Cooperation Project

Helmholtz International Training Center for Students and Young Researchers in Dubna, Russia

Helmholtz International Summer Schools (HISS)

Subject Area: Structure of Matter

Abstract

Based on the facilities of the Joint Institute for Nuclear Research in Dubna, Russia, and, in particular, in the framework of the **Dubna International Advanced School for Theoretical Physics (DIAS-TH)** organized at the Bogoliubov Laboratory of Theoretical Physics, in 2004-2006 an International Center of Training of young academics was established and successfully developed in Dubna by the Helmholtz Association under the name **Helmholtz International Summer Schools (HISS)**. These activities have been quite successfully continued in 2007-2009 and extended in 2011-2013. An overview on these activities can be found on the website:
`http://theor.jinr.ru/~diastp/diasth/hiss.html`.
All participants of the cooperation evaluated the respective activities as very useful for the education of young academics. By this reason it is proposed to continue the respective cooperation in the three forthcoming years 2014-2016, now including further Helmholtz Centres, Helmholtz Institutes and also the FAIR-Russia Research Center in Moscow.

Draft version: 30.10.2014

1. Introduction: Preconditions and Results of the Previous Project Periods

For the education of students and young researchers in order to bring them up to international top level of research, the creation and further development of **International Centers of Training** at the large national research centers as well as at the centers of mobility (like ECT Trento) are an absolute requirement both with respect to the realization of the mentioned aim as well as in order to use the financial resources in a most effective way. As one example in this respect, the Deutsche Forschungsgemeinschaft (DFG) undertook a number of initiatives in this direction with the establishment of international graduation colleges. In this process, first the processes in research and education in the German universities were interconnected with the respective facilities and networks of the West-European partner countries.

In the Helmholtz Association of German research centers, a special funding was organized some time ago directed initially to the strengthening of the cooperation network between university research and research at the Helmholtz centers. As one example, so-called virtual institutes have been founded. However, science does not know national borders. By this reason, some years ago the proposal was made, to use some of the funding of the fond of the President of the Helmholtz Society to establish at the Joint Institute of Nuclear Research in **Dubna near Moscow** an **International Center of Training for Students and Young Researchers** with the intention, to incorporate Eastern European Centers of research and Eastern European universities into the mentioned process of integration. The respective activities were denoted as **Helmholtz International Summer School (HISS)** and were successfully organized each year since 2004. This process could be realized successfully due to a variety preconditions developed in Dubna till that time.

For example, already for a long period, at the Joint Institute for Nuclear Research in Dubna a number of summer schools have been organized regularly. This process had received some new impetus in 2003 with the organization of excellence programs of education in physics by establishing at the Bogoliubov Laboratory of Theoretical Physics of the JINR the so-called DIAS-TH (Dubna International Advanced Schools for Theoretical Physics). In the framework of this excellence initiative, **HISS** could utilize the already developed infrastructure with the aim to advance the level of integration of the Helmholtz centers with partners in Eastern Europe. Some of these preconditions are the following:

- The Joint Institute for Nuclear Research has played earlier the role and retained his high reputation as the **CERN of the East**. It already before 1990 played a key role in the establishment and maintenance of scientific contacts of scientist at the states of the former

East Bloc including the Soviet Union with research centers in Western Europe and the United States. In the continuation of these activities after 1990, the **Heisenberg-Landau Program** of the Bundesministerium für Bildung und Forschung (BMBF) as a part of the funding of the cooperation between JINR and German universities was initiated directed, in particular, to the common work on scientific problems of theoretical physics. Similar programmes are established meanwhile by the JINR in their cooperation networks with Poland, Czech Republic and South Africa.

- For about 15 years, a **University Center** has been established in Dubna as well as an external branch of the Moscow State University for the graduation of students and post-graduate students. The main topics in the teaching program are directed to quantum field theory, elementary particle physics, nuclear physics, statistical physics, having a basic importance for the any problems related to **structure of matter**.

- At the JINR, there exists a long tradition over decades in the organization of **summer schools** and related activities. By this reason, there has been developed over the years an appropriate and well-established infrastructure for the realization (lecture and seminar rooms and their technical equipment, hotels and students hostels, good connections to Moscow, ...) and experience of the staff in the realization of the organizational problems connected with such activities. The summer schools have been as a rule supplemented by the acquaintance with the experimental facilities in Dubna and visits of historical places nearby and other activities. These facilities have been already used in the highly successful organization of DAAD summer schools **Many-Particle Theory** in Dubna in the framework of the **Future-Initiative Fond**.

- Each year, the best students and post-graduate students from the **18 Member Countries of JINR (Armenia, Georgia, Kazakhstan, Czech Republic, Poland, Bulgaria, ...)** and beyond apply for apprenticeship training and PhD positions both at the JINR and the University Center as well as for the participation in schools and scientific conferences. So, from this wide spectrum of applicants, the best students and post-graduate students can be selected.

- **German scientists, University professors** are actively engaged in **leading positions** in the governing bodies or have and wide influence on the strategy of JINR and the different laboratories via their participation in advisory committees (Program Advisory Committee, Steering Committee, Scientific Council, Connecting Council JINR-BMBF) At the Bogoliubov-

Laboratory of Theoretical Physics (BLTP), the sector *Physical Properties of Complex Materials* was/is headed by Prof. Röpke together with Prof. Plakida and Prof. Osipov, the sector *Mixed Phase in Heavy-Ion Collisions* is headed by Prof. Blaschke in cooperation with Prof. Sorin. Prof. Ilgenfritz is vice director of the Veksler-Baldin :aboratory for High Energy Physics where the future project **NICA** is being built up in close collaboration with Germany, in particular FAIR (e.g., CBM experiment). Prof. Blaschke is as a leading scientist at the BLTP responsible, first of all for the project **NICA** and scientific collaboration links, in particular, to Germany and Poland.

- The directorate of JINR considers the activities considers the education of students and young scientists as highly important. At the BLTP, a separate section was established for that purposes denoted as (Dubna International Advanced Schools for Theoretical Physics) (DIAS-TH). From **own resources**, in the framework of DIAS-TH 60.000,- $ per year are spent for the infrastructure and personnel expenses. As planned, the infrastructure was further improved in previous years by the allocation of a special seminar complex including lecture halls and seminar rooms and working places for lecturers, students and young and experienced scientists participating in the respective activities.

- The scientific cooperation with the Helmholtz-Centers GSI Darmstadt and DESY Hamburg/Zeuthen has top-priority in the research strategy of JINR. In the strategic project **FAIR** Dubna takes part via the cooperation networks **CBM**, **NUSTAR** and **PANDA**. Several **Collaboration Meetings** along these lines took already place in Dubna. In particular, plans for the establishment of the accelerator complex **NICA** as a new important ingredient of the infrastructure were specified in cooperation with the Helmholtz-Center GSI and DESY. Since 2004, each year a NICA Roundtable Workshop is organized in Dubna with strong participation of experts from the German Helmholtz-Centers. By the end of 2012, the Russian Parliament adopted a law that gives **NICA** the status of a "Mega-Science" project with the corresponding funding. Therefore, Dubne becomes of growing interest as a partner institution where fundamental research projects can be performed jointly, exploiting the accelerator facilities already existing and under construction.

- For the first time, in 2010 a common summer school and an International Meeting on relevant topics have been organized together by the Helmholtz International Center (HIC) for FAIR and the FAIR-Russia Research Center (FRRC) Moscow. The Moscow office of the Helmholtz Society is incorporated into this process advertising these activities in order to intensify the contacts between German and Russian research centers and Universities.

- In 2015 there will be with “Strange Quark Matter” a major International Conference in the field “Structure of Matter” held in Dubna. The organization of the planned Summer School on “Dense Matter in Heavy Ion Collisions and Astrophysics” directly before this conference will on the one hand give the opportunity to employ a few excellent lecturers among the conference participants for the school and on the other it will serve the most effective preparation of the young scientists to the world level of research.

These examples demonstrate the important role of the JINR Dubna in the strategic process of cross-linking German and Russian centers of research.

As expected, having at one's disposal the mentioned excellent pre-conditions, the engagement of the Helmholtz-Society in the establishment and further development of the International Center of Training of young academics **HISS** in the period 2004-2010 did lead to a full success. The results can be summarized as follows:

Starting with 2004, HISS summer schools were organized by JINR Dubna jointly with the Helmholtz-Centers GSI Darmstadt and DESY Hamburg/Zeuthen as well as with partners from a number of German Universities. The following 18 two-week HISS Schools have been organized so far:

- ”Hot Points in Astrophysics and Cosmology” (2004);
- ”Heavy Quark Physics” (2005, 2008, 2013),
- ”Modern Mathematical Physics” (2005, 2007, 2009),
- ”Nuclear Theory and Astrophysical Applications” (2005, 2007, 2011),
- ”Calculations for Modern and Future Colliders” (2006, 2009, 2012),
- ”Dense Matter in Heavy-Ion Collisions and Astrophysics” (2006, 2008, 2012),
- ”Lattice QCD, Hadron Structure and Hadronic Matter” (2011),
- ”Cosmology, Strings and New Physics” (2013).

In any of these schools participated at the average about 20 lecturers and 60 young academics from a wide spectrum of different countries (Germany, France, Canada, Greece, Spain, Russia, Ukraine, Armenia, Poland, Slovak and Czech Republics, Uzbekistan, Belorussia, Bulgaria, China, USA, South Korea, Switzerland, Japan, Croatia, Italy, Rumania, South Africa, Argentina, Great Britain, Norway). These facts demonstrate the success of the activities for the formation and development of

an international center of training with particular emphasis on the incorporation of East-European research centers and Universities in the process of cross-linking of the Helmholtz centers.

In addition to the scientific programme, a number of evening events and excursions have been organized allowing to the participants to get a deeper insight in the specifics of the home country of the HISS-activities and the problems and chances of the process of reorganization of life, in general, and science, in particular, in Russia. These activities led as well to a deepening of the personal contacts between the participants, which is also of great benefit in the further scientific cooperation.

By above summarized reasons, we propose to continue the programme of the HISS Dubna summer schools in largely similar form as organized in recent years and to facilitate it by financial resources of the Impulse and Networking fonds of the President of the Helmholtz Society together with the Helmholtz Center DESY and FAIR Europe / FRRC Moscow.

2. Summer schools in Dubna

2.1. General Orientation

The summer schools are planned to be directed to topics, which are of high relevance for the process of cross-linking of the Helmholtz-Centers in the general direction **structure of matter**. The basis is laid hereby by the work of the virtual institute "Dichte hadronische Materie und QCD Phasenübergang" which led to a well-established cooperation with GSI Darmstadt. In this direction, summer schools on the topics "Nuclear Theory and Astrophysics", "Dense Matter in Heavy-Ion Collisions and Astrophysics" and "Lattice QCD, Hadron Structure and Hadronic Matter" will be organized, again.

We propose as well, to continue the stronger orientation of the course on "Modern Mathematical Physics" towards Cosmology which has begun in 2013. In this field, we can take advantage of the particular expertise of colleagues at JINR Dubna on Quantum Field Theory and the high level of mathematical-analytical education of the East-European young academics could be further strengthened. This part of the program will be realized in cooperation with German Universities which have strong connections with experimental research (in particular, in elementary particle physics and astrophysics-cosmology).

A topic of high interest in the cooperation with DESY Zeuthen is reflected by the schools devoted to "Calculations for Modern and Future Colliders". Taking into account that with the LHC a modern collider has started to work and first data have been published on the results, this school will be

organized with a strong implementation of experimental data as “Modern Colliders: Theory and Experiment”.

Two further topics with relevance to research at DESY Hamburg/Zeuthen are “Quantum Fields at the Limits: from Strong Fields to Heavy Quarks“ and “Lattice QCD, Hadron Structure and Hadronic Matter“. The schools on these new topics in the spectrum of HISS Dubna have been organized in 2011 and 2013 for the first time jointly by DESY and GSI with JINR Dubna and its partners. Herewith is accounted for the fact that on the one side at GSI the physics of heavy quarkonia is newly developed and the physics of hadrons is expanded in the framework of the PANDA experiment and on the other the networking with groups of the Lattice-QCD community plays a growing role in the physics of hadrons and nuclei, in Germany as well as in Russia and at JINR Dubna.

Summarizing, in the framework of the project in total six summer schools of two weeks duration each are planned to be organized, i.e. two summer schools per year in the period 2014 - 2016.

Since for all of the proposed topics close cooperation links to research groups at German Universities exist, they will be incorporated into the process of organization and realization of the schools so that also in the new project period there will again emerge strong impulses for the networking between Universities, Helmholtz centers and now also FAIR organizations.

2.2. Topics and Organizers

The following topics are to be realized in the framework of the planned HISS **Summer Schools on the Structure of Matter** in Dubna[1]:

1. *Nuclear Theory and Astrophysical Applications*
   Organizers: J. Margueron (IPN Lyon), G. Martinez-Pinedo (GSI Darmstadt & TU Darmstadt), V. Voronov (JINR Dubna)
   Dates: 21.7.-1.8. 2014

2. *Lattice QCD, Hadron Structure and Hadronic Matter*
   Organizers: M. Ilgenfritz (JINR Dubna), O. Philipsen (Uni Frankfurt), O. Teryaev (JINR Dubna)
   Dates: 25.8.-6.9. 2014

3. *Matter under Extreme Conditions in Heavy-Ion Collisions and Astrophysics*
   Organizers: D. Blaschke (JINR Dubna & Uni Wroclaw), M. Bleicher (FIAS, HIC-for-FAIR), A.T. Filippov (JINR Dubna) B. Sharkov (FAIR Darmstadt & FRRC Moscow), A.S. Sorin (JINR Dubna)
   Year: 2015

4. *Modern Colliders - Theory and Experiments*
   Organizers: D. Bardin (JINR Dubna), D. Kazakov (JINR Dubna), K. Melnikov (KIT Karlsruhe), J. Reuter (DESY Hamburg)
   Year: 2015

5. *Quantum Fields at the Limits: from Strong Fields to Heavy Quarks*
   Organizers: A. Ali (DESY Hamburg), D. Blaschke (JINR Dubna & Uni Wroclaw), H. Gies (HI Jena), M. Ivanov (JINR Dubna), K. Peters (FAIR-PANDA, GSI Darmstadt)
   Year: 2016

6. *Cosmology, Strings and New Physics*
   Organizers: A.T. Filippov (JINR Dubna), F.R. Klinkhamer (KIT Karlsruhe), V. Rubakov (INR Moscow), V. Schomerus (DESY Hamburg), A. Starobinsky (Landau Inst. & JINR Dubna)
   Year: 2016

[1]Possible changes of Topics and Oranizers are coordinated by the end of the year preceeding the corresponding school.

2.3. Lecturers and Participants

A typical HISS summer school should bring together again for about 60 participants, the number being constituted of 15 lecturers and 45 students. As lectures, we will invited, again, the leading scientists in the respective fields, most of them coming from Germany (about 5) and Russia (about 10). Similarly, about 15 students will take part from both Germany and Russia, other participants will be invited from the member countries of JINR like Poland, Czech Republic, Ukraine, Armenia etc. and beyond. In the planning of these activities, we can base on the experience gathered in the preceding project periods.

In the present programme, we are planning to continue the **selection procedure**, similar to the renowned Summer School-Activities organized at CERN or at the Helmholtz-Centers DESY and GSI. In this way shall be garanteed, in particular, a top quality of the respective events and the publicity shall gain a wider basis in the organization process.

2.4. Program and Schedule of Activities

Summer schools will prolong as a rule 2 weeks consisting of 10 days devoted to the scientific program, 1 day for an excursion to Moscow or other places of interest, and one free day. The days devoted to the scientific program have the following general schedule:

10:00-11:00	First lecture
11:00-11:30	Break
11:30-12:30	Second lecture
12:30-14:00	Lunch break
14:00-16:00	Seminars to the lectures, Tutorials
16:00-16:30	Break
16:30-18:30	2-3 talks to be given by the students, discussion
19:00-22:00	Dinner and evening program

The lectures are devoted to the outline of theoretical knowledge and methods of analysis for the topic under consideration. The respective problem will be further discussed at the seminars and applied by the participants to the solution of particular problems. This process will be supplemented by talks on particular problems or methods of analysis to be given by the students and in discussions with the lectures on the problems dealt with in the lectures and related topics. As a rule, the lectures will be made available to the students by files put onto videotape or accessible via internet

from the homepage of the respective meeting. In this way, at least, partly, the summer school may be of use also for other young academics not participating directly in the school. In the evening program, additional lectures and discussions are planned to be organized directly to a broader spectrum of modern research activities (like supersymmetry, quantum gravitation, high-temperature superconductivity, etc.) based in the expertise of colleagues of JINR in quantum field theory and statistical physics but also by inviting additional guests.

Beyond the analysis and discussion of physical problems, the participants are planned to be acquainted with the spectrum of chances and problems in the reorganization of life, in particular, of science and education in the host country. The planned excursions and evening discussions will further lead to a deepening of the contacts between the participants allowing them to compare and understand different aspects of life in the difference countries the participants come from. The excursions will bring the participants either to Moscow or to Sergiev Posad. However, in dependence on the actual interest, also other places along the *Golden Ring*, a set of historical places surrounding Moscow, could be chosen.

2.5. Financial Resources Required for a Summer School

Accomodation (lecturers)	12 x 8 x 25 Euro	=	2.400 Euro
Accomodation for external students	12 x 40 x 20 Euro	=	9.600 Euro
Travel costs (non-FSU)	25 x 400 Euro	=	10.000 Euro
Travel costs (FSU)	20 x 100 Euro	=	2.000 Euro
Shuttle Sheremetyevo-Dubna		=	2.500 Euro
Per diems		=	4.200 Euro
Coffee breaks		=	2.000 Euro
Excursion		=	700 Euro
Opening and farewell meetings		=	1.300 Euro
Office/ conference materials		=	800 Euro
Technical support		=	500 Euro
Total costs:			36.000 Euro

3. Total Amount of Funding for the Period 2014 - 2016 (3 years)

4.1. Summer schools

2014	Nuclear Theory and Astrophysical Applications	12 days	36.000 Euro
2014	Lattice QCD, Hadron Structure and Hadronic Matter	12 days	36.000 Euro
2015	Extreme Matter in Heavy-Ion Collisions and Astrophysics	12 days	36.000 Euro
2015	Modern Colliders: Theory and Experiments & LHC Physics	12 days	36.000 Euro
2016	Quantum Fields at the Limits: from Strong Fields to Heavy Quarks	12 days	36.000 Euro
2016	Cosmology, Strings and New Physics	12 days	36.000 Euro
	Total amount (3 years):		**216.000 Euro**

The total financial support required for the period 2014-2016 amounts to **216.000 Euro** and shall be provided by the following sources:

- One third of the costs (72.000 Euro) shall be provided by the Russian side, whereby JINR Dubna shall contribute 60.000 Euro from bilateral collaboration programs and supplementary projects (RFBR, Dynastia, ...).
- The contribution from the German side amounts to 150.000 Euroand comes jointly from the Helmholtz Centres: DESY, Dresden-Rossendorf, Jülich and Karlsruhe, as well as from the Helmholtz Institutes in Mainz and Jena. DESY contributes 36.000 Euro for travel reimbursement of lecturers (6.000 Euro per school), while the remaining contributions are detailed in the Cooperation agreement between Helmholtz Association and JINR Dubna.

5. Coordination

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