5th Workshop on the Scientific Cooperation between German Research Centres and JINR

SUMMARY

The participants of the workshop have discussed the research work supported by BMBF, which comprises following main lines:

- Theoretical Physics
- Condensed Matter Physics with Neutrons
- Heavy Ion Physics
- High Energy Physics at DESY
- Perspective Projects at GSI and DESY.

Details of these topics and joint projects are given in the reports provided by the different groups.

The workshop participants stated:

The cooperation between JINR and German research centres and scientific groups based on bilateral Agreements and on the JINR–BMBF Agreement, started in 1991 and continued 4 times till now, has been successfully developed over the past years. The joint scientific programme and experiments are being continuously developed to meet the current interests of the participating institutions. Today JINR carries out research activities with 71 institutions (including 40 universities) in 45 German cities. About 280 papers per year are published in refereed journals and proceedings of international conferences. These joint publications are the best argument for continuation of our cooperation and development of common research programmes.

Theoretical Physics

The "Heisenberg-Landau Programme (HLP)" has continued to be an effective tool for maintaining and developing the cooperation in Theoretical Physics between JINR (especially the Bogoliubov Laboratory of Theoretical Physics) and German Scientific Groups from about 60 institutions. Established in 1992, this programme focuses on: Elementary Particle and Fields, Nuclear Physics, Solid State Physics, and Modern Mathematical Physics. It supports short-term research visits to Dubna and to German universities and research centres, as well as conferences, workshops which relate to joint studies on problems in Theoretical Physics.

In the period from 2002-2004 the programme developed successfully. About 8 conferences, workshops, schools and 35 joint projects were sponsored per year. In the framework of the HLP, about 280 joint publications were prepared in 2002–2004.

New aspects in the period 2002–2004 were

- The development of summer schools at Dubna. Additional support from BMBF in 2002, 2003 initiated new activities (DIAS-TH, HISS) and should be continued in future.
- New fields of research have been included, in particular in the programmes of schools: astroparticle physics, econophysics. This opens perspectives to use the expertise in theoretical physics for other fields.
- An important perspective is the inclusion of young physicists (from Western Europe and FSU) who are trained by experts from Germany and Russia.
- The HLP-work contributed also to the recent theoretical and experimental activities at DESY, GSI, and FZ Jülich, in particular to the future projects ILC and FAIR.

In conclusion, the HLP yields from a relatively small amount of money a large number of activities. It is highly recommended to continue this programme.

Condensed Matter Physics with Neutrons

The studies in Condensed Matter Physics are based on the high-flux pulsed reactor IBR-2, a leading basic facility of JINR The long pulse together with the new developed cold moderators result in the unique feature of a broad band-width wavelength spectrum tailored for individual requirement of the instruments. The development of the cold moderators at JINR represents a milestone in the development of new, more effective cold sources. Moreover, the first step in the refurbishment of the IBR-2 reactor, the replacement of the reflector, has led to an improvement of the pulse shape. Thus for a certain class of spectrometers it is of enormous advantage to be sited at a long-pulsed broad-wavelength source. The unique research possibilities were successfully used in the German-JINR collaboration in the following projects on the spectrometers:

- the reflectometer REMUR
- the reflectometer REFLEX
- the diffractometers SKAT and Epsilon
- the small-angle spectrometer YuMO
- the stress diffractometer FSD, and
- the high-pressure diffractometer DN-12.

To this list adds the collaboration in the detector development and computer network which are necessary components for an efficient use of the instrumentation.

In the frame of the German–JINR collaboration, about 310 publications were prepared in 2002–2004. It is proposed to continue this highly efficient programme using the user policy as a basic tool for collaboration.

Among the common projects, two can be mentioned explicitly as they attract very much interest from the German user community.

The studies performed on SKAT and Epsilon showed very high-quality results justifying a further investment in this spectrometer. Similar spectrometers at FZ Jülich and GKSS are going to be shut down due to a decided or possible shut-down of the reactors at these research centres. The location of SKAT and Epsilon at the high-flux IBR-2 reactor and the planned experiment with a cold moderator and a new neutron guide will lead to an unprecedented scientific centre for earth science around this highly efficient spectrometer complex.

The second project concerns the use of Larmor precession techniques for the development of studies of nanoscience. An encoding of the angular scattering as well as of the energy of the neutron is obtained with the encoding of the phase of Larmor precessing neutrons. With this new technique, new access to characterization of nanostructures will be obtained. The reflectometers at the IBR-2 reactor are ideal as first-generation instruments utilizing the broad wavelength band of the neutrons. In particular, a horizontal reflectometer for biological nanostructures will profit from the encoding technique. Again, a neutron guide tailored to the cold/thermal moderator at the front end is needed.

In conclusion, the German-JINR collaboration can be further optimized with the two highlighted projects in addition to the running programme described above.

Heavy Ion Physics

The cyclotron complex of the Flerov Laboratory of Nuclear Reactions (FLNR) is the base for the joint experiments on physics of exotic light and superheavy nuclei. The FLNR set-ups ACCULINNA and COMBAS allow performing first-class experiments in the field of exotic nuclei with radioactive beams, complementary to the GSI research programme, as well as R&D and tests of perspective equipment for the GSI FAIR project, including advanced detector systems for R3B, EXL, and ELISe. The new VASSILISSA detector system opens up new possibilities in the study of the fusion-fission dynamics of transfermium nuclei in reactions with heavy ions, in the synthesis and study of decay properties of heavy and superheavy nuclei.

The development of effective ion sources for production of intense beams of highly charged ions of rare isotopes has been of great importance for the experimental programme.

In view of the positive and stable development of research in the field of heavy element research, investigation of exotic light nuclei and detector development, the collaboration in the field of heavy ion physics should be continued.

The HADES di-lepton spectrometer is used effectively for common investigations and has good perspectives for further common investigations. A very fruitful collaboration with VBLHE JINR for designing, prototyping and production of a novel transition radiation detector (TRD) and its infrastructure for the ALICE experiment has been developed.

The ANKE COSY programme is realized successfully. With the implementation of the polarized internal target at ANKE in 2005 it has good perspectives for new investigations in the field of few-nucleon reactions and spin physics which will be also important for the PAX experiment at GSI FAIR facility.

In the framework of joint JINR–BMBF projects, about 130 publications were prepared in 2002–2004.

High Energy Physics at DESY

Cooperation with HERA. The cooperation of JINR with high energy physics experiments at HERA was included in the JINR–BMBF Agreement in 1995. HERA is the world's unique electron-proton collider, with energies of 27.5 GeV of the polarized electron beam and of 920 GeV of the proton beam. JINR has joined the proton-nucleus experiment HERA B, the polarized eN experiment HERMES and the ep collider experiment H1. Major contributions have been made to the instrumentation and the operation of HERA B (large scale honey comb tracker), of HERMES (vertex drift chambers) and of H1 (forward and very forward proton Roman pot fibre detectors, scintillator tile calorimeter, backward proportional chamber). JINR physicists are engaged in key problems of the physics of the respective experiments with innovative analyses and contacts to Dubna theorists. In the near future their work is focused on efficient data taking and on the production of charm and beauty particles in pA collisions (HERA B), on understanding quark spin contributions in QCD (HERMES) and on the phenomenon of hard deep inelastic diffractive scattering (H1).

While HERA B stopped data taking in 2003, both HERMES and H1 continue to be operated until 2007. As the data analysis will be performed far beyond the end of HERA operation, it is foreseen to continue the fruitful collaboration beyond the end of this decade and to also develop the computing and analysis infrastructure at JINR further.

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Perspective Projects at GSI and DESY

A new feature of BMBF–JINR cooperation during the last few years is a mutual understanding of the need for coordination in the scientific policy definition. The plans for realizing the new projects at GSI and DESY have an excellent scientific potential. The coordination of joint scientific programmes is an evident example of the collaboration going on in a well-organized way.

Preparation for the FAIR Programme. R&D stage is started for the CBM and PANDA experiments as well as for cryomagnetic systems and dampers at SIS100/300 in the framework of the BMBF–JINR Agreement. In the PANDA experiment, the groups from JINR perform the design study of solenoid/dipole magnetic systems, DIRC and Forward RICH detectors, MDC tracker and of the muon system. These studies are well advanced and should be continued as very important for the PANDA collaboration.

The participation in the CBM project combines the efforts of several JINR Laboratories. This work, which comprises the development of the physics programme, software, R&D for the TRD detector and dipole magnet, is very essential for this project and should be continued.

Preparation for the Linear Collider. The linear e+e- collider ILC, covering energies between 90 GeV and 1 TeV, will be built using the superconducting technology developed by the TESLA collaboration under the leadership of DESY. The contributions of the JINR physicists for the development of the linear collider and the XFEL lay-out are of strong impact continuing the important involvement at the TTF and the VUV FEL.

DESY also launched a detector R&D programme to develop the new technologies which match the requirements of the physics programme of the ILC. Laboratories from JINR are vital partners on several R&D projects. These are: Development of radiation hard large area diamond sensors for calorimeters near the beam-pipe (FCAL), the design, test and production of the read-out electronics for the prototype hadron-calorimeter (HCAL), and the design and modeling of the tracking devices, e.g. the forward chambers. All groups from JINR are contributing to key issues of the R&D projects and are well visible in the community working on ILC detector R&D. A new group from LPP expressed their interest to strengthen the collaboration in the tracking R&D (TPC project). Technologies and prototype devices are under development for beam diagnostics to measure the beam momentum with an accuracy of 10-5. In addition, physicists from JINR are strongly involved in the preparation of the physics programme of the ILC and the simulations to optimize the detector design.

Infrastructure for Experimental and Theoretical Physics

The BMBF support for the JINR infrastructure was successfully used to improve the local area network infrastructure. The JINR Gigabit Ethernet LAN became available for users in March 2004. This optical cable lay-out allows every Laboratory to use 1 Gbps. Further development of JINR's telecommunication links, networking, computing and information infrastructure, including GRID technologies is the priority activity of the JINR Laboratories. It is planned that the JINR–Moscow network channel will be increased up to 1 Gbps in the year 2005.

The participants of the workshop emphasize that fast networking is vital for all collaborations. In addition LIT has contributed discrete event network simulations for LHCb and ALICE and has developed various tracking algorithms for CBM.

New Proposals and Activities beyond the BMBF-JINR Agreement

The participants of the workshop welcome discussions on possible extensions of the scope of the Agreement between BMBF and JINR. Therefore they took note of the reports on new proposals.

The workshop participants conclude that

through the cooperation between JINR and German scientific groups the joint research has successfully been continued, deepened and widened. The cooperation has been very beneficial for both sides and we expect it to be of pronounced importance for the future. It plays an important role in the overall cooperation and development of relations between Germany and Russia, as well as the States of the Former Soviet Union and JINR Member States.

The plans and projects for the coming years have an excellent scientific potential. Coordination of scientific programmes and realization of perspective projects is an evident example of the collaboration going on in a well-organized way. The workshop has not attempted a relative scientific ranking of the projects. However, it was unanimously expressed by the participants that the support given to the JINR–BMBF collaborations should be maintained and an increase be considered for the future.

It is in the interest of both JINR and the German research groups to continue the cooperation in the future. The participants of the workshop strongly recommend the prolongation and extension of the scope of the JINR–BMBF Agreement.