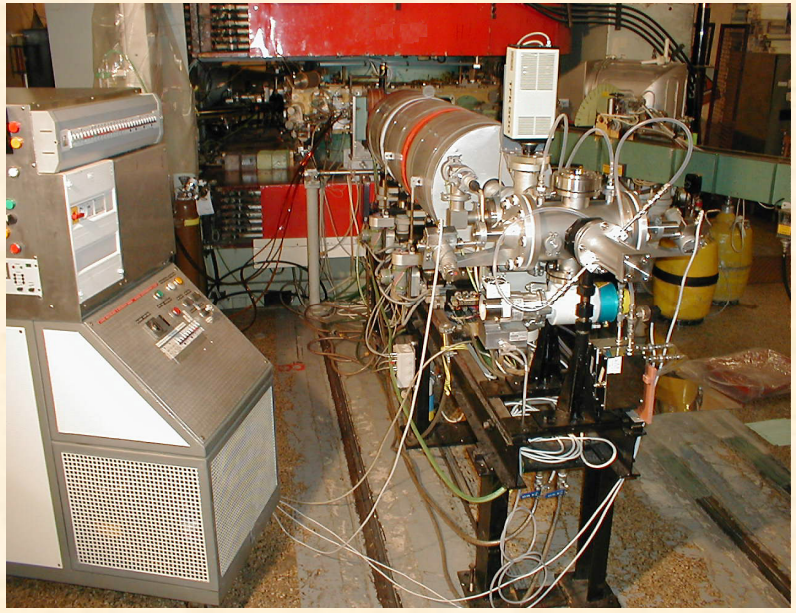
- *diagnostic products for the use on PET cameras*
  [^{18}F] FLT –fluorthymidin
- *beta radionuclides for radiotherapy*
  no-carrier-added **$^{90}YCl_3$** , **^{166}Ho** complexes
- *targeted diagnostics and therapy*
  ^{211}At, ^{123}I

fast neutron studies

EURATOM fusion program

data for IFMIF
European Activation File

fast neutron generators employing cyclotron beam



Source reaction p+D_2O

- mean energy **14 MeV**
- energy range up to **32.0 MeV**
- neutron emission
  4.4 x10^{10} n/sr/s/μA
- adjustable flux density
  10^7- 5x10^{11} n/cm^2/s

fast neutron studies

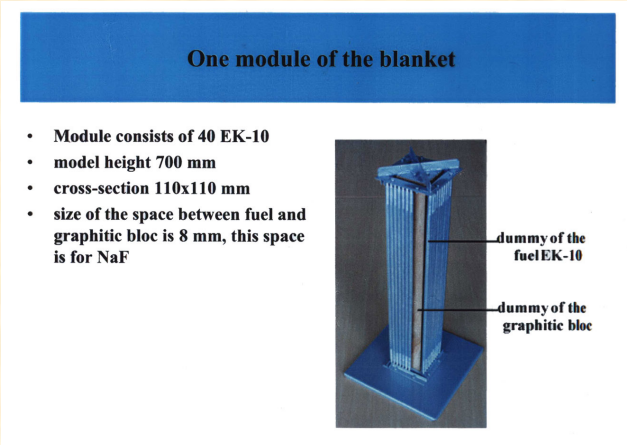
IFMIF tasks (International Fusion Material Irradiation Facility)

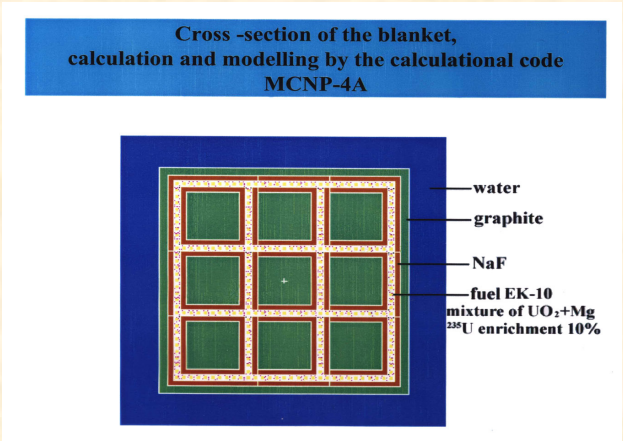
- data for Li(d,xn) source reaction
- neutron data above 20 MeV
- neutron monitors response to IFMIF neutron field

European Activation File

ADS (Accelerator driven system) studies

experimental subcritical blanket Blažka (CTU FNSPE)

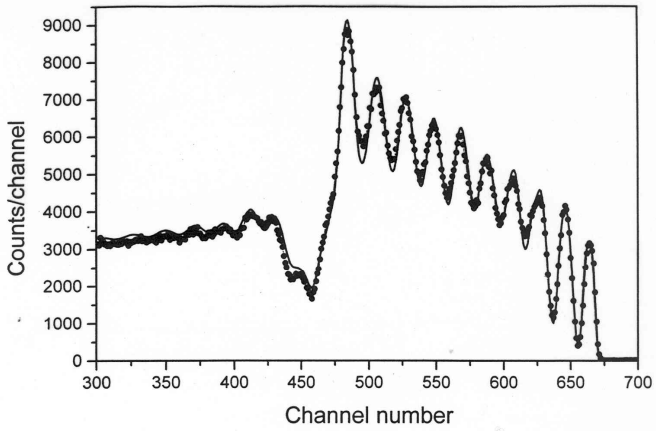




nuclear analytical methods

Van de Graaff accelerator 3.5 MV

- Rutherford Back Scattering (RBS)
- Elastic Recoil Detection Analysis (ERDA)
- Proton Induced X-Ray Emission (PIXE)
- Proton Induced Gamma-Ray Emission (PIGE)



Analysis of hard coating consisting of 10 intemittent layers of chromium (Cr) and tungsten carbide (W_xC_y) on steel. The multilayer structure combines exceptional hardness of tungsten carbide with good mechanical properties of chromium. The analysis by Rutherford Back-Scattering method (RBS) was performed at NPI electrostatic accelerator using 2.25 MeV proton beam. Spectrum evaluation with SIMNRA code gives an information on the composition and thickness of the layers, which affect the properties of the coating. Experimental spectrum of scattered protons (points) is compared with calculated one (solid line)

NRI research reactor

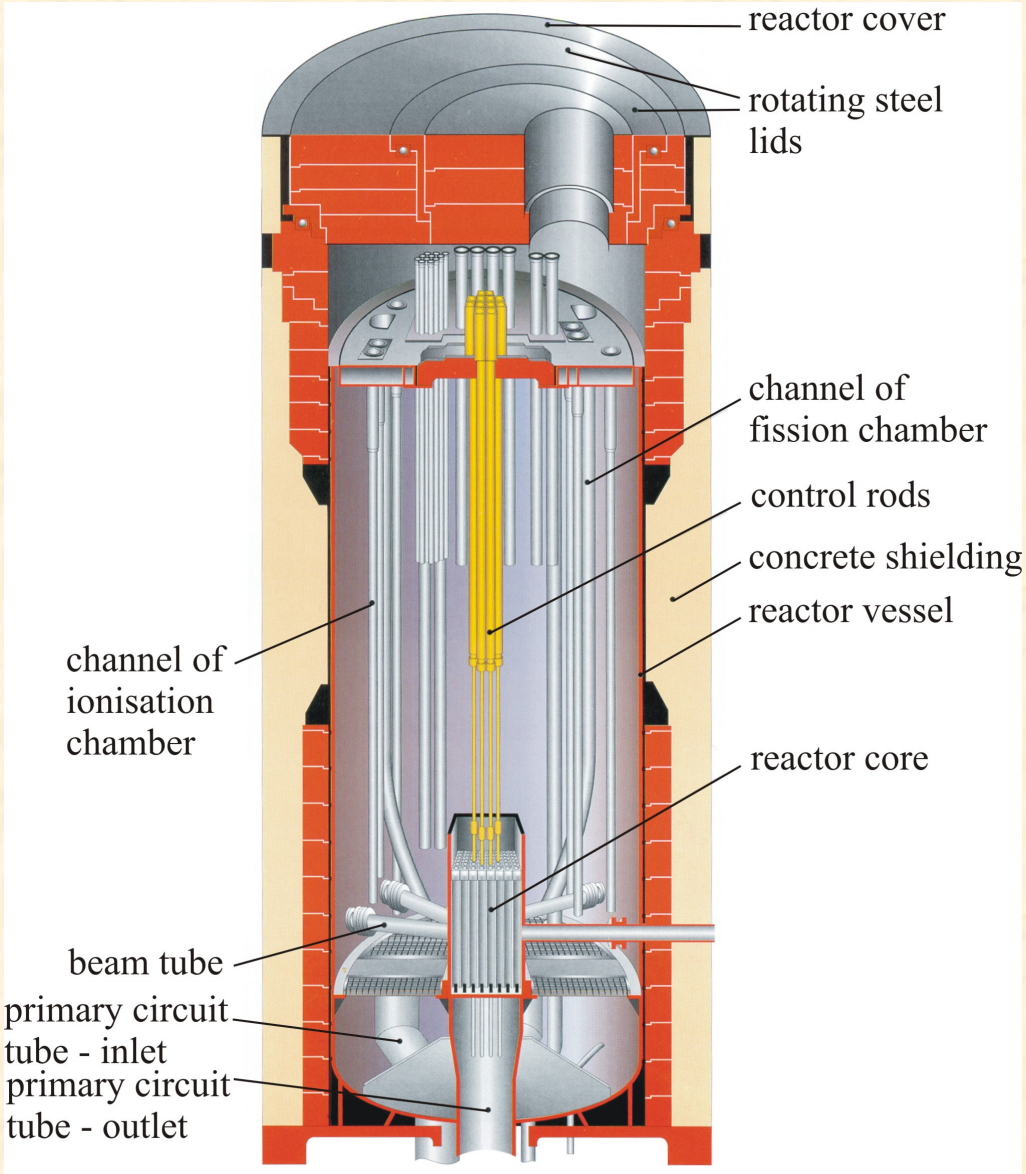
- neutron activation analysis (NAA)
- neutron Depth Profiling (NDP)

Tandetron 4130 MC

Electrostatic accelerator - terminal voltage 200 kV-3MV
H-Au ions - energies ~100 keV - ~10 MeV

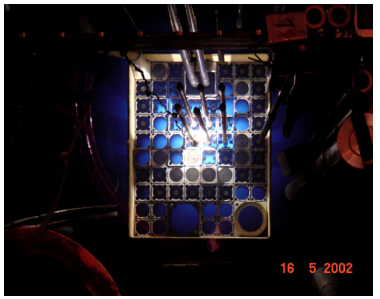
Reactor LVR 15, NRI Rez, CZ

- reactor power 10 MW
- thermal flux in the core 1.5 10^{18} $ns^{-1}m^{-2}$
- beam tube 1 10^{13} $ns^{-1}m^{-2}$
- fuel enrichment 36% ^{235}U
- tank type
- light water moderated and cooled



Neutron Physics Laboratory of NPI Řež

FP6-NMI3 - Integrated Infrastructure Initiative for Neutron Scattering and Muon Spectroscopy



4 experimental techniques are offered for Transnational Access to Large Facilities

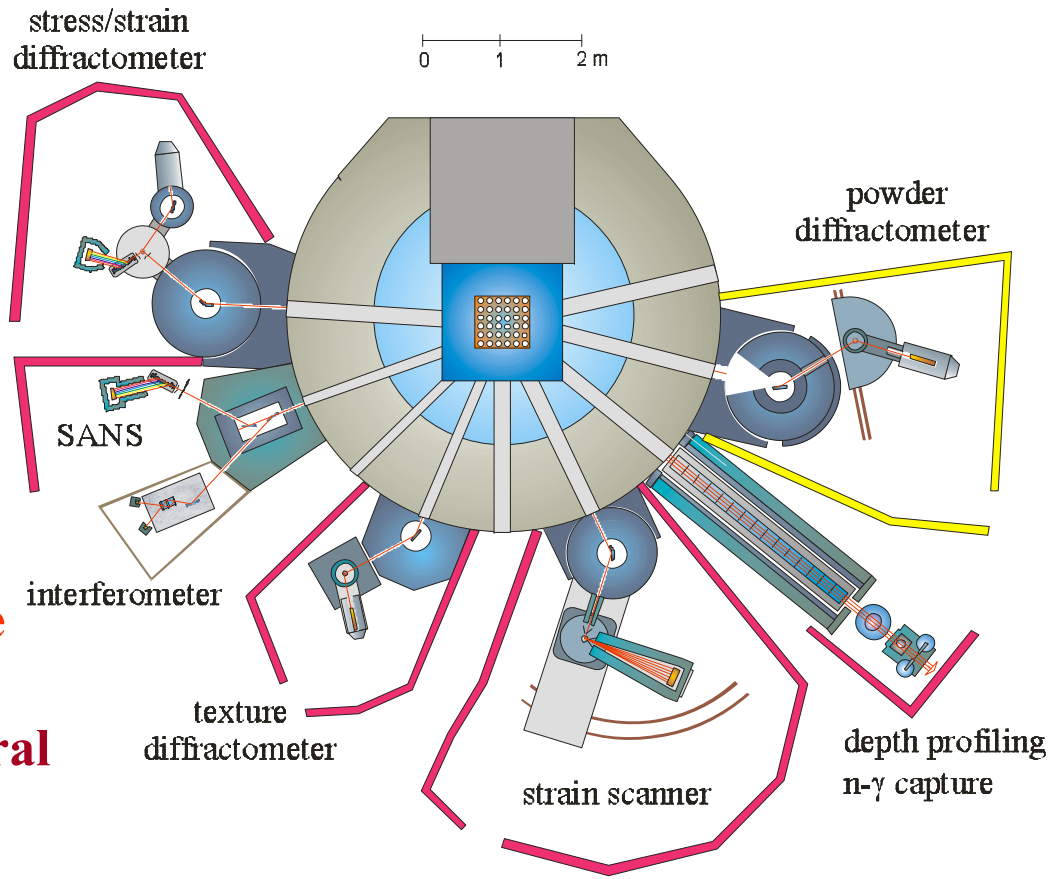
- **Residual strain/stress investigations**
- **High-resolution SANS**
- **Neutron depth profiling**
- **Neutron activation analysis**

Participation in the Joint Research Activity Programme 6 (JRA6)

- **Monte Carlo Simulation of Neutron Scattering Instrumentation**

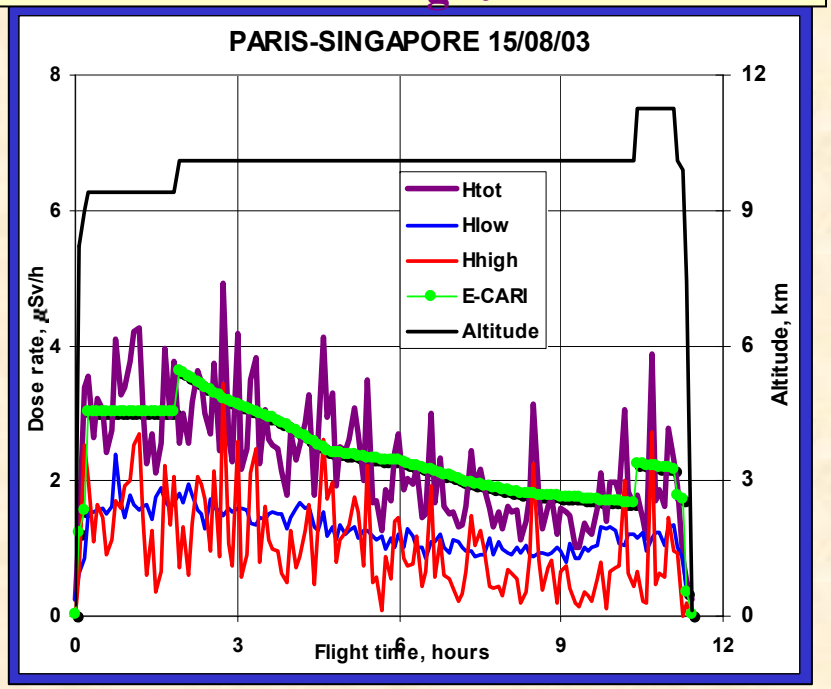
RESTRAX

Participation in the FP6 Marie Curie Programme for training researchers in the field of shape memory structural studies

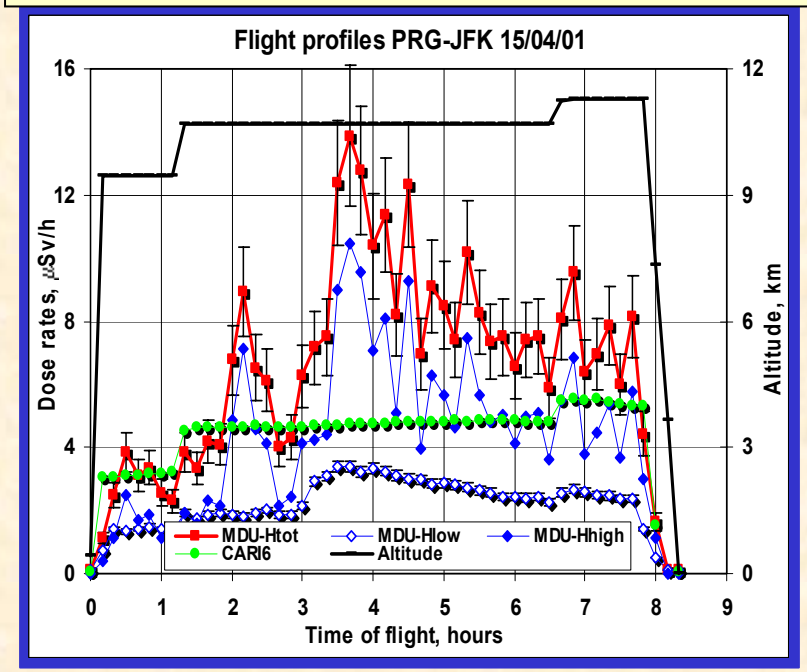


The dosimetry of natural and man-made radiation in the environment

Comparison of measured (Si-energy spectrometer) and calculated values for single flight

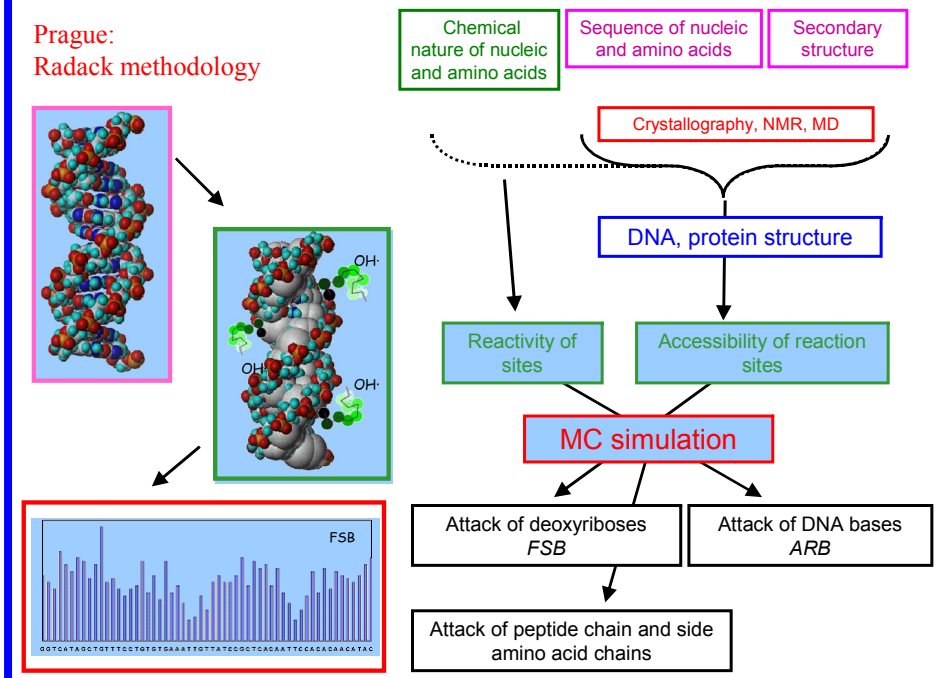


Solar flare (GLE60) registered by means of MDU; dose rate increased 3x, total E by 40%



Radiobiology of nucleic acids and proteins,

Prague:
Radack methodology



Comparison of experimental data with theoretical calculations

lac operator - *lac* represor complex