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SCIENTIFIC PROGRAMME OF THE FRANK LABORATORY OF NEUTRON PHYSICS:

Report for 2000 and Prospects for 2001

Report to the 89th Session
of the JINR Scientific Council,
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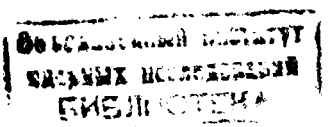

INTRODUCTION

In 2000, the FLNP scientific program was realized under the auspices of five research themes of the JINR Plan of Scientific Research and International Scientific and Technical Cooperation (PSRISTC) and it was aimed at obtaining new results in condensed matter physics (theme 07-4-1031-99/2003 "Neutron Investigations of Structure and Dynamics of Condensed Matter", headed by V.L.Aksenov and A.M.Balagurov) and neutron nuclear physics (theme 06-4-0974-92/2000 "Study of the Fundamental Characteristics of Neutrons and Nuclei", headed by W.I.Furman and V.N.Shvetsov). To effect scientific research, work to develop, modernize, and construct the FLNP basic facilities, IBR-2 (theme 07-4-0851-87/2002 "Development and Upgrading of the IBR-2 Complex", headed by V.D.Ananiev) and IREN (theme 06-4-0993-94/2004 "IREN Project", headed by W.I.Furman and I.N.Meshkov) as well as the IBR-2 computation and spectrometry complex (theme 07-4-1012-96/2000 "Development of the IBR-2 Spectrometers Complex and Computation Infrastructure", headed by A.V.Belushkin and V.I.Prihodko) continued. Also, FLNP took part in the JINR themes: «ATLAS. General-Purpose pp Experiment at the Large Hadron Collider in CERN» (theme 02-0-1007-94/2005, headed by N.A.Russakovich), «Theoretical and Experimental Investigations of the Electronuclear Method of Energy Production and Radioactive Waste Transmutation» (theme 03-0-1008-95/2002, headed by A.N.Sissakian, I.V.Puzynin and A.Baldin).

This report contains a brief account of 2000 scientific results and outlines the 2001 year plans of the Laboratory reflected in the JINR Plan of Scientific Research (PSRISTC) submitted for approval to the present session of the JINR Scientific Council. The FLNP annual report for 2000 will give a more detail account of 2000 results.

1. SCIENTIFIC RESULTS IN 2000

1.1. Condensed Matter Physics

Experimental investigations. Diffraction. Initiated in 1997 investigations of doped manganese oxides of the type $La_{1-x}Ca_xMnO_3$, $0 \le x \le 1$ in which the Colossal MagnetoResistance Effect arrises at certain levels of doping continued. The effect consists of a dramatic increase in the electric resistance of a material if an external magnetic field is applied to it. The reason for the decrease of the resistance is the phase transition from dielectric to magnetic state. The CMR effect may reach a value of 10^7 or higher. Potential technological uses of such compounds may appear to be diverse and extremely effective. In the year 2000 the main directions of research in CMR materials were experiments directed towards obtaining information about the extent of inhomogeneity of states arising at transition from dielectric to metallic state. To this end, the behavior of samples in the external magnetic field up to 4 T at 4 K temperature

was investigated. The experiments made it possible to build a diagram of one of the canonical CMR-compounds $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$ (LPCM) and determine its basic states. It is found that for large mean radii of the A-cation (r_A>1.190 Å) the basic state in LPCM is homogenous metallic with a ferromagnetic ordering. If r_A<1.185 Å, the basic LPCM state is mainly homogenous as well but the type of conductivity turns into semiconducting and the magnetic moments of manganese mainly form a noncolinear antiferromagnetic structure. For the intermediate region of r_A values a mixed state with spatially separated regions of a mesoscopic size (~1000 Å) having different types of conductivity and magnetic structures forms. The physical reasons for the formation of a two-phase state in magnetic manganese oxides is the objective of further experimental and theoretical investigations.

Structural investigations of triple compounds of mercury chalcogenid $HgSe_{1-x}S_x$ were conducted at external pressures up to 3.5 GPa. At P≈1 GPa, the phase transition from sphalerite-like cubic to hexagonal cinnabar-like structure was discovered. Curves of the dependence of the structural parameters of the hexagonal phase on the pressure are obtained.

Studying the texture of marble rocks we found out that it is noticeably more expressed than the structure arising at recrystallization of carbonate rocks. Calculations and further experiments show that in this case, thermal expansion has an expressed anisotropy. It is concluded that it is necessary to consider for the texture of marbles to take into account correctly their behavior at changes of temperature.

Small angle scattering. The scientific program of investigations with YuMO comprised many research directions in the physics of condensed matter, biophysics and molecular biology, physics and chemistry of surfactants, colloids, polymers, etc. The dependence of the structure and properties of TTABr micelles on the pressure and temperature was studied. It is found that in self-organizing systems of TTABr increasing of the concentration of salt leads to the phase transition from ball-like to cylindrical form of micelles and growth of the radius and length of the cylinder. Increasing of the temperature produces the reverse effect on the system – the radius and length of cylindrical micelles decrease.

The structure of monoglycerides intensely used in food industry as emulsifiers and initiators of the crystallization of fats dissolved in water is studied. We determined the conditions of the "solidification" of monoglycerides in water, that is of the gel-phase formation, and how the homogeneous medium monoglyceride-water forms as charged amphifiles are added to the water.

Small-angle scattering was used to investigate gels and water solutions of poly(N-vinylcaprolactam) in heavy water in the presence of ionogen surface-active substances and pyragollole at different temperatures. It is shown that adding of a thermosensitive polymer of a low-molecular substance to the solution may influence significantly the temperature behavior and the conformation state of molecules in the polymer.

Polarized neutrons and neutron optics. On the SPN spectrometer, experiments to investigate the formation of the field of neutron standing waves in layered nanostructures and the channeling effect of neutron waves in a layered structure continued. Possible applications of the new effects are the creation of a neutron beam with a super-narrow cross section (100 nm in diameter), obtaining of extramonochromatic and extracollimated neutron beams, and the use of neutron layered resonators as phase-shifting elements in spin-echo spectrometers. The channeling effect of neutron waves is observed in the structure Cu(30nm)/Ti(150nm)/Cu(100nm) deposited on glass. For the neutron momentum transfer 0.997, 0.0134 or 0.0182 $Å^{-1}$ intensity peaks corresponding to an increase of the neutron density due to coherent summation of waves with different reflection multiplicities from the copper layers are observed. Thus, it is experimentally shown that the channeling of the neutron wave occurs at distances larger than 30 mm.

In the REFLEX-P spectrometer-aided investigations of a thin polycrystalline FeCo-film signs of inelastic neutron scattering in the region of small angles were observed, which allows us to assume the existence of surface or planar magnons in this medium.

Inelastic neutron scattering. The dynamic properties and phase transitions of metallic, molecular, and ion-molecular compounds were investigated with the spectrometers DIN-2PI, KDSOG-M, and NERA-PR. The use of the NERA-PR spectrometer yielded most interesting results in the study of a dynamic disorder and glass-like phases in solids and compounds containing molecular groups of the type CH_3, CH_4, H_2O, or OH. These investigations are traditionally conducted in cooperation with specialists from different research establishments in Poland and Russia. In the year 2000 within the framework of the theme partial spectra of vibrational states of crystalline and glassy methanols were determined, the experiments being carried out using selectively doped samples of CD_3OH and CH_3OD. The obtained data were used to verify models of the dynamics of the crystalline and glassy phases in methanol and to determine the microscopic mechanism underlying the origin of the "boson peak" in the low-frequency vibrational spectrum of molecular glasses.

Investigations of water solutions with DIN-2PI were conducted to determine the effect of dissolved particles on the microdynamics of water molecules entering into their hydrate spheres. The effects of hydrophobic hydration, their influence on the diffusion mobility of the water of hydration and the rotation-oscillation dynamics of the molecules were investigated. A comparative analysis of two types of hydration reveals the fact that large apolar particles do not destroy the grid of hydrogen bonds in their surrounding water.

Methodical results. As in a few previous years, in the year 2000 in the framework of theme 1031 neutronographic investigations in the physics of condensed matter were mainly carried out at the IBR-2 reactor through the use of neutron scattering. In addition to IBR-2-aided experiments, physicists of the Division of Neutron Investigations of Condensed Matter in FLNP working on theme 1031 conducted experiments with the electrostatic generator EG-5 and X-ray diffractometers of FLNP

and also, did measurements in some neutron laboratories of Europe under accepted proposals.

During the reported year IBR-2 had eight working sessions. The IBR-2 spectrometer time was distributed in accordance with experts recommendations based on submitted proposals and taking into account the existing long-term agreements for cooperation. Ten instruments were included in the list of spectrometers to operate in the user mode in the year 2000. They are HRFD, DN-2, DN-12, SKAT, YuMO, SPN, REFLEX-P, KDSOG, NERA, and DIN.

The main methodological achievement of the year is the startup of the first stage of the new Fourier diffractrometer FSD devoted for investigations of internal stresses in materials and engineering structures. By the spring 2000 the principal elements of FSD, including the biological shielding, mirror neutron guide, fast fourier chopper, beam control systems, table for the sample, and the goniometric devices, had been installed and tested on beam 11 of IBR-2. In the reactor cycle in May the first measurements in the high resolution mode with an element of the 90-degree detector MultiCon were made on FSD. The resolution of interplane spacing $\Delta d/d \approx 0.004$ was obtained as expected.

A second detector was installed and tested in the small-angle spectrometer YuMO, which increased essentially the momentum transfer range in which the scattered neutron spectrum is also measured simultaneously.

On the spectrometer REFLEX-P, the new ZnS-screen-based low-background detector was commissioned and started to operate for physical experiment. An about 50 time decrease in the background has allowed unique experiments of registration of surface phonons and magnons in thin films on the level of $2 \cdot 10^{-7}$ of the primary elastic scattering process to be conducted.

Executing the modernization project for the SPN spectrometer a super-mirror neutron polarizer is manufactured and tested. In comparison with the existing regular polarizer it has a wider wavelength width (by about a factor of 2.6) for which the polarization efficiency exceeds 95%. The application of the new polarizer will give an essential rise to the polarization efficiency of measurements at larger wavelengths (by a factor of 10 in the interval 3÷7 Å) and will also increase the luminosity of the spectrometer.

On some of the IBR-2 spectrometers (HRFD, DN-2, DN-12, YuMO) a transition of control electronics to VME standard has completed thus enabling a new level of experiment automation.

1.2. Neutron Nuclear Physics

The 2000 experimental program in neutron nuclear physics of FLNP traditionally included the following researches: experimental and theoretical investigations of the electromagnetic properties of the neutron and the beta-decay of the neutron, studies of parity violation processes in nuclear fission; investigations of high-

excited states of nuclei in the reactions of thermal or resonance neutron capture, obtaining of new data for the purposes of nuclear astrophysics; experiments with ultracold neutrons.

Experimental investigations. The UGRA spectrometer was used to investigate the influence of the Doppler effect on the angular dependence of neutron scattering in s-resonances. A noticeable anisotropy was observed and the data procession is under way. The neutron scattering cross sections are also measured in the region of interference dips of ^{238}U s-resonances. These extremely small cross sections are largely determined by the Doppler broadening of the resonances. They have practically never been measured while interest to them is due to investigations of the electromagnetic interaction of neutrons with atoms in the region of minimums of nuclear cross sections. We managed to obtain reliable results for the first three resonances.

In the framework of a Dubna-Kiev-Garching collaboration precision measurements of the total neutron cross section of ^{208}Pb were performed on the ~24 keV filtered beam in Garching. The result allows us to refine slightly the estimate of the neutron polarizability α_n. At the same time, it has become clear that an acceptable accuracy of $\Delta\alpha_n \cong 0.2 \cdot 10^{-3}$ fm^3 can be obtained by adding at least three points of a similar accuracy situated at ~20–100 keV from 24 keV to the existing cross section points. Plans of such experiments are under development.

With the POLYANA facility on the beam of polarized resonance neutrons measurements of the left-right asymmetry and parity violation effects in the resonance neutron-induced fission of ^{239}Pu nuclei continued. An exact knowledge of the coefficient of asymmetry, α_{nf}^{lr}, and of the coefficient of P-odd effect, α_{nf}, will make it possible to determine the parameters of unkown p-resonances and extract matrix elements of the weak interaction from the experiment.

To complete the cycle of investigations in the angular anisotropy of fragments from the resonance neutron-induced fission of aligned ^{235}U nuclei, it appears necessary to know more precisely the constant of the electric quadrupole superfine interaction that determines the alignment coefficient of spins of uranium nuclei. To this end, the temperature dependence of the angular anisotropy of alpha-particles on the radioactivity of the investigated samples was measured over the temperature interval $290 - 0.4K$ and preliminary data processing was done.

The first stage of precision measurements of the mass and kinetic energy distributions of fragments from the fission of ^{235}U induced by neutrons with the energy $0 < E_n < 20$ eV aimed at obtaining information on contribution variations of different fission modes and channels in this energy region, completed. Analysis of the experimental data employing the results obtained from an analysis of the anisotropy of ^{235}U fission fragments for a coinciding neutron energy region is nearing its completion.

The intensity of two-step gamma-cascades arising after radiative neutron capture is investigated as a function of the energy of the intermediate level of the compound nuclei ^{185,187}W, and ^{191,193}Os in joint Dubna-Rez experiments with a measuring error of not larger than 10-20%. The experimental data are analyzed using original techniques of

nonmodel determination of the density of excited states in nuclei developed in Dubna.

The obtained data are of much importance for the verification of the existing and development of the new models of the excited states density that would take into account realistically the co-existence of the ordinary and superfluid phase of nuclear matter over the whole range of excitations below the neutron binding energy. In cooperation with Beijing and Tsinkhau Universities (China) experiments to measure the cross sections and angular distributions for the reactions ^{6}Li(n,α)T, ^{10}B(n,α)^{7}Li, ^{39}K(n,α)^{36}Cl, ^{40}Ca(n,α)^{37}Ar, ^{58}Ni(n,α)^{55}Fe, and ^{64}Zn(n,α)^{61}Ni were conducted at neutron energies from 1 to 7 MeV. The experiments were made at the Van de Graaf accelerator in the Institute of Heavy Ions of the Beijing University using the two-section ionization chamber with removable samples constructed in FLNP JINR. The objectives of the investigation are the study of the contributions of different reaction mechanisms (compound nucleus, pre-equilibrium and direct processes) and verification of nuclear models.

On beam 5 of IBR-30 spectra of the radiative capture of neutrons with energies up to 100 eV by nuclei of the isotopes ^{181}Ta , ^{121}Sb, and ^{123}Sb were measured in cooperation with Prof. M. Psitula's group (Lodz, Poland). For antimony isotopes correlation between the excited level population and spins of resonances was observed, which allows the use of precision gamma-spectroscopy to study the resonance structure of the investigated nucleus.

At the ILL reactor in Grenoble investigations of the mechanism of weak UCN heating continued. The temperature dependence of inelastic UCN scattering with a small energy transfer (~ 10^{-7} eV) on the surface of beryllium or copper was observed. The intensity of neutron detection on the surface of these materials decreased 2.5 times as the temperature decreased from room to liquid nitrogen temperature. The upper limits are established and the lower limits are refined for the value of UCN heating with a small energy transfer.

The experimental upper limit of UCN under-barrier transmission through a vacuum-tight beryllium foil with the thickness 14 μm is improved by two orders of magnitude, which is $(-1.2\pm1.0)\cdot10^{-8}$ per bounce.

Applied researches. In the year 2000 applied and methodological investigations were intensively conducted. The IBR-2 reactor-based instrumental neutron activation analysis (INAA) was used to solve problems concerned with environmental protection in the framework of the REGATA project. Biomonitoring of working places in a number of industrial establishments in Russia and other JINR-member-states and of heavy metal depositions in some regions of Russia, including the Moscow region and Dubna outskirts, and of other countries, was performed. The study of ecologically safety of construction materials was conducted by investigating kinescope glass breakage. Investigations of materials used in vitrification of liquid and solid radioactive wastes were performed in cooperation with the scientific and industrial enterprise RODON. FLNP together with the E. Andrinikashvili Institute of Physics (Tbilisi, Georgia) are preparing an application for a patent on the development and creation of a selenium-containing medicine on the basis of Cyanophycea *Spirulina Platensis*. The analytical

part of the work was made in Dubna by epithermal neutron activation. The publication of *Tables for Identification of Nuclides Formed in Nuclear Reactors*, which are widely used in carrying out INAA experiments at the IBR-2 reactor, must be specifically emphasized.

Original techniques were mastered and flight samples of the fast neutron detector (HEDN) for the next American mission to Mars "Mars Surveyor Orbiter 2001" were calibrated with the help of the reaction ^{7}Li(p, n) and the ridioisotope sources (^{252}Cf, Pu-Be) at the Van de Graaf accelerator.

The development of the method of a combined correlation gamma-spectroscopy of neutron-nucleus interactions was under way. The method was tested on an IBR-30 beam by carrying out the gamma-radiation spectroscopy of fragments of the resonance-neutron-induced fission of ^{239}Pu, which demonstrated the efficiency of the method. Work to build sixteen BGO-scintillation blocks for the multidetector HPGe-BGO in the gamma-spectrometer COCOS completed.

Experimental investigations of samples of the plastic scintillator with B and Gd neutron converters made in RChL of LNP were carried out to assess the effectiveness of their application as neutron detectors.

1.3. Other JINR Programs

Theoretical and Experimental Investigations of the Electronuclear Method of Energy Production and Radioactive Waste Transmutation. In 2000, work to investigate fast neutron yield fluctuations in a subcritical system, reactor + electron beam of LUE-40, and study the dependence of the neutron yield on the reactor subcritical level was carried out.

2. NEUTRON SOURCES

2.1. The IBR-2 Pulsed Reactor

In 2000 the IBR-2 reactor operated in accordance with the approved working schedule. It has operated 8 cycles for the power W=1.5 MBт, three of which were carried out with a cryogenic moderator. During the reported period there were only 7 emergency shutdowns. The maintenance plan for the period from June to September, 2000 was fulfilled on time. It involved a removal of the movable reflector PO-1 decommissioned in 1987 from an operative storeroom. This has freed room for the PO-3 movable reflector to be removed in the stage of modernization.

Modernization project. The PO-3 working project is completed. Manufacturing of PO-3 started in the JINR Central Workshops and NIKIET. A complete set of TVEL components for a new fuel loading is manufactured. The

necessary amount of PuO_2 is processed and trials started in the industrial enterprise Maiak. The fuel assembly project is completed in NIKIET. In the framework of the technical project of modernization the neutron-physical calculation of the active zone is carried out. Designing of the executive mechanisms of the control and emergency system started. Development of technical requirements for the electronic equipment of the control and emergency system started in the Institute of Atomic Energy in Swierk, Poland.

2.2. The IREN Project

The working schedule of the IREN project corrected in accordance with the recommendations of the JINR directorate formulated at the 87th Session of the Scientific Council is implemented in the main points during the year 2000.

The BINP in Novosibirsk completed the construction and tests of the accelerating tubes, buncher and the SLED system for the linac LUE-200 on time. In two test runs conducted with an accelerating tube prototype an acceleration of about 30 MeV/m was obtained, which is sufficiently close to the rated value. The final stage of test measurements carried out in October with participation of JINR experts showed that the shape of the electron energy spectrum differs from the expected. The achieved beam power is only is only 60% of the rated value. Regular financing enabled the shipment of two accelerating tubes to JINR in September. The buncher and the SLED system are due at the end of February, 2001. The design and construction of a powerful RF load and beam diagnostic elements has started in BINP in accordance with the terms of a recently signed contract. Copper tubes for the construction of a solenoid for the magnetic focusing system of the linac were partly ordered or produced. By the end of the first quarter of the year 2001 they will be delivered to JINR. Designing and manufacturing of a set of high-voltage supplies for this system started in BINP in October, 2000. Certain success is achieved in designing and modeling of a pulsed electron gun. By the end of this year a thermo-stabilization and a vacuum systems will be mounted on a full scale RF stand that FLNP assigned for testing of the accelerating tubes of LUE-200.

The contract with a known German firm, PPT, for designing and construction of two modulators for feeding of klystrons 5045 SLAC in LUE-200 is concluded and the designing will be completed in December 2000. It is financed from a long term German loan to the Russian Federation. The conditions of supply of two 5045 SLAC klystrons are agreed upon with the DOE of the USA in the respective agreement signed by JINR and DOE in 1993.

The «Mayak» plant completed the construction and received a license for the fuel elements of the multiplying target of IREN. They will remain at the plant until everything is ready for assembling of the new active zone in the reactor hall of the former IBR-30.

Specialized Moscow institutes, RINM and NIKIET, in close collaboration with JINR developed the technical project of the assembly of IREN in 2000. However, a

short delay in financing as well as the necessity to do extra calculations of IREN safety caused by recently introduced stricter requirements for nuclear hazardous facilities in the Russian Federation resulted in a four-month shift of the completion date of the first stage of the technical project. This will obviously lead to a delay in receiving of the license for the decommissioning of the IBR-30 reactor and the construction of the IREN facility. However, there is still a possibility to have this license by the date of the final shutdown of IBR-30 at the end of June 2001.

By the end of the year 2000 we will have invested in the JINR project, exclusively through JINR Directorate grants, an amount of about 300K$, which is ~ 52% of the sum requested for this year. Hence, to execute the working schedule of the project stating the date of the nominal startup to be the end of the year 2002, it is necessary to finance the project on the level of at least 960k$ in 2001. To this end, enhanced technical and manpower support of the project inside JINR is a severe necessity.

3. DEVELOPMENT OF THE IBR-2 SPECTROMETER COMPLEX AND COMPUTATION INFRASTRUCTURE

Local area network and computing infrastructure. In the year 2000, the following work aimed at further development of the information and computer infrastructure of the IBR-2 complex was carried out:

- Data traffic in the FLNP local network was optimized and the data transfer rate increased significantly (Internet).
- Two segments of the network were changed over to twisted pairs (central segment in building 119 and Nuclear Physics Department segment).
- The number of X-terminals and the disk space of the SUN-cluster were increased.

Data acquisition and control systems In 2000 the VME data acquisition and control systems on the YuMO, DN-2, FSD and DN-12 spectrometers were put into test operation. Positive results were achieved on the all spectrometers, however, at the YuMO and DN-2 spectrometers some problem involving data accumulation from PSD arose. In course of the first autumn cycles several non-trivial errors in electronics were found, which revealed them selves only when working with high count rates on the beam. During these cycles the errors were corrected and we hope that they were last ones.

The new generation detector electronics for gas linear and PSD detectors as well as for point detectors has been constructed and installed on the YuMO, DN-2, SPN and DN-12 spectrometers.

At JINR FLNP in collaboration with HMI, Berlin, the development of the main DAQ board for MSGC detector was completed as far as possible with simulation and routing programs as well as the CPLD programming and the development and debagging software. A prototype of the board is ready. FLNP is presently continuing the adjustment and testing of the DAQ board by means of a software event generator. HMI is preparing the testing of the DAQ hardware and software with the MSGC detector prototype in 2000/2001.

The reliable operation with all temperature devices, close cycle refrigerators, cryostats and other sample environment devices has been provided.

The work on improvement of existing VME systems on the spectrometers HRFD, NERA-PR, SCAT and EPSYLON was continued.

Development of the IBR spectrometer complex. The main effort on the development IBR-2 spectrometers were concentrated on the following instruments: SPN, YuMO, FSD and DN-12.

The full polarization analysis system of SPN was tested and put into operation. Two first elements of the MultiCon detectors based on a ZnS scintillator were assembled and installedat FSD. In 2000 the assembly and adjustment of the laser spectrometric system for pressure measurement in high pressure cells were completed at DN-12 spectrometer.

4. SCIENTIFIC RESEARCH PLAN FOR 2001

The 2001 FLNP Scientific Research Plan contains 5 first priority themes.

Theme	Leader	Priority	Code
Neutron investigations of the structure and dynamics of condensed matter	V.L.Aksenov A.M.Balagurov	1	07-4-1031-99/2003
Study of the fundamental properties of neutrons and nuclei	W.I.Furman V.N.Shvetsov	1	06-4-1036-01/04
Upgrading of the IBR-2 complex	V.D.Ananiev, E.P.Shabalin	1	07-4-0851-87/2002
Realization of the IREN project	I.N.Meshkov W.I.Furman	1	06-4-0993-94/2004
Development of the spectrometer complex and computation infrastructure of IBR-2	A.V.Belushkin V.I.Prikhodko	1	07-4-1012-96/2002

In the year 2001, in the framework of theme 1031 investigations in condensed matter will be carried out in the following directions:

The plan of methodical work foresees an increase of the number of detectors in the FSD diffractometer up to 8 and the start of regular experiments with it. FSD will be mainly exploited to carry out the program of investigations based on orders from MINATOM establishments.

The program of scientific research will base on experimental proposals selected by experts' committee and the approved long-term projects. It will include, in the main, the research directions traditionally investigated at the IBR-2 reactor and will focus on obtaining of new data about the microscopic properties of the investigated systems and experimental verification of theoretical predictions and models.

The following main problems are to be solved in the year 2000 in the framework of theme 1012:

- *Modernization of detector systems for the YuMO spectrometer.*
- *To improve reliability and to increase data transfer rate in the network segment of the IBR-2 experimental setups (purchase and instalation of the CISCO router)*
- *To update software for VME-systems at the IBR-2 spectrometers.*
- *To develop software for controlling experiments and preliminary processing data from multi-detector systems.*
- *To develop a new electronic modules for data acquisition and sample environment systems.*
- *Routine maintenance of measuring and control systems of the IBR-2 spectrometers.*
- *Development on the basis of the foregoing test results, of a second generation of TDC/DSP DAQ and slow-control boards using mezzanine technology (MSGC detector).*
- *Design and development of fabrication technologies for a two-dimensional position-sensitive ^{3}He multi-wire chamber detector with delay line readout; fabrication of the prototype MWPC detector elements.*
- *New reflectometry measurement shoulder of SPN will be manufactured and installed on the beam. The design works on cresting of small-angle measurement shoulder will be began. The development of the new spectrometric to use VME crate together with PC will be started.*
- *In 2001, on the FSD spectrometer the equipment of the detector systems with the multi con elements will be continued, the adaptation of the sample environment system which includes the Tira loading machine, high temperature mirror furnace, HUBER goniometer, etc., will be performed and the carring out of regular experiments will be started.*
- *Further modernization of the YuMO spectrometer (installation three-detector system and development appropriate software, improvement sample environment for the researches in polymer physics and physical chemistry of colloids further*

development of the biochemical lab and preparation of the technical project of new SANS instrument).

- *In 2001, on the DN-12 is planned to put into operation a furnace for pressure cells and to perform first methodical experiments. The upgrade of laser spectroscopic system to improve its parameters will be made. The development and methodical of VME electronics and software will be continued. The development of high pressure cell with diamond anvils and test experiments with it are planned. Development of new detector system based on ZnS scintillator will start.*

The following main tasks are to be accomplished in the year 2000 in the framework of theme 0851:

- *Providing of 2000 hr-beam time for physical measurements (8 cycles a year, including 3 cycles with the cryogenic moderator CM)*
- *manufacturing of the PO-3 movable reflector*
- *continuing of work to prepare a new fuel loading*
- *issuing of the technical project of modernization.*

The following research program will be realized with IBR-30 and other neutron sources (theme 0974):

- *Precision measurements of the total neutron cross section of argon gas as a first stage of investigations in the (n, e)-interaction.*
- *Completion of measurements of the left-right asymmetry and the spatial parity violation effect in the resonance neutron-induced fission of ^{239}Pu nuclei at the POLYANA facility. Completion of analysis of the obtained data.*
- *Carrying out of experiments with a prototype of the KATRIN facility on the neutron beam to measure the neutron beam polarization; begin the development of an optically polarized gas target containing $^{129,131}Xe$ isotopes at a pressure of up to 10 atm.*
- *Completion of PARKS facility-based measurements of angular distributions of protons from the reaction $^{35}Cl(n,p)^{35}S$ in the neutron resonance with $E_n = 398$ eV and of the forward-backward anisotropy in the reaction $^{14}N(n, p)^{14}C$ at E_n about 1 keV.*
- *Carrying out of the final series of measurements of an absolute value of the anisotropy of fission fragments in the reaction $^{235}U(n, f)$ and analysis of the whole aggregate of the results obtained using aligned targets.*
- *Completion of investigations of the radiative capture and fission reactions on ^{235}U and ^{233}U nuclei over the neutron energy range from 7 to 300 eV with the facilities ROMASHKA and PARUS.*
- *Measurements of the multiplicity spectra of gamma-quanta to refine alpha-values in separate resolved resonances or energy groups and of total cross sections, radiative capture cross sections, resonance blocking factors of ^{232}Th at 1 eV - 100 keV within an error of 3-7%.*

- *Completion of data acquisition about cascades from two sequential gamma-transitions for two little-studied types of nuclei to reveal the basic properties of nuclear matter in the vicinity of the phase transition superfluidity - normal fermi-liquid.*
- *Conduct precision measurements of gamma-radiation spectra of fission fragments from the resonance neutron induced fission of ^{239}Pu employing the neutron multiplication analysis on the multidetector (HPGe-BGO) gamma-spectrometer.*
- *Start measurements of neutron spin precession on neutron transmission through a polarized target at the KOLKHIDA facility.*
- *Continue measurements of the delay neutron output from the thermal neutron-induced fission of minor actinide nuclei using the modernized ISOMER instrument.*
- *Conduct investigations of heavy metal pollution in a number of areas in Russia, such as the Moscow, Ural, and Baikal regions, Kolsky peninsula, and in Bulgaria, Poland, Moldova, Romania, China, Egypt. Provide experimental substantiation for the development of new biotechnologies.*
- *Continue research in the physics of UCN and optics of cold neutrons at the ILL reactor in Grenoble. Continue joint experiments with fast neutrons at the electrostatic generators in Dubna and Peking.*

5. CONFERENCES AND MEETINGS

In 2000, FLNP organized the following meetings:

1. *VIII International Seminar on Interaction of Neutrons with Nuclei ISINN-8. May 11-14.*
2. *III International Seminar «Ferroelectrics-relaxors», June 23-26.*

In the year 2001, FLNP will organize the following meetings:

1. *IX International Seminar on Interaction of Neutrons with Nuclei ISINN-9. May 17-20.*
2. *School on Neutron Scattering and Synchrotron Radiation, March 19 - April 27.*

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