3. THE IBR-2 SPECTROMETERS COMPLEX AND COMPUTING INFRASTRUCTURE

In 2002, work under theme 1012 was carried out in accordance with the FLNP projects: MCC, FSD, YuMO, Texture, SPN, as well as the BMBF-JINR projects: Detectors and ECS.

Main directions of activity:

1. development of the information and computing infrastructure;
2. creation of data acquisition and control systems of the IBR-2 spectrometers;
3. development of the IBR-2 spectrometer complex:
   - automation of spectrometers and development of sample environment systems;
   - creation of neutron detectors;
   - routine maintenance of spectrometers.

1. Local area network. In the FLNP local area network (LAN) the router of information flows CISCO 8510 was installed and put into operation. For direct connection of the SUN-cluster servers via twisted pairs the 8-port interface CISCO C85FE-8-16K was purchased. In buildings 117 and 44 the high-speed commutators Catalist 29XX (CISCO) were installed and connected to the central segment of the network via optical communication lines. All the network printers of the Laboratory that exhausted their resource were replaced. The logical reconfiguration of LAN was conducted and a changeover to new versions of the network software was carried out.

The completion of the first stage of the specified works on the LAN modernization made it possible:

— to increase real throughput of the network by 50-60 % without changing physical interfaces;
— to provide mechanisms of control, analysis and filtration of the network traffic;
— to extend address space (at present, up to 4000 IP-addresses);
— to organize virtual subnetworks for groups of users (or spectrometers) irrespective of their geographical location (in 2002, four subnetworks were created: NP, CMP, SEDSC and IBR-2 reactor building);
— to provide a guaranteed passband for the most important network applications (for example, for concrete spectrometers).

2. Data acquisition systems. Work to modernize detector electronics and to optimize characteristics of the VME data acquisition systems at the IBR-2 spectrometers (DN-2, YuMO, DN-12, EPSILON) was performed.

In cooperation with HMI, Berlin, a new version of the unified TDC/DSP DAG block for acquisition and accumulation of data from position-sensitive detectors with delay line data readout, was developed and manufactured. In the block, the determination of X/Y coordinates of the event (by signals from both ends of the delay lines) and neutron time of flight from the reactor start to the moment of detection, is executed; for the methodical purposes the amplitude of signals is measured as well. Two main operating modes are provided: histogram (on-line sorting of data and building of spectra) and "list" (accumulation of raw data with subsequent off-line processing). It is also possible to simultaneously accumulate histograms (for controlling the experiment) and to write raw data. The TDC/DSP block has a PCI-interface and is installed directly in the case of PC. At present, the adjustment of electronics and debugging of microprograms (DSP) of the block are under way.

For this block the architecture was developed and the debugging of the prototype of the program driver was carried out. The driver provides interaction between the program modules of the low (DSP) and following (PC) levels for several variants of basic software packages: C++, PV-WAVE, ROOT (for more details see Experimental Reports).

New low-noise preamplifiers for MWPC and point detectors, as well as read-out electronics for scintillation detectors ASTRA were developed. Four multiprocessor blocks of RTOF-analyzers (16 channels) were adjusted.

The development of the unified software for the Fourier-diffractometers was completed and its testing on FSD is in progress.

The concept of a new generation of the software for data acquisition and control systems of spectrometers on the basis of VME-PCI adapters was worked out. The interface programs were developed and their trial operation is carried out on the NERA-PR spectrometer (for more details see Experimental Reports).

For the SPN spectrometer the programs for positioning the polarizer and controlling current sources were developed. The open G2 program was supplemented by new possibilities for processing data from YuMO and SPN.

In the reported year, work to improve and provide service support of the software of the data acquisition and accumulation systems on all IBR-2 spectrometers, was conducted.

3. Development and routine maintenance of the IBR-2 spectrometer complex.

3.1. Development of sample environment systems.

On the YuMO spectrometer the system consisting of 2 ring replaceable collimators based on step motors under control of the program of experiment **(Fig. 1)** was put into operation.

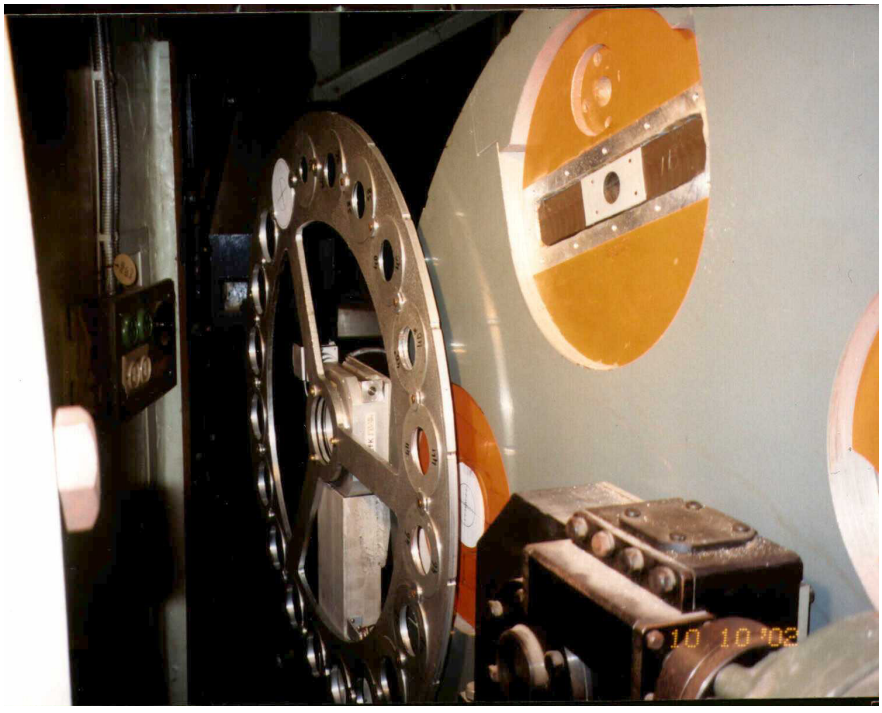

Fig.1. *Two ring replaceable collimators at the YuMO spectrometer.*

Work to modernize the control systems of choppers based on microcontrollers **(Fig. 2)** was performed for the spectrometers: YuMO, HRFD, REFLEX (chopper and monochromator) and SPN (two choppers).

Fig.2. *Chopper controller.*

The closed cycle cryostat КГУ801 for reaching a temperature of 4.2K (**Fig. 3**) was developed. The cryostat КГУ801 based on the two-stage cryogenerator RGD1245 makes it possible to obtain a constant temperature at the sample of about 4.2K using the Joule-Thomson stage.

Fig.3*. Closed cycle cryostat КГУ801 on the basis of two-stage cryogenerator RGD1245.*

A high-pressure chamber of the "toroid" type for conducting neutron diffraction investigations of structure and lattice dynamics of condensed matter was created. The volume of a studied sample is 60-100 mm^3. The chamber was graduated using the manganin pressure sensor and by the known equations of reference material state. The maximum pressure in the chamber was 10GPa, which is a record in lattice dynamics research.

3.2. Creation of neutron detectors.

In 2002, research and development of different types of neutron detectors for the IBR-2 spectrometers were carried out.

- For the FSD diffractometer, 8 working elements of wide-aperture scintillation (ZnS) ±90º-detector with time focusing ASTRA were produced, tested and put into operation. Tests have demonstrated a high quality of manufacture and complete compliance of detector parameters with the calculated values. The solid angle of each module was increased by a factor of 2 as compared with the experimental model.

- To upgrade the detector system of the DN-12 spectrometer, the method of "rough" time focusing was suggested, which makes it possible to create economical detectors with a large solid angle for classical time-of-flight spectrometers with a large flight path. The method provides for a considerable solid angle with the help of economical small-area detectors. Thus, a high resolution of the spectrometer is ensured.

- Under the contract with IPM RAS (Nizhni Novgorod, Russia) microstrip structures with a “virtual cathode” were manufactured on special glass substrates (made of glass Schott S8900) with electron conductivity. The strip layout and coordinate readout using the division of charge from two ends of a resistive wire, are analogous to the Bidim80 detector developed and constructed in ILL. These structures were tested in ILL. The results of the tests have demonstrated a high quality of the microstructures and their suitability for use in neutron detectors. At present, two glass substrates with microstrip structures manufactured in IPM are in ILL and will be used in the operating detectors to check their long-term characteristics. One substrate is installed in the body of the detector manufactured in FLNP and prepared for tests..

- In collaboration with EMBL and LNP JINR the construction of a stand for creating proportional multiwire neutron detectors was started. The equipment to control the pitch of wire winding was purchased. The stand for testing MWPC detectors with delay line data readout was equipped with electronics.

- The prototype of the medium resolution multiwire detector with individual signal readout from every wire was designed and constructed. The detector working area is 8×8 cm^2. The distribution of counts from neighboring wires for X and Y planes is presented in **Fig.4**.

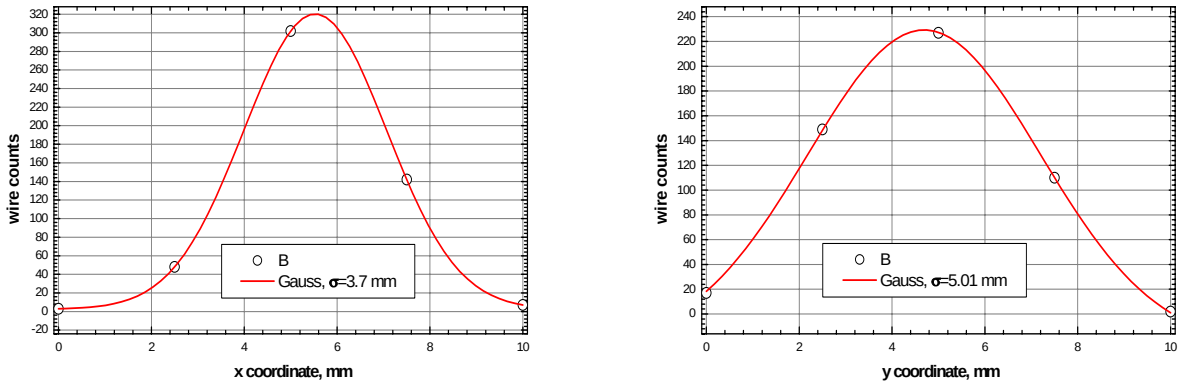

***Fig.4**. Distribution of counts from neighboring wires for X (left) and Y (right) planes of the detector exposed to a collimated alpha-particle beam.*

In the reported year, the equipment of spectrometers was prepared for operation and serviced for conducting experiments in 8 cycles of the IBR-2 reactor.