P R E F A C E

This is to introduce readers to the scientific activity report for 2001 of the Frank Laboratory of Neutron Physics.

The first part of the report presents the results achieved in the main scientific directions: condensed matter physics and neutron nuclear physics. It also includes the description of the results of work in the field of neutron sources and their state of the art. The report completes with brief reports on individual experiments and the list of publications for 2001.

In 2001 the IBR-2 reactor operated, as planned, 8 cycles in strict accordance with the approved working schedule.

Under the approved plan the IBR-30-LUE-40 booster was shut down in June 2001. The new source of resonance neutrons IREN will start operations at its sight in the nearest years.

In 2001 at FLNP neutron sources the program of physical calibration of the high-energy neutron detector HEND created in IKI RAS was executed with participation of FLNP JINR. The instrument entering the complex of research equipment on board the space apparatus Mars Odyssey 2001 started measurements of the neutron fields of Mars in February 2002.

On the neutron Fourier diffractometer FSD, the new ZnS(Ag) scintillator-based detector was put into operation. The working project of a wide-aperture scintillation detector of the new type to be assembled next year has been developed.

The data pointing to the existence of time-reversible superconductivity in Fe/V bilayers were obtained with the spectrometer SPN.

A.V.Belushkin
Director

30 March 2002

1. SCIENTIFIC RESEARCH

1.1. CONDENSED MATTER PHYSICS

Organization of research work. In 2001 under theme 1031, neutron scattering investigations in condensed matter physics were mainly conducted at the IBR-2 reactor. Physicists of the Division carried out a number of experiments in neutron laboratories of Europe (ILL, RAL, PSI, BNC) under accepted proposals and with the electrostatic generator EG-5 and the X-ray diffractometer DRON in FLNP.

During the reported year IBR-2 operated 8 cycles for physical research. The IBR-2 spectrometers time was distributed in accordance with experts recommendations on the submitted proposals and existing long-term agreements. In 2001 the following 10 spectrometers were in the spectrometer user list: HRFD, DN-2, DN-12, SKAT, YuMO, SPN, REFLEX-P, KDSOG, NERA and DIN.

Instruments development. On the neutron Fourier diffractometer FSD for internal stress investigations in materials and engineering products, work on the detector system continued. By the end of the year measurements with its prototype consisting of two elements of ZnS(Ag)-screen-based ±90°-detectors and a Li-glass-based back-scattering detector had been conducted. In 2001 a working project for wide-aperture scintillation detectors of the new type was developed (**Fig.1**) and its realization started. The first elements of the new ±90°-detector will be ready by the summer 2002.

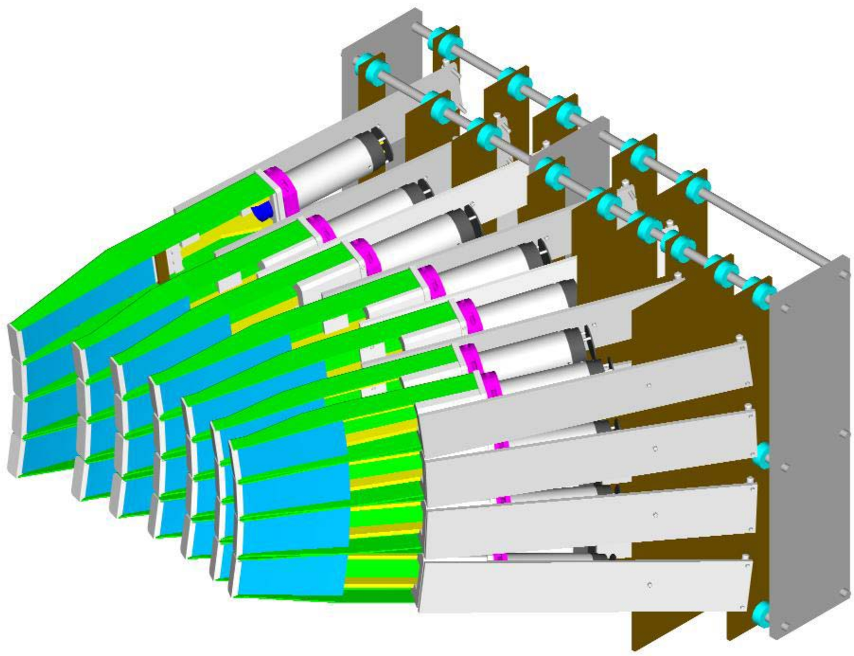

Fig. 1. A general view of the ±90-detectors of the diffractometer FSD made on the basis of ZnS(Ag)-scintillators.

On the spectrometer DN-12, a high-pressure cell of the toroidal type with tungsten carbide anvils made by IHPP (Troitsk) was successfully adapted. In 2001 there were thus created the following possibilities for conducting DN-12 experiments at high pressures. The spectrometer has a set of high-pressure cells with artificial sapphire and tungsten carbide anvils to provide pressure up to 10 GPa over the temperature range 15 to 300 K. The available *d*-spacing range is 0.5 – 12 Å at resolution $\Delta d/d \approx 0.015$. In spectroscopic experiments a cooled beryllium filter in inverted geometry providing the analyzed energy E=4.2 meV, available energy transfer range 5 – 200 meV and the resolution $\Delta E/E \approx 0.1$ and a pyrolytic graphite analyzer providing the analyzed energy E=14.9 meV, available energy transfer range 0 – 50 meV and the resolution $\Delta E/E \approx 0.05$ are used.

The next modernization stage of the small-angle spectrometer YuMO completed. A system for scattered neutron registration consisting of two ring detectors, the parameters of one being much improved, was put into regular operation. The vanadium reference unit for the determination of absolute cross section values is completely renewed. These, together with some other improvements, have increased the data accumulation rate 2 times, extended the momentum transfer dynamic range to 80 (about a 2 times increase) and dropped a low limit of available scattering vectors to $5 \cdot 10^{-3}$ Å^{-1} (for strong scattering samples) and to $6 \cdot 10^{-3}$ Å^{-1} (for medium scattering samples).

On SPN, the new head part containing the new polarization and collimation units was installed. We managed to create vacuum and conducted radiation situation monitoring. In January 2002 investigations of the spectrometer – measurements of the neutron beam and head part parameters, will start. On completion of the SPN project it will be possible to conduct experiments in two small-angle modes: to study voluminous samples (magnetics, superconductors) and layered structures.

An exclusively large volume of work to modernize the detector system was performed on the diffractometer EPSILON. Now the system includes 9 detector blocks with multi-slit radial collimators in front of each. The detectors are arranged on a ring at $2\theta=90°$, which allows an optimal combination of high luminosity and resolution. Compared with a previous variant of EPSILON the luminosity increased about 20 times.

On the diffractometer SKAT, the new system of collimators with an angular dispersion of 45' was tested in 2001. A three times gain in the integral intensity of diffraction peaks compared with previous collimators (18') was observed. At the same time, its relative resolution only decreased by ~25%. To extend the possibilities of rock texture studies, it is decided to restore the diffractormeter NSVR.

A technique for simultaneous in-beam measurements of elastic, deformation, structural and texture characteristics of geo-materials at temperatures up to 600ºC and single-axis compression to 10 kbar was developed in co-operation with IHPP. As a result, on SKAT and EPSILON it has become possible to carry out long-time experiments simulating geo-dynamic effects registering continuously changes in the physical and structure-texture properties of rock samples in the process of their deformation at high temperature and long-term single-axis loads.

The detector system of the KDSOG spectrometer was modernized. The mechanical elements of the detector, helium counters and electronic blocks were manufactured. A complete set of equipment of the modernized spectrometer is assembled and tuned on the spectrometer. The conducted experiments showed that an increased registration efficiency of the scattered neutrons resulted in a two times growth of the spectrometer's luminosity. Also, the sensitivity of the spectrometer (signal to background ratio) increased, which is important for the study of the dynamics of atoms in small or weakly scattering samples.

As far back as the late 1970's FLNP mastered the manufacturing of mirror neutron-guides with which some of IBR-2 beams were equipped. They helped increase considerably the thermal neutron flux on the sample and reduce the fast neutron background. In the mid 1980's the production of mirror-guides in FLNP was suspended due to objective reasons and the new IBR-2 spectrometers are equipped with neutron-guides produced by other organizations, first of all by PNPI (Gatchina). The demand for mirror-neutron guides is, however, so high that it was decided to restore the FLNP line for cutting and spray-coating of neutron-guide mirrors. In 2001 the first stage of the restoration of the vacuum spray-coating facility completed and test coating with natural Ni of a float glass measuring 210 by 80 mm was carried out successfully.

Methodological work on the improvement of the parameters, experimental and primary data procession conditions continued on virtually all the IBR-2 spectrometers. For example, on the diffractometer HRFD control of the low temperature regulator DRC-91C was realized, the system for the accumulationи of high resolution spectra under VME control was improved and some additional functions and possibilities were introduced.

To widen the possibilities of neutron diffraction spectra processing, the program VMRIA was created on the basis of the MRIA packet. It includes Rietveld analysis of spectra from polycrystals, automated three-dimensional Fourier-synthesis, auto-indexing of diffraction reflexes and other necessary options.

Scientific results. Diffraction. The crystalline and magnetic structures of the new complex layered manganese oxides A_2MnGaO_{5+x} (A=Sr, Ca) synthesized in E.V.Antipov's laboratory of the Chemical Faculty in M.V.Lomonosov Moscow State University were studied. Their crystalline structure, which is a derivative of the perovskite structure, belongs to the brounmillerite type and consists of alternating (CaO), (MnO_2), (CaO) and (GaO) or (GaO_{1+x}) layers. Unlike wide-known Ruddlesden-Popper (RP) phases, in A_2MnGaO_{5+x} three cation-oxygen layers separate MnO_2 layers (in RP – two). As a result, the mean distance between manganese atoms in the plane (*a,c*) is usual for manganites (≈3.8 Å) but the distance in the perpendicular direction is about 8 Å and manifestations of two-dimensional (2D) magnetism may be expected.

In 2001, main attention concentrated on the compounds $Sr_2MnGaO_{5.0}$ and $Sr_2MnGaO_{5.5}$. It is established that at δ≈0 (+3 state of Mn) the structure is orthorhombically distorted (space group Ima2) and the size of the cell is about $a_p\sqrt{2}$ in the plane and about $4a_p$ in the perpendicular direction, where a_p≈3.8 Å is the parameter of the cubic perovskite cell. If δ≈0.5 (all Mn in state +4), the crystalline symmetry becomes tetragonal (P4/mmm). In spite of the anisotropy of the distances between Mn both compounds demonstrate a three-dimensional (3D) behavior of the magnetic structure. At the same time, in compounds with δ≈0 the magnetic moments of manganese are ordered antiferromagnetically at $T \le T_N \approx 180$ K, while in the oxidized state (δ≈0.5) the AFM order retains in the plane MnO_2 but changes to the ferromagnetic order in the perpendicular direction (T_N≈100 K). To interpret such an unusual behavior of the magnetic structure, a detail analysis of possible indirect interactions between Mn atoms needs to be carried out.

Another manganite investigated in the last two years is $(Nd_{1-x}Sr_x)(Mn_{1-x}Ru_x)O_3$. The idea of synthesizing such a compound consists of simultaneous and agreed doping of both A- and B-sublattices, which makes it possible to weaken or even exclude completely the double exchange mechanism (DE-mechanism) proposed as far back as the 1950's and since then, has been considered as a basis for the explanation of the metallic state of manganites as the ferromagnetic order arises in them. From this viewpoint, an interesting element to replace Mn in the B-sublattice is Ru as soon as partial overlapping of its 4*d* orbital with oxygen is similar to the interaction of the 3*d* orbital of manganese with oxygen. In addition, a less localization degree of 4*d* electrons in Ru than of 3*d* electrons in Mn must be favorable for the arising of metallic state. Another interesting aspect of the doping of manganites with ruthenium is the possibility of varying its oxidation degree as the states +3, +4, +5 can be obtained by different temperature processing of the compound in the air. Single-phase samples of the compounds $(Nd_{1-x}Sr_x)(Mn_{1-x}Ru_x)O_{3-\delta}$ with x=0.25, 0.5 and 0.75 were successfully synthesized in A.P.Kauli's laboratory of the Chemical Faculty in MSU. They were comprehensively characterized and studied by means of electric and magnetic measurements. To obtain information about the crystalline and magnetic structure of the samples, neutron diffraction experiments were conducted. It is shown that introducing equal amounts of Sr and Ru into the A- and B-sublattices results in stabilization of the ferromagnetic state (**Fig. 2**) but it does not suppress transition to metallic state (for details see Experimental reports).

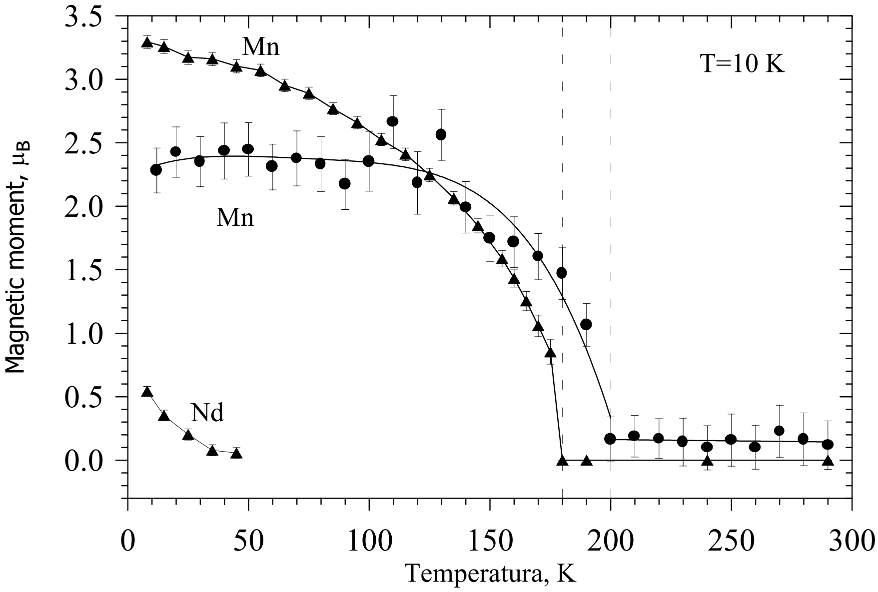

Fig. 2. The dependence of the Mn ordered magnetic momentum on the temperature for the compounds $(Nd_{0.5}Sr_{0.5})(Mn_{0.5}Ru_{0.5})O_3$ *(●) and* $(Nd_{0.75}Sr_{0.25})(Mn_{0.75}Ru_{0.25})O_3$ *(▲). In the compound* $(Nd_{0.75}Sr_{0.25})(Mn_{0.75}Ru_{0.25})O_3$ *there also takes place the ordering of Nd at temperatures below 50 K. The dash line marks the temperatures of ferromagnetic phase transitions.*

On DN-12, systematic investigations of the effect of high pressure on the atomic and magnetic structure of manganites started. As model compositions to be experimentally studied there was chosen $La_{0.67}Ca_{0.33}MnO_3$, that has a transition to the FM phase with a simultaneous transition from metallic to dielectric state at normal pressure, and $Pr_{0.8}Na_{0.2}MnO_3$ with single-valence cation replacement in the A-sublattice. In $La_{0.67}Ca_{0.33}MnO_3$ there was observed a transition from ferromagnetic to antiferromagnetic state at a pressure of 4 GPa with decreasing temperature (**Fig.3**) and in $Pr_{0.8}Na_{0.2}MnO_3$ there was discovered a change in the type of the antiferromagnetic structure with growing pressure.

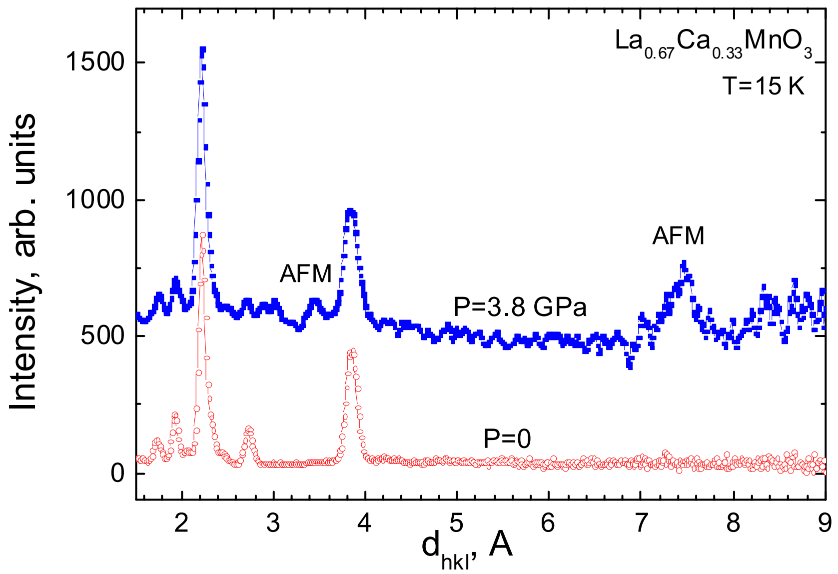

Fig. 3. *A change in the diffraction spectrum of* $La_{0.67}Ca_{0.33}MnO_3$ *at 4 GPa due to transition of the structure from ferromagnetic to antiferromagnetic state.*

Magnetic phase transitions in manganese compounds – MnAs, Mn_2Sb, were investigated. In MnAs at the pressure P=4 GPa and the temperature below 80 K we have observed a magnetic phase transition to an earlier unknown phase. The atomic and magnetic structure of the high-pressure phase is determined. In Mn_2Sb at P=2.8 GPa and room temperature a spin-reorientation magnetic phase transition resulting in a deviation of Mn magnetic moments from the axis *c* of the tetragonal structure is observed.

Polarized neutrons and neutron optics. The fundamental issues of the physics of superconductors, namely the conditions of coexistence of superconducting and ferromagnetic states, were studied with the SPN spectrometer by the method of neutron reflection of Fe/V bilayers. Superconducting profiles of the reflection coefficient were measured. The experiment was conducted at temperatures above and below T=5 K which is a critical temperature of superconducting transition for voluminous vanadium. The obtained results point to the existence of the superconducting state at some temperature above the critical or the existence of temperature-reversal superconductivity. This is a new observation in the case of bilayer systems and it is necessary to be verified.

Fe (m)/V (n)

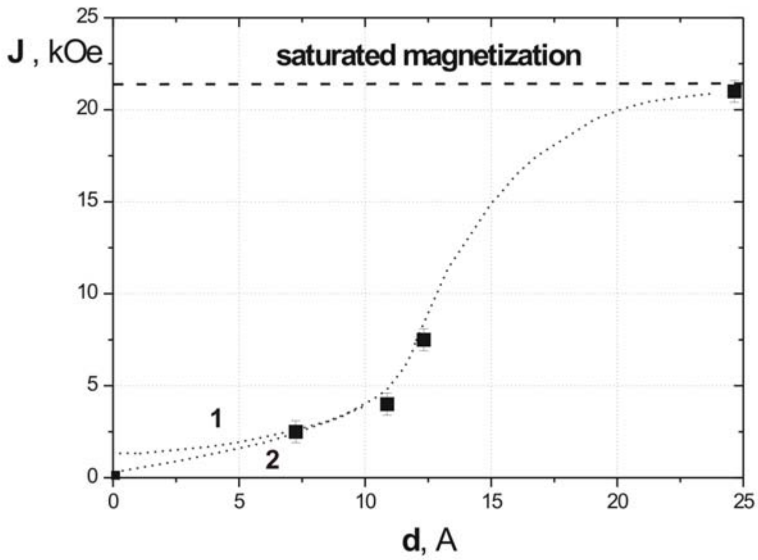

Fig. 4. *The magnetization of the iron layer in the periodic structure Fe(m)/V(n) as a function of the parameter p=m+n, where m and n are the number of Fe- and V-layers, respectively.*

This very Fe/V-structure is also used in experiments aimed at uncovering the reason for a decrease of the magnetic layer magnetization as its thickness increases, changes in magnetization over the thickness of the ferromagnetic layer and disagreement between the data on the local field on the iron nucleus and magnetization values. To this end, neutron reflection coefficients from the periodic structure Fe(m)/V(n) were measured for the different number of monolayers m and n. The experimental data confirmed by appropriate theoretical calculations show that the magnetization of the iron layer in the periodic structure Fe(m)/V(n) decreases with decreasing mean thickness of the layer d(Å)=1.45×(m+n)/2 (**Fig. 4**). For particular structures, such as Fe(5)/V(5), Fe(10)/V(5), Fe(7)/V(10) and Fe(20)/V(14) characterized by the parameter *d*=7.25, 10.9, 12.3 and 24.7 Å, the mean magnetization of iron is 2.5, 4.0, 7.5 and 21.0 кOe, respectively. In addition, it has been established that magnetization changes over the thickness of the Fe/V bilayer, which definitely indicates that there occurs interpenetration of atoms in the neighboring layers.

The interaction between neutron radiation and an ultrasonic wave-excited structure has been investigated. For this purpose, measurements of the neutron reflection coefficient as a function the transferred momentum at total reflection from glass, diffractive reflection from a layered Fe/Cr structure, neutron wave field enhancement in the wave resonator and at neutron wave channeling in a titanium layer were conducted. The measurements were carried out with longitudinal and transversal sonic waves. It is obtained that in the case of transversal waves, the reflection probability is 5 times larger than in the case of longitudinal waves. This possibly points to the fact that in the case of longitudinal waves, the reflection of neutrons is from the nodes of the standing sonic wave. The phenomenon of a sound-stimulated transition of neutrons from one to another channeling mode is observed. The probability of such transition depends on the roughness of the interface, which can be used to increase the sensitivity of determination of parameters characterizing the interface (correlation length, mean square amplitude).

Formation of interphases and surfaces with self-recovering polymer multilayers was studied by registering two-dimensional distributions at specular and off-specular neutron reflection. To do this, multilayers of symmetric polystyrene-polybutylmetacrylate two-block copolymers P(dS-b-nBMA) were used. Modeling of the obtained results shows that main peculiarities observed at off-specular neutron reflection arise due to randomly distributed islands and holes in lamelar films and interphase structure (**Fig.5**). Estimation of the geometrical parameters of islands, holes and interphase fluctuations was performed.

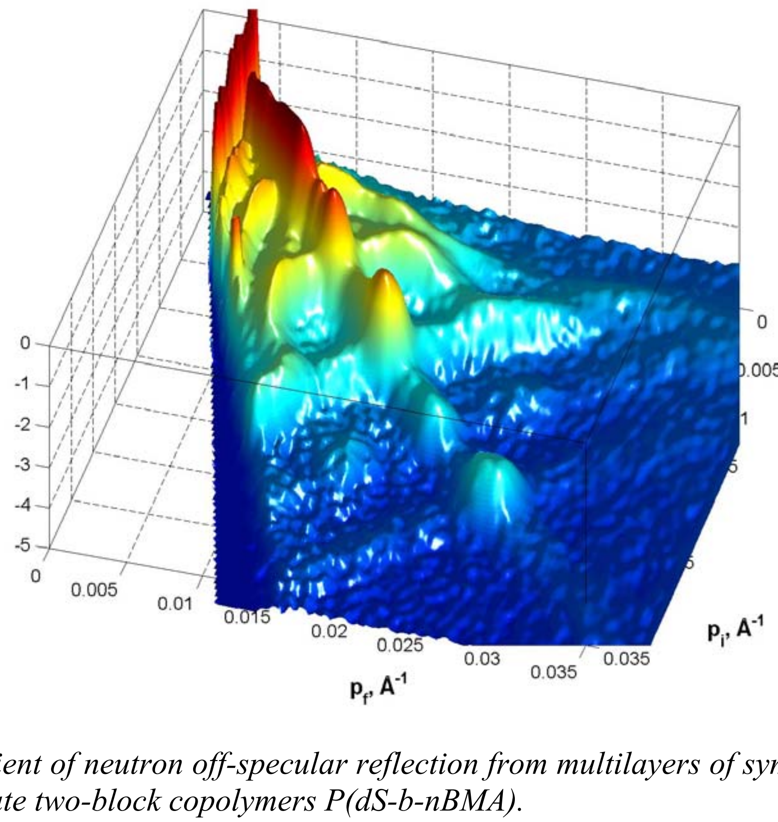

Fig. 5. *The coefficient of neutron off-specular reflection from multilayers of symmetric polystyrene-polybutylmetacrylate two-block copolymers P(dS-b-nBMA).*

Neutron wave channelling experiments continued with the aim to develop a new sensitive method for interphase investigations. To verify basic assumptions of the existence of the wave distribution of neutrons in the layer thickness of several thousand angstroms, different thickness layered structures were produced and measured on the spectrometers of polarized neutrons in FLNP and Laue-Langevin Institute (Grenoble, France). The intensity dependence of neutrons emitted from a titanium layer 3000 Å thick was obtained and the channeling length was measured to be 10 mm. The conclusion is that the channeling length does not only depend on neutron capture in titanium but also on scattering on copper-titanium interphase roughnesses .

Experiments to observe surface magnons were carried out with a record level of sensitivity on the reflectometer REFLEX (**Fig. 6**). A ZnS(Ag)-scintillator-based detector of special design provided a background level of about 10^{-7} of the intensity level registered at neutron reflection from the surface of a FeCo multilayered structure. As model calculations have shown, the reflection curve leaving the reflection plane in the specular channel must have a kinematic cut off if the quadratic dispersion law holds for surface magnons. Preliminary experiments with a FeCo multilayer structure showed that though the cross section of neutron scattering on surface magnons is very small, the effect is above the sensitivity threshold and it can be measured.

Small angle neutron scattering (SANS). The physical chemistry of surface active substances (surfactants) was studied on the example of tetramethylammonium bromide by putting it in different solutions and by varying temperature. It has been shown that the size of micelles forming in the solution decreases with temperature. An interesting change in the form of micelles was observed. For example their spherical form changes to anisometric. As the concentration of NaBr in the solution increases, micelles change their form to rod-like. The experiment conducted at different electrolyte concentrations showed that changes in the form of micelles could occur due to their gradual dehydration.

The architecture of molecular rods formed in sulfonated poly(p-phenylene was studied in the polymeric net of polyacrylamide. This problem is related to the problem of increasing absorbing ability of hydrogels due to worsening of their mechanical properties at swelling. It is thought that new opportunities will open if rod-like electrolytes playing the role of reinforcing material are put in the hydrogel. SANS really helped to show that in the interior of the polymeric gel there could actually be formed liquid crystalline self-assembling rods (of nematic type). The interrelation between the parameters of the gel and the rods was also studied.

Small angle neutron scattering was used to study the structure of a bilayer of single-layer lipid vesicles. On the basis of a model describing the distribution density of the scattering ability of the bilayer's matter as a step-like function the thickness of the hydrophobic and hydrophilic components of the bilayer as well as the number of water molecules penetrating into the hydrophilic area of the membrane were determined from small angle scattering spectra. A promising step in small angle scattering spectra analysis is the creation of a model of separated form factors of lipid vesicles which would allow a transition from description of the scattering ability density across the membrane as a step-like function to description using more complicated functions.

The molecules of phospholipids have the anisotropy of diamagnetic susceptibility $\Delta\chi$. For a DMPC molecule in the liquid crystalline phase $\Delta\chi_{DMPC} = -1.06\cdot10^{-29}$ erg·G^{-2}. In spite of the smallness of $\Delta\chi$, submolecular ensembles of phospholipid molecules (vesicles, rod-like micelles) containing a large number of molecules ($>10^7$) could be oriented in strong magnetic fields of several teslas. At the same time, phospholipid aggregates could get deformed under the action of the magnetic field. The neutron diffraction method with DMPC multilayer vesicles oriented in the magnetic field helped establish the fact that their population is a mixture of spherical and elliptical vesicles (**Fig. 7**). It was experimentally proved that the extent of vesicle deformation (deviation from spherical form) depends on the phase of the membrane. In the liquid crystalline phase of the membrane the extent of deformation is approximately two times larger than in the gel state, which reflects the difference in the elastic properties of the membrane in the different phases. Applying the method of magnetic field orientation of mixed lipid/detergent aggregates we were able to refine the structure of the state formed before the rise of a lipid bilayer of mixed lipid/detergent micelles. This structure is a polymeric Gauss ball whose constituent element is a rod-like micelle of constant length. A nonstationary element of this polymer is the ends of rod-like micelles that seem to have an increased content of detergent. The experiments were performed with a mixed DMPC/$C_{12}E_8$ system.

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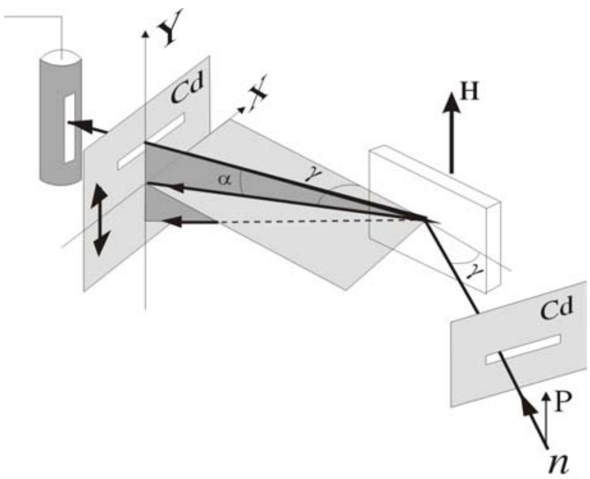

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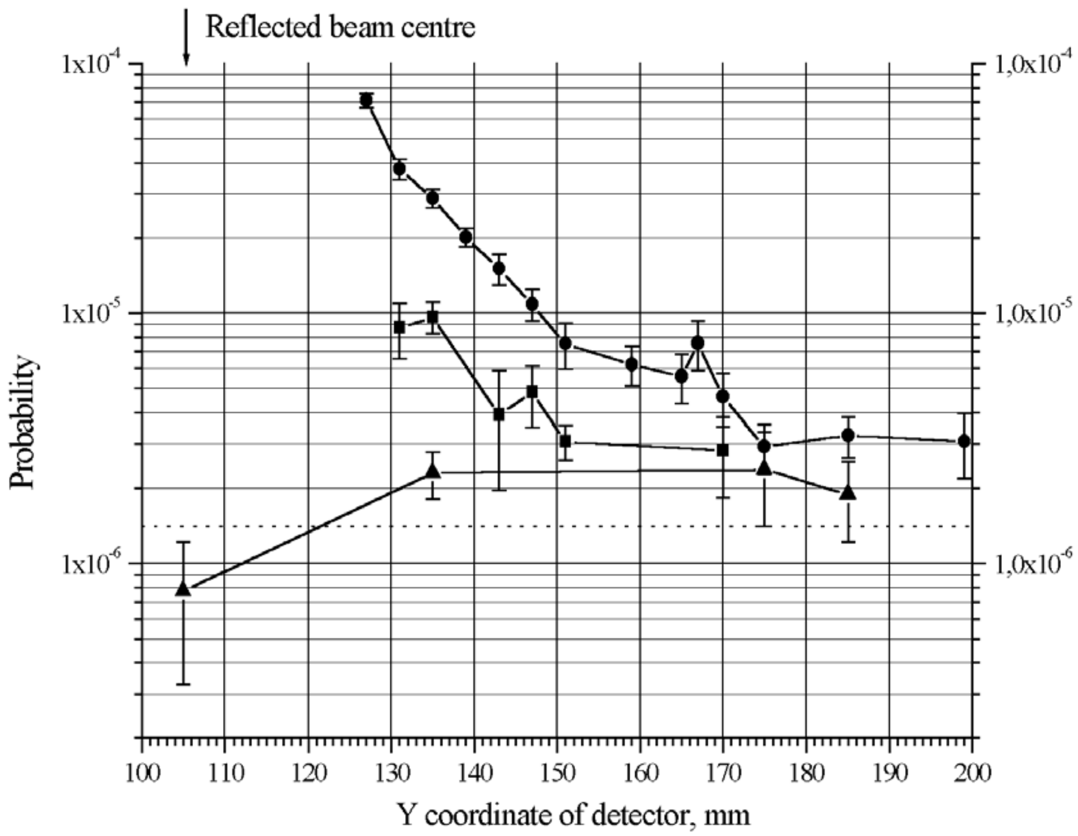

Fig. 6. The scheme of the experiment to search surface magnons (a). The beam of polarized neutrons collimated in a vertical plane reflects from a magnetized mirror in a horizontal plane at an angle of specular reflection γ. For a fixed angle of the detector, $\gamma_d=\gamma$, the detector executes vertical scanning (depending on the angle α). The intensity distribution of inelastically scattered neutrons (b). Circles – the ration of the scattered intensity in a vertical direction to the intensity of the specularly reflected beam. Squares – the same after reversing the incident beam polarization. The difference between the curves indicates that the scattering is of magnetic nature. The background is shown with triangles.

A real-time SANS experiment was made to register structural changes in the cubic lipid phase in the process of crystallization of bacteriorhodopsin (BR) from Halobium Salinarium with the aim of clearing up the mechanism of crystallization. The obtained data were then used to crystallize BR membrane proteins forming a proton pump and a membrane complex consisting of signal receptors and a transformer. As a result, we managed to obtain crystals of above components of extreme quality – it was possible to observe the diffraction pattern from them up to d≈1.2 Å. There is every reason to think that a three-dimensional diffraction experiment with the obtained crystals will make it possible to determine the atomic structure with a high resolution.

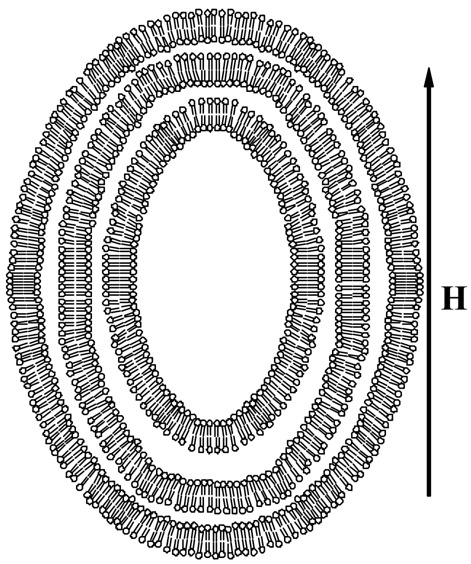

Fig. 7. *A schematic view of a multilayer lipid vesicle deformed in the magnetic field* ***H****.*

Inelastic neutron scattering. On the spectrometer KDSOG inelastic neutron scattering spectra of the recently discovered superconductor MgB_2 were measured and its generalized phonon state density was deduced. The first report about the superconductivity of MgB_2 by the group of J.Akimitsu appeared in January 2001 (see for details J.Nagamatsu et al., Nature, 410 (2001) 63) and it caused a great stir in connection with an unusually high superconducting temperature of T_c≈39 K for copper-free compounds. Moreover, this compound is remarkable for an extremely simple crystalline structure. Already in February 2001, several articles describing the properties of the new superconductor came to print stating that the majority of the described properties are in good agreement with estimates based on the classical BCS model, i.e. the setting on mechanism of superconductivity is electron-phonon. This determined the greatest importance of MgB_2 phonon state density measurements that were first conducted in FLNP. The measurements were carried out using a sample of natural boron isotope mixture, which caused serious experimental difficulties due to large absorption cross section. A high luminosity of the spectrometer and the right choice of the experimental geometry made it possible to measure the phonon spectrum with a high level of statistics **(Fig. 8).** The results of measurements allowed separation of several characteristic phonon bands to estimate the effective constant of electron-phonon interaction (see for details Experimental reports).

On the spectrometer NERA-PR neutron diffraction and neutron inelastic scattering investigations of dynamic properties and phase transitions in molecular and ion-molecular compounds continued. Attention focused on the study of dynamic disorder and glass-like phases in solid solutions and compounds containing molecular groups of the type CH_3, CH_4, H_2O and OH. These studies are being carried out in co-operation with institutes in Poland and Russia. The obtained experimental results are checked with model calculations of the dynamics of crystals and molecules performed by molecular dynamics and theoretical quantum chemistry methods.

On DN-2 vibrational spectra of the ammonium halides NH_4Cl, NH_4Br, NH_4I were investigated at up to 8-10 GPa, which is a record pressure in the case of inelastic neutron scattering. In the area of the phase transition from disordered cubic to ordered cubic structure of the type CsCl, in NH_4Cl and NH_4Br there was observed a breaking on the baric dependence of the librational mode of ammonium. In NH_4I, hybridization of transverse optical and librational modes was observed at pressures higher than 6 GPa. The observed peculiarities in the dynamics of halides help understand better what causes the observed structural phase transitions in them.

Inelastic neutron scattering investigations of crystalline electric field effects (CEF) in the systems $RAgSb_2$ (R=Er, Tm, Ho) were performed. The CEF parameters, level schemes and the wave functions of each compound were determined. The temperature dependence of the magnetic susceptibility calculated along different crystallographic directions is in good agreement with the results of measurements of single crystals. Analysis of the results shows that the magnetocrystalline anysotropy in such compounds is mainly due to CEF.

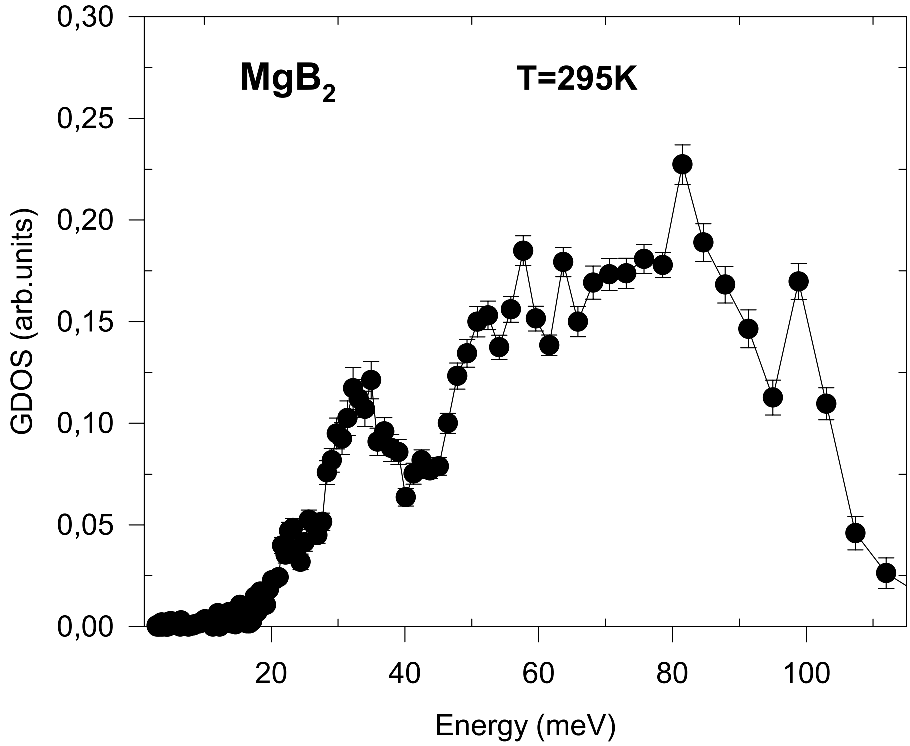

Fig. 8. *The generalized phonon states density of the new superconductor MgB_2 first measured with the spectrometer KDSOG in FLNP.*

On the spectrometer DIN-2PI complex investigations of microdynamic properties of the alloy Pb-K were carried out in the framework of a program for studies of prospective heavy heat-transfer agents for reactors of the new generation. There was investigated the microstructure of a Pb-K alloy around its eutectic composition at a temperature of 660 K for pure lead and Pb-K alloy and four concentrations of potassium: 25.0, 21.8, 14.1, 5.1%atm. It is observed that at lead concentrations lower than 10%, in the area of Q~1 $Å^{-1}$ there virtually disappears a peculiarity in the structural form factor that is conventionally considered to be evidence of the existence of clusters in the alloy and is clearly seen at higher potassium concentrations. Consequently, a Pb-K liquid metal system is an interstitial solution at lead concentrations around or lower than eutectic (9%atm). This means that addition of potassium actually modifies the physicochemical properties of lead in the required direction reducing its oxidation potential, which is particularly important for the perfecting of the technology of liquid metal heat-transfer agents. It can be expected that such liquid metal system will have a number of advantages compared with pure lead when used as a heat-transfer agent in the reactor BREST.

Incoherent inelastic neutron scattering investigations of the dynamics of the metal-organic compounds A_2MeX_4, where A is the organic radical ($N(CH_3)_4^+$, $N(C_2H_5)_4^+$), Me is a metal (Zn, Cu, Cl), X is a halide, were conducted over a wide range of temperatures above and below phase transition points. Such compounds are of interest because of a strong complex effect of complete or partial organic group replacement on the structural organization and different types of structural instability. As a result of the conducted investigations, the mechanism of the observed phase transitions is proposed.

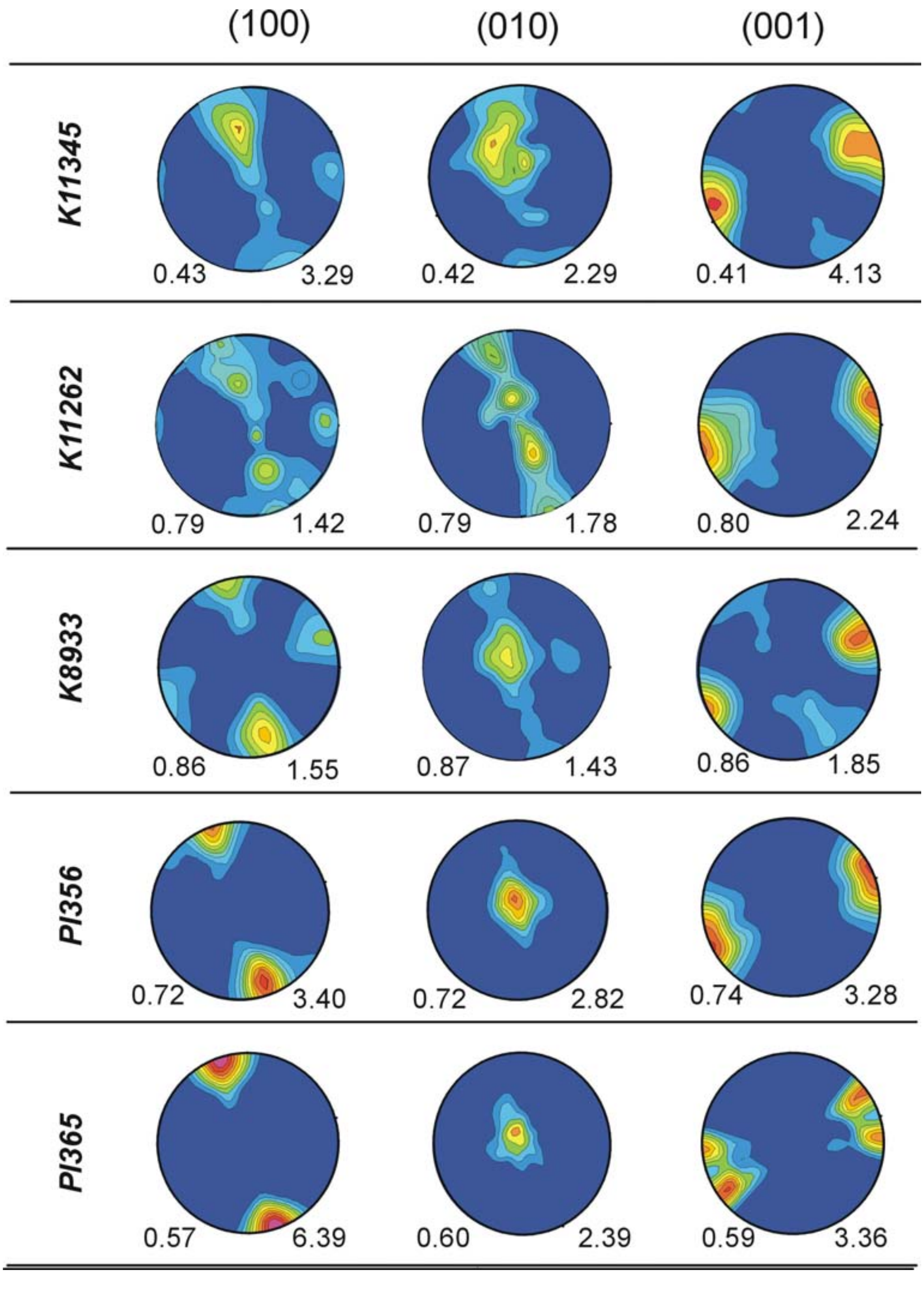

Fig. 9. *A comparison of the texture of mineral components in rocks recovered from various depths of the superdeep well SD-3 in Kola Peninsula with that of rocks in the natural outcrop.*

Geophysical investigations. Unique experimental data on the texture of rocks in the crust and upper mantle of the earth have been obtained. A collection of olivine-bearing mantle rock samples from the different areas in Europe was investigated. The quantitative texture analysis was applied to reconstruct the texture functions of ODF, and spatial distributions of elastic wave velocities in each of the investigated samples were theoretically modeled. The pole figures (PF) measured for olivine samples and data on the condition of plastic deformation in olivine were used as a basis for the determination of systems of slipping, as well as possible thermodynamic conditions and depths of texture formation.

Samples of Archean rocks from a super deep well СГ-3 in Kola Peninsula were studied. Their striking similarity not only in mineral composition but also in mineral component textures to the natural outcrop of rocks in a Kola series was discovered **(Fig. 9).** Microstructural and neutron diffraction investigations of samples taken deep from the earth crust as well as of their analogs from the surface reveal new peculiarities in the texture of these rocks, e.g., a more perfect dominating orientation of hornblende than of plagioclase grains and of plagioclase compared to quartz grains. Complex experiments at different hydrostatic pressures showed that the anisotropy coefficients of amphibolites from different depths in the SD-3 well decrease as the pressure, and correspondingly the depth, grows. The results have made it possible to explain the character of rock anisotropy at different depths on the basis of the new model of a texturised inhomogeneous fractured-porous medium.

Investigations of the effect of one-axis compression on internal microstresses in dolomite samples were conducted using a special deforming device. Under the action of different external loads there was investigated the value of residual strains and stresses in these samples. From the experimental data the Young coefficient values are obtained. The results of the texture measurements performed previous to the deformation experiments indicated the existence of a weak dominating orientation corresponding to the layered texture plane in dolomite.

Engineering investigations. Measurements of residual stresses in the elements of the VVER-1000 reactor jacket were performed in cooperation with research institutes of the RF Ministry of Atomic Energy. The investigated sample was a two-layer plate whose basic layer is made from the construction ferrite steel 15HGMFAA and the melted layer is from austenite stainless steel 12X18H10T. The σ_y component of the shell templet of the reactor jacket was investigated as a basic metal and as a melt. An analysis of the diffraction peak intensities revealed a strong texture in the austenite phase of the melt (for details see Experimental reports).

The first measurements to investigate residual stresses in graphite rods used in nuclear reactors were conducted. They show that there exists a clearly expressed broadening of diffraction peaks. This is possibly due to existence of strong microstresses in their graphite material.

Element analysis. The electrostatic generator EG-5 was successfully used for analytical investigations of the composition and structure of solid bodies **(Fig. 10).** Particularly, a number of investigations of SiC samples with implanted Fe^+ ions, hydrogen bearing fullerenes, carborundum films containing hydrogen, some geological samples, gallium arsenide implanted with indium were performed. The depth profiles of H, C, N, O and Si in carborundum samples from the Electrotechnical Institute in Bratislava were measured. In geological samples from Egypt a number of basic- and micro-elements from lithium to cadmium were discovered.

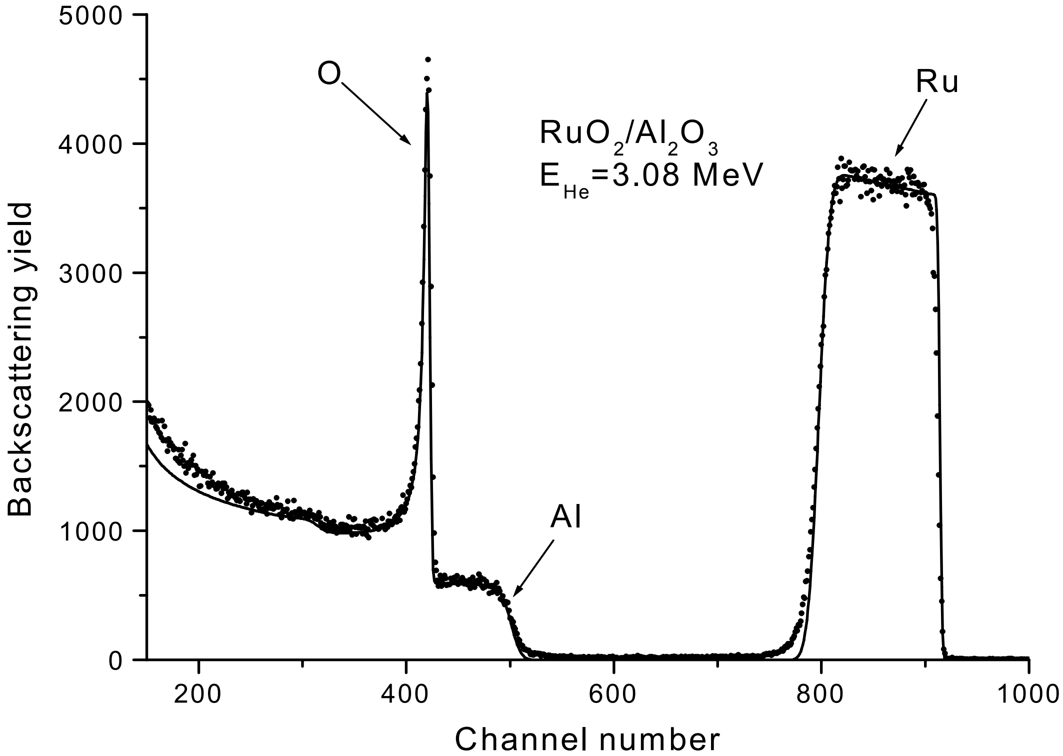

Fig. 10. *The experimental and calculated (solid line) spectra of the $^4He^+$ ions back scattered on a 680 nm RuO_2 film on a sapphire substrate.*

1.2. NUCLEAR PHYSICS WITH NEUTRONS

1. Introduction

In the year 2001 the program for experimental research in neutron nuclear physics in the Frank Laboratory of Neutron physics included the following traditional research directions: experimental and theoretical investigations of the electromagnetic properties of the neutron and its beta-decay, studies of spatial parity violation and nuclear fission processes, research into high-excited states of nuclei in the reactions of thermal and resonance neutron capture, obtaining of the new data for the purposes of astrophysics, experiments with ultracold neutrons.

The investigations were mainly conducted on the beams of IBR-30 (the first half of the year), IBR-2 and EG-5. A number of experiments, however, were performed, in cooperation with other nuclear centers in Russia, Bulgaria, Poland, Czech Republic, Germany, Republic of Korea, France, USA and Japan.

1. Experimental investigations

1.1. Spatial and time parity violation at interaction of neutrons with nuclei

1.1.1 Parity violation in compound nuclei: TRIPLE's latest results

The activity in the frame of the Time Reversal Invariance and Parity at Low Energy (TRIPLE) collaboration consisted of analysis of the previously measured parity-violating asymmetries of cross sections in neutron p-wave resonances. Detailed parity violation data together with the final results for ^{117}Sn, ^{121}Sb, ^{123}Sb, and ^{127}I are published in Phys. Rev. C, v. 64 (2001). In addition, a comprehensive review of TRIPLE experiments and a compilation of all TRIPLE parity violation results are published in Physics Reports, v. 354, number 3 (2001). The use of statistical methods for the determination of the root mean square weak matrix element for 20 nuclei studied has lead to an experimental value of $1.8\cdot10^{-7}$ eV for the spreading width of the weak interaction in compound nuclei, which is in qualitative agreement with theoretical expectations.

1.1.2 Measurements of *P*- odd asymmetry of γ- quanta emission in the reaction ^{10}B(n,α)^{7}Li* → γ → ^{7}Li(g.s.)

The existence of weak currents in weak NN-processes has not been unambiguously confirmed experimentally yet. However, the possibility to determine directly the weak meson constants and consequently, the contribution of the neutron current from *P*- odd correlations evidences in favor of the cluster representation of reactions with slow polarized neutrons on light nuclei (A≤10). The correlation coefficients are then on the level 10^{-8} - 10^{-7}.

The experiment to measure *P*- odd asymmetry of the type $\alpha_{pn}(\vec{s}_n\vec{p}_\gamma)$ in the reaction ^{10}B(n,α)^{7}Li*→γ(0.478 MeV)→^{7}Li(g.s.) was carried out with cold ($\langle\lambda_n\rangle$ = 4.7 Å) polarized (94%) neutron beams from the reactor PF1B in ILL by a FLNP-PINP-ILL collaboration.

The testing of the system was done by measuring known values of the *P*- odd asymmetry in the (n,γ) reaction using Cl, Br and Cd samples. The main measurements were carried out with a ^{10}B sample for about 20 days and several "zero" experiments were made with an aluminum foil and lithium absorber. The obtained result is α^0_{pn}= $(25.8\pm6.5)\cdot10^{-8}$.

Since the possible contribution to the measured value from *P*-odd and *P*-even effects on impurity nuclei cannot be higher than 10^{-9} and the *P*-odd asymmetries in the investigated reaction are identically equal to zero, there exists a high probability that the discovered asymmetry is due to the given reaction.

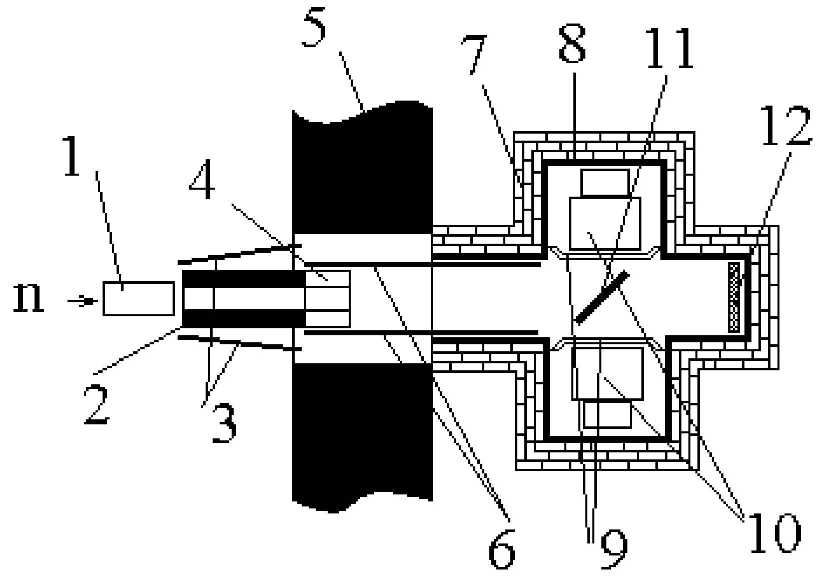

Fig. 1. *The schematic drawing of the experimental facility: 1 - polarizer; 2- adiabatic flipper with a boron collimator; 3- gradient magnetic field driver; 4- lead collimator; 5- concrete shield; 6- leading magnetic field driver; 7- lead shield; 8- boron rubber; 9 - Helmholtz coils; 10- detectors; 11-sample; 12- lithium absorber.*

To carry out further investigations, a multisectional ionization chamber with samples for the measurement of the *P*- odd correlation of the type $\alpha_{pn}(\vec{s}_n \vec{p}_t)$ in the reaction ^{6}Li(n,t)^{4}He is prepared. The experiment will be conducted in ILL in 2002.

1.1.3 Current status of the KaTRIn project

In the R&D stage of the KaTRIn experiment we tested the optical polarization of ^{3}He in an extremely low applied magnetic field. Permalloy magnetic shields were used to prevent fast relaxation of ^{3}He polarization owing to the inhomogeneity of the surrounding fields. The whole facility was installed on a neutron beam of the IBR–30 neutron facility and was used as a neutron spin filter. A prototype of the neutron polarizer of new design was thus introduced.

The polarizer comprises a 3 cm diameter spherical ^{3}He cell. The cell is inside an aluminum oven and is heated by air flow from a commercial “KRESS” fan. The oven also plays the role of protection from DC – fields. The axes of the neutron beam, laser light and magnetic shield coincide. The residual longitudinal field in the center of the shields where the oven is does not exceed 0.05 Gauss.

The neutron polarization was measured by the time-o-flight technique. If N_0 is the cell transmission for unpolarized and N for polarized ^{3}He, the neutron polarization is $p_n = \sqrt{1 - \left(\frac{N_0}{N}\right)^2}$. The neutron polarization is measured 1.5 hours after the start of optical pumping when it approaches its equilibrium value. To perform measurements without a field, the ^{3}He polarization is completely destroyed with a magnet to restore initial conditions.

The energy dependence of the neutron polarization in both cases is shown in **Fig 2**. It is seen that in a “zero” field the rubidium and ^{3}He polarization is as efficient as in a nonzero guide field.

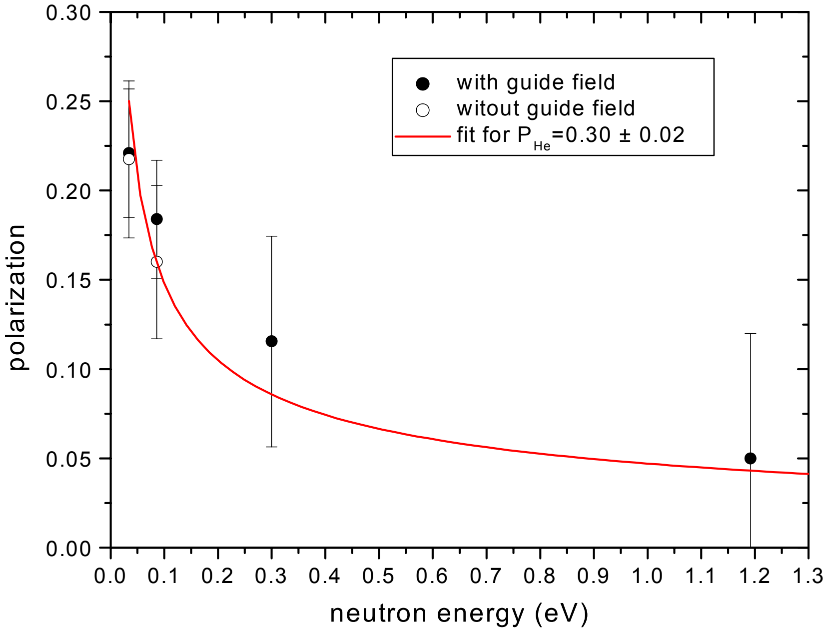

Fig. 2. *The energy dependence of the neutron polarization with and without a guide field.*

Thus, the possibility of ^{3}He and neutron polarization in an almost "zero" applied field has been confirmed. Besides, a prototype of the neutron polarizer of new design has been introduced. We intend to use this experience to design of a full-scale KaTRIn facility to test time reversal invariance in neutron-nuclear reactions.

1.1.4 Search and investigation of the structure of subbarrier neutron *p*-resonances in lead isotopes by the method of combined correlation gamma-spectroscopy

The theoretical works [1,2] confirmed experimentally [3] substantiate that in the region of weak neutron *p*- wave resonances the effect of spatial parity violation has a very large value exceeding the ratio of strong to weak interaction in nuclei by many orders of magnitude. The only unexplained result so far is the discovered and measured effect of weak spin rotation at transmission of polarized neutrons through a lead target [4]. In the recent experiments [5] it was shown that the effect is due to the nucleus ^{204}Pb. Basing on the concept of *s*- and *p*- resonances mixing it is possible to assess the expected effect of parity violation. However, for the even-even magic nucleus ^{204}Pb the level density is very small and a large distance between resonances suppresses the effect essentially. As a result, there arises a contradiction between the measured and expected value of the effect. The solution can be sought in two directions. One is indicated in the work by Zatretskii and Sirotkin [6] which, in addition to compound states mixing, assumes the participation of potential scattering in the realization of the violation effect. This approach,

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[1] Сушков О.П., Фламбаум В.В. УФН, 1982, т. 136, в. 1, стр. 3
[2] Бунаков В.Е., Гудков В.П. ЖЭТФ, письма, 1982, т. 36, в. 7, стр. 268
[3] Alfimenkov V.P., Borzakov S.B., Vo Van Thuan, Mareev Yu.D., Pikelner L.B., Khrykin A.S., Sharapov E.I. Nucl. Phys., 1983, v. A398, p. 93
[4] Heckel B., Ramsey N.F. et al. Phys. Lett., 1982, v. 119B, p. 298
[5] Ermakov O.N., Golub R., Karpikhin I.L., Krupchitsky P.A., Vasiliev V.V., ISSIN-9 Proceedings, Dubna, 2000, E3-2000-192, p. 377
[6] Зарецкий Д.Ф., Сироткин В.К. ЯФ, 1987, 45, в. 5, стр. 1302

however, is not favored by theoreticians and has not demonstrated itself in the experiment yet, which may be due to essentially larger density of states in other than lead nuclei. A different explanation may be possible if the nucleus ^{204}Pb has a *p-* resonance with suitable parameters in the energy region below the neutron binding energy, the so-called «negative resonance». In this case, the concept of compound states mixing would receive an appreciable confirmation as a counter to potential scattering. In this connection, it is quite important to discover, or vice a versa, disprove the existence of a close negative p-resonance.

As a method to discover the p-resonance it is proposed to investigate the dependence of the intensity of gamma-lines of the reaction ^{204}Pb(n,γ) on the neutron energy in the energy region from thermal to several tens eV. In the absence of resonances in the vicinity of the region the radiative neutron capture cross section is determined by distant s-resonances and obeys the «1/v law», where v is the neutron velocity. Another dependence, namely σ~v, holds for p- resonances. There thus exists a principal possibility to separate the contributions from s- and p-waves to neutron capture and its parameters and consequently, to estimate the possibility of the existence of the negative p-resonance as well as its parameters. The main experimental difficulty is that the cross section of p-wave capture is very small in the given neutron energy region, possibly less than 1% of the s-wave capture cross section. This imposes very strict requirements on statistical accuracy, requires careful analysis of the energy dependence of the cross section, etc., which in turn, imposes enhanced requirements on the experimental technique and measuring equipment. Nevertheless, to find a solution to the problem of two approaches to the explanation of spatial parity violation effects is intriguing and this stimulates the carrying out of the proposed experiment.

1.2. Parity violation and interference effects in angular distributions of fission fragments

1.2.1 Interference effects in the resonance neutron induced fission of ^{239}Pu

Intense theoretical and experimental investigations of the fission process (spontaneous and induced) conducted over fifty years have not yet resulted in a sufficiently complete understanding of the dynamics and mechanism of fission and a strict unambiguous mathematical description of its individual stages. The reason for this is first, nuclear fission is one of the most complicated nuclear transformations of a multiparticle system associated with deep redistribution of the mass and charge of the primary nucleus, formation of heavily deformed fragments with high spins and excitation energies and second, in most of the experiments nuclear fission is studied in the conditions when it is impossible to obtain information about the basic amplitudes of the process characterized by the parity π, total spin of the fission system *J* and its projection to the fission axis *K*.

In the last time, in cooperation with FLNP physicists a new approach to the description of fission induced by low energy neutrons analogous to an ordinary theory of nuclear reactions is being developed [7]. In principle, this approximation consists of the description of interference effects in neutron fission with well-developed methods of the theory of nuclear reactions.

It appears to be of vital importance is to obtain direct information about the fission barrier parity dependence for the channels $J^{\pi}K$. To this end, unique possibilities are provided by studies of *P-* even nuclear correlations of fission fragments due to the interference of *s-* and *p-* resonance fission amplitudes. Such experiments of ^{235}U, ^{233}U [8,9] and ^{239}Pu were conducted by a Dubna-Gatchina collaboration at the booster IBR-30+LUE-40. The results were obtained from two types of experiments. In the first, "forward-backward", the energy dependence of fragments emission in and against the direction of the unpolarized neutron momentum was measured. In the second, "left-right", the asymmetry in fission fragments emission in the plane of the polarized neutron spin and momentum was investigated. A more detail description of the problems's state of the art is in the

[7] Barabanov A.L., Furman W.I., Z.Phys. **A357**, 411(1997)
[8] Alfimenkov V.P.} et al. JINR-E3-97-106, Dubna(1997); Alfimenkov V.P., Chernikov A.N., Lason L. et al., Nucl.Phys., **A645**, 31(1999)
[9] Gagarski A.M., Guseva I.S., Goloslavskaya S.P. et al., Preprint PNPI NP-32-1999, 2117, Gatchina(1999)

article «Analysis of *P*-even effects in the anisotropy of fission fragments from the resonance neutron induced fission of ^{235}U and ^{239}Pu» in the Section «Experimental reports» of the present report.

In 2001, measurements of interference effects in the polarized neutron-induced fission of ^{239}Pu at the IBR-30 booster completed. The emission asymmetry of light and heavy fragments in relation to the neutron momentum-neutron spin plane was measured. This, so-called left-right asymmetry, does not violate P-parity and is due to the interference between s- and p-resonances. The results together with those on the earlier measured forward-backward asymmetry make it possible to obtain yet unavailable information on p-wave resonances in heavy nuclei.

Another measured effect is the parity violating asymmetry of fragments emission in and against the direction of the captured neutron spin. It is the first time that such data are obtained for plutonium resonances **(Fig. 3).** At present, the processing of the experimental data on both effects is nearing completion and the preparation of publications is under way.

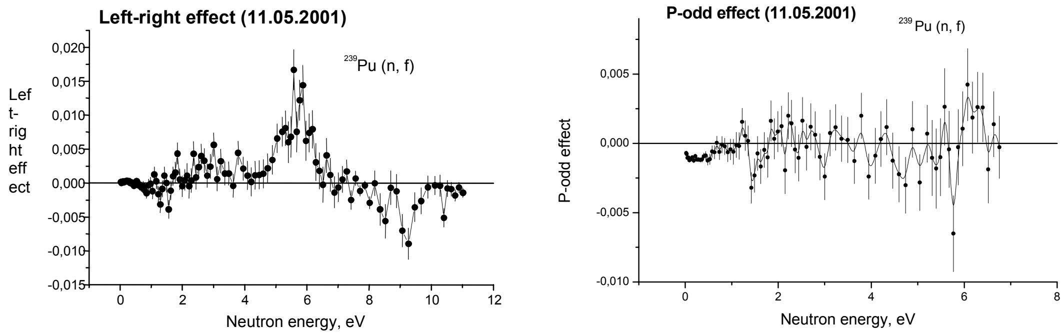

Fig. 3. *The effects of the left-right and parity violating asymmetry in the resonance neutron-induced fission of* ^{239}Pu.

1.3. High-excited states of nuclei

1.3.1 Investigation of two-step gamma cascades

In the 2001 study of the structure of high-excited nuclear states by registration of two-step cascades, the main effort concentrated on analysis and assessment of probable systematic error values using the method of model-free determination of the area of level densities and radiative strength functions of E1 and M1 transitions at neutron binding energies in nuclei with a maximally high level density proposed and developed in FLNP.

The possibilities of the method are illustrated in **Fig.4** showing two variants of the dependence of the intensity of cascades on the energy of their primary transition, the density of levels and the sum of their corresponding radiative strength functions. It also shows the estimated possible values of the sought parameters allowing exact reproduction of the intensity of the cascades (experimental and simulated). Though the intensity of the cascades can be reproduced with one and the same accuracy by an infinite number of parameters, the interval of their variations is rather small. The method has first made it possible to assess the level density in the given interval of spins (total for two parities and separately for each) without the aid of model representations of the emission probability of the nuclear reaction product (for example, neutron evaporation). The accuracy of the corresponding models in the excitation region above ~2 MeV and to the neutron binding energy is actually unknown. An analysis of the obtained results allows the statement that in spite of systematic errors our method provides a better description of the gamma-decay process of neutron resonances and improves essentially the calculation accuracy of, e.g., total gamma-radiation spectrum (especially for nuclei in the region N=82 and 126) in comparison with models of level density and partial radiative widths traditionally used for the purpose (see **Fig. 5**).

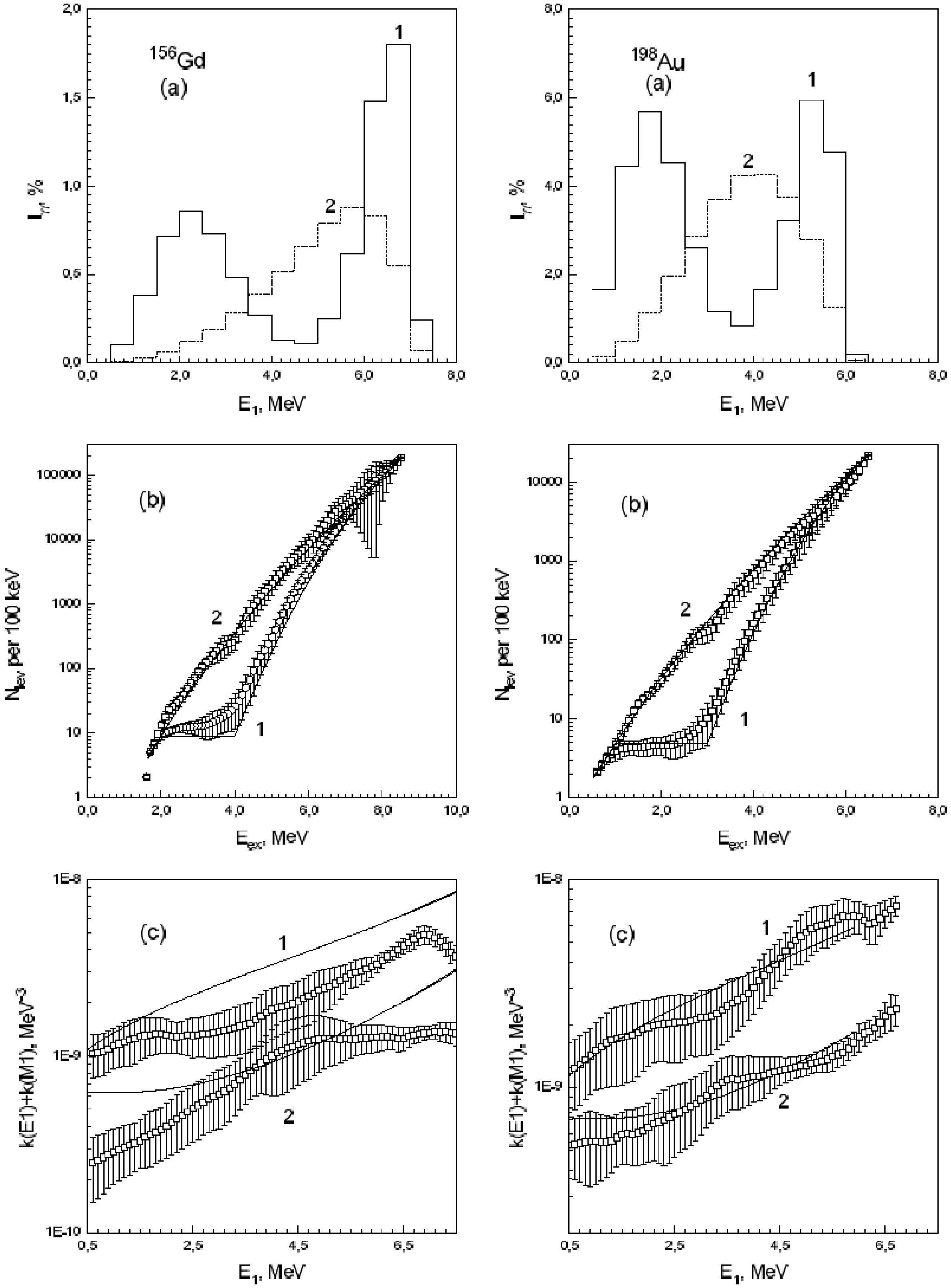

Fig. 4. *The intensity of two-step cascades (a) calculated making use of the level densities shown with solid lines in (b) and radiative strength functions (c). The points with errors represent an interval of an infinite number of level densities and strength functions enabling exact reproduction of the cascade intensities given in (a).*

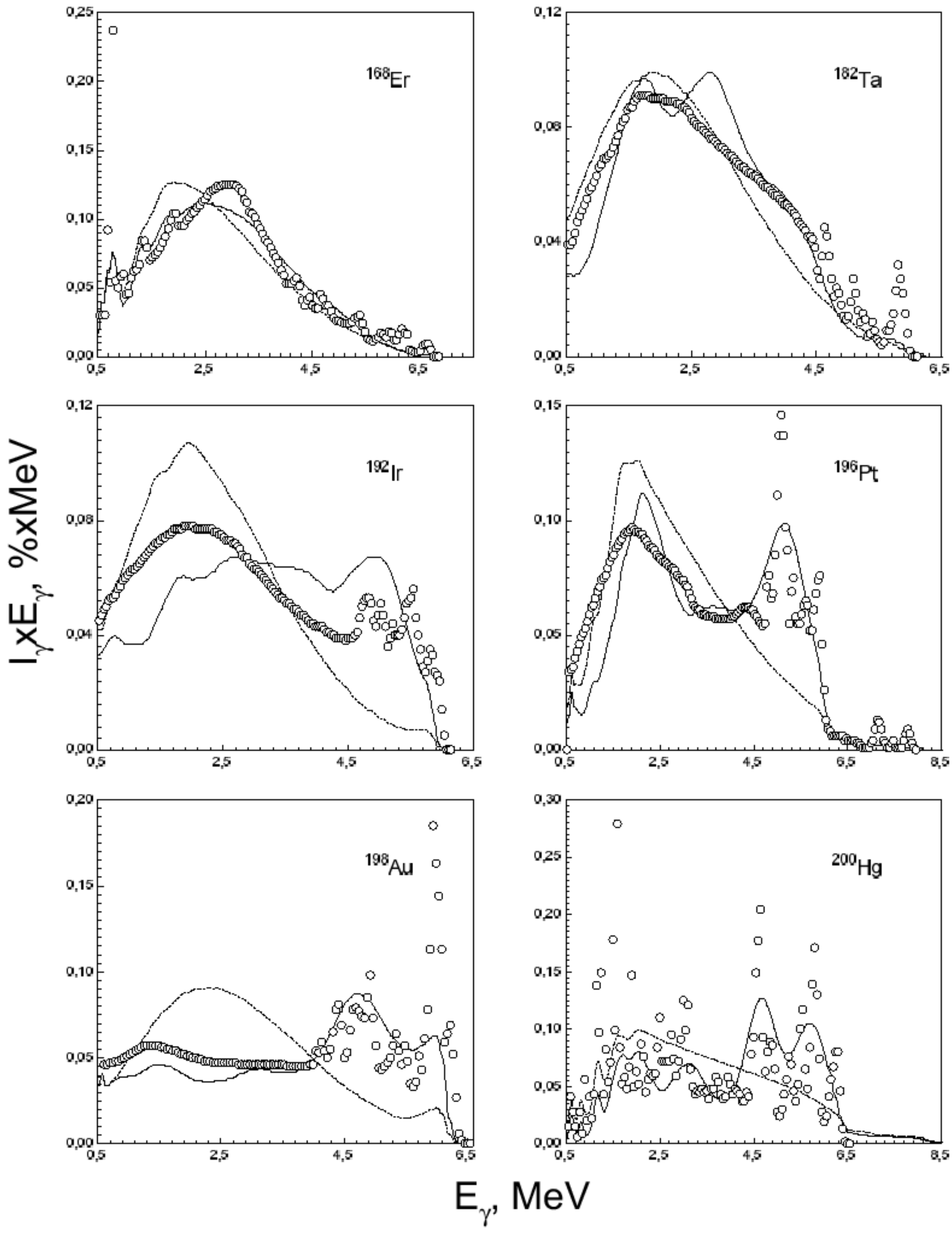

Fig. 5. *The experimental (points) total spectra of gamma-radiation after the capture of thermal or fast neutrons for the compound nuclei ^{168}Er, ^{182}Ta, ^{192}Ir, ^{196}Pt, ^{198}Au and ^{200}Hg. The solid and dot lines illustrate the results of the calculation by the method of the model-free determination of level densities and radiative strength functions and the predictions of models usually used for the purpose, respectively.*

In addition, it is established that the energy dependence of the radiative strength functions k(E1)+k(M1) of the primary and secondary transitions in the cascade differ. Also, it has been shown that this does not violate essentially the earlier conclusion about the existence in the formed nuclei at least of an excitation energy area of the width not less than 2 MeV with a practically constant or weakly changing density of levels. This is evidence of principal changes in the properties of deformed nuclei in the excitation energy region 3-4 MeV.

The last cycles of IBR-30 were used to investigate the background conditions of the registration of two-step cascades in the fissionable target nuclei U-235. It is established that prompt quanta do not interfere with the registration of two-step cascades to the final levels in U-236 with an energy up to 1÷1.5 MeV. This means that there is a possibility to obtain new precision experimental data on the fission and capture cross sections of actinides with the help of this technique.

Besides, it is possible to obtain detail information about the density of excited levels and radiative strength functions of dipole transitions at radiative neutron capture in even-odd fissionable target nuclei at least. Without this information it is impossible to improve the accuracy of the theoretical description of the interaction processes of neutrons with materials of importance in the reactor construction practice. As a result, the study of two-step cascades in fissionable nuclei through development of model representations may provide an increase in the accuracy of the interaction cross section estimates of neutrons with an energy from tens to hundreds keV.

1.3.2 Investigations of radiative neutron capture, the nuclear data program

In the first half of the reported year, on the 122-m flight path of IBR-30 there were measured the multiplicity spectra of gamma-quanta from the reactions (n,γ), (n,f) for the isotopes ^{238}U,^{235}U, ^{239}Pu and natural Pb with the help of a 16-section liquid detector of the spectrometer PARUS. For the isotope ^{235}U, similar measurements were performed with the spectrometer ROMASKHKA on the 500-m flight path. For ^{238}U,^{235}U, ^{239}Pu, the time-of-flight spectra of gamma-ray multiplicity were measured with and without sample filters from uranium or plutonium in the neutron beam at two temperatures, 77 K and 293 K. The measurements were conducted in good geometry with thin sample radiators (293 K) in gamma-detectors and with filters of equal thickness (0.5mm) in the neutron beam. These investigations will make it possible to determine the coefficients of resonance blocking and Doppler effects in the capture and fission cross sections, as well as in the value of $\alpha = {\sigma_\gamma}/{\sigma_f}$. In parallel, on the 124-, 504- and 1000-m flight paths there were conducted measurements of the time-of-flight spectra of natural lead and fissionable nuclei of uranium and plutonium using batteries of boron and helium counters to determine the transmission abilities and total cross sections of these materials in the energy range from 1 eV to 100 keV. The conducted measurements will make it possible to achieve a higher accuracy of determination of neutron constants (within (2÷7)% error).

1.3.3 Measurements of capture partial cross sections by the shift of the primary gamma-transition energy

In 2001, EG-5 experiments to measure the energy dependence of partial cross sections of the (n,γ) reaction continued. In the basis of the method lies the dependence of the primary gamma-transition populating one of the low-lying levels of the daughter nucleus on the incident neutron energy. At the same time, the intensity of the registered γ- transition is proportional to the (n,γ) reaction cross section. As a neutron source there was used the reaction ^{7}Li(p,n). The energy range of neutrons incident on the sample was 5÷100 keV. The γ- spectra were registered with a Ge(Li) detector. Also, gamma-spectra from the reaction ^{48}Ti(n,γ)^{49}Ti were measured. It is the first time that the energy dependence of the partial cross section is obtained for the γ- transition populating the first excited state (1382 keV, $J^\pi = 3/2^-$) of the daughter nucleus ^{49}Ti. The results of the experiments were reported to the international seminar ISINN-9 and published in the ISINN-9 proceedings.

1.4. Neutron reactions with emission of charged particles

1.4.1 Analysis of α-widths of neutron resonances in ^{147}Sm over energy interval from 3 eV to 700 keV

In 1999-2000 a FLNP JINR- Oakridge National Laboratory- Lodz University collaboration conducted an experiment to measure the cross section of the reaction $^{147}Sm(n,\alpha)^{144}Nd$ on resonance neutrons at the neutron source ORELA, Oakridge, USA. The data on total α-widths of 104 resolving resonances with $J^{\pi}=3^-$ and $J^{\pi}=4^-$ at energies from 3 eV to 700 keV were obtained (**Fig. 6**).

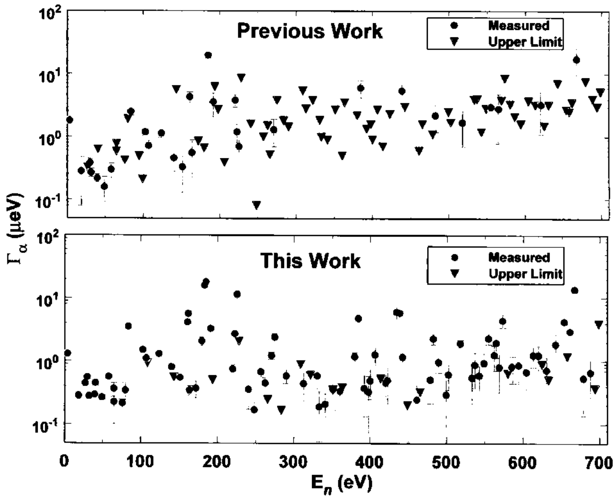

***Fig. 6.** The experimental obtained α-widths and the data from earlier works.*

An analysis of the renewed data was conducted. An unusual resonance with an energy around 184 eV was discovered Satisfactory fitting to the experimental points under R-matrix analysis is only possible under assumption of the existence of a doublet of resonances with E_0=183.30 eV and E_0=184.92 eV though having anomalously large α-widths – 16 μkeV and 18.1 μkeV, respectively (for $<\Gamma_\alpha(3^-)>=2.54$ μkeV, $<\Gamma_\alpha(4^-)>=0.63$ μkeV).

Another interesting result comes from an analysis of mean α- widths. By the statistical theory of nuclear reactions the α- particle strength function $S_\alpha = <\gamma_\alpha^2>/D$ is a constant value and consequently, the mean α-width $<\Gamma_\alpha> = <\gamma_\alpha^2>P$ cannot depend on the energy interval because the kinetic energy of the neutron is small compared to the binding energy and does not affect the penetrability of the potential barrier. The results of the mean α- width calculation for different intervals are shown in **Fig. 7.**

It is seen that mean α- widths may grow with increasing neutron energy, which in turn points to the manifestation of some nonstatistical effects.

1.4.2 Reactions with fast neutrons

The cross sections and angular distributions of the $^{64}Zn(n,\alpha)$ reaction products for E_n= 5-7 MeV were obtained with the Van de Graaf accelerator in the Institute of Heavy Ion Physics of the Peking University (**Figs.8 and 9**).

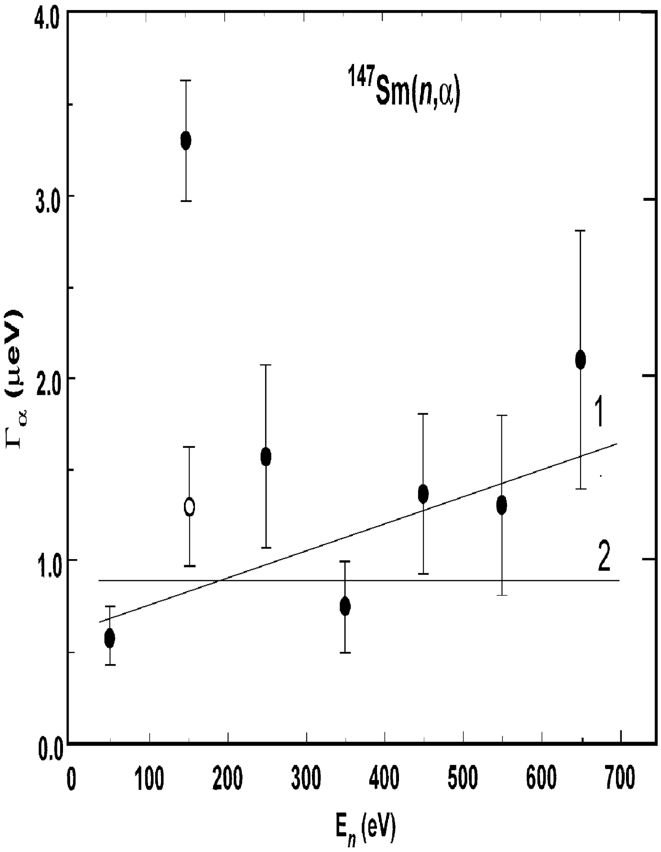

Fig. 7. Mean α-width values. The open circle – the doublet of resonances near 184 eV is excluded from analysis. 1-linear fit; 2- fitting under assumption that <Γ$_\alpha$>=const.

A systematics of the cross sections of the (n,p) reactions on fast neutrons has been developed on the basis of the theses of the statistical theory of nuclear reactions.

A channel at the EG-5 accelerator of FLNP has been equipped to study the (n,p) and (n,α) reactions on neutrons from the D-D reaction at 3-6 MeV.

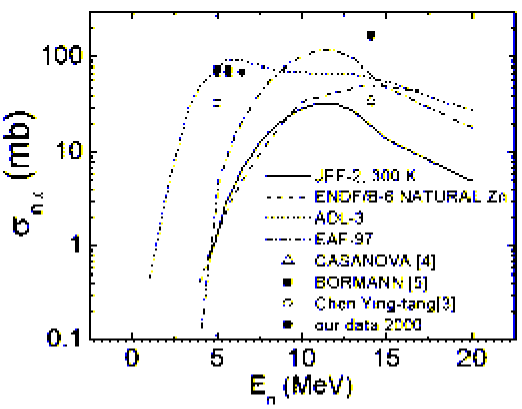

***Fig.8**. The experimental data and theoretical estimates of the $^{64}Zn(n,\alpha)^{61}Ni$ reaction cross section.*

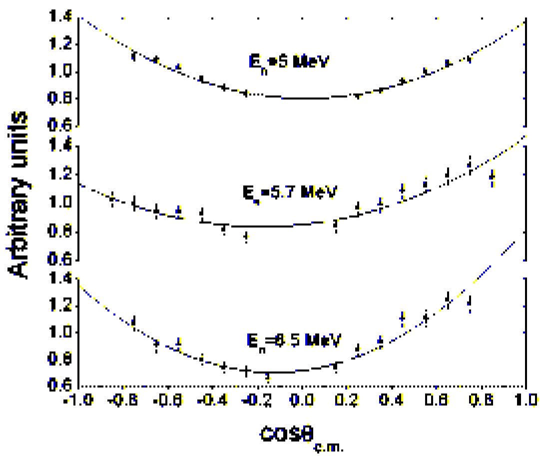

***Fig.9.** Angular distributions for the $^{64}Zn(n,\alpha)^{61}Ni$reaction.*

1.5. Astrophysical aspects of neutron physics

1.5.1 Measurement of ^{147}Pm neutron capture cross section to determine neutron density in s-process

The data from a joint Dubna-Karlsruhe experiment to measure the neutron capture cross section on the radioactive isotope ^{147}Pm at the «standard» astrophysical temperature kT=25 keV have been processed. The isotope is one of the branching points on the way of the s-process in the region Nd-Sm and the cross section data are necessary for the determination of neutron density in the s-process of nucleosynthesis. The obtained cross section $<\sigma_{kT=25keV}>=685\pm69$ mb, which is almost two times smaller than the theoretical estimates.

1.5.2 Modeling of neutron nucleosynthesis in the region of sulphur and chlorine at helium burning in stars with the mass 25 M⊙

In cooperation with scientists from the Lodz University a program is elaborated to calculate neutron nucleosynthesis in a stationary phase of star evolution – practically constant temperature, electron density and matter density in the area of burning. The conditions are characteristic for hydrostatic burning of helium in massive stars which are considered to be the main suppliers of the nuclides of the weak component of the s-process. It is believed that it is in such stars the major part of neutron excess isotopes of light and average mass is formed. The program has been caried out under the computer program «Mathematics». Test calculations for the regions S-Cl-Ar (**Fig.10**) have demonstrated good agreement with the results of other authors.

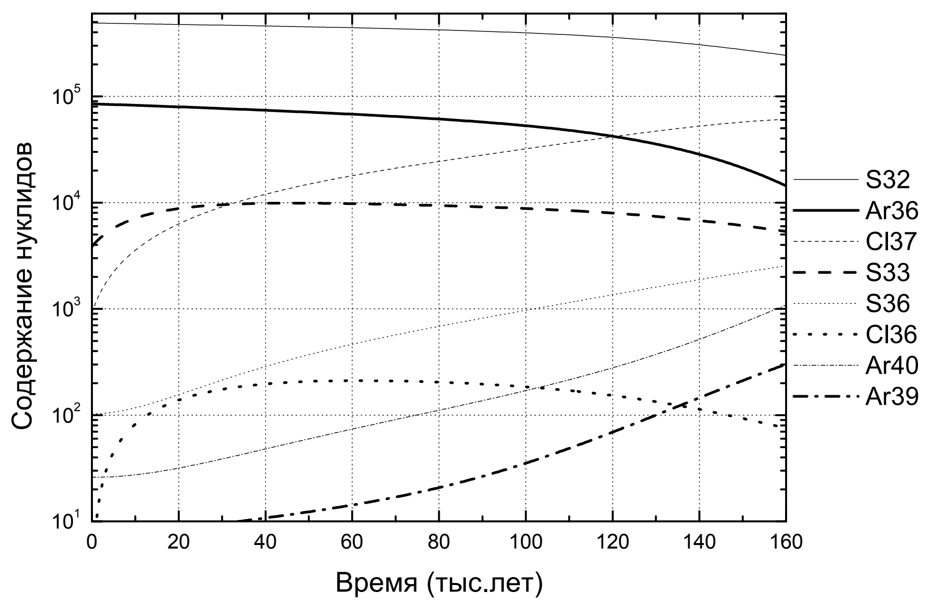

Fig. 10. *The calculated dependence of the abundance of a number of isotopes on the time at burning of He.*

1.6. Ultracold neutron physics, neutron optics

1.6.1 Investigation of super-small energy transfer processes at interaction of neutrons with surfaces of solid bodies

Under RFBR and INTAS projects comprehensive a experimental study of the new phenomenon, super-small UCN energy transfer at interaction with the surface of solid bodies, continued. Plans include the experimental determination of absolute values of the probability of super-small heating (in the energy interval up to 150 neV) and cooling of UCN at interaction with various substances, determination of the dependence of the discussed probability on the temperature over the interval 100 - 300 K, determination of the spectral characteristics of the processes, including the spectra of heated/cooled neutrons, the dependence of the energy transfer probability on the UCN spectrum. In 2001 the creation of the new gravitation spectrometer completed. The facility was moved to ILL (Grenoble, France) and assembled on the beam PF2 (**Fig 11**).

Test measurements were conducted with the new facility confirming its ability to operate as a spectrometer of ultracold neutrons with a higher (up to 8 times) sensitivity to small energy transfers than its predecessor. Of no less importance is good conformity between the probability of UCN "small heating" for copper and stainless steal surfaces obtained in the tests and the expected values determined from the previous experiments.

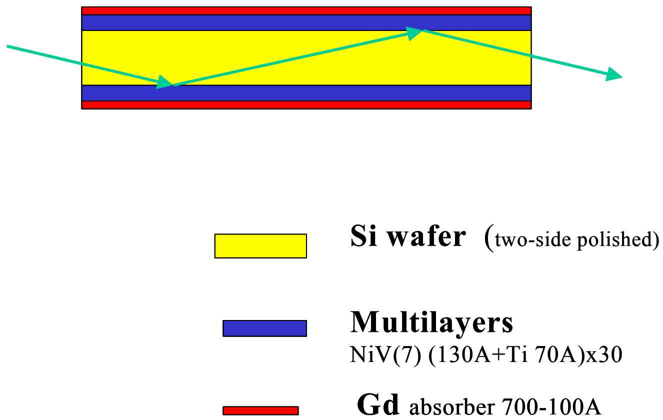

Fig. 11. *Assembling of the gravitational spectrometer on the channel PF2 .*

Of certain interest are the results of test measurements with sapphire. Total UCN losses on a sapphire monocrystal appear to be essentially higher than theoretical, which is possible to explain by surface impurities as the sample was not subjected to preliminary degassing and “small heating” on the sample in the energy range 50-150 neV does not give any noteable contribution against the background of heating on the spectrometer walls.

The created gravitational spectrometer is the most advanced instrument today for the study of "small transfers" of energy at interaction of UCN with the surface of solid bodies.

1.6.2 UCN Optics

Work to study the optics of strongly absorbing media with the help of an UCN spectrometer with interference filters started. The samples are natural gadolinium with an UCN absorption cross section of the order of 10Mb deposited on silicon substrates. A unique situation is created due to the fact that in this case, the UCN absorption wavelength in matter $(\rho\sigma)^{-1}$ is of the order of the neutron wavelength.

Initially, the purpose of the experiment was to show that the transmission ability of thin Gd samples does not depend on the velocity component parallel to the substance interface. It is the result that is predicted by the model of complex optical potential. However, a considerable deviation from the prediction was observed. The obtained result has not found its explanation yet.

In the second stage, systematic measurements of the dependence of the transmission ability of the samples on the (“normal”) neutron velocity were conducted. In this case, the obtained results are also in contradiction with theoretical predictions. The explanation of the result as being due to methodological reasons fails, though it cannot be completely neglected because of extreme difficulties of staging such an experiment.

1.6.3 Measurement of interaction time of neutrons with quantum objects by the method of Larmor clock

Work to measure the interaction time of neutrons with quantum objects by the method of Larmor clock was carried out on the spin-echo spectrometer IN15 in ILL. In the basis of the method lies the fact that the neutron precessing in the magnetic field interacts with the sample. A finite time of interaction results in the appearance of an additional spin precession angle. The experiment to measure the tunneling time of neutrons to a quasibound state yielded the first result reported at an international conference.

An apparent delay due to the resonance character of the tunneling was registered. In the experiment to measure the neutron diffraction time, the time of neutron transmission through the sample was measured in the direct geometry of transmission and the double diffraction reflection geometry. The result is shown in **Fig 12**.

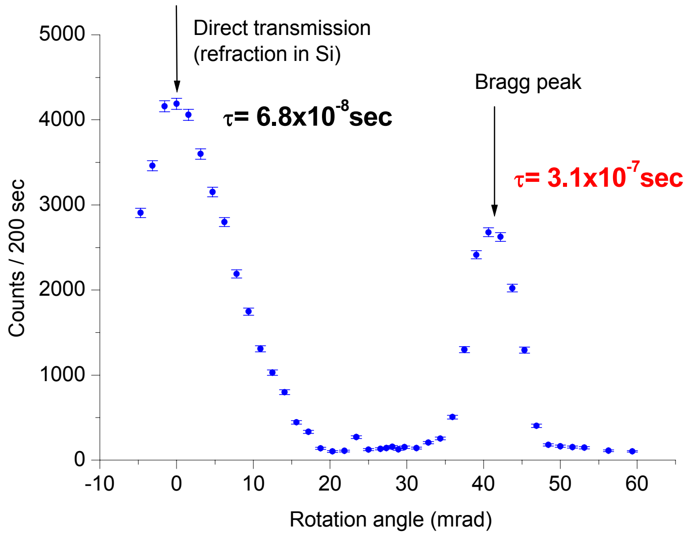

Fig. 12. *The transmission curve as a function of the neutron incidence angle.*

1.7. Proposal for direct measurement of neutron-neutron scattering at the reactor YAGUAR

The recent results of fundamental nuclear physics experiments indicate that the neutron-neutron interaction is stronger than the nuclear part of the proton-proton interaction implying breaking of the charge symmetry of strong nuclear force. The best way to verify this and to stimulate further development of the isotopic-spin invariance concept is to perform a direct measurement of neutron-neutron scattering by colliding free neutrons. The proposal for such an experiment - the ISTC Project 2286, which is a joint project of JINR (Dubna), VNITF (Snezhinsk) and TUNL (Durham, NC, USA) has been prepared and submitted to the International Science Technology Center.

The experimental study of thermal neutron fields formed by polyethylene converters inside the central channel of the aperiodic pulsed reactor YAGUAR demonstrates that the reactor provides a required instantaneous value of about 10^{18} n/cm^2·s for the thermal neutron flux density during the neutron burst of 700 μs. These results were presented at the Dubna ISINN-9 International Seminar.

2. Theoretical investigations

1.8. Weak parity-violating NN-potential

On the basis of the characteristic weak parity-violating *NN*-potential the weak parity-nonconserving single-nucleon Hartree-Fock potential V_W^{HF} has been constructed following a general theoretical scheme applied earlier to the case of standard strong *NN*-interaction. The general formulae for all the components of the weak single-nucleon HF-potential V_W^{HF} accounting for the isotopic dependence (τ_{1z} -terms) and explicit contributions of π- , ρ- and ω-meson exchanges have been derived. It is ascertained that the potential V_W^{HF} has a considerably more complicated structure than phenomenological weak nucleon-nucleus potentials but, nevertheless, incorporates some features which have direct phenomenological analogues. The calculation of the coefficients at ($\boldsymbol{\sigma}_1 \hat{\mathbf{k}}_1$) in the main *P*-odd term of the potential V_W^{HF} ($\hat{\mathbf{k}}_1$ is the nucleon wave vector operator) for the centres of the doubly-magic spherical nuclei ^{208}Pb and ^{40}Ca have demonstrated (for the nucleon energy range $E = (0 \div 100)$ MeV) sufficiently good agreement with the phenomenological data. The relations between the magnitudes of various contributions to V_W^{HF} (Hartree and Fock parts, isoscalar and isovector components, π-, ρ- and ω-meson parts) are studied.

The investigation of the other terms in the potential V_W^{HF} and the study of radial distributions of different components in V_W^{HF} will continue.

1.9. Free neutron β- decay

This year, investigating the neutron β- decay was continued. Whereas the previous calculations were entirely based on the effective Lagrangian describing weak interactions on a pure hadronic level, the present-day inquiry is carried out upright within the electroweak standard theory (the Weinberg-Salam theory) treating interactions of leptons (e, ν,…), quarks (u, d, …), gauge bosons ($\gamma, W^{\pm}$, Z) and Higgs particles which all cause eventually the β- decay of neutrons. In describing the radiative corrections to the neutron β- decay, a renormalization scheme for the electroweak standard model is utilized in which the electric charge and the masses of the gauge bosons, Higgs particle and fermions (leptons and quarks) are used as physical input parameters. The effective quantities, formfactors, come naturally into consideration in order to allow for strong interactions. Detailed calculations of the one-loop electroweak radiative corrections to the neutron lifetime and electron angular distribution are for now under way and will come to fruition before long.

3. Methodology

3.1. Calibration of fast neutron detectors HEND

In 2001, in cooperation with DRRI specialists the program for the calibration of the fast neutron detector HEND (High Energy Neutron Detector) to operate on board the American research apparatus Mars Odyssey 2001 as an element of the gamma-spectrometer complex completed. The work was carried out under a long-term agreement with the Institute for Space Research of the Russian Academy of Sciences in accordance with which JINR was to develop the physical concept of the apparatus, accomplish physical and mathematical modeling of its characteristics and calibrate the apparatus efficiency. The calibration was done using one of the three instruments made in IKI RAS. One was installed on board the space apparatus and is presently operating successfully on the Mars orbit registering the neutron radiation of the planet.

3.2. Development and construction of new neutron scintillation detectors

Cooperation with RCL LNP in the creation of new detectors for neutron and neutrino investigations continued. The RCL synthesized organic scintillators with boron and gadolinium were tested on neutron beams in the Scientific Research Department of Physics of SRDPN to investigate the efficiency of their application.

4. Analytical investigations at IBR-2: neutron activation analysis and radiation research

A successful application of the nuclear analytical technique for biotechnological and biochemical development, namely, of **Selenium- and Chromium-containing pharmaceuticals** based on the blue-green algae *Spirulina platensis*) has brought two patents in co-authorship with scientists from the Tbilisi Institute of Physics named after Andronikashvili and a number of internationally recognized papers.

A combination of these vitally important elements with protein-containing algae, called the "food of the future", allows to produce pharmaceuticals of great potential for the treatment of a wide spectrum of diseases: from ishaemic heart disease - to enhancement of the immune system to fight AIDS. Investigations to develop a technique for the determination of the element content in *Spirulina platensis* are carried out by the group of Neutron Activation Analysis.

2. NEUTRON SOURCES

2.1. The IBR-2 Pulsed Reactor

In the year 2001 the IBR-2 reactor operated in accordance with the approved working schedule. It operated 8 cycles (~2066 hr) at W=1.5 MW for physical experiments with 8 cases of emergency shutdowns by the automatic emergency system (AES). The details of the IBR-2 operation are summarized in Tables 1 and 2 and Figures 1 and 2.

Table 1

The operation parameters of the IBR-2 reactor in the period from January 1, 2001 to January 1, 2002

Cycle №	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	***Total:***
Time of cycle	*15.01 – 26.01*	*19.02 - 02.03*	*12.03 – 23.03*	*9.04 - 25.04*	*14.05 - 25.05*	*22.10 - 3.11*	*12.11 - 23.11*	*03.12 - 14.12*	
Operation for physical experiment, hr	267	241	263	259	264	249	257	266	**2066**
Operation of movable reflector, hr	275	270	278	276	273	273	274	275	**2194**
Generated power, MW·hr	403	370	399	393	402	381	389	401	**3138**
Number of emergency shutdowns (AES)	–	3	1	2	–	1	1	–	**8**
Due to:									
▪ Voltage drops	–	1	–	–	–	1	1	–	**3**
▪ Instrumental malfunction or failure	–	1	–	1	–	–	–	–	**2**
▪ electronic equipment failure	–	–	–	–	–	–	–	–	**0**
▪ personnel error	–	1	1	1	–	–	–	–	**3**

Table 2

The IBR-2 parameters as of 01.01.2002

№	**Parameter (counted from the start of reactor operation)**	**actual**	**rated**
1	Total operation time for physical experiment, hr	40633	
2	Total generated power, MW·hr	74498	85000
3	Mechanical operation time of the movable reflector MR-2P, hr Radiation generation by MR-2P, MW·hr *(with the flux density over the center of the blade $5{\cdot}10^{13}$n/cm^2 for neutrons with E>0.1 MeV)*	16060 27150	18000 36000
4	Maximum fluence on the reactor jacket in the center of active zone (10^{22} n/cm^2): • for En > 0.1 MeV • for En > 0.8 MeV	3.21 1.38	3.72
5	Maximum fuel burn (%): • for pellet TVELs • for spigot TVELs	5.6 6.0	6.5 8.2
6	Reactivity resource (%)	0.69	
7	Total number of emergency shutdowns	438	550

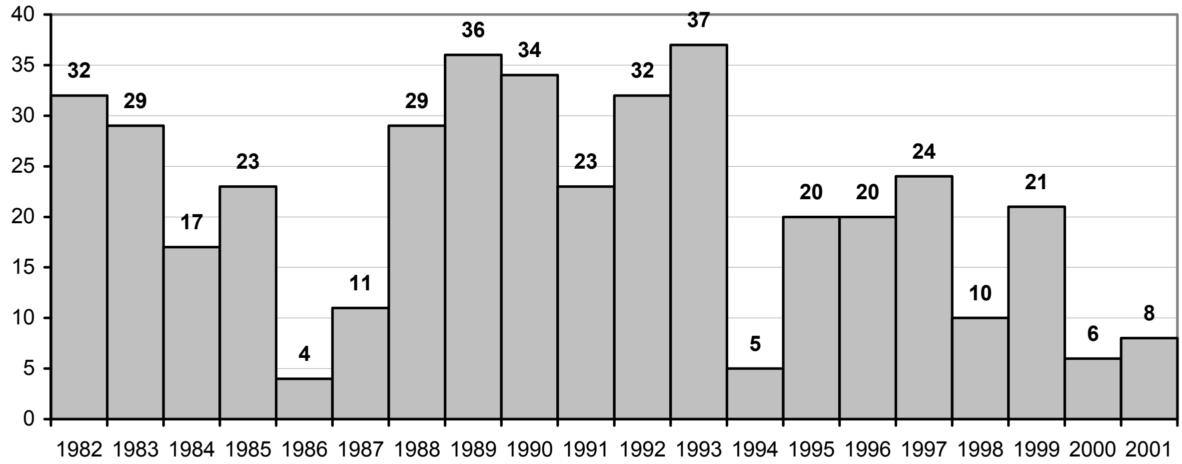

Fig. 1. *The number of unscheduled (AES-triggered) shutdowns per year*

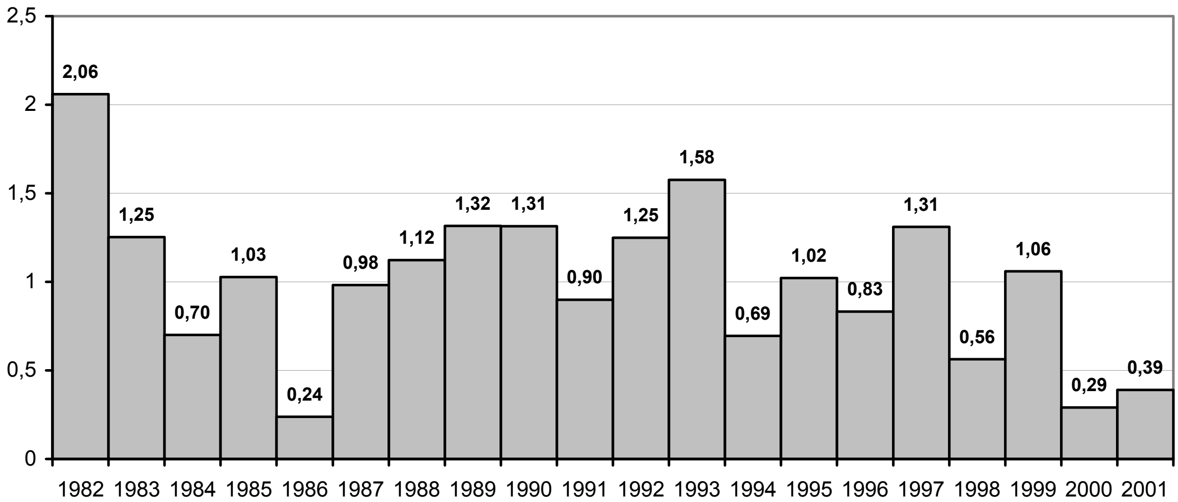

Fig. 2. *The number of unscheduled (AES-triggered) shutdowns per 100-hour operation time*

In the scheduled period (June-October) the preventive maintenance plan for 2001 (PMP-2001) was executed, including the removal of the used movable reflectors from the operative depository. The MR-2 taken out of operation in 1994 was removed providing a space for the MR-3 in the operative depository for the modernization period.

For safety reasons a diesel electric power station to be used in the event of failure of the IBR-2 regular power supply systems was put into operation in 2001.

In 2001, IBR-2 modernization works were conducted as planned:

1. MR-3 (chief task):

   The readiness of the parts is over 50%; an agreement with the "BRUEL&KJAER VIBRO A/S" for the delivery of vibration control equipment for MR-3 was signed; the method was developed and an ultrasonic test of forgings from nickel alloy to manufacture reactivity modulators was conducted. The working schedule on MR-3 project is presented in **Fig. 3.**

2. Manufacturing of TVELs:

   − The industrial enterpriseна "Maiak" completed works to reinforce the shielding of the facility "Packet" for the manufacturing of TVELs for IBR-2,

- The technology of the manufacture of pellets for TVELs is was developed,
- Investigations of 2 used fuel assemblies from IBR-2 with a maximum burn (5%) are set up in NIKIET.

3. The technological project for the modernization of IBR-2 is completed in the main. The technical solution that would allow the replacement of moderators without the dismantling of the executive mechanisms of the Control and Safety System (CSS) was found. General types of CSS motor drives and prototypes of the AES motor drive were developed.
4. Started the working drawings of the reactor jacket.
5. The technical project for the disassembly of the IBR-2 jacket was elaborated.
6. The "Geliimash" started the development of a special cryogenic helium facility for the cold moderator.

In 2001 the financing of works on IBR-2 modernization went in accordance with the plan (see Table 3).

Table 3

The financing of the project "IBR-2 Modernization" in 2001 (k$)

Working direction	JINR		MAE		Σ	
	Plan	Actual	Plan	Actual	Plan	Actual
MR-3	140	**189**	89	**89**	229	**278**
TVELs	68	**23**	154	**159**	222	**182**
Basic equipment	283	**21**	57	**53**	340	**74**
TOTAL:	491	**223**	300	**301**	791	**534**

Plan for the modernization of IBR-2 in 2002

1. MR-3:
   - Complete manufacturing in the 2nd quarter of 2002,
   - Test assembling (beginning) – 3rd quarter, 2002.
2. Development of design documentation:
   - Working documentation for the reactor equipment,
   - Project of works to disassembly the existing jacket.
3. Construction of a prototype of the AES CSC motor drive.
4. The reactor jacket (start manufacturing).
5. Fuel assembly for IBR-2M:
   - Manufacturing of TVELs,
   - Manufacturing of the fuel assembly parts.
6. CSS electronic equipment: development of the project.
7. CHF for CM: development of the project.

2.2. The IREN Project

In spite of serious problems with funding in year 2001 some progress in implementation of the IREN project has been achieved. The time-tables of two JINR laboratories FLNP and PPL responsible for this activity which have been approved in February and corrected by August were realized for many items.

First of all it was the activity connected with creation of elements of the electron linear accelerator (linac) LUE-200 carried out in new linear accelerator division of the PPL and the design bureaus of the FLNP and PPL. As result it was completed construction of all elements of the electron gun and it was mounted at the stand. The full set of general working drawings of the linac assembly was prepared by the end of August. It allows one to fix precisely a position and sizes of all linac elements in accelerator halls of Bld. 43 of FLNP. It was completed also a geodesic survey of the axis of the old linac dismantling since August. The results of this survey will be necessary during mounting of the new linac which beam should be directed to the center of the multiplying target with high precision. The problem is that a mounting of elements of LUE-200 should start in bld. 43 FLNP before a completion of IBR-30 reactor dismantling. A technological design of the magnetic focusing system was completed, the materials necessary for its construction was partly obtained and technological line for its mounting is installing now in PPL. A large work was carried out on full scale RF stand. During summer the vacuum system was installed and tested, the pressure of $2x10^{-8}$ Torr was achieved. After a completion of some auxiliary systems the modulator M-350 together with the klystron 5045 SLAC was tested at the regime of enhancing of RF power. The power as much as 70% of the planned one was really obtained at the repletion rate 50Hz. Last test experiments with long (210 nc) electron pulse and at high level (50 Mw) of the RF power have been successfully carried out at linac prototype in BINP, Novosibirsk with participation of Dubna experts. An electron beam (1.3 A) was transported throughout three accelerating tubes similar to the LUE-200 ones with minimal loses at the repletion rate 2Hz. It was confirmed a possibility to achieve the planned parameters of LUE-200.

Very important stage of the IREN project was got after final shut-down of IBR-30+LUE-40 neutron source on 15 June. At that moment the technical project of decommissioning of the IBR-30 reactor was completed by GSPI and after preparation of many other necessary documents by FLNP experts the license of Russian Gosatomnadzor for start up process of decommissioning has been obtained by the end of August. Since this moment JINR got the rights to begin technical preparation for dismantling of IBR-30. In October a construction of the new building #117/6 for storing of activated elements of IBR-30 has started. The technological regulation of IBR-30 dismantling and a design of necessary equipment has started to work out in November and should completed and approved by Gosatomnadzor in third quarter of year 2002. After that JINR will get the right to start real work for dismantling of the IBR-30 reactor. In accordance with the IREN project time-table this work should started in last quarter of year 2002.

Large progress was achieved in working out of the modernized technical project of the multiplying target by NIKIET, Moscow in tight collaboration with JINR. As it is planned the project was competed in general by the end of 2001. Its formal approval in Russian authorities and delivery to JINR will be completed in the first quarter of year 2002 with delay of three months. With much lower rate a preparation of the general technical project of the IREN source was been carrying out by GSPI, Moscow during this year. So a completion of the partial project necessary for official approval is shifted now at least by two quarters.

Taking into account large delay in implementation of the JINR budget of year 2001 (first funds were provided only by the end of August) and respective shift of many item of the IREN time-table JINR directorate approved the proposal of the project management to realize in next two years a reduced variant of the IREN source. This first stage includes full scale multiplying target and electron linac based on one 5045 SLAC klystron instead of previously planned two ones. This stage envisages also only one modulator and reduced (up to 50Hz) repetition rate. The time-table for years 2001-2003 has been approved by JINR directorate in September. It foresees the start up of the first stage of the IREN source by the end of 2003. At the same time a corrected plan of financing for year 2001 was confirmed too. But due to the limited period for payments charging and the shifts of time-tables of some contracts this plan was realized only in part. The total investments in year 2001 consisted of about 270K$ including a delivery of equipment from Bulgaria and Czech Republic which will be made really in year 2002.

3. THE IBR-2 SPECTROMETERS COMPLEX AND COMPUTATION INFRASTRUCTURE

Work on the theme went in keeping with the FLNP projects ICC, FSD, YuMo, Texture, PNS, Detectors, BMBITF – ECS, etc. in the following main directions:

1. Development of the information-computation infrastructure.
2. Creation of data acquisition and spectrometer control systems.
3. Development of the IBR-2 spectrometer complex:
   - automation of spectrometers and development of “sample environment” systems;
   - creation of neutron detectors;
   - creation of neutron-optical systems;
   - Routine operation of spectrometers.

Local area network. Work to build a local area network (LAN) started over 10 years ago. Initially, it consisted of several segments linked together via repeaters and switches. Since 1996 the network has continuously been modernized. The chief directions of the modernization are a transition from cables to twisted pairs, installing of 2^{nd}-level commutators in the LAN segments, and a transition to the technology Fast Ethernet.

At present, the local area network of FLNP contains about 500 different devices and the number of them continues to grow. A gradual transition of users to Fast Ethernet has raised load on the channels connecting the buildings of the Laboratory. To the LAN FLNP there are switched computing systems controlled with a variety of operational systems. The LAN users communicate employing virtually all the existing time protocols. Among users there exist a small number of relatively independent working groups, each operating a computation system for a particular instrument. At the same time, all LAN users have access to general resources of the FLNP central computation complex, including subsystems for data storage, e-mail, WWW, etc.

A historically established star-like communication structure and the absence of intellectual control devices do not make it possible to distribute flows between users in an optimal way. In addition, the experiments conducted with FLNP facilities are being transformed to a distributed model of data acquisition and processing, which also increases load on LAN. A remote-control policy that has been increasingly used at large physical facilities calls for much stricter observation of such LAN parameters as packets transportation time and percent of losses.

Chief current problems:

- Absence of free IP-addresses
- A large wide broadcast traffic (~30% of the total LAN traffic) is not filtered with commutators and is processed in each network unit
- A poorly tuned or virus-infected working station may hamper, even paralyze, the operation of the entire segment
- Localization and fixing of malfunctions in the network units are difficult.

For the solution of the enumerated problems there has been elaborated a project for the modernization of basic segments and key elements of LAN in 2001. Designing the network of the next generation the following requirements were investigated.

- *Failure immunity* – the topology of the network allows it to retain the operation ability at breaking down of separate elements and switch automatically reserve paths of by-passes for data traffic.
- *Controllability* – operative control of network configuration, possibility of changing the logic structure of the network without changing its physical topology.
- *Service quality control* – guaranteed transmission widths for particular subscribers and network applications, guaranteed delay to response, predictable percentage of packets losses, operative

analysis of traffic aimed at optimization of data flows and service quality, network transmission capability over 100 Mbit/s and over 1Mpacket/s (1st stage), and up to 1 Gb/s (2nd stage).

- *Protection ability* – all the switched units are protected from internal and external attacks.
- *Module structure* – enables easier extension of the network and makes it possible to apply new network technologies.

The existing physical topology of channels linking the FLNP buildings (8 buildings over an area of 1 km in radius) and difficulties in laying new communications between the buildings, in reactor buildings and experimental halls have also been considered.

In the reported year, for the realization of the 1st stage of the project a transition to Fast Ethernet 100 Mbitit standard was executed in two segments of the network (bldg. 42a – NICM Division and bldg. 42 – PN Division). In bldg. 42a, the commutator Catalist 2924XL (CISCO) is installed and put into operation, which increased the reliability and rate of data transmission in the NICM segment. A contract for purchasing of the 3rd level router (CISCO router 8510) is signed and preparative work to install it is fulfilled. The router will be put into operation at the beginning of 2002.

To modernize the network, a two-level scheme is chosen. The entire FLNP network is divided into distributed virtual subnetworks (VLANs) each being a 2nd level domain with an imposed IB subnetwork. This will make it possible to reduce to minimum the size of the broadcast domain and decrease the volume of parasitic traffic. It should be noted that the applied technology makes it possible to form groups of user devices irrespective of their geographical position. The formation of VLAN is executed by the commutators Ethernet / Fast Ethernet providing the access layer of the network. The core layer is a 3rd level commutator of the type ISO. The core accomplishes the routing of packets over the FLNP subsystems and provides access to a basic network of JINR. The existing optical **highways** are used to connect the central and user commutators.

Thus organized network will make it possible to increase a real transmission ability of the network by 50-60% without changing its physical interfaces. In-built mechanisms of control and analysis of traffic will allow operative debugging and determination of reasons for network slow operation. Rich possibilities of quality control provided by 3rd level commutators guarantee reliable data delivery and ensure a guaranteed transmission width for most important network applications. Further extending of the network without changing its logic structure appears possible – commutation on the 3rd level allows increasing of the number of routable IP and IPX networks, application of the address translation technology to improve protection from external attacks, and a more effective use of the address space.

Data acquisition systems. In the reported year, detector systems in a number of spectrometers were modernized. In particular, low-noise electronic blocks for the detectors NEW and YuMO were developed, manufactured and tested, the 32-channel detector of SPN was debugged, detector electronics in KDSOG was completely renewed, a linear PSD with a resistive wire was introduced into DN-2.

To the EPSILON spectrometer a unified VME-system for data acquisition is introduced. In addition to a standard set of functions, its electronics executes neutron time of flight correction (time focusing).

For the MSGC detector (IHM Berlin), a second TDS/DSP data acquisition block with a PCI interface is produced and is tested with a programmable generator of events. A single block of its type processes events from two conjugate planes of the detector situated on two sides of the neutron converter. The block consists of four 8-channel transformers of the type F1 (Acam), different types of FIFO memory, programmable logic matrices, a histogram memory of 256 Mbit, a TMS320C6701 high performance signal processor, and a PCI interface. For every event the coordinates X,Y are measured (by signals from both ends of the delay line) as well as the time of flight (TOF) and pulse height (PH). In DSP on-line calibration and transformation of the X/Y/TOF/PH data into two-dimensional spectra (e.g., 2θ/TOF) are performed. These data are accumulated in the histogram memory and at the end of the measurement, are sent to PC for further processing. At present in FLNP it is used to develop and debug software products.

A multi-processor module (four DSP TMS320C51) for the computation of the correlation function and histogramming of the data from the ZnS-scintillation detector of the FSD facility has been tuned.

Work continued to develop and install on the spectrometers a unique SONIX programs complex for data acquisition. In particular:

- SONIX packet is installed on the spectrometer SPN and EPSILON
- MAX program for on-line viewing and express analysis of data is developed (installed on DN-2, SPN, and EPSILON)
- New SONIX version with automated restart of measurements in the event of malfunctions in the system or network is prepared and tested on the SKAT spectrometer (at present, it is being transferred to the other spectrometers)
- Network VME controller with a data transmission rate of up to 100 MBIT/s is tested (it will be installed on the YuMo facility).
- New version 2.15 of the ISP network packet for OS-9 is tested and has demonstrated a high stability of operation.

Based on the packet Open G2 there are being developed programs for the reduction of the data from the point detectors of the YuMO spectrometer taking into account automatically the geometric parameters of the facility.

A large volume of work to support and upgrade the FLNP web-server was carried out.

Work started to master mezzanine technologies with the aim of their application in data acquisition systems.

Development and routine operation of the IBR-2 spectrometers complex. *Development of sample environment systems*. The development of sample environment systems continued:

- New executive mechanisms adapted to the existing step-motor-based control systems were incorporated into the spectrometer schemes
- Certification of the existing devices, including furnaces, refrigerator heads, etc., continued with the aim of creation of a data base on the temperature control and regulation devices in the spectrometers HRFD, FSD, PNS, YuMO, DN2 and the X-ray diffractometer DRON.
- Research into the connecting of two control elements: the heater and the refridgerator, to one Eurotherm regulator of the type 902S or 906S, was carried out. The results are used on the DRON diffractometer. The precision of the control system is +/- 0.03 degrees.
- A second channel for control of the temperature of the annealing furnace in the sample preparation room is completed and put into operation.
- Work to develop a RGD-1245-refrigerator-based cryostat CHF for up to 4.2 K was carried out and at present, the manufacturing of CHF is being completed.

Creation of neutron detectors. The methodological investigations conducted in the Frank Laboratory of Neutron Physics in 1998-2000 have allowed the development of new-type wide-aperture detectors for high-resolution diffractometers. At present, two experimental prototypes of the detectors built on the basis of a ZnS(Ag)/LiF scintillation screen and spectrum-shifting fiber are in test operation on the fourier spectrometer for internal stress analysis (FSD). The detectors are used to investigate internal stresses in specimens of the reactor jacket on request of the RF Atomic Energy Ministry.

In the nearest years, the new detectors raising dramatically the efficiency of investigations with time-of-flight diffractometers are to be installed on the FSD diffractometer and the DN-12 spectrometer for the investigation of microsamples at high pressures.

So far, the necessary modeling of the facility has been done and a three-dimensional model of the FSD detector has been developed. Manufacturing of the detector blocks started.

Work to create a «clean room» and a gas test-rig for assembling gas detectors continued.

Creation of neutron-optic systems. In the reported year work to create a technology for manufacturing of basic elements of neutron guides started – to manufacture glass sections with a metallic thin-film coating on the basis of the glass FLOATGLASS:

- Equipment for cutting glass based on a milling machine with diamond cutters is put into operation; a test lot of four glass plates is made;
- Test supply of 19 mm Planilux float-glass of Saint-Gobain make is purchased
- Thermovacuum spray-coating facility with the following parameters is put into test operation:
  - Vacuum chamber volume - 1 m^3,
  - Number and size of simultaneously spray-coated glasses – 2 pieces each measuring 750x300 mm^2,
  - Vacuum in the spray-coating mode – $9x10^{-6}$ mm Hg,
  - Heaters – 2 ∅ 3 mm tungsten rods by 1000 mm long,
  - Maximum temperature of the heater - 2000 C,
  - Temperature of heating the substrate – 215 C,
  - Chamber jacket's cooling – water,
  - Sprayed material –Ni, NiCr in the form of a ∅ 0.3-0.5 mm wire,
  - Consumption power in the spray-coating mode – 2 kW.
- Test spray-coating of natural Ni on a float glass measuring 210x80 mm as conducted.

Modernization of spectrometers. The main spectrometer development effort focused on SPN, YuMO, FSD, and DN-12.

Modernization of the spectrometer of polarized neutrons (SPN)

The program for the modernisation of SPN in 1999-2002 involves the following stages:

- Dismantling of outdated equipment, manufacturing and installment of the new head part and a reflectometric shoulder in SPN-2.
- Creation and integration of the new wide-aperture polarization.
- Creation and integration of the new system for data acquisition, storage and control in VME standard.
- Automation of the experiments and extension of the magnetic field and temperature ranges of sample environment systems.

Main results in 2001:

- The dismantling is accomplished and the new head part is installed.
- The adjustment table for the polarization analyzer is made.
- The system for control of the executive mechanisms is modernized to increase the number of control devices to 32.
- Specifications for a polarizer in the small-angle mode of the spectrometer are developed.
- Automatically controlled diaphragms, a shutter and polarizers for separate measuring regimes, a wide-aperture spin-flipper and some step-motor-based elements for control of the physical experiment are integrated into the scheme of the spectrometer.

Modernization of the small angle spectrometer (YuMO)

The first successful experiments in the long-time regime using the final version of VME electronics were carried out.

Work to automate the control systems of the executive mechanisms continued:

- System for control of an УР-7-motor-based device for pressure building on the sample was developed.
- Design work to create a ДШИ-200-step-motor-based-device to introduce standard scatterers into the beam was carried out and four devices were integrated into the executive mechanism systems.
- Systems for control of the executive mechanisms were modernized to increase the number of control devices to 32.
- Work to design devices for the displacement and adjustment of the PSD detector began.

Neutron fourier diffractometer (FSD) for internal stress analysis

Main results in 2001:

Work to design and manufacture a 90-degree detector continued:

- Experimental prototypes of the detector on the basis of ZnS(Ag)/Li^6F scintillation screens with an optimized optical trap were created and tested.
- .A computer model and a technical project of the wide-aperture 90-degree scintillation (ZnS) detector ASTRA was developed.
- Manufacturing and assembling of the first section (8 counters) of the detector ASTRA are under way.

The first version of the table for samples with a three-axis goniometer and a turning ring was manufactured. The equipment and software for sample positioning were debugged.

Neutron spectrum intensities at sample position are calculated for three moderator-neutron guide geometries and a report is prepared.

Neutron spectrometer for investigation of microsamples at high pressure (DN-12)

In 2001 the following work to modernize the spectrometer was performed:

- A section for the loading of high-pressure cells was created.
- A torroid-type high-pressure cell was developed, manufactured and calibrated.

Cracow-Dubna inverted geometry spectrometer (KDSOG-M)

The spectrometer KDSOG-M was built on channel 10 of the IBR-2 reactor in 1982 to investigate the atomic and magnetic structure of condensed matter by inelastic neutron scattering.

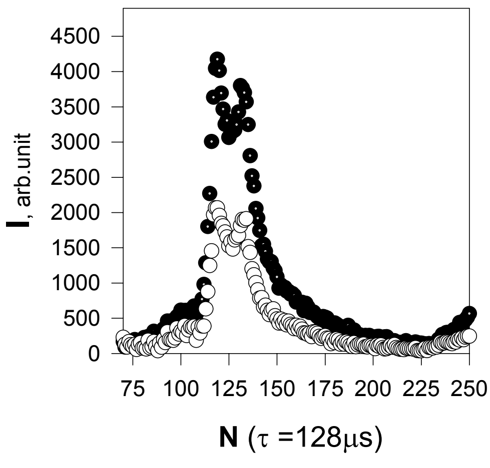

Fig.1. *The time-of-flight IINS spectra of vanadium measured in a time of 10 hours in equal experimental conditions: ● – new detectors, ◦- old detectors*

In 2001 the detector system was modernized. Preamplifiers, a high-voltage-power-supply block, NIM-TTL transformers, and mechanical elements of the detector and of 60 helium counters were manufactured. The equipment of the modernized detector was assembled and adjusted with the spectrometer.

IINS measurements of vanadium showed that the luminosity of the spectrometer increased about 2 times due to only increasing of the efficiency of registration of the scattered neutrons **(Fig.1).** The sensitivity of the spectrometer (signal/background ration) increased significantly, which is important for measurements of small or weakly scattering samples.

In the reported year the spectrometers equipment was prepared for operation and serviced during a total of 8 cycles of the IBR-2 reactor.

4. EXPERIMENTAL REPORTS

4.1. CONDENSED MATTER PHYSICS

Diffraction

Residual Stress Evaluation in Core Component of a Nuclear Reactor
G.Bokuchava, V.Sumin, A.Tamonov

Atomic and Magnetic Structures of $Sr_2MnGaO_{5+\delta}$, a New Layered Oxide
A.M.Balagurov, V.Yu.Pomjakushin, A.M.Abakumov, E.V.Antipov, M.V.Lobanov, P.Fischer, D.V.Sheptyakov

Crystal and Magnetic Structures of $(Nd_{1-x}Sr_x)(Mn_{1-x}Ru_x)O_{3-\delta}$ Perovskite
A.M.Balagurov, S.N.Bushmeleva, V.Yu.Pomjakushin, O.Yu.Gorbenko, A.R.Kaul, L.Keller, D.V.Sheptyakov

Magnetic Property of Quasibinary $(Zr_{1-x}Ti_x)Fe_2$ Laves Phase
Z.Surowiec, A.I.Beskrovnyi, M.Budzynski, J.Sarzynski, M.Wiertel

Structural Study of Ternary Mercury Chalcogenide $HgTe_{0.85}S_{0.15}$ under High Pressure
D.P.Kozlenko, V.P.Glazkov, S.E.Kichanov, B.N.Savenko, V.V.Shchennikov, V.I.Voronin

Neutron Diffraction Study of Crystal and Magnetic Structure of MnAs at High Pressure
V.P.Glazkov, D.P.Kozlenko, K.M.Podurets, B.N.Savenko, A.V.Somenkov

An Effect of High Pressure on the Crystal and Magnetic Structure of Manganite $Pr_{0.8}Na_{0.2}MnO_3$
Z.Jirak, D.P.Kozlenko, V.P.Glazkov, B.N.Savenko

Hybridization of Libron and Phonon Modes in NH_4I: Neutron Spectroscopy Studies at Pressures up to 10 GPa
V.P.Glazkov, D.P.Kozlenko, B.N.Savenko, V.A.Somenkov, A.S.Telepnev

Neutron Diffraction Study of Crystal and Magnetic Structure of Mn_2Sb at High Pressure
V.P.Glazkov, V.S.Goncharov, D.P.Kozlenko, V.M.Ryzhkovskii, B.N.Savenko

Coarsening of Antiferromagnetic Domains: th Key Role of Magnetocrystalline Anisotropy
D.L.Nagy, L.Bottyan, L.Deak, J.Dekoster, H.J.Lauter, V.Lauter-Pasyuk, M.Major, O.Nikonov, A.Petrenko, E.Szilagyi

Small-Angle Scattering

Analysis of Magnetic Scattering Effect in SANS from Ferrofluids
V.L.Aksenov, M.Balasoiu, M.V.Avdeev, L.Vekas, D.Bica, V.M.Garamus, J.Kohlbrecher

SANS Study of Fullerene Aggregates in Pyridine/Water Solutions
V.L.Aksenov, M.V.Avdeev, A.V.Belushkin, R.P.May, D.Mihailovic, A.Mrzel, L.Rosta, I.N.Serdyuk, A.A.Timchenko

Thickness of Lipid Bilayer and Lipid Surface Area in Unilamellar DMPC and DPPC Liposomes Evaluated from Small-Angle Neutron Scattering Curves Measured at Different Contrasts
N.Kucerka, D.Uhrikova, A.Islamov, P.Balgavy

DMPC Multilamellar Vesicles and Mixed DMPC/$C_{12}E_8$ Micelles Orientation in Strong Magnetic Fields
M.A.Kiselev, M.Janich, P.Lesieur, A.Hoell, J.Oberdisse, G.Pepy, A.M.Kiselev, I.V.Gapienko, T.Gutberlet, V.L.Aksenov

Resolution Functions in Small Angle Scattering Experiments Energy Dispersive SANS
B.Grabchev, Yu.V.Nikitenko, A.I.Kuklin, A.Ch.Islamov, M.Balasoiu

Inelastic Scattering

Investigation of Phase Transitions and Lattice Dynamics in $[N(C_2H_5)_4]MeCl_4$ (Me=Zn, Cu) Compounds by Neutron Diffraction and Neutron Spectroscopy Methods
V.Yu.Kazimirov, I.Natkaniec, Z.Tylczynski

Neutron Scattering Studies and Quantum Chemistry Modeling of Internal Vibrations of Kinetin
K.Holderna-Natkaniec, I.Natkaniec, W.Kasperkowiak, V.Khavryutchenko, A.Pawlukojc

Ammonium Ion Behaviour in the $LiRb_{1-x}(NH_4)_xSO_4$ Mixed Crystals $(0.77<x<1.0)$
L.S.Smirnov, L.A.Shuvalov, M.L.Martinez Sarrion, L.Mestres, M.Herraiz

Neutron Optics

Polarization Analysis with Spatial Neutron Beam-Splitting
V.L.Aksenov, Yu.V.Nikitenko, S.V.Kozhevnikov

RBS and FRD Study of the Epitaxial RuO_2 Films Grown on Different Single Crystal Substrates
D.Machajdik, A.P.Kobzev, K.Frohlich

Magnetization in a Fe/V Periodic Structure
V.L.Aksenov, Yu.V.Nikitenko, V.V.Proglyado, M.A.Andreeva, B.Kalska, R.Wappling

4.2. NEUTRON NUCLEAR PHYSICS

Fission

The Analysis of P-Even Angular Correlations of Fission Fragment from $^{235}U(n,f)$- and $^{239}Pu(n,f)$-Reaction Induces bu s- and p-Wave Neutron Resonance Interference
A.B.Popov, W.I.Furman, A.L.Barabanov

Applied Research

Epitermal Neutron Activation Analysis for Developing Selenium-, Iodine-, and Chromium-Containing Pharmaceuticals Based on Blue-Green Algae *Spirulina Platensis* Matrix
M.V.Frontasyeva, S.S.Pavlov, S.F.Gundorina, N.G.Aksenova, L.M.Mosulishvili, E.I.Kirkesali, A.I.Belokobylsky, A.I.Khizanishvili

The analysis of P-even angular correlations of fission fragment from $^{235}U(n,f)$ - and $^{239}Pu(n,f)$ - reaction induced by s- and p-wave neutron resonance interference.

A.B.Popov, W.I.Furman and A.L.Barabanov[1]
[1] *RNC Kurchtov institute, Moscow*

Relation between A.Bohr's "fission channels" and fission modes is during last decades a subject of some theoretical and experimental investigations [1-3]. It was shown [2] the wave function of a transition state $J^{\pi}K$ (generalized A.Bohr's fission channel) can be represented as an expansion over the wave functions of distinct fission modes with the coefficients depending on deformation of fissioning system.

The new approach [4] to a description of nuclear fission induced by low energy neutrons based on the standard reaction theory joints naturally the extended concept of transition states [2] and a consistent description of angular correlations of fission products observed in the experiments [5-9] Using a modified helicity representation for fission product channels c_f introduced firstly by V.Strutinski [10] a summation over huge number of c_f channels taking place in real experiments has been carried out [4,11] in the framework of a pole expansion of the S-matrix. It was shown how P-even and P-odd correlations of fission products could "survive" and the "reduced" S-matrix defined for the "observed" $J^{\pi}K$ multi mode channels f was obtained in consistent way. This multi level S-matrix equivalent to "ad hoc" introduced Reich – Moore S-matrix allows one to describe the observed interference effects in the total and differential cross sections of (n,f)-reaction. Very recently on the basis of correct account for total parity of fission product channels in a helicity representation the new formulas for fission product angular correlation were obtained [12].

These formulas are used below for analysis of experimental data on angular anisotropy of fission fragments from resonance neutron induced fission of aligned nuclei ^{235}U [9] and P-even angular correlations for $^{235}U(n,f)$ reactions [8]. In the framework of the approach [4,12] outlined above the differential cross section of (n,f)-reaction could be written in the form:

$$\frac{d\sigma_{nf}(E)}{d\Omega_f}=\frac{1}{4\pi}\{\sigma_{nf}^{(0)}(E)+\sigma_{nf}^{(1)FB}(E)(\vec{n}_f\vec{n}_k)+\sigma_{nf}^{(1)RL}(E)p_n(\vec{n}_f[\vec{n}_k\vec{n}_s])+$$
$$+\sigma_{nf}^{(2)}(E)f_2P_2(\vec{n}_f\vec{n}_I)\},\qquad(1)$$

where

$$\sigma_{nf}^{(0)}=\pi\lambda\!\!\!^{-2}\sum_{J^{\pi}}g_J\sum_{lj}\sum_{K}|S_J(ljE\to K\pi f)|^2=\sum_{J^{\pi}}\sigma_{nf}^{(0)J^{\pi}}(E)\qquad(2)$$

is the total fission cross section expressed as a sum of the spin-separated components.
Other terms of (1) can be expressed as

$$\sigma_{nf}^{(1)}=\pi\lambda\!\!\!^{-2}\sum_{J^{\pi}}\sum_{J'j}\pi_0 g_J(-1)^{\frac{3}{2}-j}\sqrt{6(2j+1)}\times$$
$$\times U(IjJ1,J'\tfrac{1}{2})\,\mathrm{Im}\Big((1-i\beta_j)\times$$
$$\times\{-C_{J010}^{J'0}S_{J'}^{*}(1j\to 0f)S_J(0\tfrac{1}{2}\to 0f)+$$
$$+\sum_{K>0}C_{JK10}^{J'K}S_{J'}^{*}(1j\to Kf)S_J(0\tfrac{1}{2}\to Kf)\}\Big)\qquad(3)$$

and

$$\sigma_{nf}^{(2)} = \pi\lambda^2 G \sum_{J^\pi}\sum_{J'j}\sum_{K} g_J U(\frac{1}{2}IJ'2, JI) C_{JK20}^{J'K} S_{J'}^{*}(0\frac{1}{2}E \to K\pi f) S_J(0\frac{1}{2}E \to K\pi f). \qquad (4)$$

Here the quantum numbers l and j are orbital and total momenta of incident neutron, I is a spin of target nucleus, $\vec{n}_i$ ($i = k, s, I, f$) denotes unit vectors of neutron momentum and spin, a target nucleus spin and a fission product relative momentum, respectively. The coefficients $\beta_j = 1$ for $j = \frac{1}{2}$ and $\beta_j = -0.5$ for $j = \frac{3}{2}$, p_n is neutron beam polarization, f_2 is alignment of target nuclei,

$$G = \frac{15I^2}{\sqrt{(2I-1)I(I+1)(2I+3)}},$$

$U(IjJQ, J'I)$ and $C_{JKQ0}^{J'K}$ are Racah and Clebsh-Gordon coefficients respectively.

In the framework of the same theoretical approach it is possible to obtain the next expression for P-odd part of the differential cross section:

$$\frac{d\sigma_{nf}^{PV}(E)}{d\Omega_f} = \frac{1}{4\pi}\sigma_{nf}^{(1)PV}(E) 3\tau'_{10}(s)(\vec{n}_f \vec{n}_s), \qquad (5)$$

where

$$\tau'_{10}(s) = \frac{1}{\sqrt{3}} p_n$$

$$\sigma_{nf}^{(1)PV} = \pi\lambda^2 [-\frac{2}{2I+1}\sqrt{\frac{I(+1)}{3}} \sum_{\pi=\pi_0,-\pi_0} \pi \times$$

$$\times \mathrm{Im}\{S^{*}_{I+\frac{1}{2}}(0\frac{1}{2} \to 0-\pi f) S_{I-\frac{1}{2}}(0\frac{1}{2} \to 0\pi f)\} +$$

$$+ 2\pi_0 \sum_{JJ'} g_J U(I\frac{1}{2}J1, J'\frac{1}{2}) \sum_{K>0} C_{JK10}^{J'K} \mathrm{Im}\{S_{J'}^{*}(0\frac{1}{2} \to K-\pi_0 f) S_J(0\frac{1}{2} \to K\pi_0 f)\}] \qquad (6)$$

and π_0 is the parity of target nucleus so $\pi = (-1)^l \pi_0$.

It is important to note that the study P-even and P-odd angular correlations caused by an interference of s- and p-wave reaction amplitudes provides a direct information on the parity dependence of the fission barriers for $J^\pi K$ channels. The experimental investigation of such correlations has been carried out by Dubna – Gatchina collaboration for target nuclei ^{235}U and ^{233}U (see refs. {8] and [13]) and has been finished recently [14] for ^{239}Pu target nucleus. For P-even correlations the experiments of two types were fulfilled. In the first type of the experiments an energy dependence of fission fragment yield difference along and opposite to the direction of unpolarized incident neutron momentum ("forward-back")

$$\alpha^{FB} = \frac{N^F - N^B}{N^F + N^B}. \qquad (7)$$

was measured. In the second type of experiments the asymmetry of fission fragment emission in a respect to the plane formed by the spin of polarized neutron and its momentum

$$\alpha^{RL} = \frac{N^R - N^L}{N^R + N^L} \qquad (8)$$

was investigated.

Using the formulas (1) – (3) one can obtain the next expressions for the coefficients α^{FB} and α^{RL} ($\alpha^{RL} = -\alpha^{LR}$) which can be applied for analysis of experimental data.

The forward-back asymmetry can be written as

$$\alpha^{FB} = \frac{A}{B}, \qquad (9)$$

where

$$A=\sum_J g_J \sum_{J'j}\sum_K Z(JJ'Kj)[\cos\Delta\phi(\mathrm{Re}\,W_1\,\mathrm{Im}\,W_0-\mathrm{Im}\,W_1\,\mathrm{Re}\,W_0)+$$

$$+\sin\Delta\phi(\mathrm{Re}\,W_1\,\mathrm{Re}\,W_0+\mathrm{Im}\,W_1\,\mathrm{Im}\,W_0)], \qquad (10)$$

$$B=\sum_{Jl} g_J \sum_K |W_l(JK)|^2 \qquad (11)$$

and the right-left asymmetry can be expressed in the form:

$$\alpha^{RL}=\frac{C}{B},$$

where

$$C=p_n\sum_J g_J \sum_{J'j}\sum_K Z(JJ'Kj)\beta_j[\cos\Delta\phi(\mathrm{Im}\,W_1\,\mathrm{Re}\,W_0-\mathrm{Re}\,W_1\,\mathrm{Im}\,W_0)+$$

$$+\sin\Delta\phi(\mathrm{Re}\,W_1\,\mathrm{Re}\,W_0+\mathrm{Im}\,W_1\,\mathrm{Im}\,W_0)]$$

In these formulas the S-matrix was taken in the form

$$S^J_{nfl}=2e^{-i\phi_l}W \text{ with } W=[(I-K)^{-1}]_{nf},$$

where for the matrix elements K_{nf} the expression

$$K_{nf}=-\frac{1}{4}\sum_\lambda\frac{\Gamma_{\gamma\lambda}\sqrt{\Gamma_{n\lambda}\Gamma_{f\lambda}}}{d_\lambda}+\frac{i}{2}\sum_\lambda\frac{(E_\lambda-E)\sqrt{\Gamma_{n\lambda}\Gamma_{f\lambda}}}{d_\lambda}$$

$$d_\lambda=(E_\lambda-E)^2+\Gamma^2_{\gamma\lambda}/4$$

was used. Here the multi indexes n and f are defined as $n\equiv\{ljJ\}$ and $f\equiv\{J^\pi K\}$. The index λ enumerates compound states of fissioning nucleus. In the formulas (10) – (13) Z is a combination of geometric coefficients, $\Delta\phi=\phi_1-\phi_0$, $\phi_0=ka$, $\phi_1=ka-\arctan(ka)$, a is the potential scattering radius in an entrance channel, $k=k_n$.

In the following analysis the parameters of S-matrix for s-wave fission are extracted from ref. [15] for ^{235}U and from ref. [16] for ^{239}Pu and are kept fixed during the fit procedure. The energy dependence of the experimental coefficients $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ was fitted to obtain information on the positions and parameters of the p-wave resonances lying in the energy interval under consideration..

The range of S-matrix for s- and p-wave fission in principle is different. In entrance channels the range is estimated in an apparent way but for exit channels a situation is not trivial. The interference terms in formulas for α^{FB} and α^{LR} have the same projections K for the s- and p-wave fission but in the total p-wave fission cross section the additional $J^\pi K$ channels could contribute. But these channels could be forbidden according to the angular momentum and parity conservation laws for the s-wave fission. These additional resonance parameters should be included in the fit to preserve the unitarity of corresponding S-matrix.

The result of new fit of $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ values for the case $^{235}U(n,f)$-reaction are shown in fig.1. It is seen that a quality of the fit is approximately the same as in the previous analysis [17] carried out with something different formulas for α^{FB} and α^{LR} which are revised now [12] to include more correct description of a total parity in exit fission channels. Such result could be explained by the fact that a lot of free parameters for p-wave resonances are used in fitting of experimental data which have in turn very complicated dependence on neutron energy.

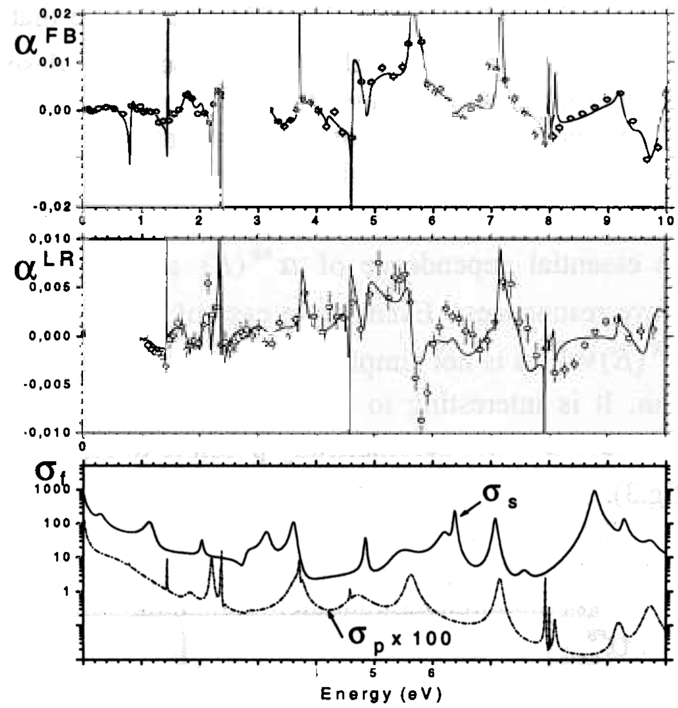

Fig.1. The fit of experimental values of $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ for $^{235}U(n,f)$-reaction, realized with s-wave and p-wave fission cross sections shown in lower part of the figure.

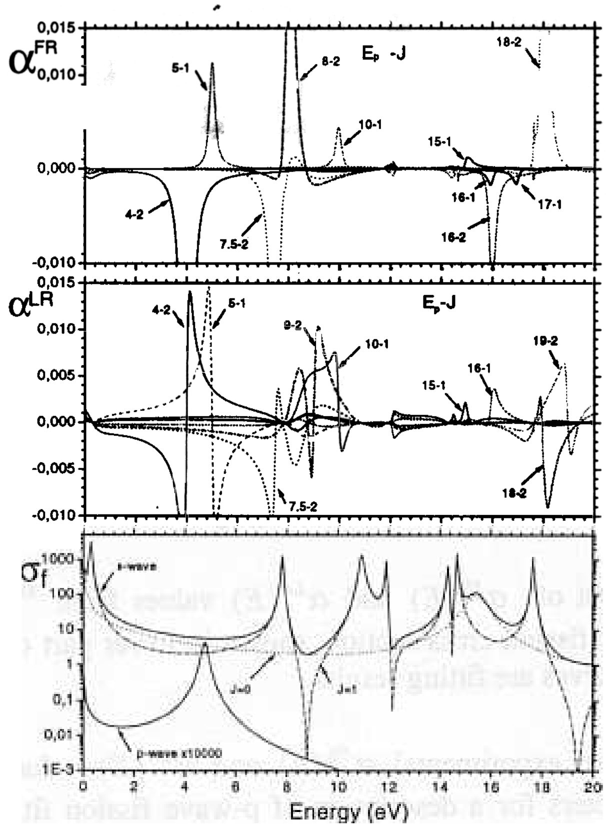

Fig.2. The test calculations of the $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ dependences for $^{239}Pu(n,f)$-reaction carried out with one p-wave resonance. The different curves correspond to the various positions and spins of the assumed p-wave compound state.

The case of $^{239}Pu(n,f)$-reaction is something more simple that $^{235}U(n,f)$-one because only an account of the $1^{+}0$ and $0^{+}0$ fission channelsis enough for description of the respective cross sections. To get some intuition on influence of different parameters of p-wave resonances onto the value and the energy behavior of the correlation coefficients some methodical calculations have been carried out. The results are presented in fig. 2. It is seen that energy behavior of $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ has strong dependence on the value of p-wave resonance spin. Also one can see the essential dependence of $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ on relative position of interfering s- and p-wave resonances. Even in the case of $^{239}Pu(n,f)$-reaction a simultaneous fit of $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ values is not simple due to the fact that two $0^{+}0$ channels contribute [16] for s-wave fission. It is interesting to note that if one fit reproduces in some way the experimental $\alpha^{FB}(E)$ values it is not automatically possible to reproduce the experimental data for $\alpha^{LR}(E)$ too (see fig.3).

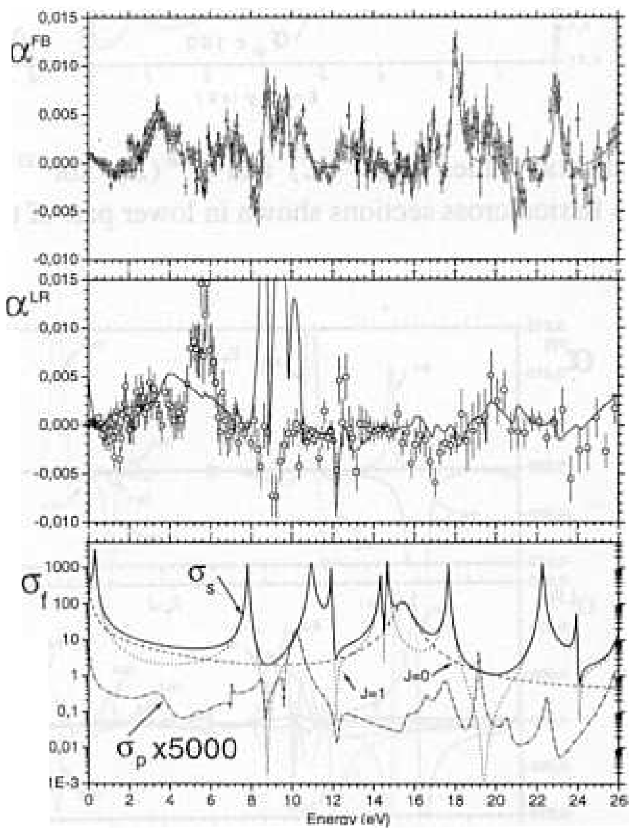

Fig.3. The preliminary fit of $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ values from $^{239}Pu(n,f)$-reaction realized with s-wave and p-wave fission cross section, shown in lower part of the figure. The points are experimental data, the curves are fitting results.

Now the joint analysis of experimental $\alpha^{FB}(E)$ and $\alpha^{LR}(E)$ values is continued to obtain a consistent set of parameters for a description of p-wave fission fitting respective interference effects. After completion of such analysis it will become possible to derive some conclusions on parity dependence of fission barriers for fixed number of $J^{\pi}K$.

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Refereences

[1] F.J.Humbsch, H.H.Knitter, C.Budtz-Jorgenesen and J.P.Theobald, Nucl. Phys.,**A491**, 56 (1989)

[2] W.I.Furman and J.Kliman, Proc. 17th Int. Symp. on Nuclear Physics, Gaussig, 1987, Dresden, ZfK, 1988, p.86.

[3] H.Weigmann and F.J.Hambsch, Proc. Seminar on fission, Pont d'Ore, Belgium, 1991,p.90.

[4] A.L.Barabanov and W.I.Furman, Z.Phys. **A357**, 411(1997); A.L.Barabanov and W.I.Furman, Proc.Int.Conf. on Nuclear Data for Science and Technology, Gatlinburg, Tennessee, 1994, ed. J.K.Dickens, v.I,p.448.

[5] N.J.Pattenden and H.Postma, Nucl.Phys., **A167**, 225 (1971)

[6] G.V.Danilian, B.D.Vodennikov, V.P.Dronyaev et al., Pis'ma ZhETPh, **54**, 9(1977)

[7] V.P.Alfomenkov, G.V.Valsky, A.M.Gagarsky et al., Yad.Fiz.,**58**, 799(1995)

[8] V.P.Alfimenkov, A.N.Chernikov, L.Lason et al., Nucl.Phys., **A645**, 31 (1999).

[9] D.I.Tambovtsev, L.K.Kozlovsky, N.N.Gonin, et al., Phys.At.Nucl., **60**, 877 (1997) .

[10] V.M.Strutinski, ZETPh, **30**, 606(1956).

[11] W.I.Furman, in FJ/OH Spring Session '99, May 17-21, 1999,Geel, Belgium.

[12] A.L.Barabanov and W.I.Furman, Z.Phys., to be published.

[13] A.M.Gagarski, I.S.Guseva, S.P.Goloslavskaya et al., PNPI NP-32-1999,2117, Gatchina (1999).

[14] A.M.Gagarsky, I.S.Guseva, S.P.Goloslovskaya et al., in ISINN-8, Dubna May 17-20, 2000, Abstracts, JINR E3-2000-71, p.49.

[15] Yu.Kopach,A.B.Popov,V.I.Furman et al., Phys.At.Nucl., **62**, 840(1999)

[16] National Nuclear Data Center, *http://www.nndc.bnl.gov.*

[17] A.B.Popov, W.I.Furman and L.Lason, in Proc.II Int. Workshop of fission and fission fragment spectroscopy, ed. by G.Fioni et al., Seissyn, France, April 21-24, 1998, p.349 (Woodbury, New York, 1998).

EPITHERMAL NEUTRON ACTIVATION ANALYSIS FOR DEVELOPING SELENIUM-, IODINE-, AND CHROMIUM-CONTAINING PHARMACEUTICALS BASED ON BLUE-GREEN ALGAE *SPIRULINA PLATENSIS* MATRIX

M.V.Frontasyeva, S.S.Pavlov, S.F.Gundorina, N.G.Aksenova,
L.M. Mosulishvili*, E.I. Kirkesali*, A.I. Belokobylsky*, A.I.Khizanishvili*

Frank Laboratory of Neutron Physics of the Joint Institute for Nuclear Research
Dubna, 141980, Russia
**E.Andronikashvili Institute of Physics of the Georgian Academy of Sciences*
Tbilisi, 380077, Georgia

Neutron activation analysis was successfully used to substantiate developing of selenium-, iodine-, and chromium-containing pharmaceuticals based on blue-green algae *Spirulina platensis,* which is widely used in fundamental and applied biotechnology. This algae was chosen as a matrix for these pharmaceuticals due to its fast growth, non-toxicity, assimilability (85-95%), high protein content (60-70%), well-balanced amino acid compositions, richness in vitamins, and a great variety of biologically active agents in appreciable amounts. The ability to biotransform and endogenously add the desired elements producing complexes easily assimilated by a human organism is a distinctive feature of *Spirulina platensis* [1, 2].

As a preliminary stage of research, the background levels of the elements in cells of *Spirulina Platensis* biomass cultivated in a standard nutrient medium with distilled water were studied by epithermal neutron activation analysis (ENAA) at the fast pulsed reactor IBR-2.

The concentrations of 31 macro-, micro- and trace elements (namely Na, Mg, Al, Cl, K, Ca, Sc, V, Cr, Mn, Fe, Co, Ni (using (*n, p*) reactions), As, Br, Zn, Rb, Mo, Ag, Sb, I, Ba, Sm, Tb, Tm, Hf, Ta, W, Au, Hg, and Th) ranging from 10^{-3} up to 10^{5} ppm were determined (Fig. 1).

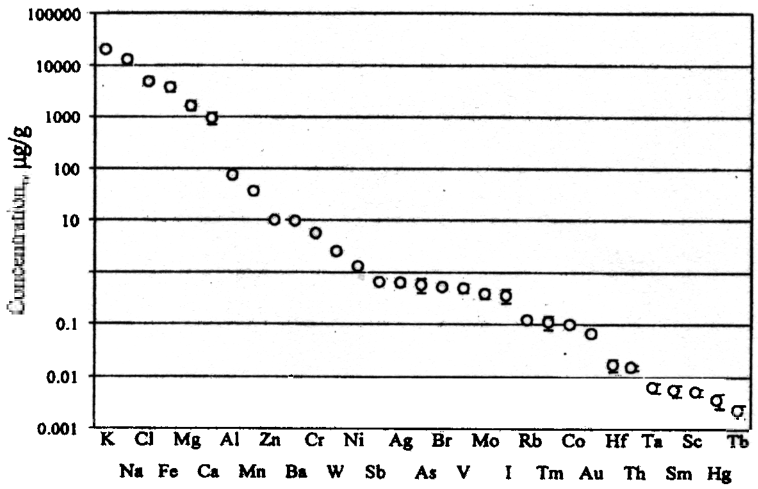
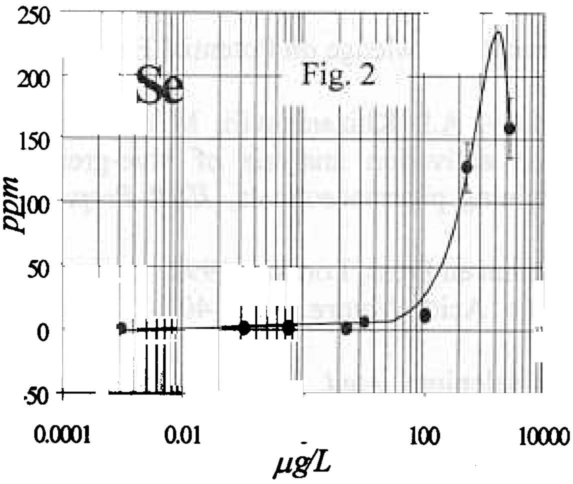


Fig. Background concentrations of macro-, micro- and trace elements in the *Spirulina platensis* biomass [3].

It is evident that the cultivated *Spirulina Platensis* biomass does not contain toxic elements in concentrations above the tolerance levels and such product can be utilized as a matrix for the manufacturing of pharmaceuticals based on it (see http://www.spirulina.com/spbnutrition.htlm).

The deficiency of certain elements and compounds in the human organism is the cause many ailments [4]. One of such elements is selenium. Selenium is a component of some enzymes, proteins and is incorporated in the 21[st] amino acid, selenocysteine, which plays a unique part in the readout of genetic information during the synthesis of proteins [5-7]. A low level of selenium may cause such diseases as cancer, cardiomyopathy, anemia, *etc.*

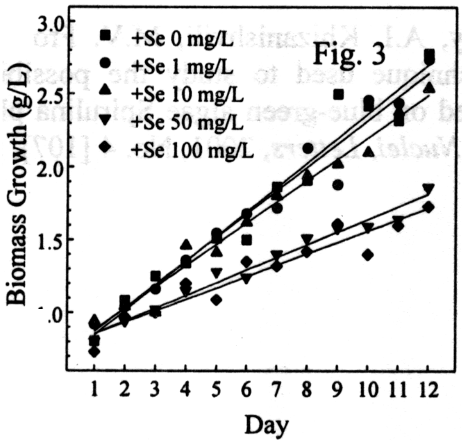
Another equally important element is iodine. It is a vitally important element for the function, development and growth of the human organism. Iodine affects metabolism enhancing the oxidation-reduction processes. Iodine deficiency results in dysfunction of the thyroid and is reduction of the level of intellectual development [8]. For experimental investigation of the possibility of creation of Se- and I-containing pharmaceuticals, a method for cultivation of the *Spirulina* biomass in nutrient medium with the given concentration of loading is developed [9, 10].

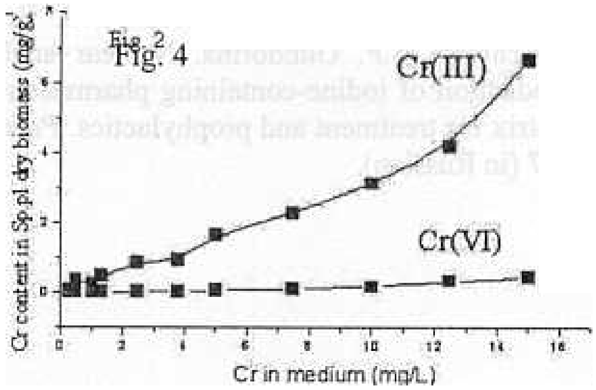


The dynamics of Se and I accumulation by *Spirulina Platensis* in the process of its cultivation was studied. A polynomial relationship between the accumulation of selenium and iodine in the Spirulina biomass and their concentration in the nutrient medium is found. The concentration of selenium in the *Spirulina* biomass versus its concentration in the nutrient medium is shown in Fig. 2.

On the basis of the results obtained, the physiological doses of Se and I in the *Spirulina* biomass required for manufacturing medical and prophylactic preparations were determined.

The influence of different doses of selenium on the growth of Spirulina cells, on the chlorophyll content and on the total protein are studied. The range of selenium concentration was 0.5–15 mg/L. It is shown that the increase of the Se concentration in the given range practically does not influence the growth of the *Spirulina platensis* biomass and its natural properties (Fig. 3).





However, in the case of large doses of Se in the Spirulina biomass a decrease of chlorophyll and total protein contents was observed In the process of Spirulina biomass cultivation with biogenically bound chromium it was established that the Cr^{+6} (in the form of $K_2Cr_2O_7$) reduce the growth of cells and the content of chlorophyll and total protein, while Cr^{+3} (in the form of $Cr(CH_3COO)_3$) stimulates the biomass growth (Fig. 4). Thus Spirulina cells actively accumulate Cr^{+3} and do not bind Cr^{+6}.

The study carried out allow to optimize the concentrations of Se, I and Cr in the nutrient medium for obtaining their predetermined doses in *Spirulina platensis* biomass intended to be used as bioactive nutrients for medical purposes.

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References:

1. D.Fox, Health Benefits of Spirulina. In *Spirulina, Algae of Life*, Bulletin No. 12. April 1993, Publ. by Institute of Oceanography, Monaco.
2. A.Belay, Y.Ota, K.Miyakawa., H.Shimamatsu, Current Knowledge on Potential Health Benefits of Spirulina. *J. Appl. Phycol.*, No.5 (1993) 235-241.
3. L.M.Mosulishvili, Ye.I. Kirkesali, A.I. Belokobilsky, A.I. Khizanishvili, M.V. Frontasyeva, S.F. Gundorina, C.D. Oprea. Epithermal neutron activation analysis of blue-green algae *Spirulina platensis* as a matrix for selenium-containing pharmaceuticals, *JINR Preprint* E14-2000-225, Dubna, 2000 (submitted to *JRNC*).
4. H. Foster. Health, Disease and the Environment. Belhaven Press, London, 1992.
5. J.F.Atkins, R.F.Gestland. The Twenty-First Amino Acid. *Nature*, Vol. 407, 28 September (2000) 463-464.
6. G. F.Combs Jr., Chemopreventive mechanisms of selenium. *Med. Klin.*, Oct.15, 94, Suppl. 3 (1999) 18-24.
7. D.H. Holben and A. M.Smith, The diverse role of selenium within selenoproteins: a review. *J. An. Diet. Assoc.* 1999, July; 99(7) (1999) 836-843.
8. N.Katamadze, N.Kuchava, L.Mosulishvili, M.Tsitskishvili. Evaluation of thyroid gland irradiation dose induced by Chernobyl radiation for Tbilisi Region population. *Bull. Georg. AS*, 157/2 (1998) 213-216.
9. L.M.Mosulishvili, Ye.I. Kirkesali, A.I. Belokobilsky, A.I. Khizanishvili, M.V. Frontasyeva, S.S.Pavlov, S.F. Gundorina. Experimental substantiation of the possibility of developing Selenium-and iodine-containing parmaceuticals based on blue-green algae *Spiruliba platensis. JINR Preprint* D14-2001-39, Dubna, 2001 (submitted to *Journal of Pharmaceutical and Biomedical Analysis*).
10. L.M.Mosulishvili, Ye.I. Kirkesali, A.I. Belokobilsky, A.I. Khizanishvili, M.V. Frontasyeva, S.S.Pavlov, S.F. Gundorina. Nuclear analytical technique used to study the possibility of production of iodine-containing pharmaceuticals based on blue-green algae Spirulina platensis matrix for treatment and prophylactics. *Particles and Nuclei, Letters*, 2001, No. 4 [107], p. 110-117 (in Russian).

5. PUBLICATIONS

CONDENSED MATTER PHYSICS

Diffraction

1. Abakumov A.M., Rozova M.G., Pavlyuk B.Ph., Lobanov M.V., Antipov E.V., Lebedev O.I., Van Tendeloo G., Sheptyakov D.V., Balagurov A.M., Bouree F. Synthesis and crystal structure of novel layered manganese oxide $Ca_2MnGaO_{5+\delta}$. J. of Solid St. Chemistry, 2001, v.158, pp.100-111.
2. Agafonov V., Beskrovnyi A.I., Natkaniec I., Pawlukoic A., Simkin V. G., Smirnov L.S., Holderna- Natkaniec K.. Research of structural and dynamic properties caffin by means of dispersion of neutrons and quantum-chemical methods of molecular modeling. RSNE-2001.21-25 May 2001, Moscow. Theses of reports. Page 398.
3. Aksenov V.L., Balagurov A.M., Bokuchava G.D., Zhuravlev V.V., Kuzmin E.S. Neutron Fourier-diffractometer for stress analysis: the first results. JINR, P13-2001-30, Dubna, 2001 (in Russian).
4. Alexandrov K.S., Belushkin A.V., Beskrovnyi A.I., Vasilovskiy S.G., Sikolenko V.V., Tresso A., Flerov I.N.. Neutron research of structural phase transition in Rb_2KFeF_6. RSNE-2001. 21-25 May 2001, Moscow. Theses of reports. Page 22.
5. Avdeev M.Y., Nabaldyan V.B., Beskrovnyi A.I., Balagurov A.M.. Refinement of structures of two-layered cationic conductors. Russian Journal of Inorganic Chemistry, 2001, vol. 46, № 4, page 565-571 (in Russian).
6. Avdeev M.Yu., Nalbandyan V.B., Beskrovnyi A.I., Balagurov A.M. Refinement of the Structures of Two Layered Cationic Conductors. Synthesis & Propert. of Inorg. Compounds, 2001, v.46, pp. 489-495.
7. Balagurov A., Beskrovnyi A., Borisov S., Simkin V., Trepakov V., Vakhrushev S. Temperature evolution of structure of KLTM singl crystals. . International Conference on Neutron Scattering. Munchen, 9-13 September 2001. Abstracts. C-168. p.199.
8. Balagurov A.M., Pomjakushin V.Yu., Sheptyakov D.V. Structural and magnetic long-range phase separation in $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$ perovskites. J. Phys. Soc. Japan, Supplement A, 2001, v.70, pp.82-84.
9. Balagurov A.M., Pomjakushin V.Yu., Sheptyakov D.V., Aksenov V.L., Babushkina N.A., Belova L.M., Gorbenko O.Yu., Kaul A.R. A-cation size and oxygen isotope substitution effects on $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$ structure. Eur. Physical J. B, 2001, v.19 (2), pp.215-223.
10. Balagurov A.M., Pomjakushin V.Yu., Sheptyakov D.V., Aksenov V.L., Fischer P., Keller L., Gorbenko O.Yu., Kaul A.R., Babushkina N.A. Long-scale phase separation versus homogeneous magnetic state in $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$: A neutron diffraction study. Phys. Rev. B, 2001, v.64, pp.024420-1 – 024420-10.
11. Balagurov A.M., V.Yu.Pomjakushin V.Yu, D.V.Sheptyakov, Babushkina N.A. Oxygen isotope effect on crystal and magnetic structure of $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$. Submitted to Applied Physics A, 2001.
12. Beskrovnyi A., Golosovvsky I., Fokin A., Kumzerov Yu, Kurbakov A., Naberezhnov A., Vakhrushev S.. Structure evolution and formation of a pre-melted state in $NaNO_2$ confined within porous glass. Submitted to “Journal Apl. Phys”.
13. Beskrovnyi A.I., Gvasaliya S.N., Lushnikov S.U., Chelkova I.G.. RSNE-2001, 21-25 May, Moscow. Theses of reports. Page 357.
14. Beskrovnyi A.I., Vasilovskiy S.G., Belushkin A.V., Smirnov L.S., Balagurov A.M., Sarion M., Mestres L., Herrias M. Neutron and X-ray powder diffraction investigated of the novel compound $Bi_{2.53}Li_{0.29}Nb_2O_9$. Submitted to “Kristallografiya”.
15. Beskrovnyi A.I., Voloshin A.E., Malaxova L.F.,. Furmanova N.G., Fyikin L. E.. Research of structure of crystals DKDP belonging to different pyramids of growth RSNE-2001. 21-25 May 2001, Moscow. Theses of reports. Page 106.
16. Bikkulova N.N., Danilkin S.A., Fuss N., Beskrovnyi A.I., Skomoroxov A.N., Yagafarova Z.A., Yadrovskiy E.L., Gareva M.Y. The structural features research of uprum selenide of non-stochiometric composition by inelastic neutron and x-ray scattering. The second International symposium. 24-26 September 2001. Sochi. Page 49-50.
17. Gadjiev B.R.. Strukture genesis and magnetic ordering in compaunds of the ThCr2Si2 type. International Conference on Neutron Scattering. Munchen, 9-13 September 2001. Abstracts. A-96.p.59.
18. Kozlenko D.P., Belushkin A.V., Knorr K., McGreevy R.L., Savenko B.N., Zetterström P. A Study of Orientational Disorder in NaCl-type Phase I of ND_4I by Reverse Monte Carlo and Maximum Entropy Methods. Physica B, 2001, v. 299, pp. 46-55.
19. Kuzmin E.S., Balagurov A.M., Bokuchava G.D., Zhuk V.V., Kudryashev V.A., Bulkin A.P., Trounov V.A. Detector for the FSD Fourier-diffractometer based on ZnS (Ag) /^{6}LiF scintillation screen and wavelength shifting fiber readout. Submitted to J. of Neutron Research, 2001.
20. Kuzmin E.S., Balagurov A.M., Bokuchava G.D., Zhuk V.V., Kudryashev V.A., Bulkin A.P., Trounov V.A. Detector for the FSD Fourier-diffractometer based on ZnS (Ag) /^{6}LiF scintillation screen and wavelength shifting fiber readout. JINR, E13-2001-204, Dubna, 2001.
21. Lokshin K.A., Pavlov D.A., Putilin S.N., Antipov E.V., Sheptyakov D.V., Balagurov A.M. Enhancement of T_c in Hg-1223 by fluorination. Phys. Rev. B., 2001, v.63, pp.064511-1 – 064511-5.

22. Mironova G.M. Equilibium vs nonequilibrium phase transitions as a key for selforganization understanding. 6-th Int.Workshop on HTSC , June 24-30, 2001, Moscow, p. PII-33.
23. Morozov S., Beskrovnyi A., Danilkin S., Antoshina I., Terehov S. International Conference on Neutron Scattering. Munchen, 9-13 September 2001. Abstracts. C-190, p.204.
24. Nietz V.V. Prospects for the use of the pulsed fields in condensed matter neutron research. Submitted to "Journal of Magnetism and Magnetic Materials".
25. Nietz V.V. Neutron research of hysteresis at a spin-flop transition induced by a pulsed magnetic field. Submitted to "Journal of Magnetism and Magnetic Materials".
26. Nietz. V.V. Neutron diffraction at domain structure reorganization of hematite in a pulsed magnetic field. Submitted to "Journal of Magnetism and Magnetic Materials".
27. Nietz.V.V. Neutron scattering by magnetic ball solutions. Submitted to "Journal of Magnetism and Magnetic Materials".
28. Plyasova L.M., Anufrienko V.F., Beskrovnyi A.I., Molina I.Y. et al. Influence reductive-oxidative processings on magnetic properties of chromite copper. Submitted to "Journal of Structural Chemistry".
29. Plyasova L.M., Beskrovnyi A.I. Influence reductive-oxidative processings on structure and magnetic properties хромита меди. RSNE-2001.21-25 May 2001, Moscow. Theses of reports. Page 127.
30. Sheptyakov D.V., Abakumov A.M., Antipov E.V., Balagurov A.M., Billinge S.J.L, P.Fischer, L.Keller, M.V.Lobanov, V.Yu.Pomjakushin. Crystal and magnetic structure of new layered oxides A_2GaMnO_{5+x} (A=Ca, Sr). Submitted to Applied Physics A, 2001.
31. Surowiec Z., Beskrovnyi A.I., Budzynski M., Sarzynski J., Wiertel M. Neutron diffraction and Mossbauer study of magnetic property of quasibinary $Zr_{1-x}Ti_xFe_2$ laves phase compounds. Submitted to "Molecular Physics".
32. Taran U.V., Daymond M.R., Eifler D., Schreiber J. "In-situ mechanical characterization of fatigue austenitic steel samples under an applied load using neutron diffraction" In: The ISIS Facility Annual Report 2000-2001, RAL-TR-2001-050, Didcot, 2001, v.2, ISIS Experimental Reports, PEARL, RB 12023.
33. Vasilovski S.G., Beskrovnyi A.I., Smirnov L.S., Balagurov A.M., Sarion M., Mestres L., Herrias M. Neutron and X-ray powder diffraction investigated of the novel compound Bi2.53Li0.29Nb2O9. International Conference on Neutron Scattering. Munchen, 9-13 September 2001. Abstracts. A-161. p.71.
34. Voronin V.I., Berger I.F., Kuchin A.G., Sheptyakov D.V., Balagurov A.M. Real disordered crystal structure and Curie temperature of intermetallic compounds $Y_2Fe_{17-x}M_x$ (M=Si or Al)". Journal of Alloys and Compounds, 2001, v.315, pp.82-89.
35. Watanabe J., Smirnov L., Natkanietz I., Balagurov A., Beskrovnyi A., Mkasahara, Yagi T. International Conference on Neutron Scattering. Munchen, 9-13 September 2001. Abstracts. –C-184.p.203.
36. Voronin V.I., Schennikov V.V., Berger I.F., Glazkov V.P., Kozlenko D.P., Savenko B.N., Tikhomirov S.V. "Neutronographic investigations of the structural phase transition in triple systems of mercury chalcogenids $HgSe_{1-x}S_x$ at high pressures", Fizika Tverdogo Tela, 2001, 43, №11, pp.. 2076-2080.
37. Voronin V.I., Schennikov V.V., Berger I.F., Glazkov V.P., Kozlenko D.P., Savenko B.N., Tikhomirov S.V. Neutronographic investigations of the structural phase transition in triple systems of mercury chalcogenids $HgSe_{1-x}S_x$ at high pressures", JINR Preprint P14-2001-51, Dubna (2001).

Textures and stresses

1. Groeger H.R., Leiss, B, Ullemeyer, K. & Lebit, H., 2001: Textures and microstructures of naturally deformed amphibolites from the northern Cascades, NW USA. Geological Society of London Special Publications (in press).
2. Hrouda, F. & Ullemeyer, K., 2001. Quantitative correlation of biotite lattice preferred orientations and magnetic fabrics in granulites from the Southern Bohemian Massif. Z. dt. geol. Ges. 152, 547-562.
3. Ivankina T.I., Nikitin A.N., Telepnev A.S., Ullemeyer K., Efimova G.A., Kireenkova S.M., Sobolev G.A., Sukhoparov V.A., Walther K. The effect of temperature and long-term mechanical stresses on deformational, thermal and textural characteristics of marble. Physica Zemli. 2001, 1, pp. 50-65.
4. Ivanova, T.M. & Nikolayev, D.I., 2001. New standard function for quantitative texture analysis. phys. stat. sol. (b) 228 (3), 825-836.
5. Lobanov K.V., Kazansky V.I., Kuznetsov A.V., Zharikov A.V., Nikitin A.N., Ivankina T.I., Zamyatina N.V. The comparison of Archean rocks from the drilling core of the Kola superdeep borehole and their surface analogues from the results of structural- pertrological, petrophysical and neutron diffraction investigations. Petrology. 2001, 6.
6. Lychagina, T.A. & Brokmeier H.G., 2001. Some practical results for calculating elastic properties of textured cubic polycrystals. phys. stat. sol. (a) 184 (2), 373-380.
7. Nikitin A.N., Ivankina T.I., Burilichev D.E., Klima K., Locajicek T., Pros Z. Anisotropy and texture of olivine-bearing mantle rocks at high pressures. Physica Zemli, 2001, 1, pp. 64-78.
8. Nikitin A.N., Ivankina T.I., Ullemeyer K., Locajicek T., Pros Z., Klima K., Smirnov Yu.P. Kusnetzov Yu.I. Texture controlled elastic anisotropy of amphibolites from the Kola superdeep borehole SG-3 at high pressure. Physica Zemli. 2001, 1, pp. 41-49.

9. Nikitin A.N., Ivankina T.I., Zamyatina N.V., Kazansky V.I., Lovanob K.V., Zharikov A.V. Texture – an indicator of rock metamorphism and deformation processes in the continental crust. Proc. V International conference "Crystals: growth, properties, real structure, applications". 2001. v. 2. Alexandrov: VNIISIMS. pp. 316-322.
10. Sobolev G.A., Nikitin A.N. Neutron diffraction in geophysics. Physics of elementary particles and atomic nuclei. 2001, v. 32, 6, pp.1359-1404.
11. Sobolev G.A., Nikitin A.N., Savelova T.I., Yakovlev V.B. A theoretical and experimental approach to the study of microscopic and macroscopic properties and state of rocks: a possible direction in the development of the earthquake source models. Physica Zemli. 2001, 1, pp. 6-15.
12. Ulyanov V., Walther K., Kuznescov I., Frischbutter A., Medvedev E., Scheffzuek Ch. & Shebetev A.. Upgrade of the TOF-Diffractometer EPSILON. Appl. Phys. A, Material Science & Processing, 2001 (in press).
13. Walther K., Scheffzuek Ch. & Frischbutter A.: Strain-stress - experiments on dolomite using neutron TOF diffraction. Izvestiya, Physics of the Solid Earth 200137 (1), 28-32.

Small angle scattering

1. Aksenov V., Avdeev M., Balasoiu M., Rosta L., Torok Gy., Vekas L., Bica D., Garamus V., Kohlbrecher J. SANS study of concentration effect in magnetite/oleic acid/benzene ferrofluid. Applied Physics A 2001, accepted.
2. Aksenov V., Avdeev M., Balasoiu M., Rosta L., Torok Gy., Vekas L., Bica D., Garamus V.M., Kohlbrecher J. SANS study of concentration effect in magnetite/oleic acid/benzene ferrofluid. Applied Physics A, 2001 (in press).
3. Aksenov V.L., Avdeev M.V., Belushkin A.V., Mihailovic D., Mrzel A., Rosta L., Serdyuk I.N., Timchenko A.A. Structure of fullerene aggregates in pyridine/water solutions by small-angle neutron scattering. JINR Communication, E14-2001-62, ,Dubna 2001.
4. Aksenov V.L., Avdeev M.V., Balasoiu M., Vekas L., Bica D., Rosta L., Torok Gy. Concentration effect in magnetic fluids by SANS. Poverkhnost, 2001 (in press).
5. Aksenov V.L., Avdeev M.V., Balasoiu M., Vekash L., Bica L., Rosta L., Torok L. "The concentration effect in magnetic liquids deduced from small angle neutron scattering data", Poverkhnost, accepted for publication.
6. Aksenov V.L., Avdeev M.V., Mihailovic D., Mrzel A., Vasiliev V.D., Timchenko A.A., Serdyuk I.N. Study of fullerene aggregates in pyridine/water solutions, In "Electronic properties of novel materials – molecular nanostructures", Eds. H.Kuzmany, J.Fink, M.Mehring, S.Roth, AIP Conference Proceedings, 2001 (in press).
7. Aksenov V.L., Avdeev M.V., Timchenko A.A., Serdyuk I.N., May R.P. Aggregation of fullerenes in pyridine/water solutions, In "Frontiers in Molecular-Scale Science and Technology of Fullerene, Nanotube, Nanosilicon, Biopolymer (DNA, Protein) Multifunctional Nanosystems", Eds. E. Buzaneva and P. Scharff, Kluewer Academic Publishers, 2001 (in press).
8. Avdeev M., Balasoiu M., Bica D., Rosta L., Torok G., Vekas L. Influence of Particle "Concentration on Ferrofluids Microstructure Studied by SANS", Materials Science Forum Vols.373-376 (2001) pp.457-460.
9. Avdeev M., Balasoiu M., Torok Gy., Bica D., Rosta L., Aksenov V.L. and Vekas L. SANS study of particle concentration influence on ferrofluid nanostructure. J. Mag. Mag. Materials, 2001, accepted.
10. Avdeev M.V., Balasoiu M., Bica D., Rosta L., Torok Gy., Vekas L. Influence of particle concentration on ferrofluids microstructure studied by SANS, Materials Science Forum, 2001, v.373-376, pp.457-463.
11. Avdeev M.V., Balasoiu M., Torok Gy., Bica D., Rosta L., Aksenov V.L. and Vekas L. SANS study of particle concentration influence on ferrofluid nanostructure, J. Mag. Mag. Materials, 2001 (in press).
12. Bakeeva R.F., Kosacheva E.M., Kudryavtsev D., Kudryavtseva L.A. , Raevska A., Kuklin A., Islamov A.Kh. and Sopin V.F. Substrate specifity of hydrolysis of phosphor ether in hexagonal mesophase of the system cetyldimethylammine bromide/NaOH/water. Liquid Cryst. and Applications" (2001) (in press).
13. Bakeeva R.F., Kudryavtsev D., Zakharova L. Raevska A., Sopin V. Micellar, Liquid Crystalline and Polymer Systems Based on Surfactant and Polyethylene Imine as Nanoreactors for the Transfer of Phosphoryl Group Mol cryst. Lig.Cryst (2001) (in press).
14. Balgavý P., Kučerka N., Gordeliy V.I., Cherezov V.G. Evaluation of small-angle neutron scattering curves of unilamellar phosphatidylcholine liposomes using a multishell model of bilayer neutron scattering length density. Acta Physica Slovaca vol. 51 No.1 (2001) 53-68.
15. Balgavý P., Uhríková D., Karlovska J., Dubnichkova M., Kučerka N., Devinsky F., Lacko I., Cizmarik J., Lohner K., Degovocs G., Rapp G., Yaradaykin S., Kiselev M., Islamov A., Gordeliy V. X-ray Diffraction and Neutron Scattering Studies of Amphiphilic- Lipid Bilayer Organization. Cellular and Mol. Biol. Letters 6 (2001) 283-290.
16. Bulavin A.L., Kopylchuk V.A., Garamus V.M., Avdeev M.V., Almasy L., Hohryakov A.A. SANS studies of critical phenomena in ternary mixtures. Applied Physics A, 2001 (in press).
17. Eckold G., Gorski N. Small-angle neutron scattering from tetradecyltrimethilammonium bromide in NaBr aqueous solutions. Colloids Surfaces A: Physicochemical and Engineering Aspects, 2001, 183-185, 361-369.
18. Gorski N., Kalus J. Temperature dependence of the sizes of tetradecyltrimethilammonium bromide Micelles in aqueous solutions. Langmuir, 2001, 17, 4211-4215.
19. Häußler F. Neutronenkleinwinkelstreuung - Ein Beitrag zur mikrostrukturellen Aufklärung des hydratisierenden Zementsteins, Baustoff-Kolloquium, F.A. Finger-Institut für Baustoffkunde der Bauhaus-Universität Weimar, 06.04.2001.

20. Pleštil J, Pospíšil H., Kadlec P., Tuzar Z., Kriz J., Gordeliy V.I. SANS study of multilayer nanoparticles based on block copolymer micelles. Polymer 42 (2001) 2941-2946.
21. Pleštil J, Pospíšil H., Kuklin A.I., Cubitt R. SANS study of three-layer micellar particles. Applied Physics A, (2001) (in press).
22. Schmiedel N., Jörchel P., Kiselev M., Klose G. Determination of Structural Parameters and Hydration of Unilamellar POPC/C12E4 Vesicles at High Water Excess from Neutron Scattering Curves Using a Novel Method of Evaluation. J. Phys. Chem. B (2001) 105.
23. Uhríková D., Kučerka N., Islamov A., Gordeliy V.,Balgavý P. Small-Angle Neutron Scattering Study of N-Dodecyl-N,N-dimethylamine N-Oxide Induced Solubilization of Dioleoylphosphatidylcholine Bilayers in Liposomes. General Physiology and Biophysics 20 (2001) 183-189.
24. Zouhar G., Bergner F., Bersch H., Bläsner R., Nocke K., Vetter B., Worch H., Worch H., Häußler F. Voraussagemodell zur Beurteilung des Ermüdungsverhaltens von Aluminiumlegierungen, Dresdner Leichtbausymposium 2000, Technische Universität Dresden, 15.-17.06.2000.

Reflectometry, polarized neutrons

1. Aksenov V.L., Nikitenko Yu.V, Proglyado V.V., Raitman E.A., Gavrilov V.N. Neutron reflection from an ultrasonically excited layered structures. Submitted to journal “Surface, rentgen, synchrotron and neutron investigations”, 2001.
2. Aksenov V.L., Nikitenko Yu.V. Layered structures as elements of the neutron spin-echo reflectometer. Preprint JINR, E14-2001-82, Dubna, 2001; Excepted to “Nuclear Instruments B”, 2001.
3. Aksenov V.L., Nikitenko Yu.V. Neutron interference in layered structure at grazing–incidence reflection. Neutron standing waves: application, status, perspectives. Physica B, 2001, v. 297, pp. 101-112.
4. Aksenov V.L., Nikitenko Yu.V. Layered nanostructures as elements of the neutron spin-echo spectrometer. Procedings of the ILL millenium symposium, 6-7 April 2001, pp. 323-325.
5. Aksenov V.L., Nikitenko Yu.V., Kozhevnikov S.V. Spin-flip spatial neutron beam-splitting in magnetic media. Physica B, 2001, v. 297, pp. 94-100.
6. Kravtsov E., Lauter –Pasyuk V., Lauter H., Toperverg B., Nikonov O., Petrenko A., Milyaev M.A., Romashev L., Ustinov V. Interface formation and magnetic ordering in Fe/Cr hybrid nanostructures. Physica B, 2001, v.297, pp. 118-121.
7. Krinitsina T., Kravtsov E., Kurtina N., Lauter-Passiouk V., Lauter H., Romashev L., Semerikov A., Toperverg B., Tsurin V., Ustinov V. Proceedings of ICMFS-16, August 2000, Natal, Brasil, p.127.
8. Lauter H., Lauter-Pasyuk V., Toperverg B., Nikonov O., Kravtsov E., Petrenko A., Milyaev M., Romashev L., Ustinov V. Magnetic off-specular neutron scattering from Fe/Cr multilayers. Proceedings of ICMFS-16, August 2000, Natal, Brasil, p.108.
9. Lauter H., Lauter-Pasyuk V., Toperverg B., Nikonov O., Romashev L., Kravtsov E., Ustinov V. Magnetic domains in Fe/Cr multilayers and relation to GMR effect. Proceedings of Russian-German user-meeting, April 2001, pp. 10-17.
10. Lauter H., Lauter-Pasyuk V., Toperverg B., Nikonov O., Romashev, Ustinov V., Kravtsov E., Vorobiev A., Major J. Spin-resolved unpolarized neutron off-specular scattering for magnetic multilayers studies. Applied Physics A: Material Science.
11. Lauter H., Lauter-Pasyuk V., Toperverg B., Romashev L., Milyaev M.A., Kravtsov E., Ustinov V., Nikonov O., Leiner V., Aksenov V. Growth conditions and magnetic ordering in Fe/Cr multilayers. Proceedings of ILL Milllenium Symposium, 6-7 April 2001, p.187.
12. Lauter-Pasyuk V., Lauter H., Toperverg B., Nikonov O., Kravtsov E., Milyaev M.A., Romashev L., Ustinov V. Magnetic neutron off-specular scattering for the direct determination of the coupling angle in exchange couple multilayers. Journ. Magn. Magn. Mat., 2001, v. 226-230, p. 1694.
13. Lauter-Pasyuk V., Lauter H., Toperverg B., Nikonov O., Kravtsov E., Petrenko A., Romashev L., Ustinov V. Interface formation and magnetic ordering in Fe/Cr hybrid nanostructures. Proceedings of ICMFS-16, August 2000, Natal, Brasil, p.180.
14. Lauter-Pasyuk V., Lauter H., Toperverg B., Nikonov O., Petrenko A., Schubert D., Petry W., AksenovV. Off-specular neutron scattering study of the interface and surface formation in a self-assembled polymer multilayer. Proceedings of Russian-German user-meeting, April 2001, pp.10-17.
15. Lauter-Pasyuk V., Lauter H., Toperverg B., Nikonov O., Petrenko A., Schubert D., Petry W., Aksenov V. Off-specular neutron scattering study of the interface and surface formation in a self-assembled polymer multilayer. Proceedings of ILL Millenium Symposium, 6-7 April 2001, p.84.
16. Lauter-Pasyuk V., Lauter H., Toperverg B., Nikonov O., Petrenko A., Schubert D., Petry W., Aksenov V. Interface and surface formation in self-assembled polymer multilayers by off-specular neutron scattering. Applied Physics A: Material Science.
17. Nikonov O., Lauter-Pasyuk V., Toperverg B., Lauter H., Romashev L., Kravtsov E., Ustinov V. Analysis of Magnetization in Fe/Cr multilayers with unpolarized neutrons. Proceedings of Russian-German user-meeting, April 2001, pp. 10-17.

18. Toperverg B., Nikonov O., Lauter-Pasyuk V., Lauter H. Towards 3D polarization analysis in neutron reflectometry. Physica B, 2001, v.297, pp. 169-174.

Inelastic scattering of neutrons

1. Clementyev E.S., Conder K., Furrer A., Sashin I.L. Phonon density-of-states in new superconductor MgB. Eur. Phys. J. B, 2001, 21, 465-467.
2. Ecolivet C., Czarnecki P., Wąsicki J., Beaufilis S., Girard A. and Bobrowicz-Sarga L. Elastic and Anharmonic Properties of Pyridinium tetrafluoroborate ($[C_5NH_6]^+$ $[BF_4]^-$ ≡ $PyBF_4$): Light Scattering Study of Phase Transitions at various pressures. J. Phys. Condens. Matter, 13 (2001) 6563-6576.
3. Hołderna-Natkaniec K., Kasperkowiak W., Natkaniec I., Slusarek G. Spectroscopy of Kinetin. Molecular Physics Reports, 34/2 (2001) in press.
4. Kazimirov V.Yu., Natkaniec I., Tylczynski Z. Inelastic incoherent neutron scattering investigations of lattice dynamics of $[N(C_2H_5)_4]_2MeCl_4$ (Me=Zn, Cu) compound. JINR Communications, P14-2001-156, Dubna, 2001 (in Russian).
5. Kazimirov V.Yu., Sashin I.L., Tressaud A. Lattice dynamics investigations of $(NH_4)_3MeF_6$ (Me=Al, Sc, Ga) compounds by inelastic incoherent neutron scattering. JINR Communications, P14-2001-10, Dubna, 2001 (in Russian).
6. Lipinski I.E., Kuriata J., Natkaniec I., Pawlukojc A. Neutron scattering study of sodium ammonium sulphate dihydrate. phys. stat. sol. (b), 227, №2, 2001, pp. 477-483.
7. Majerz I., Pawlukojc A., Sobczyk L., Grech E., Nowicka-Scheibe J. Dimerization of 1,8-diaminonaphthalene, DFT Theoretical, Infra Red, Raman and Inelastic Neutron Scattering Studies. Journal of Polish Chemistry 2001 (in press).
8. Mikuli E., Migdał-Mikuli A., Natkaniec I., Grad B. Phase transition and water dynamics of $[Co(H_2O)_6](BF_4)_2$ studied by neutron scattering methods. Z. Naturforsch., 2001, v.56a, pp.244-248.
9. Natkaniec I., Dianoux A-J., Martinez-Sarrion M.L., Mestres L., Herraiz M., Smirnov L.S., Shuvalov L.A. Influence of concentration and temperature on tunneling and rotational dynamics of ammonium in $Rb_{1-x}(NH4)_xI$ mixed crystals. Preprint JINR, E14-2001-171, Dubna, 2001.
10. Natkaniec I., Holderna-Natkaniec K., Kalus J. Neutron spectroscopy and computing simulation of lattice and internal vibrations of differently deuterated p-xylene. Submitted to J. Phys. Chem.
11. Novikov A.G., Sobolev O.V., Tihonov G.V. The structure and dynamic properties of liquid phosphorus oxychloride $POCl_3$ from neutron scattering experiments. Submitted to J. of Molecular Liquids, 2001.
12. Padureanu I., Rapeanu S.N., Kozlov Zh.A., Semenov V.A., Radulescu A. High Temperature investigation of the Dynamics and Thermodynamics of ZrH-U System by Neutron Scattering. phys. stat. sol. (b) 223, 2001, pp.831-841.
13. Padureanu I., Rotarescu Gh., Radulescu A., Kozlov Zh.A., Semenov V.A., Turcanu C., Dragolici C. Investigation of microdynamic in hydrating cement pastes by inelastic slow neutron scattering. Preprint IPPE-2893, Obninsk, 2001, pp.1-8.
14. Pajzderska A., Wasicki J., Bobrowicz-Sarga L., Natkaniec I., Wasiutynski T. Lattice dynamics and internal modes in tetraphenyltin. Mol. Phys. Rep., 31, 2001, pp.103-107.
15. Pawlukojć A., Leciejewicz J., Tomkinson J., Parker S.F. Neutron scattering, infrared, Raman spectroscopy and ab initio study of L-threonine. Spectrochimica Acta Part A: Mol. and Biomol. Spectroscopy 57, 12, 2001, pp. 2513–2523.
16. Pawlukojć A., Natkaniec I., Majerz I., Sobczyk L. Inelastic neutron scattering (INS) studies on low frequency vibrations of pentachlorophenol. Spectroscopica Acta Part A: Mol. and Biomol. Spectroscopy, 57, 14, 2001, pp. 2775-2779.
17. Pawlukojć A., Natkaniec I., Majerz I., Sobczyk L., Grech E. Inelastic neutron scattering (INS) studies on low frequency vibrations of 1,4-benzoquinone. Chemical Physics Letters, 2001, v.346, pp.112-116.
18. Radulescu A., Padureanu I., Rapeanu S.N., Kozlov Zh.A., Semenov V.A. On the dynamics and site occupation of D atoms in delta and epsilon deuterides of Zr. phys. stat. sol. (b), 222, 2000, p.445-450.
19. Sheka E., Barthel H., Khavryutchenko V., Natkaniec I., Nikitina E., Weis J. INS and IR studies of intermolecular interaction at the silicone-fumed silica interface II. Fumed silica, Phys. Low-Dim. Struct., 2000, v.9-10, pp.1-24.
20. Sheka E., Barthel H., Khavryutchenko V., Natkaniec I., Nikitina E., Weis J. INS and IR studies of intermolecular interaction at the silicone-fumed silica interface III. Adsorption complexes, Phys. Low-Dim. Struct., 2000, v.9-10, pp.25-50.
21. Smirnov L.S., Baranov A.I., Shuvalov L.A., Bobrowic-Sarga L., Natkaniec I., Waplak S. Low-temperature phase transitions and ammonium dynamics in $(NH_4)_3H(SO_4)_2$ and $[(NH_4)_{1-x}Rb_x]_3H(SO_4)_2$ crystals. sol.stat. phys. 43, 2001, pp. 115-123.
22. Smirnov M.B., Kazimirov V.Yu. LADY: software for lattice dynamics simulations. JINR communications, E14-2001-159, Dubna, 2001.
23. Smirnov M.B., Kazimirov V.Yu. Lattice dynamics and structural phase transition in $RbMnCl_3$. JINR Communications, P14-2001-160, Dubna, 2001 (in Russian).

Accelerator ions and mSR

1. Budzynski P., Tarkowski P., Jartych E., Kobzev A.P. Evolution of mechanical properties in tool steel implanted with high energy nitrogen ions. Vacuum, 2001, v. 63/4 , pp. 737-742.
2. Huran J., Hotovy I., Hascik S. Kobzev A.P., Balalykin N.I. Investigation of radiation damage in N doped a-SiC:H films annealed by pulsed electron beam. Vacuum, 2000, v. 58, Issues 2-3, pp. 428-433.
3. Kobzev A.P., Kravtcov E.A., Romashev L.N., Semerikov A.V., Ustinov V.V. Using of a high-grade layered structure for the demonstration of the depth resolution of the RBS method. Vacuum, 2001, v. 63/4 , pp. 501-505.
4. Popov Yu.P., Voinov A.V., Sedyshev P.V., Parzhitski S.S., Kobzev A.P., Gundorin N.A, Serov D.G., Sedysheva M.V. Neutron Spectrometry Method for Partial Radiative Capture Cross-section Measurements. Nuclear Instruments and Methods in Physics Research A, 2001, v.463, pp. 309-315

Biophysical Research

1. Balgavy P., Dubnichkova M., Kucerka N., Kiselev M.A., Yaradaikin S.P., Uhrikova D. Bilayer thickness and lipid interface area in unilamellar extruded 1,2-diacylphosphatidylcholine liposomes: A small-angle neutron scattering study. Biochimica et Biophysica Acta, 2001, v. 1521, pp. 40-52.
2. Balgavy P., Uhrikova D., Karlovska J., Dubnichkova M., Kucerka N., Devinsky F., Lacko I., Cizmarik J., Lohner K., Degovics G., Rapp G., Yaradaikin S., Kiselev M., Islamov A., Gordeliy V. X-ray diffraction and neutron scattering studies of amphiphile - lipid bilayer organization. Cellular and Molecular Biology Letters, 2001, v. 6, pp. 283-290.
3. Kiselev M.A., Janich M., Lesieur P., Hoell A., Oberdisse J., Pepy J., Kisselev A.M., Gapienko I.V., Gutberlet T., Aksenov V.L. DMPC vesicles and mixed DMPC/$C_{12}E_8$ micelles orientation in strong magnetic fields. J. Applied. Physics. A, 2001 (in press).
4. Kiselev M.A., Lesieur P., Kisselev A.M., Lombardo D., Aksenov V.L. Model of separated form factors for unilamellar vesicles. JINR Communication, E3-2001-133, Dubna, 2001.
5. Kiselev M.A., Lesieur P., Kisselev A.M., Lombardo D., Aksenov V.L. Model of separated form factors for unilamellar vesicles. J. Applied Physics A, 2001 (in press).
6. Kiselev M.A., Lesieur P., Kisselev A.M., Lombardo D., Killany M., Lesieur S., Ollivon M. A sucrose solutions application to the study of model biological membranes. Nuclr. Inst&Method A, 2001, v. 470, pp. 409-416.
7. Kiselev M.A., Lesieur P., Kisselev A.M., Lombardo D., Killany M., Lesieur S. Sucrose solutions as prospective medium to study the vesicle structure: SAXS and SANS study. J. Alloys and Compounds, 2001, v. 328, pp. 71-76.
8. Kiselev M.A., Lesieur P., Kisselev A.M., Lombardo D., Ollivon M. Sucrose influence on the structure and properties of dimyristoylphosphatidylcholine membranes, Poverhnost, 2001, (in press).
9. Kiselev M.A., Gryzunov I.A., Dobretsov G.E., Komarova M.N. Size of a human serum albumin molecule in solution. Biofizika, 2001, v. 46, pp. 423-427.
10. Schmiedel H., Joerchel P., Kiselev M., Klose G. Determination of structural parameters and hydration of unilamellar POPC/$C_{12}E_4$-vesicles at high water excess from neutron scattering curves using a novel method of evaluation. J. Phys. Chem. B, 2001, v. 105, pp. 111-117.
11. Serdyuk I.N. Physical methods in structural biology in XXI century, Uspekhi Fizicheskhikh Nauk, 2001 (in press) (in Russian).

Conferences

1. Agafonov B., Beskrovnyi A.I., Natkaniec I., Pavlukoicz A., Simkin V.G., Smirnov L.S., Holderna-Natkaniec K. «Investigation of the structural and dynamical properties of caffeine ny neutron scattering and quantum-mechanical methods of molecular modling». Proceedings of the II National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p. 398.
2. Aksenov V.L., Avdeev M.V., Balasoiu M., Rosta L., Torok Gy., Vekas L., Bica D., Garamus V.M., Kohlbrecher J. SANS study of concentration effect in ferrofluids. International Conference on Neutron Scattering. ICNS'2001, September 9-13, 2001, Munich, Germany.
3. Aksenov V.L., Avdeev M.V., Balasoiu M., Vekas L., Bica D., Rosta L., Torok Gy. Concentration effect in magnetic fluids by SANS. RSNE2001, May 21-25, 2001, Moscow, Russia.
4. Antonov V.E., Bashkin I.O., Natkaniec I., Fedotov V.K., Hansen T. "Neutronography and neutronspectroscopy of the new high-pressure phase ScH_3", Proceedings of the II National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p. 351.
5. Avdeev M., Balasoiu M., Torok G., Bica D., Rosta L., Vekas L., Investigation of the particle concentration influence on the ferrofluid microstructure. ICMF, Bremen, 23-27 July 2001.
6. Avdeev M.V., Aksenov V.Lbalasoiu M. .Bica D., Rosta L., Vekash L. "The concentration effect in magnetic liquids deduced from small angle neutron scattering data". Proceedings of the III National Conference on the Use

of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p.33.

7. Avdeev M.V., Balasoiu M., Torok Gy., Bica D., Rosta L., Aksenov V.L. and Vekas L. SANS study of particle concentration influence on ferrofluid nanostructure. IX International Conference on Magnetic Fluids. ICMF'9, July 23-27, 2001, Bremen, Germany.
8. Bakeeva R.F., Kosacheva E.M., Kudriavtsev D.B., Kudriavtseva L.A., Raevcka A., Kuklin A.C., Islamov A.H., Sopin V.F. Phosphorus esters hydrolysis in hexagonal mesophase of the cetyldimethylammonium bromide-NaOH-water system. III International Conference "Chemistry of highly organized substences and scientific basic of nanotechnology. St. Petersburg, Russia 26-29 June 2001, c.137-140.
9. Balagurov A.M., Pomjakushin V.Yu, Sheptyakov D.V., Babushkina N.A. Oxygen isotope effect on crystal and magnetic structure of $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract B-218, p.144.
10. Balagurov A.M., Pomjakushin V.Yu. Phase separation in magnetic oxides: mesoscopic vs. Microscopic. MSU-HTSC VI, Moscow-St.Peterburg, 24 – 30 July 2001, Abstract OR11.
11. Balagurov A.M., Pomjakushin V.Yu. Phase separation in mixed magnetic oxides at different scales. ODPO-2001, Big Sochi, 27-29 September 2001. Abstracts, p.45.
12. Balasoiu M., Avdeev M., Aksenov V., Bica D., Rosta L., Kohlbrecher J., Vekas L. SANS study of concentration effects in ferrofluids, International Conference on Neutron Scattering, Munchen, 9-13 September 2001.
13. Balasoiu M., Avdeev M.V., Kuklin A.I., Bobarykina G.N., Nikitenko Yu.V., Aksenov V.L., Grabcev B., Bica D., Vekas L. Neutron scattering experiments on ferrofluids at IBR-2 pulsed reactor, 2-nd National Conference "New research Trends in Material Science" ARM-2, Constanta, 24 - 26 September 2001.
14. Balasoiu M., Bobarykina G., Kuklin A., Bica D., Vekas L. Investigation of H_2O and D_2O ferrofluids by means of SANS and AFM. International Conference on Magnetic Fluids, 23-27 July 2001.
15. Belushkin A.V., Bogdzel A.A., Gordeliy V.I., Islamov A.Kh., Kirilov A.S., Korobchenko M.L., Sirotin A.P., .Kuklin A.I. SANS – YuMO instrument: some results and prospects. II Russian-German User Meeting, Dubna, April 21-25, 2001.
16. Bickulova N.N., Danilkin S.A., Fuess X., Beskrovnyi A.I., Skomorokhov A.N., Jagofarova Z.A., Jadrowski E.L. The study of the $Cu_{2-x}Se_x$ structure by the elastic neutron scattering and the X-ray diffraction. Abstracts, pp.49-50. The Second Inter. Symp., 24-26 of September 2001, Sochi, Lazorevskoe, Russia.
17. Blagoveshchenskii N.M., Lisichkin Yu.V., Novikov A.G., Savostin V.V., Shimkevich A.L. Neutron Scattering Investigation of Lead-Potassium Eutectic Alloy. ICNS2001, Conference Programme and Abstracts, p. 74. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
18. Bobarykina G., Efremov R., Islamov A., Kuklin A., Gordely V. and Bueldt G. Investigations of the mechanism of membrane proteins crystallization in a lipidic cubic phase, International conference "Dynamical properties of solids (DYPROSO XXVIII)", Kerkrade, NL , 16-20 September 2001.
19. Bogoyavlenskii I.V., Puchkov A.V., Lauter H.J., Skomorokhov A. Surface excitations in thin helium film in silica aerogels. ICNS2001, Conference Programme and Abstracts, p. 90. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany
20. Bokuchava G.D., Aksenov V.L., Balagurov A.M., Zhuravlev V.V., Kuzmin E.S., Bulkin A.P., Kudryashev V.A., Trounov V.A. Neutron Fourier diffractometer FSD for internal stress analysis: first results. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract C-17, p.167.
21. Brzustowicz Mr., Cherezov V., Caffrey M., Stillwell W., and Wassall SR (2001), 2H NMR and X-ray diffraction studies of cholesterol in polyunsaturated lipid bilayers mechanizm for domain formation? Biophys. J. (Annual Meeting Abstracts) 80: 516a
22. Burilichev D.E. Texture and anisotropy of olivine-bearing rocks at different confining pressures. Meeting "Reactor IBR-2 in XXI century". 2001, May 25-26, Dubna, Russia.
23. Burilichev D.E., Nikitin A.N., Ivankina T.I., Klima K., Locajicek T., Pros Z. The investigation of anisotropy and texture of olivine rocks at different confining pressures. XIV Russian meeting on experimental mineralogy, 2001, October 2-4, Chernogolovka, IEM RAN, Russia.
24. Cherezov V., Caffrey M., and Diat O., (2001), Too hot handle? Synchrotron X-ray damage of lipid membrane and mesophases. Biophys. J. (Annual Meeting Abstracts) 80: 296a
25. Cherezov V., Caffrey M., Pector V., and Ruysschaert JM, (2001), DNA-Cationic (amidine) complex structure, Biophys. J. (Annual Meeting Abstracts) 80: 490a .
26. Cherezov V., Fersi H., and Caffrey M., (2001), Crystallization screen solutions. Compatiblity with lipidic cubic phase for in meso crystallization, Biophys. J. (Annual Meeting Abstracts) 80: 54a.
27. Eckold G., Gorski N. Selbstorganisation von Tetradecyltrimetethiylammoniumbromid in waessrigen NaBr-Losungen. Deutsche Neutronenstreutagung, Juelich, Februar 2001.
28. Efremov R., Bobarykina G., Islamov A., Kuklin A., Gordely V. and Bueldt G. Investigations on the mechanism of membrane proteins crystallization in a lipidic cubic phase. Second German-Russian User Meeting, Dubna, April, 2001.
29. Gordeliy V.I. SANS study of polymers at IBR-2 reactor report on the project "Architectures of Molecular Rods in a Polymer Network". Working Meeting,1 -4 September, Max-Planck Institute für Polymerforschung, Mainz, Germany.

30. Gordeliy V.I.. Biomembranes: a new field of complex fluids. International Conference on Physics in Liquid Matter: Modern Problems, Kyiv, Ukraine, September, 14-19, 2001.
31. Gorski N., Frielinghaus H., Eckold G. Temperautrue-Dependent SANS-Investigation of Cylindrical Micelles in TTABr-D_2O-NaBr Systems. International Conference on Neutron Scattering, Muenchen, 9-13 September, 2001.
32. Gvasalia S.N., Kazimirov V.Yu., Lushnikov S.G., Natkaniec I., Sashin I.L. Temperature evolution of the density of vibrational states in the complex-component perovskites $PbMg_{1/3}Nb_{2/3}O_3$ and $BaMg_{1/3}Ta_{2/3}O_3$. Proceedings of the II National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p.361.
33. Haussler H., Kuklin A.I., Palzer S. and Eckart A. SANS – studies on differently hydrating tricalcium silicate II Russian-German User Meeting, Dubna, April 21-25, 2001.
34. Hinca R. and Bokuchava G. Neutron diffraction measurements of residual stresses in NPP construction materials. Proc. of International Youth Nuclear Congress 2000, April 9-14, 2000, Bratislava, Slovakia.
35. Holderna-Natkaniec K., Kasperkowiak W., Khavryutchenko V.D., Natkaniec L., Pawlukojc A. Neutron spectroscopy and QC modeling vibrational spectra of Kinetin. ICNS2001, Conference Programme and Abstracts, p. 79. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
36. Holderna-Natkaniec K., Natkaniec I., Pawlukojc A., Syczewski A. Progesterone and testerone studies by neutron scattering methods and quantum chemistry calculations. ICNS2001, Conference Programme and Abstracts, p. 80. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
37. Huran J., Hotovy I., Kobzev A.P., Balalykin N.I. Hydrogenated amorphous N-doped silicon carbide films deposited by PECVD: structural and electrical properties. 15-th International Symposium on Plasma Chemistry. 9-13 July, 2001, Orleans, France.
38. Huran J., Hotovy I., Kobzev A.P., Balalykin N.I. Some characteristics of N-doped a-SIC:H films deposited by PECVD. Diamond films and films of related materials. (Proceedings of 12-th International Symposium «Thin Films in Electronics»). Edited by V.I.Lapshin, M.A.Prelas, B.V.Spitsyn, V.M.Shulaev. ISTFE - 12, 23-27 Apryl, 2001, Kharkov, Ukraine.
39. Ivankina T.I., Nikitin A.N., Locajicek T, Pros Z., K.Klima, Burilichev D.E. Texture and P-wave anisotropy of olivine xenoliths determined by neutron diffraction and ultrasonic sounding. XXVI General Assembly of European Geophysical Society. 2001, March 25-30, Nice, France.
40. Ivankina T.I., Nikitin A.N., Scheffzuk Ch., Frischbutter A. Lattice deformation of a calcite rock sample induced by temperature and mechanical load using time-of-flight neutron diffraction. XXVI General Assembly of European Geophysical Society. 2001, March 25-30, Nice, France.
41. Ivankina T.I., Nikitin A.N., Zamyatina N.V. Texture-controlled elastic anisotropy of core samples from the Kola superdeep borehole and their surface analogues. Plenary meeting of IGCP-408 Project "Comparison of composition, structure and physical properties of rocks and minerals in the Kola Superdeep Borehole (SG-3) and their homologues on the surface". 2001, September 4-6, Windischeschenbach, Germany.
42. Janich M., Kiselev M., Hildebrand A. SANS study of structure of DPPC/NaDC aggregates as a function of lipid/detergent ratio. International Conference on Neutron Scattering. ICNS'2001, September 9-13, 2001, Munich, Germany.
43. Kazimirov V.Yu., Natkaniec I., Tylczinski Z. The first results of the inelastic incoherent neutron scattering study of the lattice dynamics of the crystals $[N(C_2H_5)_4]_2MeCl_4$ (Me=Zn, Cu). Proceedings of the II National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p. 364.
44. Kiselev M.A. Dimethyl sulfoxide influence on the phospholipid membrane structure and properties. II International Symposium on Problems of Biochemistry, Radiatiion and Space Biology, May 29 – June1, 2001, Moscow, Dubna, Russia.
45. Kiselev M.A., Gutberlet T., Kisselev A.M., Gapienko I.V., Lombardo D., Janich M., Hauss T., Ollivon M., Lesieur P. Study of glass transition in DPPC/DMSO/water system at low temperatures. International Conference on Neutron Scattering. ICNS'2001, September 9-13, 2001, Munich, Germany.
46. Kiselev M.A., Janich M., Lesieur P., Hoell A., Oberdisse J., Pepy G., Kisselev A.M., Gapienko I.V., Gutberlet T., Aksenov V.L. DMPC vesicles and mixed DMPC/$C_{12}E_8$ micelles orientation in strong magnetic fields. International Conference on Neutron Scattering. ICNS'2001, September 9-13, 2001, Munich, Germany.
47. Kiselev M.A., Janich M., Lesieur P., Lombardo D., Kisselev A.M., Wartewig S., Neubert R. Sucrose influence on the properties of unilamellar phospholipid vesicles: SANS, SAXS and DLS study. II Russian-German User Meeting, 23-25 April, 2001, JINR, Dubna, Russia.
48. Kiselev M.A., Lesieur P., Lombardo D., Ollivon M., Kisselev A.M., Janich M., Wartewig S. The study of sucrose influence on the structure and properties of dimyristoylphosphatidylcholine membranes. RSNE2001, May 21-25, 2001, Moscow, Russia.
49. Kiselev M.A., Wartewig S., Janich M., Lesieur P., Kisselev A.M., Ollivon M., Neubert R. Dopes sucrose influence the properties of DMPC vesicles? 9th European Conference on the Spectroscopy of Biological Molecules. September 8-13, 2001, Prague, CR.
50. Kiselev M.A. Investigation of phospholipid vesicle structure in aqueous sucrose solutions via small-angle X-ray scattering at the synchrotron source DCI. Second International Workshop JINR Synchrotron Radiation Source: Perspectives of Research, April 2 - 6, 2001, JINR, Dubna, Russia.

51. Kiselev M.A., Lesieur P., Kisselev A.M., Lombardo D., Aksenov V.L. Model of separated form factors for unilamellar vesicles. International Conference on Neutron Scattering. ICNS’2001, September 9-13, 2001, Munich, Germany.
52. Kiselyova O.I., Gordely V.I. , Bobarykina G.N.˒ , Efremov R.G. Yaminsky I.V., Yanushin M.F., Yaguzhinsky L.S. and Büldt G. Partial dehydration as way to investigate the surface of strong-hydrated regular three-dimensional protein structures by Atomic Force MicroscopyII International Symposium on "Problems of Biochemistry, Radiation и Space Biology", Dubna, 29-31 May 2001.
53. Kiselyova O.I., Gordely V.I., Bobarykina G.N., Efremov R.G.˒ Yaminsky I.V., Yanushin M.F., Yaguzhinsky L.S. and Büldt G. Partial dehydration as a way to investigate the surface of strong-hydrated regular three-dimensional protein structures by Atomic Force Microscopy, International Seminar on protein crystallization, Institute of Crystallography, Moscow, June 2001.
54. Klose G., Schmiedel H., Jorchel P., Kiselev M. Determination of structural parameters and hydration of unilamellar vesicles by neutron scattering using a novel method. International Conference on Neutron Scattering. ICNS’2001, September 9-13, 2001, Munich, Germany.
55. Kobzev A.P., Abu Al Azm S.M., Helal A.I., Zahran N.F. Some peculiarities of element analisys using charged particle beams. 3rd Conference on Nuclear and Particle Physics. NPPAC 2001, 21-24 October, 2001, Cairo, Egypt.
56. Kobzev A.P., Chepurchenko I.A. Electrostatic accelerator as effective source of fast and intermediate neutrons. XIV International Conference on Electrostatic Accelerators and Beam Technologies. ESACCEL 2001. 06-09 June 2001, Obninsk, Russia.
57. Kohlbrecher J., Balasoiu M., Avdeev M., Bica D., Vekas L., SANS investigation of magnetic correlations in ferrofluids. International Conference on Magnetic Fluids, Bremen, 23-27 July 2001.
58. Kornyshev A.A., Kundler I., Mergel J., Spohr E., Efremov R.G., Gordely V.I., Islamov A.Kh., Kuklin A.I., Mukhamedzajnov R.E. Neutron scattering investigations of the structure of polymer electrolyte membrane for fuel cell applications II Russian-German User Meeting, Dubna, April 21-25, 2001.
59. Kozlenko D.P., Glazkov V.P., Savenko B.N., Somenkov V.A., Telepnev A.S. High Pressure Inelastic Neutron Scattering Studies at IBR-2 reactor. International Workshop on Crystallography at High Pressures, 4-8 September 2001, Orsay-Saclay, France.
60. Kozlenko D.P., Voronin V.I., Glazkov V.P., Savenko B.N., Schennikov V.V. Neutronographic investigation of the structure $HgTe_{0.85}S_{0.15}$ at high pressures. Proceedings of the III National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow.
61. Kozlenko D.P., Voronin V.I., Glazkov V.P., Savenko B.N., Shchennikov V.V. Structural Study of Ternary Mercury Chalcogenide $HgTe_{0.85}S_{0.15}$ at High Pressure. International Workshop on Crystallography at High Pressures, 4-8 September 2001, Orsay-Saclay, France.
62. Kozlenko D.P., Voronin V.I., Glazkov V.P., Savenko B.N., Shchennikov V.V. Neutron diffraction study of structural transformations in ternary mercury chalcogenides at high pressure. International Conference on Neutron Scattering (ICNS-2001), 9-13 September 2001, Munich, Germany.
63. Kuklin A.I.. Instrumentation for small-angle neutron scattering at IBR-2 pulsed reactor. Report on the project “Architectures of Molecular Rods in a Polymer Network”, Working Meeting,1-4 September, Max-Planck Institut fur Polymerforschung, Mainz, Germany.
64. Kul'ment'eva O.P., Pogrebnjak A.D., Kshnjakin V.S. Tyurin Yu.N., Kobzev A.P., Skiba Yu.A. Features of morfology and phase composition of α-Fe surface layers after pulsed plasma processing. Proceedings of 4-th International Symposium «Vacuum technology and equipment». Edited by V.I.Lapshin, N.M.Shulaev. ISVTE – 4, 23-27 Apryl 2001, Kharkov, Ukraine.
65. Locajicek T., Pros Z., Klima K., Nikitin A.N, Ivankina T.I., Ullemeyer K., Smirnoff Y.P., Prikryl R. Experimental and modeled seismic properties of amphibolites from Kola Superdeep Borehole KSDB-3. XXVI General Assembly of European Geophysical Society. 2001, March 25-30, Nice, France.
66. Loose A., Wozniak K., Dominiak P., Sarin V.A., Smirnov L.S., Baranov A.I., Natkaniec I., Dolbinina V.V., Shuvalov L.A. Neutron and X-ray single crystal diffraction study of $[Rb_x(NH_4)_{1-x}]_3H(SO_4)_2$, (T=290K, $x \approx 0.05$). 20th European Crystallographic Meeting, ECM-20, August 25-31, 2001, Cracow, Poland.
67. Majerz I., Pawlukojc A., Sobczyk L., Grech E., Nowicka-Scheibe J. Dimerization of 1,8-diaminonaphthalene, DFT, Infra Red, Raman and Inelastic Neutron Scattering Studies. First Russian-Ukrainian-Polish Conference on Molecular Interactions, School of Physical Organic Chemistry, Gdansk, June 10-16, 2001, Poland.
68. Majerz I.,. Pawlukojc A,. Sobczyk L, Grech E., Nowicka-Scheibe J. Dimerization of 1,8-diaminonaphthalene, DFT Theoretical, Infra Red, Raman and Inelastic Neutron Scattering Studies”. Horizons in Hydrogen Bond Research XIV Conference – Workshop, Torino, September 3-7, 2001, Italy.
69. Martinez Sarrion M.L., Mestres L., Smirnov L.S. Ammonium ion behaviour in the $LiRb_{1-x}(NH_4)_xSO_4$ mixed crystals. ICNS2001, Conference Programme and Abstracts, p. 143. International Conference on Neutron Scattering, ICNS’2001, Munchen, September 9-13, 2001, Germany.
70. Mayer J., Krawczyk J., Janik J., Masalska-Arodz M., Natkaniec I., Steinsvoll O. Neutron scattering study of low energy excitations in triphenyl phosphate. ICNS2001, Conference Programme and Abstracts, p. 107. International Conference on Neutron Scattering, ICNS’2001, Munchen, September 9-13, 2001, Germany.
71. Melik-Nubarov N.S., Islamov A.H., Krylova O.O., Demina T.V., Bobarykina G.N., Kuklin A.I., Antonenko Yu.N. and Gordeliy V.I. Influence of ethylene oxide and propylene oxide block

copolymers on the permeability and structural organization of lipid membranes. II Russian-German User Meeting, Dubna, April 21-25, 2001.

72. Migdal-Mikuli E., Mikuli L., Hetmanczyk I., Natkaniec W., Lasocha M., Michalec R. Phase transitions, structural changes and molecular motions in $[Zn(NH_3)_4](BF_4)_2$ studied by neutron scattering methods and X-ray diffraction". 20^{th} European Crystallographic Meeting, ECM-20, August 25-31, 2001, Cracow, Poland.
73. Natkaniec I. «Simultaneous measurements of the diffraction and inelastic scattering of neutrons as a unique method for the study of phase transitions at pulsed sources», Proceedings of the III National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p. 351.
74. Natkaniec I. Combine neutron diffraction and spectroscopy as powerful method for study phase transitions at pulsed neutron sources. 20^{th} European Crystallographic Meeting, ECM-20, August 25-31, 2001, Krakow, Poland
75. Natkaniec I., Diano A.I., Martinez-Sarrion M..L., Mestres L., Gerrais M., Smirnov L.S., Shuvalov L.A. "Librational dynamics and tunneling of ammonium groups in $Rb_{1-x}(NH_4)_xI$ solid solutions ". Proceedings of the II National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow, p.375.
76. Natkaniec I., Dianoux J.-A., Martinez Sarrion M.L., Mestres L., Smirnov L.S., Shuvalov L.A., Tunnelling transitions and librational modes of ammonium in $Rb_{1-x}(NH_4)_xI$ mixed salts. ICNS2001, Conference Programme and Abstracts, p.213. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
77. Natkaniec I., Holderna-Natkaniec K. Structural phase transition and methyl dynamics in solid mesitylene. ICNS2001, Conference Programme and Abstracts, p. 212. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
78. Natkaniec I., Holderna-Natkaniec K., Kalus J., Khavryutchenko V.D., Pawlukojc A. Neutron spectroscopy and QC modeling low frequency internal vibrations m-xylene molecules with deuterated subunits. ICNS2001, Conference Programme and Abstracts, p. 35. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
79. Natkaniec I., Holderna-Natkaniec K., Khavryutchenko V.D., Parlinski K. Lattice and Internal dynamics of crystalline and glassy methanol. 28^{th} International Conference on Dynamical Properties of Solids, DYPROSO XXVIII, September 16-20, 2001, Kerkrade, NL.
80. Natkaniec I., Parlinski K., Holderna-Natkaniec R., Mayer J. Neutron spectroscopy and computer simulation dynamics of crystalline urea. ICNS2001, Conference Programme and Abstracts, p. 215. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
81. Nikitin A.N. Investigation of internal strain/stress of marble using neutron scattering in a wide interval of temperatures. X International conference «Imperfections interaction and anelasticity phenomena in solids». 2001, November 13-15, Tula, TSU, Russia.
82. Nikitin A.N. Texture analysis of rocks from continental crust and upper mantle by neutron diffraction. III meeting "Physical, chemical and petrophysical researches in Earth sciences". 2001, October 30-31, IGAC RAN, JIPE RAN, Moscow, Russia.
83. Nikitin A.N., Ivankina T.I., Burilichev D.E., Klima K., Locajicek T., Pros Z. Study of anisotropy and textures of mantle rocks using neutron diffraction. X International conference «Imperfections interaction and anelasticity phenomena in solids». 2001, November 13-15, Tula, TSU, Russia.
84. Nikitin A.N., Ivankina T.I., Ullemeyer, Kazansky V.I., Lobanov K.V, Zharikov A.V. Texture measurements and modelling of P-wave velocity anisotropy of core samples from the Kola superdeep borehole and their surface analogues. XXVI General Assembly of European Geophysical Society. 2001, March 25-30, Nice, France.
85. Nikitin A.N., Ivankina T.I., Zamyatina N.V., Kazansky V.I., Lovanob K.V., Zharikov A.V. Texture – an indicator of rock metamorphism and deformation processes in the continental crust. V International conference "Crystals: growth, properties, real structure, applications". 2001, September 10-14, Alexandrov, Russia.
86. Novikov A.G., Rodnikova M.N., Sobolev O.V. The protons dynamics of ethylene glycol. ICNS2001, Conference Programme and Abstracts, p.108. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
87. Novikov A.G., Sobolev O.V. The structure and dynamic properties of liquid phosphorus oxychloride $POCl_3$ from neutron scattering experiments. ICNS2001, Conference Programme and Abstracts, p. 178. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
88. Parzhitski S.S., Kobzev A.P., Popov Yu.P., Gundorin N.A., Voinov A.V., Oprea A.I. Spheroidal fission chamber for monitoring of neutron flux. IX International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Sructure, Related Topics. May 23-26, 2001, Dubna, Russia.
89. Pawlukojc A., Majerz A., Natkaniec I., Sobczyk L. Inelastic neutron scattering (INS) studies on chloro and bromo derivatives of phenol. ICNS2001, Conference Programme and Abstracts, p. 211. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
90. Pepy G., Kuklin A., Apel P. Small Angle Neutron Scattering (SANS) Observation of Channels in Nuclear Membranes. International Conference on Neutron Scattering, Muenchen, 9-13 September, 2001.
91. Plestil J., Pospísil H., Kuklin A.I., Cubitt R. SANS study of three-layer micellar particles. International Conference on Neutron Scattering, Munchen, 9-13 September 2001, Poster A-82.

92. Pomjakushin V., Balagurov A., Aksenov V., Fischer P., Keller L., Sheptyakov D., Gorbenko O., Kaul A., Babushkina N. Long scale phase separation versus homogeneous magnetic state in $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract B-226, p.146.
93. Rajewska A., Bakeeva R.F., Kuklin A.I., Islamov A.Kh. Micellization in the Mixed System of Cationic and Non-Ionic Surfactants in Heavy Water by SANS Method. International Conference on Neutron Scattering, Muenchen, 9-13 September, 2001.
94. Reehuis M., Loose A., Sarin V.A., .Smirnov L.S., Natkaniec I., Baranov A.I., Dolbinina V.V., Shuvalov L.A. Phase transition II-III study in $(NH_4)_3H(SO_4)_2$ by neutron scattering. ICNS2001, Conference Programme and Abstracts, p. 210. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
95. Savenko B.N., Glazkov V.P., Kozlenko D.P., Somenkov V.A., Telepnev A.S. INS study of vibrational spectra of NH_4I at very high pressures. International Conference on Neutron Scattering (ICNS-2001), 9-13 September 2001, Munich, Germany.
96. Savenko B.N., Glazkov V.P., Kozlenko D.P., Somenkov V.A., Telepnev A.S. Inelastic neutron scattering investigation of the vibrational spectra of NH_4I at high pressures. Proceedings of the III National Conference on the Use of X-rays, Synchrotron Radiation, Neutrons and Electrons to Study Materials (XSNE-2001), 21-25 May 2001, Moscow.
97. Sheptyakov D.V, Antipov E.V., Abakumov A.M., Balagurov A.M., Fischer P., Keller L., Lobanov M.V., Pomjakushin V. Crystal and magnetic structure of new layered oxides A_2GaMnO_{5+x} (A=Ca, Sr). ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract B-217, p.144.
98. Smirnov L.S., Smith D., Natkaniec I., Zlokazov V. Neutron spectroscopy and model calculations of librational modes of ammonium in monoclinic phase of NH_4SCN. ICNS2001, Conference Programme and Abstracts, p.213. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
99. Tamonov A.V., Bokuchava G.D., Balagurov A.M., Levin D.M., Shamsutdinov N.R. Residual stress study by neutron diffraction in perforator striker. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract B-274, p.157.
100. Taran Yu.V., Daymond M.R., Eifler D., Schreiber J. Neutron diffraction study of martensitic transformation in austenitic stainless steel under low cycling tensile-compress loading. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract A-229, p.84, 2001.
101. Taran Yu.V., Daymond M.R., Schreiber J. The time-of-flight neutron diffraction investigations of elastic and anisotropy strains in fatigued austenitic stainless steel. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract A-227, p.84, 2001.
102. Taran Yu.V., Kockelmann H., Schreiber J., Wright J.S. Attempt of determination of a kind of residual stresses within a welding interface of bi-metal austenitic and ferritic steel tube from time-of-flight neutron diffraction spectra. ICNS-01, Munchen, Germany, 9 – 13 September 2001. Abstract B-271, p.157, 2001.
103. Valiev E., Bogdanov S, Pirogov A, Kuklin A. Small-Angle Scattering Studies of Carbon Sorbents Porous Structure. International Conference on Neutron Scattering, Muenchen, 9-13 September, 2001.
104. Voinov A.V., Serov D.G., Popov Yu.P., Kobzev A.P., Gundorin N.A, Parzhitski S.S. Partial cross section of radiative neutron capture on ^{48}Ti. IX International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. May 23-26, 2001, Dubna, Russia.
105. Watanabe J., Smirnov L.S., Natkaniec I., Balagurov A.M., Beskrovnyi A.I., Kasahara M., Yagi T. Neutron and Raman scattering studies of $[K_{1-x}(NH_4)_x]_3H(SO_4)_2$ mixed crystals. ICNS2001, Conference Programme and Abstracts, p. 203. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
106. Watanabe J., Smirnov L.S., Natkaniec I., Kubanek F., Kasahara M., and T.Yagi. Raman, Neutron and X-ray Scattering Studies of $[K_{1-x}(NH_4)_x]_3H(SO_4)_2$ Mixed Crystals. Horizons in Hydrogen Bond Research XIV Conference – Workshop, Torino, September 3-7, 2001, Italy.
107. Winter R., Gordely V.I., Kuklin A.I., Islamov A.H., Utrobin P.K. SANS study of high pressure phase transitions in lipid membranes as function of lipid/water content and temperature. II Russian-German User Meeting, Dubna, April 21-25, 2001.
108. Zaezjev M., Novikov A., Savostin V., Shimkievich A. Termodynamic functions of liquid potassium from slow neutron frequency spectrum. ICNS2001, Conference Programme and Abstracts, p. 202. International Conference on Neutron Scattering, ICNS'2001, Munchen, September 9-13, 2001, Germany.
109. Zaharescu T., Balasoiu M., Kobzev A.P., Hasegan D., Klinov D. Microstructural investigations of irradiated ethylene-propylene (EPDM) and polypropylene (PP) elastomers. 12-th International Conference on Surface Modification of Materials by Ion Beams, September 9-14, 2001, Marburg, Germany, P.4.08.
110. Zaroslov Yu.D. Neutron scattering study of self-assembly of poly(sodium p-phenylene sulfonate) in aqueous solutions and inside polymer gel. Report at working meeting "Architectures of Molecular Rods in a Polymer Network", 1-4 September, Max-Planck Institut, Mainz, Germany.
111. Zaroslov Yu.D. Small-angle neutron scattering study of the aggregation of rigid-rod polyelectrolyte. Student conference, Educational-scientific center on chemistry and physics of polymers and thin organic films, St.Petersburg, October 18-20, 2000, Book of abstracts, p. 33.
112. Zaroslov Yu.D., Gordely V.I., Kuklin A.I., Islamov A.Kh., Philippova O.E., Khokhlov A.R., Wegner G. Neutron

scattering study of self-assembly of rigid-rod polyelectrolyte in aqueous solutions and inside the polymer gel. II Russian-German User Meeting, Dubna, April 21-25, 2001.

NEUTRON NUCLEAR PHYSICS

Rewievs

1. Alexandrov Yu.A. Neutron physics of low energies – one of the sources of information about the structure of the neutron. //Science and Technology in Russia - 2000.- N.4. - p.1-4.
2. Grigoriev Yu.V. et al. Investigation of nuclear data on the beams of IBR-30 and IBR-2. Particles and Nucleus, 2001 (Review article). (Accepted for publication).
3. Kopatch Yu.N., Popov A.B., Furman W.I., Gonin N.N., Kozlovsky L.K., Tambovtsev D.I., Alfimenkov V.P., Lason L., Pikelner L.B., Gagarsky A.M., Petrov G.A., Sokolov V.E. Resonance neutron induced fission of heavy nuclei (submitted to Particles and Nucleus).
4. Mitchell G. E., Bowman J. D, Crawford B. E., Delheij P. P. J., Grossmann C. A., Haseyama T., Knudson J. N., Lowie L. Y., Masaike A., Matsuda Y., Penttila S., Postma H., Roberson N. R., Seestrom S. J., Sharapov E. I., Smith D. A., Stephenson S. L., Yen Y.-F., Yuan V. W., in: Fundamental Physics with Pulsed Neutron Beams, edited by Gould C. R., Greene G. L., Plasil F., and. Snow W. M (World Scientific, Singapore, 2001), p. 108.

Experimental Investigations

1. Abov Yu.G., Alfimenkov V.P., Galinsky E.M., Mareev Yu.D., Pikelner L.B., Chernikov A.N. et.al. Spectrometer of polarized neutrons. //PTE. - 2000.- N.3. - p.9-12.
2. Ainbund M.R., Bogdzel A.A., Gundorin N.A., Matveev D.V., Serov D.G. Investigation of spectrometric and operational characteristics of scintillation block of BGO-PM-165 over temperature interval from +25 to –140^{o}C. - Dubna, 2001. – 10p. - (JINR P13-2001-130).
3. Aksenov V.L., Gundorin N.A., Nikitenko Yu.V., Popov Yu.P., Cser L. Observation of neutron standing waves at total neutron reflection by the method of precision gamma-spectroscopy. //Poverkhnost - 2000.- N.6. - p.7-10.
4. Alexandrov Yu.A., Phys.Part.Nuclei, 2001, v.32, p.1359.
5. Alfimenkov V.P., Mareev Yu.D., Novitsky V.V., Pikelner L.B., Chernikov A.N. et al. Investigation of spatial parity violation and interference effects in angular distributions of fragments from resonance neutron induced fission of ^{233}U. //Jad.Fiz - 2000.- v.63, N.4. - p.598-603.
6. Arlandini C., Heil M., Reifarth R., Käppeler F., Sedyshev P.V.. Stellar neutron capture rate of ^{147}Pm for constraining the s-process neutron density. Nucl. Phys. A 688 (2001) 487489.
7. Boreiko V.F., Bystritsky V.M., Voznyak Ya., Krylov A.R., Grebenyuk B.M., Ivanov A.I., Kalinin A.I., Parzhitsky S.S., Slepnev V.M , Stolupin V.A. ^{3}He-detectors in experiments at pulsed neutron sources. - Dubna, 2001. – 22p. - (JINR Д15-2001-145).
8. Borzakov S.B. Study of properties of delay neutrons in therma neutron induced fission of ^{235}U, ^{233}H, ^{239}Pu and ^{237}Np nuclei. Author’s abstract of dissertation for Candidate of Science (Phys. and Math) . - Dubna, 2000. - 19 p. - (JINR 3-2000-4).
9. Borzakov S.B., Chrien R.E., Panteleev Ts.Ts., Telezhnikov S.A., a.o. An Accurate Redeterimination of the ^{118}Sn Binding Energy. - Dubna, 2001. - 15 p. - (JINR E3-2001-55).
10. Borzakov S.B., Panteleev Ts., Strelkov A.V. Search for dineutron in interaction of neutrons with deuterons. (Submitted to Particles and Nucleus Letters).
11. Bystritskii Vit.M., Bystritsky V.M., Chaikovsky S.A., Filipowicz M., Grebenyuk V.M., Gula E., Makhrin V.I., Parzhitski S.S., Pen'kov F.M., Stolupin V.A., a.o. The Astrophysical S Factor for dd Reaction at Ultralow Energies. //Yad. Fiz.,. - 2001. - v.64, N.5. - c.920-925.
12. Frank A., Kozlov A., Bondarenko I.V., Ehlers G., Hoghoj P. Spin Precessing Optics on the IN15 spin-echo Spectrometer. ILL Annual Report, 2000, pp. 100-101.
13. Grigoriev E. P., Khitrov V. A., Sukhovoj A. M. and Vasilieva E. V. A search for the gamma-decay of the ^{168}Er compound in the (n,2gamma) reaction, Fizika B vol. 9 (2000) no. 4, pp 147-168. Grigoriev Yu.V., Borzakov S.B. et al. Investigation of the ^{93}Nb neutron cross-sections in resonance energy range. Voprosy at. Nauki i Tekhniki, seriya “Yadernye konstanty”, 2001, v. 1, p. 5.
14. Grigoriev Yu.V., Kitaev V.Ya., Zhuravlev B.V., Sinitsa V.V., Borzakov S.B., Faikov-Stanchik H., Ilchev G., Mezentseva Zh.V., Panteleev Ts.Ts., Kim G.N. Investigation of the ^{93}Nb neutron cross-section in resonance energy range. «Voprosy at. Nauki i Tekhniki», 2001.
15. Khitrov V.A., Sukhovoj A.M. Estimations of Level Density and Radiative Strength Functions from Experimental Data and Probable Change in Peculiarities of Nuclei at E_{ex}~3-4 MeV. //ЯФ. - 2001. - т.64, N.7. - p.1271-1274.
16. Koehler P.E., Gledenov Yu.M., Andrzejewski J., Guber K.H. Improving Explosive Nucleosynthesis Models via (n,α) Measurements. //Nucl. Phys.A. - 2001.- v.688, N.1,2. - p.86c-89c.
17. Kolachevsky N.N., Papchenko A.A., Prokofichev A.A., Skoy V.R., Sobelman I.I., Sorokin V.N. Wide-band laser optic pumping of Rb to create nuclear polarization in ^{3}He. //Kvantovaia Elektronika. - 2000.- v.30, N.1. - p.81-86.

18. Lychagin E.V., Muzychka A.Yu., Nekhaev G.V., Strelkov A.V., Shvetsov V.N. et.al. Investigation of inelastic ultracold neutron scattering on surfaces of solid bodies accompanied with small energy transfers. - Dubna, 2001. – 20p. - (ОИЯИ P3-2001-49).
19. Lychagin E.V., Muzychka A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Strelkov A.V. Experimental assessment of possible subbarier UCN penetration through sealed foils. - Dubna, 2000. - 6 p. - (JINR P3-2000-70).
20. Lychagin E.V., Muzychka A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Strelkov A.V. Experimental assessment of possible subbarier UCN penetration through sealed foils.. //ZhETF Pis'ma - 2000.- v.71, issue.11,12. - p.657-62.
21. Lychagin E.V., Muzychka A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Taldaev R.R., Strelkov A.V., Shvetsov V.N. Investigation of inelastic ultracold neutron scattering on surfaces of solid bodies accompanied with small energy transfers. Preprint JINR P3-2001-49; Poverkhnost 2002 (Accepted for publication).
22. Lychagin E.V., Muzychka A.Yu., Nesvizhevsky V.V., Nekhaev G.V., Taldaev R.R., Strelkov A.V. Temperature dependence of inelastic ultracold neutron scattering with small energy transfers. //Jad.Fiz. - 2000.- v.63, N.4. - p.609-612.
23. Matsuda Y., Bowman J.D., Crawford B.D., Sharapov E.I., a.o. Parity Violation in Neutron Resonances of Antimony and Iodine. //Phys. Rev.C. - 2001.- v.64, N.1. - p. 015501.
24. Mineva M.N., Hellstroem M., Bernas M., Gerl J., Grawe H., Pfuetzner M., Regan P.H., Rejmund M., Rudolph D., Becker F., Bingham C.R., Enqvist T., Fogelberg B., Gausemel H., Geissel H., Genevey J., Gorska M., Grzywacz R., Hauschild K., Janas Z., Kojouharov I., Kopatch Y., Korgul A., Korten W., Kurcewicz J., Lewitowicz M., Lucas R., Mach H., Mandal S., Mayet P.,. Mazzocchi C, Pinston J.A., Podolyak Zs., Schaffner H., Schlegel Ch., Schmidt K., Suemmerer K., Wollersheim H.J. A new μ isomer in ^{136}Sb produced in the projectile fission of ^{238}U. EPJA11/1(2001), pp 9-13.
25. Mitchell G.E., Bowman J.D., Penttila S.I., and Sharapov E.I., Phys. Rep. 354, 157 (2001).
26. Nesvizhevsky V.V., Lychagin E.V., Muzychka A.Yu., Nekhaev G.V., Strelkov A.V. About Interpretation of Experiments on Small Increase in Energy of UCN in Traps. //Phys. Lett.B. - 2000.- v.479, N.4. - p.353-357.
27. Popov Yu.P. Peculaliarities of the modern neutron spectrometry. PRAMANA-journal of physics, v.57 (2001) 601-610.
28. Popov Yu.P., Voinov A.V., Sedyshev P.V., Parzhitski S.S., Kobzev A.P., Gundorin N.A., Serov D.G., Sedysheva M.V. Neutron Spectrometry Method for Partial Radiative Capture Cross-Section Measurements. //Nucl. Instr. Meth. Phys. Res.A. - 2001.- v.463, N.1,2. - p.309-315.
29. Postma H., Bowman J.D., Corvi F., Crawford B.E., Delheij P.P.J, Frankle C.M., Grossmann C.A., Gunsing F., Haseyama T., Knudson J.N., Lowie L.Y., Masaike A., Matsuda Y., Mitchell G.E., Penttila S.I., Roberson N.R., Seestrom S.J., Sharapov E.I., Smith D.A., Stephenson S.L., Yen Y.-F., Yuan V.W., and Zanini L., Czech J. Phys. 51, A289 (2001).
30. Pourimani R., Olejniczak U., Popov Yu.P., Przytula M., Wojtkiewicz R. Resonance Capture Gamma-Ray Spectrometry at Lead Slowing-Down Neutron Spectrometer. - Dubna, 2000. - 30 p. - (JINR E3-2000-297).
31. Sharov V.I., Zaporozhets S.A., Anischenko N.G., Azhgirey L.S., Bartenev V.D., Blinov N.A., Borisov N.S., Borzakov S.B., Borzunov Yu.T., Budkin L.V., Burinov V.F., Bushuev Yu.P., Chernenko L.P., Chernykh E.V., Dolgii S.A., Drobin V.M., Fedorov A.N., Fimushkin V.V., Finger M., Finger M.Jr., Golovanov L.B., Janata A., Karpunin A.V., Khachaturov B.A., Kirillov A.D., Kovalenko A.D., Kolomiets V.G., Kuzmin E.S., Ladygin V.P., Lazarev A.B., Maniakov P.K., Matafonov V.N., Neganov A.B., Nikolaevsky G.P., Nomofilov A.A., Panteleev Tz., Pilipenko Yu.K., Pisarev I.L., Piskunov N.M., Plis Yu.A., Rukoyatkin P.A., Shchevelev O.N., Shilov S.N., Shishov Yu.A., Shutov V.B., Slunecka M., Sluneckova V., Starikov A.Yu., Stoletov G.D., Strunov L.N., Svetov A.L., Tsvinev A.P., Usov Yu.A., Volkov V.I., Yershov V.P., Zhmyrov V.N. Measurements of the np Total Cross Section Difference $^{D}d_{L}$ at 1.59,1.79 and 2.20 GeV. //Europ. Phys.J., C. - 2000.- v.13, N.2. - p.255-265.
32. Shevchenko N.V., Belyaev V.B., Rakityansky S.A., Sofianos S.A., Sandhas W. Photoproduction of ρ-mesons off light nuclei. Nuclear Physics A, 689 (2001), 1-2 (июнь 18), 383-386.
33. Skoy V.R. Possible Test of Space-Parity and Time-Reversal Invariance in Gamma-Ray Transmission Through an Aligned Target. //J.Phys.G: Nucl. Part. Phys. - 2000.- v.26, N.10. - p.1527-44.
34. Smith D. A., Bowman J. D., Crawford B. E., Grossmann C. A., Haseyama T., Johnson Mikkel B., Masaike A., Matsuda Y., Mitchell G. E., Nazarenko V., Penttila S.I., Roberson N. R., Seestrom S. J., Sharapov, Stephenson S. L., Tomsovic S., Yen Y.-F., and Yuan V. W., Phys. Rev. C 64 E. I., 015502 (2001).
35. Szalanski P., Stempinski M., Malka A., Gledenov Yu.M., Sedyshev P.V., Mashrafi R., Padureanu I. On the possibility of modeling nucleosynthesis with computer systems. Formation of elements in the area of sulfur and chlorine at burining of helium in stars with mass 25 M⊙. JINR Communication, P10-2001-161, Dubna, 2001.
36. Vasilieva E. V., Sukhovoj A. M., and Khitrov V. A. Direct Experimental Estimate of Parameters That Determine the Cascade Gamma Decay of Compound States of Heavy Nuclei, Physics of Atomic Nuclei 64(2) (2001) 153-168.
37. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Direct experimental estimation of parameters determining cascade gamma-decay of compound states of heavy nuclei, Jad.Fiz., 2001, 64(2), p. 195-210.
38. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Level densities, radiative strength functions and basic properties of heavy nuclei below neutron binding energy. Izvestia RAN, Ser. Phys., 2001, v.65, N 5, p. 718-724.
39. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Level densities, radiative strength functions and basic properties of heavy nuclei below neutron binding energy. // Izvestia RAN, Ser. Phys. - 2001.- v.65, N.5. - p.707-713.

40. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Two-quantum cascades after thermal neutron capture in ^{139}La nucleus. // Izvestia RAN, Ser. Phys. - 2000.- v.64, N.5. - p.942-949.

Theoretical Investigations

1. Bunatian G.G. On the Proton Spectrum in Free Neutron β-Decay. - Dubna, 2000. - 34 p. - (JINR E4-2000-19).
2. Bunatian G.G. The Effect of Electromagnetic Interactions on the Proton Spectrum in Free Neutron β-Decay. //Particles and Nuclei, Letters. - 2000.- N.6. - p.63-69.
3. Ignatovich V.K. Apocrypha of Standard Scattering Theory (SST) and Quantum Mechanics of the de Broglie Wave Packet. - Dubna, 2001. - 31p. - (JINR E4-2001-42).
4. Ignatovich V.K., Radu F. Theoretical Desription of Neutron Resonances in Multilayer Systems. //Physica B. - 2000.- v.292, N.1,2. - p.160-163.
5. Ignatovich V.K., Bloch J.-F. A new approach to bound states in potential wells. Am. J. Phys. 69, 1177 (2001).
6. Ignatovich V.K. Chemical shift of neutron resonances and some ideas, related to theory of neutron resonances and scattering. JINR P4-2001-256, Dubna, 2001 (in Russian).
7. Ignatovich V.K., Ignatovitch F.V. Designing of Multilayered Systems with desirable properties,Proceedings of International Conference on Neutron Scattering 2001,ICNS2001, Munich, 9.-13. September 2001, to be published in Applied Physics A.
8. Rakityansky S.A., Sofianos S.A., Shevchenko N.V., Belyaev V.B., Sandhas W. Near-threshold hd resonance. Nuclear Physics A, 684 (2001), 1-4 (март 12), 383-385.
9. Tretyakova T.Yu., Lanskoy D.E. Neutron-rich Λ-hypernuclei: Σ admixture and production in the K^-, π^+ reaction, Nuclear Physics, A691, p. 51, 2001.

Applied Research

1. Culicov O.A., Frontasyeva M.V., Steinnes E., et al. A heavy metal deposition study around the lead and copper zinc smelters in Baia Mare, Romania, employing the moss biomonitoring technique, ENAA and FAAS. Preprint of JINR, E14-2001-163, 2001, Dubna (accepted by J. Radioanal. Nucl. Chem.).
2. Mosulishvili L.M., Kirkesali Ye.I., Belokobylsky A.I., Khizanishvili A.I., Frontasyeva M.V., Gundorina S.F., Oprea C.D. Epithermal Neutron Activation Analysis of Blue-Green Algae Spirulina Platensis as a Matrix for Selenium-Containing Pharmaceuticals. - Dubna, 2000. - 8 p. - (JINR E14-2000-281).
3. Mosulishvili L.M., Frontasyeva M.V.et al. Experimental substantiation of the possibility of developing selenium- and iodine-containing pharmaceuticals based on blue-green algae Spirulina Platensis. Preprint of JINR, D14-2001-39, Dubna, 2001 (accepted for publication by the Journal of Pharmaceutical and Biomedical Analysis).
4. Mosulishvili L.M., Kirkesali E.I., Belokobylski A.I., Frontasyeva M.V., Gundorina S.F., Investigation into possibility of creation of iodized compounds on the basis of microalga spirulina platensis for medical and preventive treatment purposes using nuclear physics methods of analysis. Pis'ma Particle and Nucleus, 2001, № 4 [107], p. 110-117.
5. Mosulishvili L.M., Kirkesali E.I., Belokobylski A.I., Khizanishvili A.I., Frontasyeva M.V., Pavlov S.S., Gundorina S.F. Experimental substantiation of possibility to develop selenium and iodide bearing drugs on the basis of green-blue alga Spirulina Platensis. - Dubna, 2001. – 15p. - (JINR Д14-2001-39).
6. Tsertsvadze L.A., Kirkesali E.I., Frontasyeva M.V., Pavlov S.S., Gundorina S.F. Development of the method of bacterial leaching of metals from lean ores, rocks and industrial wastes using neutron activation analysis. Dubna, 2001. 18p. (JINR P14-2001-102).

Reports at Schools and Conferences

1. Aksenov V.L., Cser L., Gundorin N.A., Nikitenko Yu.V., Popov Yu.P. Observation of Neutron Standing Waves at Total Reflection of Polarized Neutrons by Precision Gamma-Spectroscopy. //ECNS'99: Proc.of the 2-nd European Conf.on Neutron Scattering, Budapest, Hungary, Sept. 1999. -(Physica B., vol.276-278). - Amsterdam etc.: Elsevier Sci., 2000, p.809-810.
2. Aksenov V.L., Nikitenko Yu.V., Radu F., Gledenov Yu.M., Sedyshev P.V. Observation of Resonance Enhanced Neutron Standing Waves Through (n,α) Reaction.//ECNS'99:Proc.of the 2-nd European Conf.on Neutron Scattering,Budapest,Hungary,Sept. 1999. -(Physica B.,vol.276-278). -Amsterdam etc.: Elsevier Sci., 2000, p.946-947.
3. Ali M.A., Khitrov V.A., Sukhovoj A.M. On Stepwise Change in Heavy Nuclei Properties at 3-5 MeV Excitation Energy, Proc. Nuclear and Particle Physics Conference, 13-17 Nov. 1999, Cairo, Egypt, Ed. Comsan M.N.H., Hanna K.M., NRC, Atomic Energy Authority Egypt, 2000, pp. 451-466.
4. Andrzejewski J., Gledenov Yu.M., Koehler P.E., Guber K.H., Rausher T. A Monte Carlo evaluation of the angular correlation coefficients in 35Cl(n,p)35S reaction. 9 International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. ISINN-8, Dubna, May 17-20, 2000, E3-2000-192, 146.

5. Brudanin V.B., Gundorin N.A., Filossofov D.V., Nemtchenok I.B., Smolnikov A.A., Vasiliev S.I., Bregadze V.I. Element-loaded organic scintillators for neutron and neutrino physics, Proceedings of the Third International Workshop on the Indentification of Dark Matter, York, UK, 18-22 September 2000, pp.626-634.
6. Danilkin S., Konstantinov V., Solovjev B., Zeinalov Sh., a.o. SANS Spectrometer for 1MW NUR Reactor at URGN, Algeria. //ECNS'99: Proc.of the 2-nd European.Conf.on Neutron Scattering,Budapest,Hungary,Sept. 1999.-(Physica B.,vol.276-278). - Amsterdam etc.: Elsevier Sci., 2000, p.100-101.
7. Enik T.L., Ermakov V.A., Kharjuzov R.V., Mitsyna L.V., Nikolenko V.G., Parzhitski S.S., Popov A.B., Samosvat G.S., Vtjurin V.A. Neutron Scattering in Argon and (n,e)- Interaction . IX International Seminar on Interaction of Neutrons with Nuclei, Dubna, 2001, E3-2001-192.
8. Florek M., Frontasyeva M., Mankovska B., Oprea K., Pavlov S., Steinnes E., Sykora I.. Air pollution with heavy metals and radionuclides in Slovakia studied by the moss biomonitoring technique. Preprint of JINR, E14-2001-255, 2001. Dubna (submitted to Proceedings of IX Int. Seminar on Interaction of Neutrons with Nuclei (23-26 May, 2001, Dubna)).
9. Frank A.I., Bondarenko I.V., Kozlov A.V., Hoghoj P. and Ehlers G. Larmor clock and measuring of neutron interaction time with quantum objects. Proceeding of the Third International Workshop on Polarised Neutrons for Condensed Matter Investigations, Gatchina, St. Petersburg, Russia, 20 - 25 June 2000. Physica B: Condensed Matter 297, (2001) 307-310.
10. Frontasyeva M.V., Morzhukhina S.V.et al. Nuclear and related analytical techniques used to study the anthropogenic impact on the Sister River in the vicinity of the town of Klin (Moscow Region, Russia). Preprint of JINR, E14-2001-54; Proceedings of NATO ARW (as above), 2001, p. 195-200.
11. Frontasyeva M.V., Smirnov L.I., Romanov S.A., Cherchintsev V.D., Lyapunov S.M., Steinnes E.. Assessment of the radionuclides 90Sr and 137Cs in soil samples collected in 1990-1998 in the areas affected by the «Mayak» plutonium production association. Proceedings of NATO ARW (as above), 2001, p. 29-36.
12. Frontasyeva M.V., Yermakova Ye.V., Steinnes E., Rahn K.A.. Study of trace elements in annual segments of moss biomonitors using epithermal neutron activation analysis: link with atmostheric aerosol. Proceedings of NATO ARW «Man-Made Radionuclides and Heavy Metals in the Environment». (Frontasyeva M.V., Vater P.and Peregygin–edts V.P.) Kluwer Academic Publishers, NATO Science Series. 2001, IV. Earth and Environmental Sciences – Vol. 5, p. 165-170.
13. Gareev F.A., Gareeva G.F. Exact Relations between Structures of Proton and Nuclei. //International Conference on Nuclear Physics. Clusters in Nuclear Physics: Abstracts. (L Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus), Saint Petersburg, June, 2000. - SPb.: PINP, 2000, p.142.
14. Gareev F.A., Gareeva G.F. Exact Relations between Structures of Proton and Nuclei. //Nuclear Structure and Related Topics:Intern.Conf.,Dubna,June 2000. Contributions. - (JINR E4-2000-96). - Dubna, 2000, p.29.
15. Gledenov Yu.M., Koehler P.E., Andrzejewski J., Popov Yu.P., Gledenov R.Yu. 147Sm(n,α) cross sections measurements from 3 eV to 500 keV: resonance neutrons. Nuclear Data for Science and Technology, ND2001, Tsukuba, Japan, October 7 – 12, 2001, Abstracts, 1.3-P-24.
16. Gledenov Yu.M., Koehler P.E., Andrzejewski J., Popov Yu.P., Gledenov R.Yu. Statistical analysis of α-particle widths of neutron resonances in 147Sm(n,α) reaction. 9 International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. ISINN-9, Dubna, May 23-26, 2001 (Abstracts) E3-2001-67, 71.
17. Gledenov Yu.M., Mashrafi R., Oprea A.I., Sedyshev P.V. A Monte Carlo evaluation of the angular correlation coefficients in 35Cl(n,p)35S reaction. 9 International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. ISINN-9, Dubna, May 23-26, 2001 (Abstracts) E3-2001-67, 70.
18. Gledenov Yu.M., Sedysheva M.V., Oprea A.I., Zemin Chen, Yingtang Chen, Jing Yuan, Guoyoui Tang, Guohui Zhang, Khuukhenkhuu G., Szalanski P.J. Measurements of the 64Zn(n,α)61Ni cross sections at En=4.5 – 6.5 MeV. Nuclear Data for Science and Technology, ND2001, Tsukuba, Japan, October 7 – 12, 2001, Abstracts, 1.3-P-23.
19. Gledenov Yu.M., Sedysheva M.V., Xuemei Zhang, Zemin Chen, Yingtang Chen, Guohui Zhang, Guoyoui Tang, Jingtang Chen, Khuukhenkhuu G. Measurements of the 39K(n,α)36Cl and 40Ca(n,α)37Ar cross sections at En=4.5 – 6.5 MeV. 8 International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. ISINN-8, Dubna, May 17-20, 2000, E3-2000-192, 173.
20. Granja C., Pospisil S., Rubacek L., von Egidy T., Wirth H.F., Borner H., Lehmann H., Aprahamian A., Telezhnikov S., Nosek D., Chrien R.E. for E906 Collaboration, Eisermann Y., Graw G., Hertenberger R. Structure of 159Gd. International Nuclear Physics Conference 2001, Berkeley, CA, 30 July - 3 August 2001, (poster).
21. Granja C., Pospisil S., Rubacek L., Telezhnikov S. A., von Egidy T., Wirth H.-F., Borner H., Lehmann H., Aprahamian A., Chrien R. E. Spectroscopy of 159Gd in Neutron Spectroscopy, Nuclear Structure, Related Topics, Abstracts of the 9-th International Seminar on Interaction of Neutrons with Nuclei, Dubna, 2001, p.40.
22. Granja C., Pospisil S., Rubacek L., Telezhnikov S. A., von Egidy T., Wirth H.-F., Borner H., Lehmann H., Aprahamian A., Chrien R. E. Spectroscopy of 159Gd IX International Seminar on Interaction of Neutrons with Nuclei, Dubna, May 23-26, 2001, (poster).
23. Grigoriev E.P., Sukhovoj A.M., Khitrov V.A.. Discharging of new levels in 168Er. LI Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus, Abstracts, Sarov, Russia, September 2001, p.174.

24. Grigoriev Yu.V. et al. Investigation of the 93Nb Neutron Cross-Sections in Resonance Energy Range. ISSIN-9, Dubna, May 23-26,2001.ВАНТ, в.1, 2001.
25. Grigoriev Yu.V. et al. The Investigation of Resonance Structure of Neutron Cross- Sections and the α-Value of 235U for Different Temperatures. ISSIN-9, Dubna, May 23-26,2001.
26. Ignatovich V.K. A Challenge for Mathematicians: Equations of a General Physical Problem in Classical Charged Particle Mechanics. //Modern Trends in Computational Physics:Second Intern.Conf. (In Memory of N.N.Govorun), Dubna, July 2000:Book of Abstracts. - (JINR D11-2000-155). - Dubna, 2000, p.86.
27. Ignatovich V.K., Lychagin E.V., Nesvizhevsky V.V., Nekhaev G.V., Muzychka A.Yu., Strelkov A.V. Neutron transportation in a closed vessel. //Neutron Spectroscopy, Nuclear Structure, Related Topics; ISINN-9 Dubna May23-26, JINR Report E3-2001-192, pp. 406-414.
28. Kadmensky S.G., Lyuboshitz V.V., Tchuvil'sky Yu.M.. The weak single-nucleon Hartree-Fock potential based on the weak parity-violating NN-interaction. Proceedings of the 9-th International Seminar on Interaction of Neutrons with Nuclei (ISINN-9), Dubna, 2001 (in press); ISINN-9 abstracts , JINR E3-2001-67, Dubna, 2001, p.35; also in Abstracts of the Workshop on Nuclear Spectroscopy and Nuclear Structure (Sarov, September 2001) .
29. Kang Y.S., Lee D.W., Kim G.N., Frontasyeva M.V., Pavlov S.S., Galinskaya Y.E.. Epithermal neutron activation analysis of tree bark, pine-needles and moss for environmental pollution monitoring in Pusan and Kyungnam. Proceedings of 2001 Workshop on Nuclear Data Production and Evaluation (August, 2001, Pohang, Korea).
30. Khitrov V.A., Sukhovoj A.M. Direct Estimates of Level Density of Heavy Nucleus Excited in (n,gamma) Reaction up to Eex ~ 3-4 MeV International Conference on nuclear data for science and technology. Oct. 7-12, 2001, Japan, Abstracts, p. 5-P-2.
31. Khitrov V.A., Sukhovoj A.M. Estimates of Level Density and Radiative Strength Functions on the Experimental Basis, Probable Change in Peculiarities of Heavy Nuclei at Eex~3-4MeV. //Nuclear Structure and Related Topics: Intern.Conf.,Dubna, June 2000. Contributions. -(JINR E4-2000-96). - Dubna, 2000, p.41.
32. Khitrov V.A., Sukhovoj A.M. Model Independent Method for a Simultaneous Estimation of the Level Density and Radiative Strength Functions of Dipole gamma-Transitions, International Conference on nuclear data for science and technology. Oct. 7-12, 2001, Japan, Abstracts, p. 5-P-3.
33. Khitrov V.A., Sukhovoj A.M. On the errors in the method of determination of the level density and radiative strength functions from the spectra of the primary gamma-TRANSITIONS, IX International Seminar on Interaction of Neutrons with Nuclei, Dubna, 23-26 May 2001, Abstracts, e3-2001-67, Dubna, 2001, p. 43.
34. Khuukhenkhuu G., Gledenov Yu. M., Sedysheva M. V. Statistical model approach to the fast neutron induced (n,p) reaction cross section. 9 International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. ISINN-9, Dubna, May 23-26, 2001 (Abstracts) E3-2001-67, 70.
35. Khuukhenkhuu G., Unenbat G., Gledenov Yu.M., Sedysheva M.V. Statistical model approach to (n,p) reaction cross section systematics. Nuclear Data for Science and Technology, ND2001, Tsukuba, Japan, October 7 – 12, 2001, Abstracts, 5-P-5.
36. Levakov B.G., Litvin V.I., Lyzhin A.E., Furman W.I., Lychagin E.V., Muzichka A.Yu., Nekhaev G.V., Strelkov A.V., Sharapov E.I., Shvetsov V.N., Howell C.R., Mitchell G.E.,Tornow W., Bowman C.D., Crawford B.E., Stephenson S.L. Thermal neutron fields at the reactor Yaguar for the nn-scattering experiment. //Neutron Spectroscopy, Nuclear Structure, Related Topics; ISINN-9 Dubna May23-26, JINR Report E3-2001-192, pp.27-32.
37. Lucaciu A., Oprea C.D., Frontasyeva M.V., Stan O., Pavlov S.S., a.o. Atmospheric Deposition of Trace Elements in Romania Using the Moss Biomonitoring Technique. //Advanced Research Workshop: Monitoring of Natural and Man-Made Radionuclides and Heavy Metal Waste in Environment,Dubna,Oct.2000:Abstracts. - (JINR E14-2000-225). - Dubna, 2000, p.57.
38. Mutterer M., Kopach Yu.N., Klemens M., Hotzel A., a.o. Emission of 5He and 7He in Spontaneous Ternary Fission of 252Cf. //Dynamical Aspects of Nuclear Fission:Proc.of the 4th Intern.Conf.on..., Casta-Papeirnicka, Slovak Republic, Oct. 1998. - Singapore etc.:World Sci., 2000, p.136-148.
39. Popov Yu.P., Voinov A.V., Gundorin N.A., Kobzev A.P., Sedyshev P.V., Parzhitski S.S., Serov D.G.. KeV - neutron spectrometry method for partial cross-section measurements. Nuclear Data for Science and Technology, ND2001, Tsukuba, Japan, October 7 – 12, 2001, Abstracts, 4-P-6.
40. Popov Yu.P., Voinov A.V., Parzhitski S.S., Kobzev A.P., Gundorin N.A., Serov D.G., Sedyshev P.V., Sedysheva M.V. Analysis of the partial neutron capture cross sections by 58Ni nucleus. 8 International Seminar on Interaction of Neutrons with Nuclei. Neutron Spectroscopy, Nuclear Structure, Related Topics. ISINN-8, Dubna, May 17-20, 2000, E3-2000-192, 75-81.
41. Prokofjevs P., Boneva S., Khitrov V.A., Sukhovoj A.M., a.o. Nuclear Structure of 166Ho Studied in Neutron-Capture, (d,p) and (d, 3He) Reactions. //Межд. конф. по яд. физике. Кластеры в ядерной физике: Тезисы докл. (L Совещ. по яд. спектроскопии и структуре ат. ядра), Санкт-Петербург, июнь 2000. - СПб.: ПИЯФ, 2000, p.161.
42. Stan O.A., Luicaciu A., Frontasyeva M.V., Steinnes E. New results from air pollution studies in Romania. Proceedings of NATO ARW «Man-Made Radionuclides and Heavy Metals in the Environment». (M.V.Frontasyeva, P.Vater and V.P.Peregygin–edts.) Kluwer Academic Publishers, NATO Science Series. 2001, IV. Earth and Environmental Sciences – Vol. 5, p. 179-190.

43. Stephenson S.L., Crawford B.E., Bowman C.D., Tornow W., Muzichka A.Yu., Sharapov E.I. Collision rate in the proposed nn-scattering experiment at the reactor Yaguar, IX International Seminar on Interactions of Neutrons with Nuclei, ISINN-IX, E3-2001-192, Joint Institute for Nuclear Research, Dubna, 2001, p. 84.
44. Sukhovoi A.M., Khitrov V.A. Experimental study of transformation process of low-lying levels in N. Bohr's compound state. LI Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus, Abstracts, Sarov, Russia, September 2001, p 160.
45. Tsertsvadze L.A., Dzadzamia T.D., Petriashvili Sh.G., Shutkerashvili D.G., Kirkesali E.I., Frontasyeva M.V., Pavlov S.S., Gundorina S.F.. Proceedings of NATO ARW «Man-Made Radionuclides and Heavy Metals in the Environment». (Frontasyeva M.V., Vater P. and Peregygin–edts V.P.) Kluwer Academic Publishers, NATO Science Series. 2001, IV. Earth and Environmental Sciences – Vol. 5, p. 1245-257.
46. Vasilieva E.V., Grigoriev E.P., Sukhovoj A.M., Khitrov V.A. Spectroscopic data on 156,158Gd and 168Er nucei from the reactions (n,2γ) and (n,γ). // International Conference on Nuclear Physics. Clusters in Nuclear Physics: Abstracts. (L Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus), Saint Petersburg, June, 2000. - SPb.: PINP, 2000, p.156.
47. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Cascade gamma-decay of 80Br compound states. LI Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus, Abstracts, Sarov, Russia, September 2001, p.164.
48. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Level densities, radiative strength functions and basic properties of heavy nuclei below Bn. //International Conference on Nuclear Physics. Clusters in Nuclear Physics: Abstracts. (L Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus), Saint Petersburg, June, 2000. - SPb.: PINP, 2000, p.199.
49. Vasilieva E.V., Sukhovoj A.M., Khitrov V.A. Two-quanta gamma-cascades after thermal neutron capture in 39K. // International Conference on Nuclear Physics. Clusters in Nuclear Physics: Abstracts. (L Workshop on Nuclear Spectroscopy and Structure of Atomic Nucleus), Saint Petersburg, June, 2000. - SPb.: PINP, 2000, p.158.
50. Zeinalov Sh.S., Florek M., Furman W.I., Kriachkov V.A., Zamyatnin Yu.S. Neutron Energy Dependence of Fission Fragment Mass & TKE Distributions of 235U(n,f)- Reaction Below 10 eV. //Dynamical Aspects of Nuclear Fission: Proc.of the 4-th Intern.Conf.on..., Casta-Papiernicka, Slovak Republic, Oct. 1998. - Singapore etc.: World Sci., 2000, p.417-423.

THE IBR-2 SPECTROMETER COMPLEX AND COMPUTATION INFRASTRUCTURE

1. Aksenov V.L., Balagurov A.M., Bokuchava G.D., Zhuravlev V.V., Kuzmin E.S., Bulkin A.P.,.Kudriashov V.A, Trunov V.A. Neutron fourier diffractometer FSD for internal stress analysis. First results. JINR Communication P13-2001-30 (in Russian).
2. Astakhov Yu., Prikhodko V., Sukhomlinov G. Prospects for Developing the FLNP JINR Local Computing Network. Book of Abstract of NEC'2001, p.p. 12-13.
3. Astakhova N.V., Kirilov A.S. Temperature Control in the Sonix Control Software. JINR E10-2001-11, Dubna 2001, p.p. 272-274.
4. Astakhova N.V., Kirilov A.S., Salamatin I.M. Remote Control of the YUMO Spectrometer and User Interface. JINR E10-2001-11, Dubna 2001, p.p. 275-278.
5. Astakhova N.V., Kirilov A.S., Salamatin I.M. Program of Visualization of Sample Environmental Characteristics in Sonix Control Software. JINR E10-2001-11, Dubna 2001, p.p. 269-271.
6. Belushkin A.V., Manoshin S.A. Monte Carlo Optimisation of SANS Spectrometer at IBR-2 Reactor. J. Phys. Soc. Jpn, 70 (2001) pp. 451-452 (In English).
7. Belushkin A.V., Manoshin S.A. Simulating of virtual SANS spectrometers at IBR-2 reactor, Dubna, 2001, (submitted in to Journal of Neutron Research, preprint JINR also, In English).
8. Belushkin A.V., Manoshin S.A. The project of SANS spectrometer at the IBR-2 reactor, Differentials equations and applied problems, Tula State University, 2000. (In Russian).
9. Bogdzel A., Gundorin N., Matveev D. Electronics for a 16 Channel BGO Scintillation Detector. Book of Abstracts of XVIII JINR International Symposium on Nuclear Electronics and Computing (NEC'2001), September 12-18, 2001, Varna, Buldaria, p.l5. (full paper will published in Proc. NEC'2001).
10. Butenko V.,.Drozdov V., Gebauer B.et al. Application of DSP in Date Acquisition Systems for Neutron Scattering Experiments at the IBR-2 Pulsed Reactor. Proc. of Inter. Conf. on Computing in High Energy and Nuclear Physics (CHEP'2001), September 3-7, 2001, Beijing, China, p.p.560-561.
11. Butenko V.A.et al. RTOF-correlator of the parralel-serial type for Fourier diffractometer at steady-state neutron sources. JIRN E10-2001-11, Dubna 2001, p.p.120-124.
12. Desiati P., Leich H., Drozdov V.et al. The Digital Analog Optical Module (DAOM) – a Technology for the AMANDA Experiment at the South Pole. Proc. of Inter. Conf. CHEP'2001, p.p. 570-571
13. Gebauer B., Schulz Ch., Richter G., Levchanovski F., Nikiforov A. Development of a Hibrid MSGC Detector for Thermal Neutron Imaging with a MHz Data Acquisition and Histogramming System. NIM A 471 (2001), p.p. 249-253.
14. Glazkov V.P., Kozlenko D.P., Savenko B.N., Somenkov V.A., Telepnev A.S."Hybridization of Libron and Phonon Modes in NH4I : Neutron Spectroscopy Studies at Pressures up to 10 Gpa.

15. Glazkov V.P., Kozlenko D.P., Savenko B.N., Somenkov V.A., Telepnev A.S."High Pressure Inelastic Neutron Scattering Studies at IBR-2 Reactor" International Workshop on Crystallography at High Pressures, September 4-8, 2001, Orsay-Saclay, France.
16. Kirilov A. Current State and Prospects of the IBR-2 Instrument Date Acquisition Systems. Book of Abstract of the Second German-Russian User Meeting "Condensed Matter Physics with Neutrons", April 21-24, FLNP JINR, Dubna, Russia, p.p.206-211 (full paper will published in Proc. of the Workshop).
17. Kirilov A.S. Current State and Perspectives of the IBR-2 Instrument Control Software. Proceedings of the Second International Workshop on Data Acquisition Systems for Neutron Experimental Facilities DANEF-2000, JINR E10-2001-11, Dubna 2001, p.p. 206-211.
18. Kirilov A.S. Script Interpretation in the Sonix Control Software. JINR E10-2001-11, Dubna 2001, p.p. 318-321.
19. Korobchenko M., Levchanovski F. The Use of Integral TDCs with Picosecond Resolution at the IBR-2 Spectrometers. Book of Abstract of NEC'2001, p.28.
20. Kuklin A.et al. Control Systems of Executive Mechanisms of Experimental Setups at the IBR-2 Pulsed Reactor. Book of Abstract of NEC'2001, p.29.
21. Kuklin A.I., Sirotin A.P. et al. Control systems for executive mechanisms of the IBR-2 experimental instruments. Conference on Nuclear Electronics, September 13-15, 2001, Varna, Bulgaria (in Russian).
22. Kuzmin E.S., Balagurov A.M., Bokuchava G.D., Zhuk V.V., Kudryashev V.A. Time-focused Large area Counters on the Base of ZnS(Ag)/LiF screen and WLS-fibers readout. Russian-German Meting, Dubna, 2001. Proceedings of the Second German-Russian User Meeting, E14-2001-215, Dubna, 2001.
23. Kuzmin E.S., Balagurov A.M.,.Bokuchava G.D, Zhuk V.V.,.Kudryashev V.A, Bulkin A.P., Trunov V.A. Detector for the FSD Fourrier-diffractometer based on ZnS9Ag)/LiF scintillation screen and wavelength shifting fiber resdout. Communication of the JINR, E13-2001-204.
24. Levchanovski F. DSP-based Neutron Spectrometer DAQ Systems and the Adaptability Problem. Book of Abstract of Inter. Workshop on Position-Sensitive Neutron Detectors (PSND), June 28-30, 2001, HMI, Berlin, Germany, p.p. 86-87 (full paper will published in NIM).
25. Levchanovski F.V.et al. A PCI DAQ Board for a Two-Dimentional High-Resolution Delay Line Detector, JINR E10-2001-11, Dubna 2001, p.p.89-95.
26. Litvinenko E.I. The Implementation of NeXus Data Format in OpenG2 Software Package. JINR E10-2001-11, Dubna 2001, p.p. 227-241.
27. Litvinenko E.I., Pikelner T.L., Prikhodko A.V., Semenov R.N. Hypertext Information System on Neutron Sources and Neutron Instruments, Proceedings of the International Workshop on Computer Science and Information Technologies CSIT-2001, Ufa, Yangantau, Russia, 2001.
28. Litvinenko E.I., Semenov R.N. The Experience with Testing of TACO System. JINR E10-2001-11, Dubna 2001, p.p. 242-250.
29. Manoshin S.A., Belushkin A.V. About calculation of mirror neutron guide by Monte Carlo method. The advanced version of the program mcguide-new, Proceeding of 4th conference of young sciences and specialists JINR, Dubna, 2000, (In Russian).
30. Murashkevich S.M., Kirilov A.S. DAQ Control in the Sonix Control Software. JINR E10-2001-11, Dubna 2001, p.p. 251-255.
31. Petukhova T.B. Software for the Control System of X-Ray Diffractometers DRON and SAX. JINR E10-2001-11, Dubna 2001, p.p. 256-263.
32. Petukhova T.B., Kirilov A.S. Step Motor Control in the Sonix Control Software. JINR E10-2001-11, Dubna 2001, p.p. 264-268.
33. Poliakov V.N.et al. The Way a Common Specification for Interfaces between Layers in the Neutron Spectrometers DAQ Systems. JIRN E10-2001-11, Dubna 2001, p.p. 322-327.
34. Savenko B.N., Glazkov V.P., Kozlenko D.P., Somenkov V.A., Telepnev A.S. Inelastic neutron scattering investigations of vibrational spectra at high pressures, RSNE-2001, May 21-25, 2001, Moscow (in Russian).
35. Savenko B.N., Glazkov V.P., Kozlenko D.P., Somenkov V.A.,Telepnev A.S. "INS Study of Vibrational Spectra of at Very High Pressures" International Conference on Netron Scattering, September 9-13, 2001, Munich, Germany
36. Schulz Ch., Gebauer B., Balykov L., Richter G., Levchanovski F., Nikiforov A. Development of High-Resolution, Large-area Hybrid MSGC detector for Thermal Neutron Imaging, Abstract of PSND, p.p. 74-76.

6. PRIZES

JINR Prizes:

Applied Physics Research*:*

Second Prize:

K.Walther, T.I.Ivankina, A.N.Nikitin, K.Ullemeyer, K.Szeffzuk. "Neutronography in Geology and Geophysics".

Special Prize:

Yu.A.Alexandrov, Yu.S.Zamyatnin, A.V.Ignatyuk, M.V.Kazarnovsky, V.Yu.Konovalov, N.V.Kornilov, L.B.Pikelner, V.I.Plyaskin, Yu.P.Popov, W.I.Furman. "Low-Energy Neutrons and their Interaction with Nuclei and Matter".

Encouraging Prizes:

N.Gorski, J.Kalus, Yu.M.Ostanevich. "SANS Investigations of Self-Assembling Aggregates".

E.A.Bondarchenko, Yu.N.Pepyolyshev, A.K.Popov. "Experimental and Model Investigations of IBR-2 Pulsed Reactor Dynamics Peculiarities".

***FLNP Prizes*:**

In Nuclear Physics:

First Prize:

V.K.Ignatovich. «Apocrypha of Standard Scattering Theory and Quantum Mechanics of de Broglie Wave Packet».

Second Prize:

S.B.Borzakov, H.Faikov-Stanczyk, Ts.Panteleev, S.A.Telezhnikov. «Study of the Reaction of Thermal Neutron Capture by ^{117}Sn Nuclei».

Third Prize:

V.K.Ignatovich, E.V.Lychagin, G.V.Nekhaev, A.Yu.Muzychka, A.V.Strelkov. «Transport of Neutrons in Closed Vessels».

In Condensed Matter Physics:

First Prize:

A.M.Balagurov, V.Yu.Pomjakushin, D.V.Sheptyakov, V.L.Aksenov. «Long-Scale Separation versus Homogeneous Magnetic State in $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$: a Neutron Diffraction Study».

Second Prize*:*

I.Natkaniec. «Investigation of Intermolecular Interactions of Polydimethysilane at Adsorption on the Surface of SiO_2 Silica Nanoparticles».

Third Prize:

I.Natkaniec, A.M.Balagurov, A.I.Beskrovnyi, I.G.Shelkova, V.G.Simkin, L.S.Smirnov. «Investigation of Phase Transitions and Dynamics of Mixed Crystals of the Type $A_{2-x}C_xBX_4$ and $Rb_{1-x}(NH_4)_xI$».

8.1. STRUCTURE OF LABORATORY AND SCIENTIFIC DEPARTMENTS

Directorate:
Director:
A.V.Belushkin
Deputy Director:
W.I.Furman
Scientific Secretary:
V.V.Sikolenko

Reactor and Technical Departments
Chief engineer: V.D.Ananiev
IBR-2 reactor
Chief engineer: A.V.Vinogradov
Department of IREN
Head: V.G.Pitaev
IBR-30 booster + LUE-40 Group
Head: S.A.Kvasnikov
Mechanical maintenance division
Head: A.A.Belyakov
Electrical engineering department
Head: V.P.Popov
Design bureau
Head: A.A.Kustov
Experimental workshops
Head: A.N.Kuznetsov

Scientific Departments and Sectors
Condensed matter department
Head: V.L.Aksenov
Nuclear physics department
Head: V.N.Shvetsov
Department of IBR-2 spectrometers complex
Head: A.V.Belushkin
Nuclear Safety and applied research sector
Head: E.P.Shabalin

Administrative Services
Deputy Director: S.V.Kozenkov
Secretariat
Finances
Personnel

Scientific Secretary Group
Translation
Graphics
Photography
Artwork

CONDENSED MATTER DEPARTMENT

Sub-Division	Title	Head
Diffraction sector. Head: A.M.Balagurov		
Group No.1	HRFD	V.Yu.Pomjakushin
Group No.2	DN-2	A.I.Beskrovnyi
Group No.3	DN-12	B.N.Savenko
Group No.4	NSVR	A.N.Nikitin
Group No.5	SKAT	K.Ullemeyer
Small-angle neutron scattering group. Head: V.I.Gordeliy		
Neutron optics sector. Head: V.L.Aksenov		
Group No.1	SPN-1	Yu.V.Nikitenko
Group No.2	REFLEX	D.A.Korneev
Inelastic scattering group. Head: I.Natkaniec		
Biophysics investigations group. Head: I.N.Serdyuk		

NUCLEAR PHYSICS DEPARTMENT

Sub-Division	Title	Head
Group No.1	Polarized neutrons and nuclei	Yu.D.Mareev
Group No.2	Neutron spectroscopy	Yu.N.Kopatch
Group No.3	Nuclear fission	Sh.S.Zeinalov
Group No.4	Thermal polarized neutrons	M.I.Tsulaya
Group No.5	Proton and α-decay	Yu.M.Gledenov
Group No.6	Properties of γ-quanta	A.M.Sukhovoy
Group No.7	Neutron structure	G.S.Samosvat
Group No.8	Ultra-cold neutrons	
Group No.9	Neutron optics	A.I.Frank
Group No.10	Neutron activation analysis	M.V.Frontasyeva
Group No.11	Theory	V.K.Ignatovich

DEPARTMENT OF IBR-2 SPECTROMETERS COMPLEX

Sub-Division	Title	Head
Sector No.1	Electronics	V.I.Prikhodko
Group No.1	Analogous electronics	A.A.Bogdzel
Group No.2	Digital electronics	V.F.Levchanovsky
Group No.3	Software	A.S.Kirilov
Group No.4	Local networks	G.A.Sukhomlinov
Group No.5	Technology	A.B.Melnichuk
Sector No.2	Spectrometers	V.V.Zhuravlev
Group No.1	Development	G.A.Varenik
Group No.2	Samples environment	A.P.Sirotin
Group	Detectors	E.S.Kuzmin

8.2. USER POLICY

The IBR-2 reactor usually operates 8 cycles a year (2000 hrs.) to serve the experimental programme. A cycle is established as of 2 weeks of operation for users, followed by a one week period for maintenance and machine development. There is a long shut-down period between the end of June and the middle of October.

All experimental facilities of IBR-2 are open to the general scientific community. The User Guide for neutron experimental facilities at FLNP is available by request from the Laboratory's Scientific Secretary.

Condensed matter studies at IBR-2 have undergone some changes in accordance with the experience gained during the last several years. It was found to be necessary to establish specialized selection committees formed of independent experts in their corresponding fields of scientific activities. The following four committees were organized:

1. Diffraction *Chairman* - V.A.Somenkov - Russia	3. Neutron optics *Chairman* - A.I.Okorokov - Russia
2. Inelastic scattering *Chairman* - W.Nawrocik - Poland	4. Small angle scattering *Chairman* - L.Cser - Hungary

Scientific Secretary, Dr. Vadim V.Sikolenko is responsible for the user policy. Deadline for proposal submission is May 16.

The IBR-2 beam schedules are drawn up by the head of the Condensed Matter Department together with instruments responsibles on the basis of experts recommendations and are approved by the FLNP Director or Deputy Director for condensed matter physics. The schedules are sent to Chairmen of Selection Committees.

After the completion of experiments, "Experimental Report" forms are filled out by experimenter(s) and submitted to the Scientific Secretary.

The Application Form and other information about FLNP are available by WWW: http://nfdfn.jinr.ru/

Contact address:

Dr. V.Sikolenko, *Frank Laboratory of Neutron Physics*
Joint Institute for Nuclear Research
141980 Dubna, Moscow region, Russia
Tel.: (+7)-095-926-22-53, Fax: (+7)-09621-65085; (+7)-09621-65484;
E-mail: Vadim.Sikolenko@jinr.ru

8.3. MEETINGS AND CONFERENCES

In 2001, FLNP organized the following meetings:

1.	IX International Seminar on Interaction of Neutrons with Nuclei (ISINN-9)	May 17-20	Dubna
2.	School on Neutron Scattering and Synchrotron Radiation,	March 19 – April 27	Dubna
3.	IBR-2 in the XXI century. User's Meeting	May 24-26	Dubna

In 2002, FLNP will organize the following meetings:

1.	X International Seminar on Interaction of Neutrons with Nuclei (ISINN-10)	May 22-25	Dubna
2.	School on Neutron Scattering and Synchrotron Radiation	February 8 – March 7	Dubna
3.	JINR-Romania Workshop on Material Science	March 22-25	Dubna
4.	IBR-2 User's Meeting	June 17-19	Dubna

8.4. COOPERATION

List of Visitors from Non-Member States of JINR in 2001

Name	Organization	Country	Dates
M.M.El-Saied	NRC, AEA, Cairo	Egypt	01.01-12.03
A.H.Murbut	University of Bagdhad	Iraq	01.01-17.11
G.Pepy	LLB, Saclay	France	09.01-18.01
V.Lauter	ILL, Grenoble	France	17.01-27.01
H.-J.Lauter	ILL, Grenoble	France	20.01-27.01
W.Kraan	TU Delft	The Netherlands	20.01-25.01
M.Rekveldt	TU Delft	The Netherlands	20.01-25.01
D.Aston	London University	UK	04.02-08.02
A.Lloid	London University	UK	04.02-08.02
S.D.Hope	London University	UK	04.02-08.02
K.Walther	GeoFRZ, Potsdam	Germany	27.02-04.03
S.S.Bhatti	ABZ AGGREGATE-BAU	Germany	27.02-04.03
V.V.Chupin	University of Utrecht	The Netherlands	05.03-06.03
F.Haussler	Leipzig University	Germany	19.03-26.03
A.Frischbutter	GeoFRZ, Potsdam	Germany	22.03-06.04
Ch.G.Geibel	Inst. of Chem. Phys. Sol. State, Dresden	Germany	04.04-04.04
S.A.Danilkin	HMI, Berlin	Germany	08.04-25.04
M.Jung	TU, Darmstadt	Germany	09.04-20.04
M.Hoelzel	GSI, Darmstadt	Germany	17.04-25.04
K.Walther	GeoFRZ, Potsdam	Germany	19.04-26.04
G.Klose	Leipzig University	Germany	19.04-21.04
A.Frischbutter	GeoFRZ, Potsdam	Germany	19.04-26.04
V.Lauter	ILL, Grenoble	France	20.04-30.04
H.-J.Lauter	ILL, Grenoble	France	20.04-30.04
A.A.Nikolaev	Uhlm University	Germany	21.04-22.04
B.H.Tietze-Jaensch	FZ, Julich	Germany	29.04-01.05
O.Steinsvoll	Inst. for Energy Technology,Kjeller	Norway	13.05-26.05
Kang Youn Soo	Pusan National University	Korea	14.05-09.06
J.Teixeira	LLB, Saclay	France	19.05-26.05

D.Radnovic	Univ. of Novi Sad	Yugoslavia	22.05-28.05
V.V.Chupin	University of Utrecht	The Netherlands	23.05-24.05
D.Richter	FZ, Julich	Germany	24.05-27.05
M.C.B.Funel	LLB, Saclay	France	29.05-30.05
P.Fischer	PSI, Villigen	Switzerland	31.05-02.06
A.Schenck	PSI, Villigen	Switzerland	31.05-03.06
S.Billindge	University of Michigan	USA	20.06-23.06
Ya.Veyberman	University of Rochester	USA	01.06-25.06
M.Rudalics	RISC, JK Univ., Linz	Austria	01.07-01.08
T.Kavai	RRI, Kyoto University	Japan	22.07-27.07
Ya.Tsuruta	RRI, Kyoto University	Japan	19.08-25.08
M.Shimonaka	RRI, Kyoto University	Japan	19.08-25.08
R.Machrafi	Univ.Mohamed V.Rabat	Morocco	25.08-31.12
D.Richar	ILL, Grenoble	France	22.09-29.09
A.Chatt	Dalhausie University, Halifax	Canada	03.10-13.10
A.Gabriel	European Molecular Biology Lab., Grenoble	France	08.10-17.10
K.Walther	GeoFRZ, Potsdam	Germany	08.10-26.10
K.N.Clausen	FZ, Julich	Germany	08.10-12.10
P.Tindemann	FZ, Julich	Germany	08.10-12.10
H.Kuzmani	Inst. fur Materialphysik, Vienna	Austria	23.10-24.10
A.Frischbutter	GeoFRZ, Potsdam	Germany	08.11-14.11
Kang Youn Soo	Pusan National University	Korea	11.11-18.12
Kim Gui Nyun	Kyungpook Nat. Univ., Taegu	Korea	11.11-20.11
Lee Dae Won	Kyungpook Nat. Univ., Taegu	Korea	14.11-20.11
V.Lauter	ILL, Grenoble	France	19.11-25.11
H.-J.Lauter	ILL, Grenoble	France	19.11-25.11
G.Klose	Leipzig University	Germany	19.11-25.11
T.A.Salama	NRC, AEA, Cairo	Egypt	06.12-06.03.02

8.5. EDUCATION

The objective of the FLNP educational program is the training of specialists in the field of neutron methods for condensed matter and nuclear physics research. In the year 2001 in Moscow State University named after M.V.Lomonosov the neutron diffraction division as a part of physics department was opened and it is a basic department for FLNP. In addition to the students of this department, the students of the MSU Interfaculty Center «Structure of Matter and New Materials» carry out their diploma work in FLNP. In the Center the students from the Chemical Faculty of MSU, Higher College of Materials Sciences under MSU, Tula State University, Tula Pedagogical University, Tver State Univesity and other universities of Russia and JINR member-states do the course.

In the year 2001, the traditional annual Spring School on Neutron Scattering for Condensed Matter Research was organized by FLNP in cooperation with MSU. The participants listened to the lectures by eminent scientists and did a series of practical works at the IBR-2 reactor and other JINR facilities under the guidance of FLNP specialists.

8.6. PERSONNEL

Distribution of the Personnel per Department as of 01.01.2001

Theme	Departments	Main staff
-0974-	Nuclear Physics Department	60.5
-1031-	Condensed Matter Physics Department	48.5
-1012-	IBR-2 Spectrometers Complex Department	53.5
-0993-	IREN Department	22.5
-1007-	Nuclear Safety Sector	14.75
-0851-	IBR-2 Department	51
	Mechanical and Technical Department	61
	Electric and Technical Department	34
	Central Experimental Workshops	39
	Design Bureau	8
	FLNP infrastructure:	
	Directorate	6
	Services and Management Department	22
	Scientific Secretary Group	6
	Supplies Group	5
Total		**432**

Personnel of the Directorate as of 01.01.2001

Country	People
Azerbaijan	1
Armenia	1
Bulgaria	2
Egypt	1
Germany	4
Georgia	2
Kazakhstan	1
Mongolia	2
Poland	5
Romania	4
Russia	20
Ukraine	1
TOTAL	**44**

8.7. FINANCE

Financing of the FLNP Scientific Research Plan in 2001 (th. USD)

No.	Theme	Financing plan, $ th.	Expenditures for 12 months, $ th.	In % of FLNP budget
I	**Condensed matter physics**	**4067.8**	**1979.8**	**48.7**
	-1031-	2514.6	1186.2	47.2
	-0851-	929.2	483.3	52.0
	-1012-	624.0	310.3	49.7
II	**Neutron nuclear physics**	**1121.4**	**618.0**	**55.1**
	-1036-	647.6	420.1	64.9
	-0993-	473.8	197.9	41.8
III	**Elementary particle physics**			
	-1007-	**6.2**	**20.0**	**322.5**
IV	**Relativistic nuclear physics**			
	-1008-	**41.6**	**8.8**	**21.1**
V	**TOTAL:**	**5237.0**	**2626.6**	**50.2**