# INFORMATION TECHNOLOGY AND COMPUTER PHYSICS

In 2023, the GPU component of the Govorun supercomputer was expanded, which enabled a peak performance of 1.7 PFlops to be reached. The GPU component gives users of the Govorun supercomputer the opportunity to employ machine and deep learning algorithms to solve tasks with the help of the neural network approach, namely, to process experimental data of radiobiological studies, to detect particle tracks in the experiments at the NICA accelerator complex and perform quantum computing using quantum computing simulators.

- *Podgainy D.* Govorun Supercomputer for JINR Tasks // 10th Intern. Conf. "Distributed Computing and Grid-Technologies in Science and Education" (GRID'2023), Dubna, Russia, 3–7 July 2023.

The 8th BM@N physics run was the first time at JINR when the entire computing infrastructure, integrated by the DIRAC platform, was used for the complete reconstruction of raw experimental data. During the session, there were received about 550 million events, which were written in 31 306 files with a total size of more than 430 TB. Tier1, Tier2, the NICA cluster and the Govorun supercomputer were used in processing; meanwhile, large files (16–250 GB) could only be processed on the Govorun supercomputer. During data processing, new methods and approaches to using the DIRAC platform were developed. The applied methods provided detailed information on the functioning and capabilities of the distri-
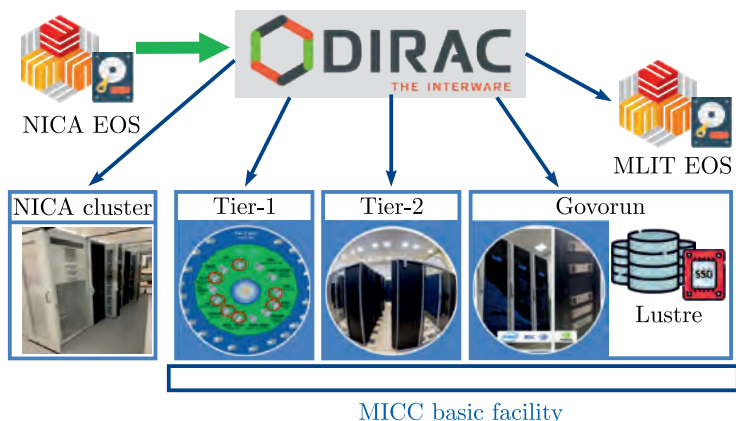
Scheme for the DIRAC-based integration of geographically distributed heterogeneous resources used in BM@N Run 8 data processing

buted computing system. Thanks to the results, the time for preparing and launching new tasks related to intensive data processing was significantly reduced.

- *Pelevanuk I., Gertsenberger K*. BM@N Run 8 Data Reconstruction on a Distributed Infrastructure with DIRAC // 10th Intern. Conf. "Distributed Computing and Grid-Technologies in Science and Education" (GRID'2023), Dubna, Russia, 3–7 July 2023.

- *Pelevanuk I., Gertsenberger K*. BM@N Mass Data Production on Distributed Infrastructure for Run 8 Using DIRAC // 10th Collab. Meeting of the BM@N Experiment at the NICA Facility, St. Petersburg, Russia, 14–19 May 2023.

The platform and a mobile application (DoctorP) for detecting plant diseases and pests are under development at JINR. Both a general model capable of detecting 68 disease classes and specialized models for 29 ornamental and agricultural crops are available. Since the beginning of 2023, the platform has processed over 70 000 user requests. To obtain a prediction and treatment recommendations from experienced agronomists, one just needs to send a photo showing the problem. The platform can be accessed by third-party applications and services. Garden Retail Service (formerly Fasko) and the Andijan

Examples of DoctorP platform interfaces

Institute of Agriculture and Agrotechnologies (Uzbekistan) have already taken advantage of this opportunity.

- *Uzhinskiy A*. Artificial Intelligence in Agriculture // Open Systems. 2023. No. 3. P. 20–23 (in Russian).
- *Uzhinskiy A*. Advanced Technologies and Artificial Intelligence in Agriculture // AppliedMath. 2023. V. 3. P. 799–813; https://doi.org/ 10.3390/ appliedmath3040043.

A software complex for creating digital twins of distributed data acquisition, storage and processing centres (DDPCs) was developed and registered in the Register of Russian Computer Programs. The uniqueness of this program is that the digital twins created with its help effectively monitor the DDPC functioning in terms of data flows and related tasks. The software complex for creating digital twins has no analogues yet. A DDPC digital twin is a virtual copy of a data centre that demonstrates how it operates under any possible scenario. Such twins can be employed in the construction, operation and enhancement of computing architectures of various DDPC types.

- *Korenkov V., Priakhina D., Trofimov V*. Software Complex for Creating Digital Twins of Distributed Data Acquisition, Storage and Processing Centres // Register of Russian Computer Programs. No. 2023667305.

An overview of studies devoted to simulating the process of electron hydration based on the approach developed by the authors within the dynamic polaron model is presented. Papers on theoretical and experimental research in the problem of electron hydration are reviewed. Mathematical formulations of problems and computational schemes were developed, and complexes of problem-oriented programs were created using MPI parallel programming technology. The results of the numerical simulation and calculation of the observed physical characteristics of the electron hydration process under study are delivered. The agreement between the obtained numerical results and the corresponding experimental data confirms the adequacy of the elaborated approaches and the prospects for their further use and development.

- *Lakhno V., Amirkhanov I., Volokhova A., Zemlyanaya E., Puzynin I., Puzynina T., Rikhvitsky V., Bashashin M*. Dynamic Polaron Model for the Study of the Electron Hydration Process // Part. Nucl. 2023. V. 54, No. 5. P. 1076–1105 (in Russian).