Helmholtz Russia Joint Research Group HRJRG-002
Physics Analysis and Calorimetry at the Terascale

Activity Report 2007

Participating Institutes:

Deutsches Elektronen-Synchroton. DESY, Hamburg
Institute for Theoretical and Experimental Physics, ITEP, Moscow
Moscow State University, MSU, Moscow
Moscow Engineering Physics Institute, MEPHI, Moscow

Group Members of the HRJRG:

Principle Investigator (Germany):	Dr. Kerstin Borras (DESY)
Principle Investigator (Russia):	Dr. Roman Mizuk (ITEP)
Group Leaders:	Dr. Felix Sefkow (DESY)
	Prof. Dr. Michael Danilov (ITEP)
	Dr. Michael Merkin (MSU)
	Prof. Dr. Boris Dolgoshein (MEPHI)
Key Researcher:	DESY: 1, ITEP: 1,
Post Doctoral Fellows:	DESY: 2, MSU: 2
Graduate Students:	DESY: 3, ITEP: 1, MEPHI: 1, MSU: 1

The concept of Helmholtz Russian Joint Research Groups was launched with the primary goal to promote the scientific cooperation with Russia and to provide attractive research conditions for young scientists in the field of particle physics. The Helmholtz Russian Joint Research Group HRJRG-002 was approved in September 2007. The program started on the 1st of November 2007. In total the group will consist of 20 members from DESY and the three Russian Institutes.

Description of goals of the group:

The Helmholtz Russia Joint Research Group HRJRG-002 continues the long-lived and very fruitful cooperation between DESY and Russian Institutes beyond the common efforts for HERA experiments, physics and detector R&D towards new activities imminent at the LHC and for the future ILC. Within the project several excellent young scientists and students are supported, opening the possibility for a future career in high energy particle physics.
The combination of physics and detector activities pursued in this Joint Research Group makes the project extraordinary and exceptional. The basis of the project is provided by the profound experience in detector operation and physics analysis collected at HERA. The gained knowledge flows directly into an imminent project at LHC and provides input to the projects for the future linear collider ILC. For a healthy project with future prospects it is mandatory to closely relate physics, experiment and the development of novel technologies for the next generation of colliders.

In the area of physics the results of HERA on the structure of the proton, the underlying event, multi-parton interactions and dependencies of several QCD processes will provide crucial input for searches of new physics phenomena and

other studies at the LHC. The understanding of the HERA results with their consequences for the LHC needs a strong effort in phenomenology. The studies for the physics analyses require significant will be performed especially at the Helmholtz Analysis Center at DESY, providing valuable input for the TIER 2 centers in Russia.

The correct extrapolation of HERA results into the kinematic regime of the LHC needs input of initial data with a special hadron calorimeter in the forward region. Members of the project will participate in the construction and operation of the calorimeter, cultivate skills obtained at HERA and develop further knowledge in detector operation.

One mainstream activity for an ILC detector involving both DESY and the participating Russian institutes is the development of a hadronic calorimeter. A novel technology was invented in Russia for its readout based on solid state photo-sensors, the so-called SiPM.It is mandatory to strongly pursue its optimization to keep the leading position in this successful development. Beside this novel technology new reconstruction algorithms for hadronic energy deposition are developed.

The activities of the group are centered around the development of experiments in high energy physics from HERA towards the LHC and the ILC. The proposed HRJG is tailored to allow efficient participation in this programme by selecting a few important key topics where exciting expertise of participating Helmholtz and Russian institutes can be brought in and further developed. Conducting the activities of the HRJRG as proposed will strengthen the role of the participating Russian institutes and DESY in particle physics over the next years. The acquired experience will provide the basis for a sustained, long-term participation in fore-front experiments of particle physics.

Main Activities of the group in the year 2007:

During the two months after the start of the project on the 1st of November 2007 a lot of activity went into the setup of the structure of the group and into the administrative regulation of the cooperation between the German and the Russian institutes. The kick-off meeting for the group was organized to take place beginning of February 2008. Although the timescale was short, it was possible to connect it with the traditional ITEP Winter School of Physics, in which several members of the group participated in addition to the kick-off meeting.

The analysis of HERA data progressed with a new ansatz for a fit of the proton parton density functions. These new parton density functions will be employed for simulations of physics processes at the LHC, for which phenomenological calculations could be finalized.
For the CASTOR calorimeter at the CMS experiment at LHC a major milestone was achieved in passing successfully the engineering design review and regular follow-up status reviews. This approval allowed the start of procurements and production of mechanics and electronics.

For the ILC hadron calorimeter, a new concept for the precise mechanical integration of scintillator tiles with their readout electronics was verified, and new, more efficient photo-sensors (SiPMs) have been successfully tested.
The analysis of the data from the existing test beam prototype focused on stability studies with the large sample of SiPMs, and on the estimation of shower leakage using topological information, a method of potential use also at HERA and the LHC.