Super-brain in the Service of Cutting-edge Research

KIT's High-performance Computer ForHLR Starts Operation – Petaflop System with More Than 24,000 Processor Cores – Innovative Visualization Laboratory

Using the new high-performance computer, scientists of all disciplines can solve complex problems in new dimensions. (Photo: Markus Breig, KIT)

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The new ForHLR high-performance computer of Karlsruhe Institute of Technology (KIT) offers high computing capacity and an innovative visualization technology for latest simulation methods. The computer can be used by researchers from all over Germany to calculate complex problems in new dimensions. Today, operation of ForHLR was started officially by the Baden-Württemberg Minister of Science, Theresia Bauer, and the President of KIT, Professor Holger Hanselka.

"This new supercomputer was funded with a total of EUR 26 million under the Research Installations Program, half of which was financed from the central budget of the state. We are taking this effort, because digitization is associated with enormous opportunities in managing the big challenges of society. For the Baden-Württemberg state government, digitization is of central political importance. ForHLR will enable users in the areas of environmental research, energy research, nanosciences, and materials sciences to handle complex application problems in new dimensions," the Baden-Württemberg Minister of Science, Theresia Bauer, said during

the official presentation of ForHLR at the Steinbuch Centre for Computing (SCC) of KIT. ForHLR is funded by the State of Baden-Württemberg and the Federal Republic of Germany.

(Photo: Markus Breig, KIT)

"High-performance computing and sophisticated simulation methods today play an important role in cutting-edge research," emphasized the President of KIT, Professor Holger Hanselka. "Whoever wants to be top in research, needs maximum computing power and storage capacity. With their help, science will succeed more quickly in finding new solutions for problems in energy, mobility, and environmental research. In this respect, ForHLR perfectly fits to the strategy of KIT."

The new ForHLR II is a petaflop system with more than 1170 nodes, more than 24,000 processor cores, and 74 terabytes of main memory. One petaflop corresponds to a billion computation operations per second. Compared to ForHLR I that started operation in September 2014 at KIT, ForHLR II's performance is increased by a factor of about 2.5. The ForHLR computer is accommodated in a building equipped with latest cooling technology for energy-efficient operation. Its construction was also funded by the Federal Republic of Germany and the State of Baden-Württemberg. In the cold season, the waste heat of the system is used for heating the office building.

(Photo: Markus Breig, KIT)

"The high-performance computer perfectly fits to the existing computer infrastructure of KIT and facilitates optimal use of the different systems by the scientists," Professor Bernhard Neumair, Managing Director of the Steinbuch Centre for Computing of KIT, added. "Big data volumes can be analyzed seamlessly on the ForHLR and other high-performance computing systems or at the Smart Data Solution Center Baden-Württemberg and then visualized at KIT. The BelWü science network ensures quick data transfer from other universities to KIT and back."

Improved Simulations in Energy, Environmental, Nano, and Materials Sciences

The high-performance computer distributes computation work to several processor cores (parallelization). Scientists can use the computer to calculate complex research problems, especially in the areas of energy, environmental, nano, and materials sciences. With improved simulation methods, models of various physical systems and spatial and temporal scales can be coupled. Researchers are enabled to compute highly complex climate models and to study e.g. global warming, its impact on regional climate fluctuations, complete

integration of the local water cycle from the biosphere to the atmosphere, or the dispersion and detailed effect of air pollutants.

In connection with the energy transition, research relating to environmentally compatible energy conversion, storage, and distribution is of high relevance to society. For instance, development of low-pollutant and low-noise engines and turbines requires the simulation of flow phenomena. In addition, chemical combustion processes and material oscillations are studied.

“Success and efficiency of new technologies decisively depend on the development and production of new materials,” Professor Peter Gumbsch, Head of the Institute for Applied Materials of KIT and Member of the Council of Science and Humanities, pointed out in his keynote speech. “With the help of this new high-performance computer, we will study functional materials and nanostructures, friction, wear, and deformation processes for the development of materials with customized properties.”

Service for Science in Germany

The new high-performance computer is available to scientists of all disciplines all over Germany. As a level-2 parallel computer, the new high-performance computer of KIT perfectly fits to the state’s strategy and closes the gap between national supercomputing centers (level 1) and the state universities’ basic supply with computing capacity (level 3).

Energy-efficient Computation – Visualized Results

Science presently is generating constantly growing data volumes. At the same time, higher requirements have to be met by the optical representation of measurement and simulation results. Hence, special visualization computers are integrated into the computer system. By means of the new visualization laboratory, the simulation results can be displayed in 3D technology by a projection of 6.7 x 2.3 m. Resolution exceeds 13 megapixels. The visualization can be run on the screen in the 2D or 3D Cinerama mode.

In spite of its high performance, the computer is energy-efficient: All over the year, warm water cooling of the central system is ensured. Practically, the system does not need any energy-consuming additional refrigerators. In the cold months, the waste heat of the system is used for heating office buildings, which reduces overall heating costs and enhances environmental compatibility. For those components of the system that still require classical cold air cooling, the

existing district cooling network of KIT Campus North will supply economically efficient and environmentally compatible cooling power via a combined power / heating / cooling plant.

Sponsoring of Art by Construction Projects – "Wachsender Stein"

Timm Ulrich's work of art "Wachsender Stein" (growing stone) has won the competition under the program to sponsor contemporary art in the context of construction projects. This work of art represents the stepwise growth of a stone. Nine stone objects cross the entrance hall of the new building, the first one being located in the inner court and the last one outside of the building. The growing stones reflect precise mathematic progression in terms of both size and distance. Their unimaginably small nucleus is hidden in the computer and radiates from there out along a straight line.

„Wachsender Stein" (Photo: Markus Breig, KIT)

Karlsruhe Institute of Technology (KIT) pools its three core tasks of research, higher education, and innovation in a mission. With about 9,300 employees and 25,000 students, KIT is one of the big institutions of research and higher education in natural sciences and engineering in Europe.

KIT – The Research University in the Helmholtz Association

Since 2010, the KIT has been certified as a family-friendly university.

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