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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

RUSSIAN INSTITUTES DEALING WITH NUCLEAR DATA RESEARCH

B. Fursov

on behalf of the
Russian Nuclear DataCommission

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Abstract: The report summarizes for twelve Russian nuclear Physics institutes, the experimental facilities that are used for nuclear data research. The facilities include particle accelerators and their specifications, time-of-flight spectrometers, detectors, etc. The measurement programs include neutron capture cross-sections; neutron induced gamma-ray spectra; inelastic neutron scattering; transactinide cross-sections, fission yields, delayed neutron yields, prompt fission neutron yields and spectra; double differential charged-particle induced neutron emission cross-sections; proton induced fission cross-sections up to 100 MeV; and many others.

March 1995

Russian Institutes Dealing With Nuclear Data Researches.

1. SSC of Russian Federation - Institute of Physics and Power Engineering.

1.1. Experimental Facilities:

1.1.1. Electrostatic accelerator (Van-de-Graaf)

Maximal potential 4.6 MeV

Accelerated particles (in a direct and a pulse mode): H^+, D^+.

Maximal current in a direct mode - 30 μA.

To obtain quasi-monochromatic neutrons the Li(p,n), T(p,n), D(d,n) reactions are used.

Neutron intensity is (1-3)*10^8 $s^{-1}ster^{-1}$ in the neutron energy range 130 kev - 7.4 MeV.

The accelerator is designed to perform the following experiments:

a) To measure the cross-sections of transuranium elements.

Detectors: fast current ionization chambers to measure the cross-sections using high α-active (up to 10^8 s^{-1}) fissile target in a direct mode. Besides, to check the efficiency, the track-detector (glass, mica) technique was used, which is not sensitive to α-particles. The tracks are counted under the microscope.

Spontaneously fissile isotope cross-sections (for example, $^{244,246,248}Cm$) researches are carried out in a pulse synchronization mode which helps to reduce the spontaneous fission background 10^3-10^4 times due to the pulse mode of the accelerator.

b) To measure the neutron capture cross-sections ($E_n < 1$ MeV)

The fast neutron selector on the basis of the accelerator in a pulse mode (the flight path < 2 m). The neutron source is metal lithium target.

Detectors: liquid scintillators, ^6Li glasses of various thickness, the BGO crystal detectors.

The investigated nuclei: $A > 100$.

c) Measurements of non-elastic neutron scattering cross-sections (E_n=0.2-3 MeV).

Time-of-flight spectrometer (flight path 1.5-2 m)

Detectors: plastic scintillators with a registration threshold 0.1 MeV. Movable shielding of the detector makes it possible to measure 20-120° angular distribution of the secondary neutrons.

1.1.2. Electrostatic accelerator (Van-de-Graaf) EG-2.5.

Maximal potential 2.6 MeV.

Maximal current 50 μA.

Accelerated particles (in a direct mode): H^+, D^+, N^+, Ar^+.

The accelerator is designed to perform the nuclear microanalysis of the surfaces in microelectronics material corrosion and impurities in clean materials.

There is also a set of nuclear physical techniques such as: back scattering, charged particles channeling, emission of X-rays induced by protons and so on.

1.1.3. Cascade generator CG-2.5.

Maximal potential 2.2 MeV.

Accelerated particles: H^+, D^+.

Maximal current (direct mode) 500 μA.

To obtain neutrons the following reactions are used: Li(p,n), T(p,n), D(d,n), D(T,n), D(Be,n).

The CG-2.5 accelerator is one of the most accurate accelerators of this class in Russia and the most reliable one (its experimental capacity is 3500 hours per year).

A wide range of experiments is performed at the CG-2.5 accelerator.

a) Measurements of transuranium nuclide cross-sections.

Detectors: fast current ionization chambers, track detectors.

High intensity of neutron current (up to $5*10^9$ $n*s^{-1}sterad^{-1}$) makes it possible to measure small fissile samples (< 1-2 μg) with acceptable statistics.

b) Measurements of full and partial yields and delayed neutron half-lives.

It takes the pneumatic system very little time (at least 300 msec) to transport the sample from the target to the neutron detector and thus to register the 3 H group which has the shortest half-life.

Detector: an assembly of 24 BF_3 counters in polyethylene moderator.

Neutron flux monitor - a detector with a flat curve efficiency (McKiben type). This technique is used to measure the delayed neutron yields for the isotopes subject to transmutation, ^{237}Np in the first place.

c) Measurements of neutron spectra resulting from transactinides fission.

Detectors: multi-layer current ionization chamber with 3-5 g of investigated isotope (U, PU, Np, Th).The moment of neutron flight (fission moment) is obtained right from the fission chamber (time resolution is 2 nsec). The fission neutron spectrum is measured with the time of flight technique. The detector with gamma rays discrimination was put within the shielding.

d) Measurements of radiative capture cross-sections by the activation technique.

A relative measuring technique is used (with regard to capture cross-section ^{197}Au and fission cross-section ^{235}U).

Detectors: the ionization chambers, Ge(Li) gamma-detector, scintillator (plastic), the detector of 4π-beta-gamma coincidences. This technique is used to measure the radiation capture cross-sections of fissile nuclei and the nuclei of fission fragment mass region (tin, gadolinium).

e) Measurements of the primary fissile fragments yields for the little-known transactinides (Np).

Detector: multielectrode spectrometric fission chamber with Frisch grids which makes it possible to obtain multidimensional spectra characterizing the fission fragments kinetic energies, their masses, charges and their escape angle from the target.

To perform the work a unique system of storing, sorting and primary processing of experimental data on sixdimensional spectra was set up.

f) Fundamental investigations of the rare fission modes of heavy nuclei by fast neutrons (cold fragmentation).

g) Investigations of the (n,α) reaction mechanisms.

The work's fundamental value is to investigate the reaction mechanism. It's applied value is to develop nuclear data which will help to predict the gas production of helium in structural materials.

Detector: multielectrode spectrometric fission chamber with Frisch grids.

h) Investigations of the role of the angular moment in the course of the oriented uranium nuclei fission by fast neutrons.

The facility: cryostat based on the principle of ^3He solution to obtain the temperature <0.1 K.

The target: the uranil-rubidium nitrate matrix covered with uranium oxides.

Detectors: semiconductive surface-barrier detectors.

i) Investigations of the laser-active media properties under the proton bombardment using the subthreshold diagnostics technique.

The CG-2.5 accelerator specific mode is the pulsating arc ion source, the beam interruption and transportation system.

The work is performed within the framework of the "reactor-laser" program (nuclear pumped laser).

1.1.4. Cascade generator - CG-0.3 (the 14 MeV neutrons generator).

Voltage: 250 kV

Accelerated particles: D^+.

Maximal current in direct mode: 0.7 mA.

Pulse width: (1.5-2) nsec.

Pulse frequency: (1.25-2.5) MHz.

Average current for the pulse mode: 5 μA.

Flight path: 1.5-7 m.

Resolving power of the spectrometer for the flight path 7 m is 0.4 nsec/m.

Neutron detectors: detectors based on various scintillators like: stilbene, paraterphynil and NE-218.

Gamma-quantum detectors: Ge(Li)-detector with a volume 50 cm^3, a scintillator based on NaI(Tl) crystal 100*100 mm.

The following experiments are performed at the accelerator:

a) Investigations of leakage neutron spectra with spherical assemblies.

The purpose of these investigations is to verify the evaluated data on structural materials (iron and so on) on the basis of the experimental results.

b) Measurements of gamma ray production cross-sections in the 14 MeV neutron reactions.

The purpose of these measurements is to obtain the new data on cross-sections and gamma ray spectra resulting from neutron-nuclei interaction. These data will be used to calculate the radiational shielding and to predict the heat release in the nuclear reactors.

The investigated nuclei: Na, Al, Pb and others.

c) Measurements of neutron spectra from the (n,xn') reaction.

The secondary neutron spectra are registered within the angular interval 30°-165°, the secondary neutron registration threshold is 100 kev.

1.1.5. Tandem-Accelerator EGP-10M.

Maximal potential: 4.5 MV

Accelerated particles in a direct and pulse mode: H^+, D^+.

Pulse length: 1-1.5 nsec.

Pulse frequency: 1 and 5 Mhz.

Average current on the target: 2 μA.

Flight path: up to 2 m.

The experiments performed:

a) Measurements of the transactinide fission cross-sections.

The measurements are similar to the ones carried out at EG-1 but the neutron energy range is wider.

b) Measurements of fission neutron cross-sections.

The measurements are similar to the ones carried out at CG-2.5 but the energy range is wider.

c) Measurements of double differential neutron emission cross-sections in the (p,n) and (d,n) reactions.

The purpose of this work is to determine the level density of the excited nuclei close to the magic nuclei and the level density of the nuclei with $A > 70$ for which there is some evidence that their experimental level density differs from the model predictions.

Detectors: scintillator detectors based on stilbene crystals and paraterphynil.

d) Investigations of the proton induced α-emission reactions.

Detectors: α-particles - surface barrier silicon ΔE-E detectors.

Investigated nuclei: structural materials (Ni, Cr, Fe, V, Ti).

Purpose of the work: to measure the average cross-sections (p,α)-reactions in the subthreshold area (coulomb barrier); to formulate the basic aspects which determine the shape of the coulomb barrier and its penetration.

e) Investigation of the shape of the optical proton potential.

Equipment: scattering chamber, semiconductor detectors of charged particles, registering the scattering protons at 0°-180° angle.

Purpose of the work: basic researches of nuclear reactions mechanisms induced by the charged particles.

1.1.6. Tandem-generator EGP-15.

The generator was constructed and put in operation with the intermediate parameters (voltage, current, the kind of accelerated ions).

The design parameters EGP-15:

Maximum potential: 7.5 MV

Accelerated particles: H^+, D^+, He^{+2}, heavy ions.

Direct pulse mode.

Flight path: up to 20 m.

The works to be performed: measurements of double differential neutron cross-sections in the (p,n), (d,n), (α,n) reactions with in the incident particles energy range 10-22 MeV. These measurements are made to investigate the nuclear level density, the excited state composition, the reaction mechanisms.

1.1.7. Pulse microtron MI-30.

Maximum electron energy:

1-st Mode - 30 MeV

2-nd Mode - 12 MeV

Pulse width:

1-st Mode - 1-2 msec

2-nd Mode - 0.2 msec.

Pulse frequency:

1-st Mode - 1000 Hz

2-nd Mode - 2500 Hz

Average electron current - 20 αA.

Works performed:

1. Measurement of the neutron spectra within the critical assembly with the time-flight technique (fast neutron reactors).
2. Investigation of nuclei fission process with gamma-ray technique (photofission).

Measurement of the excitation function, heavy nuclei cross-sections in the energy range below the neutron binding energy in the course of photofission, angular distributions of the photofission fragments.

Detectors: track detectors (mica, glass).

1.1.8. Pulse fast reactor IBR-30 (Dubna).

Since the commissioning of the IBR-30 reactor in Dubna, a group of the IPPE specialists together with the JINR specialists and the specialists from the member-states of this International Organization, has been conducting the researches on nuclear constants and nuclear physics problems using the IBR-30 neutron beams.

The investigated energy range: resonance neutrons, fast neutrons (<200 KeV).

Investigation technique: the time-of-flight technique.

Detectors: multicellular gamma-ray scintillator detectors with NaI(TL) crystals and liquids; multicellular 4π-neutron detectors; fast ionization chambers; equipment for cooling and heating the samples to investigate the Doppler effect.

The work performed: measurements of the nuclei resonance parameters (energies, spins, widths), transmission and self-shielding measurements for radiation capture, transmission and self-shielding measurements for fission reactions (determination of group cross-sections and their self-shielding factors), measurement of the Doppler-effect of the transactinide cross-sections in the resonance energy range.

2. All-Russian Scientific-Research Institute of Experimental Physics. RFNC-ARSRIEP, Arzamas-16.

2.1. Experimental facilities.

2.1.1. Electron linear accelerator-LU-50 ("Khrizantema").

Maximum electron energy - 55 MeV.

Pulse length - 10 nsec.

Pulse frequency - 2400 Hz.

Maximum pulse current - 10 A.

Average neutron yield from uranium target - $3*10^{12}$ n/sec.

Flight path - 25 m and 50 m.

Neutron energy range - 100 KeV - 10 MeV.

The work performed:

1. Measurements of energy dependence of the prompt neutron average number during the transuranium element fission.

Detectors: plate avalanche detectors of fission fragments; a big 400 liter liquid scintillator detector loaded with gadolinium; fast current ionization chambers; flash gamma-ray detectors (stop signal) based on the hydrogen-free scintillator ZhS-52.

Measuring Technique: the data was normalized with regard to the spontaneous fission of californium.

2. Measurements of energy dependence of fission cross-sections with a relative technique.

Detectors: fast ionization chambers, avalanche detectors.

3. Investigations of the total cross-section characteristics in the unresolved resonance region with a transmission technique (E_n=0.3-20 MeV).

Detectors: fast ionization chambers containing up to 6 g of uranium.

4. Measurements of gamma-rays accompanying inelastic neutron scattering on various nuclei.

Detectors: NaI(TL) scintillators (100-150 mm), fast ionization chambers.

2.2.1. Electrostatic tandem-generator EGP-10.

Maximum potential: 6.2 MV.

Accelerated particles: H^+, D^+, T^+.

Maximum current: 10 μA.

Works performed:

1. Investigation of the heavy nuclei fissility in their reactions with the charged particles: (d,pf) and (t,pf).

Detectors: scattering chamber, ΔE-E semiconductor detectors.

2. Investigations of the reaction cross-sections induced by the charged particles for fusion applications.

2.2.2. Critical assemblies.

To conduct integral experiments with spherical shell (up to 300 mm), to test the neutron group constants of structural and fissile materials.

2.2.3. Electromagnetic mass-separator to obtain separated isotopes of transuranium elements.

3. All-Russian Scientific-Research Institute of Technical Physics. ASRITP. Chelyabinsk-70.

3.1.1. Neutron generator NG-200.

Accelerated deutron energy - 200 kev.

Pulse length - 15 nsec.

Pulse frequency - 0.5 MHz.

14 MeV neutron yield in (d,T) reactions - $5*10^{10}$ n/sec.

Deuteron pulse current - 1 mA.

The works performed:

1. Integral experiments to test the nuclear constants.

The time-of-flight technique: measurement of the neutron spectra of spherical and semispherical samples taken from structural and fissile materials. Calculations to test the nuclear data libraries.

2. Applied works.

Setting up the "AZOT" facility for instant protein analysis in the grain by nitrogen concentration determination by gamma-ray neutron capture measurement.

3.1.2. Neutron generator NG-12 E.

The construction works of the facility with the following parameters have nearly come to an end.

Direct mode: $2*10^{12}$ n/sec.

Pulse mode: 10^9 n/sec

Pulse frequency: 0.1 MHz.

Pulse length: 10 nsec.

4. Scientific-Research Institute of Nuclear Reactors.
SRINR. Dimitrovgrad.

4.1. Experimental facilities.

Mechanical four-rotors neutron selector on a horizontal channel of the BOR-60 reactor (at the renovation stage).

Thermal neutron current - 10^{11} $n*sec^{-1}m^{-2}$.

Epithermal neutron current - 10^{12} $n*sec^{-1}m^{-2}$.

The pulse neutron beam is produced by 4 rotors suspended in a magnetic field (three rotors-collimators and a rotor-chopper).

The works performed: measurement of transmissions in 0.02-5000 eV energy range. The investigated nuclides are the nuclides used for industrial purposes (mainly radioactive nuclei).

Detectors - ^3He proportional counter.

Method: measurement of the neutron transmissions with the samples irradiated and non-irradiated in the reactor (in the high-intensity vertical channels of the SM-2 reactor).

5. The V.G.Khlopin Radium Institute.St.Petersburg.

5.1. Experimental facilities.

5.1.1. Proton synchrophasotron PI.

Maximum energy: 200 MeV.

Pulse length: 20 μsec.

Pulse frequency: 50 Hz.

The facility is not used as a neutron source. It can be used to measure the nuclear data in the intermediate energy range.

The works performed:

1. Measurement of the proton induced transactinide fission cross-sections (E_p=10-100 MeV).

Detectors: thin film avalanche counters.

2. Measurement of (p,xn) reactions cross-sections on the fissile and structural materials.

3. Measurement of gamma-ray yields resulting from 30-100 MeV protons collision with heavy nuclei.

5.1.2. Electrostatic accelerator Van-de-Graaf EA-5.

Maximum voltage: 3.5 MV.

Accelerated particles: H^+, D^+, He^{++}.

Maximum current in a direct mode: 30 μA.

Pulse length from 2 to 20 nsec.

Pulse frequency: 2 MHz.

Average pulse current: 1-3 μA.

The works performed:

1. Measurement of the absolute cross-sections by the correlated particles technique.

2. Measurement of spectra and cross-sections of gamma-ray production resulting from neutron-transactinide interaction.

3. Measurement of the excitation functions of the inelastic neutron scattering on the structural materials nuclei (excitation of isolated levels).

4. Measurement of the radiation neutron capture cross-sections for the fission product nuclei.

5. Measurement of the light charged particles yields (protons, -particles, tritium) resulting from transactinide fission by neutrons.

Detectors: current ionization chamber, scintillators.

6. Measurement of the fission neutron spectra.

Detector: fast multilayer ionization chamber with time resolution 2-3 nsec.

5.1.3. Neutron generator NG-400.

Accelerated deuterons energy - 340 keV.

Average deutron current - from 1 to 3 μA

14 MeV neutron yield - 10^{11} n/sec.

1. Measurement of fission neutron spectra.

2. Measurement of tritium yields in the course of transactinide fission by 14 MeV neutrons.

3. Measurement of the gamma-ray spectra and total yields when neutrons interact with heavy

nuclei. Measurement of gamma-ray production cross-sections in 0.2-3 MeV energy range and average spectrum energy.

4. Measurement of discrete gamma-ray spectra produced by neutron interaction with fissile nuclei.

5.1.4. Intermediate neutron spectrometer at PIAF cyclotron.

Flight path - 50 m.

The work performed - measurement of the transactinide fission cross-section by intermediate energy neutrons (1-200 MeV).

5.1.5. Proton cyclotron MGC-20.

Maximum energy - 20 MeV.

Average current - 25 μA.

The works performed:

1. Measurement of the (p,n), (p,2n) and (p,p'n) reaction cross-section for ^{237}Np.
2. Applied researches.

5.1.6. Experiments with spontaneous fission sources.

The works performed:

1. Precise measurements of ^{248}Cm, ^{252}Cf spontaneous fission spectra.

   Detectors: fission fragment-multichannel plates, neutron-scintillator detectors.

2. Measurement of the average number of the spontaneously fissile nuclei secondary neutrons.

   Detectors: a big liquid scintillator tank, surface barrier semiconductor detectors of fission fragments with large area.

5.1.7. Radiochemical group.

Production of fissile targets.

Production of semiconductor detectors with specific characteristics (large area, better energy resolution on superclean p-silicon).

6. Joint Institute of Nuclear Researches (OIYAI) Dubna.

6.1. Experimental facilities.

6.1.1. Pulse fast reactor IBR-30 with a booster on the basis of LUE-40.

Average power - 7 kW.

Pulse length - 4 μsec.

Pulse frequency - 100 Hz.

Neutron current - $5*10^{12}$ $n*sec^{-1}sm^{-2}$.

Detectors:

1. Multisection scintillator gamma-ray detector with NaI(TL) crystals (volume - 32 liters).
2. Multisection liquid gamma-ray detector of 80 liter volume.
3. Multisection liquid gamma-ray detector of 400 liter volume.
4. Fast ionization chambers with the layers of ^{239}Pu (0.4 g and 1.6 g) and layers of ^{235}U (2 g and 10 g).
5. Multisection 4π-geometry neutron detectors based on ^{3}He counters.
6. Facilities for heating and cooling samples.

The works performed:

1. Measurement of nuclei resonance parameters and gamma-ray multiplicity distribution.
2. Measurement of transmission and self-indication in radiation capture and heavy nuclei fission (determination of group cross-sections and self-shielding factors for them).
3. Measurement of the Doppler effect in the transactinide cross-sections and in the neutron resonance energy range.
4. Determination of the transactinide delayed neutrons yield in the millisecond range.
5. Investigation of gamma-ray spectra from $^{233,235}U$ and ^{239}Pu fission fragments.
6. Measurement of angular anisotropy of the fragments produced in the result of ^{235}U oriented nuclei collision with resonance neutrons.
7. Investigation of the mechanisms of nuclear reactions resulting in the charged particles escape with regard to the neutron energy.
8. Investigation of the gamma-transition cascades in heavy nuclei.

6.1.2. IREN Project.

The project is aimed at LUE-40 replacement for LUE-150 + Booster-neutron multiplier with multiplication coefficient 20-30.

The expected parameters:

Neutron pulse length - 0.4 μsec.

Average power - 30 kW.

Pulse frequency - 150 Hz.

Average flux - $1.5*10^{15}$ n/sec.

The project is expected to be realized in 1996. The realization of the project will considerably increase the intensity and resolution of the resonance neutron source at the same neutron guide structure.

7. RSC "Kurchatov Institute", Moscow.

7.1. Experimental facilities.

7.1.1. Linear electron accelerator "Phakel"

Electron energy - 60 MeV

Pulse length - 30 nsec

Pulse frequency - 900 Hz

Pulse current - 1.5 A

Integral neutron yield - $5*10^{13}$ n/sec

Flight path - 45 m

Detectors: multisection scintillator detectors based on NaI(Tl) crystals "Romashka".

The works performed:

1. Measurement of α- values (capture cross-sections/fission radio).
2. Investigation of the unconventional states of the excited nuclei (gamma-ray multiplicity spectra, gamma-cascades on heavy nuclei resonances, measurement of power functions with regard to the spin).
3. Measurement of p-odd asymmetry in radiation capture reaction with the use of multiple spectrometry.
4. Applied researches - the use of neutron and multiple spectrometry techniques for element composition analysis and ores separation.

7.1.2. Electrostatic acceleration Van-de-Graaf - ESU-2.5.

Detectors: track detectors (glass), scintillator detectors, avalanche detectors.

The works performed:

1. Measurement of the transactinide cross-sections.
2. Measurement of angular anisotropy of fission fragments.
3. Measurement of energy dependence of transuranium nuclei fission cross-sections in nanogram samples.

8. Institute of Theoretical and Experimental Physics (ITEF), Moscow.

8.1. Experimental facilities.

No neutron sources available at the Institute.

The works performed: participation in joint researches at JINR, RSC "KI", PIAF, IPP reactor (Grenoble).

9. St.Petersburg Institute of Nuclear Physics
PIAF. Gatchina.

9.1. Experimental facilities.

9.1.1. Time-of-flight spectrometer "GNEIS".

Basic facility - synchrophasotron.

Proton energy - 1 GeV.

Pulse length - 10 nsec.

Pulse frequency - 50 Hz.

Total neutron yield - $3*10^{14}$ n/sec.

5 flight paths (35-50 m).

Neutron energy - from 10^{-2} Ev to 100 MeV.

The works performed:

1. Measurement of transactinide fission cross-sections for intermediate energy neutrons (1-100 MeV) joint with NPO "RI".
2. Investigations of low-lying p-resonances in heavy fissile nuclei ($E^n < 100$ eV).
   Detector - 32 electrode ionization chamber (2 g ^{235}U).
3. Measurement of the neutron capture cross-sections for fissile nuclei . Measurement of gamma-ray spectra in resonances (E^n < 1 kev).
4. Investigations of properties of the nuclei lying outside the beta-stability valley.

9.1.2. VVR-M Reactor.

Thermal neutron flux- $2*10^{14}$ $n*sec^{-1}sm^{-2}$.

The works performed:

1. Fast neutron and gamma-ray transmissions through crystal samples.
2. Measurement of thermal neutron capture cross-sections for nuclei-isomers.
3. Measurement of the excited states life-time in (n,γ)-reactions (subnanosecond states).
4. Measurement of soft gamma-ray (10-50 kev) in (n,γ) reactions.

9.1.3. Neutron generator NG-200.

Potential - 170 and 130 kV.

Deutron current - 20 mA (rotating target).

Neutron flux - $2*10^{12}$ n/sec.

Neutron activation analysis technique, applied works (oxygen composition analysis in VTSP ceramics).

10. St.Petersburg Technological Institute. PTI.

10.1. Experimental facilities.

10.1.1. Microtron M-22.

Electron energy - 22 MeV.

Current - 20 μA.

10.1.2. Neutron generator NG-200.

Total 14 MeV neutron yield -10^9 n/sec.

The works performed.

1. Measurement of proton energy spectra in (n,p), (n,np) reactions and on structural materials nuclei.
2. Mass-spectrometric researches of the fission product yields on odd nuclei in fission reactions induced by slow neutrons and gamma-rays.
3. Non-destructive control of nuclear fuel composition by photofission delay neutrons.

11. Institute of Nuclear Researches RAN, IYAI RAN, Troytsk.

11.1. Experimental facilities.

11.1.1. A set of neutron sources based on proton beams produced at the accelerator of the Moscow meson facility (MMF).

Proton energy - 600 Mev.

Pulse length - 0.2 μsec.

Frequency - 100 Hz.

Proton current - 0.5 mA.

Beam microstructure - 0.2 nsec.

Frequency - 200 KHz.

Average intensity of resonance neutrons - (25 nsec,

400 Hz) $3*10^{16}$ n/sec.

Peak intensity of main neutrons (35 μsec) - $2*10^{15}$ $n*s^{-1}sm^{-2}$

Average intensity of fast neutrons (0.2 nsec,200 Khz) - $3*10^{13}$ n/sec.

After the Moscow Meson Facility is commissioned a wide range of experiments on thermal, resonance and fast neutrons (including the intermediate energy range) may be performed at it.

12. Scientific-Research Institute of Nuclear Physics of the Moscow State University NIIAF MGU. Moscow.

In 1995 the project on microtron with a cut magnet RM-100 (electron energy up to 120 MeV, electron current 100 μA) will be realized.

The commissioning of this facility will make it possible to perform a wide range of experiments on photonuclear processes.

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