IT4Innovations national supercomputing center

# NEWSLETTER

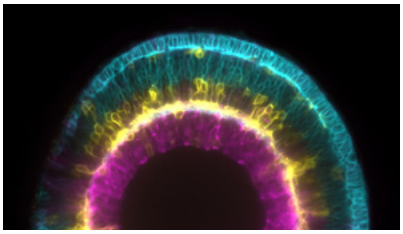
Q1 2018

## A look back at 2017 at IT4Innovations

Here we present a brief review of 2017 for you to see what events took place and what results were achieved. In this brief summary, you will learn about new national and international projects we ventured into in 2017. We will also mention the awards achieved by our colleagues. We organized several workshops, courses, conferences, and public events attended by more than 1700 visitors.

Let´s have a look at the important and interesting moments of the last year.

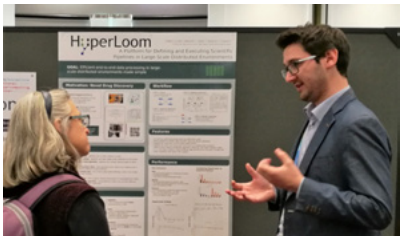
Read more



## Results of the 12th Open Access Grant Competition

The 12th Open Access Grant Competition was evaluated in January 2018. Almost 59 million core hours were allocated across the 62 successful projects.

Read more




## HyperLoom for User-friendly Data Processing Using High Performance Computing Systems

For defining and executing complex computational pipelines containing large numbers of interconnected tasks on supercomputers, scientists can currently use the HyperLoom software.

Read more

## The Czech Republic has joined the European Union‘s EuroHPC initiative, the objective of which is to build new top European supercomputers

The joint EuroHPC initiative will have a global budget of about 1.4 billion euros, which will be invested in building new high performance computing systems capable of $10^{18}$ operations per second in Europe.

Read more

## The Next Open Access Grant Competition will be announced in June 2018

In June 2018, the 14th Open Access Grant Competition will be announced for you to apply for the computational resources of our supercomputers. For updates, please visit our website.

More info

## Applications for the Computational Sciences PhD Study Programme

Candidates for the Computational Sciences PhD study programme shall submit their application for study by 15th June 2018 at the latest.

More info

## 17th PRACE Project Access Call

Until 2nd May 2018, you can apply for the computational resources of the ten most powerful supercomputers in Europe (e.g., Piz Daint, Marconi, SuperMUC, etc.) within the PRACE Project Access grant competition. Computational resources will be allocated for the period of one year beginning in October 2018. For further information and required forms, please visit the PRACE website.

More info

## TETRAMAX Project Provides Funding for Projects Focused on Interdisciplinary Technology Transfer.

Project applications shall be submitted by 31st May. These projects should be focused on the domain of customized low-energy computing. Cooperation among three or more partners from at least two different EU member states and/or countries associated with the Horizon 2020 programme is required. For more information, please visit the TETRAMAX project website.

More info

01 In January 2018, our centre was visited by the Minister of Industry and Trade in resignation Tomáš Hüner and the Governor of the Moravian-Silesian Region Ivo Vondrák.

02 IT4Innovations Review 2017

03 Our colleagues, graduates of the Faculty of Electrical Engineering and Computer Science at VŠB-TUO, have succeeded in the Prof. Babuška Prize Competition. Jan Zapletal from the Parallel Algorithms Research Laboratory (now works in the Infrastructure Research Laboratory) won first place, Martin Hasal from the Big Data Analysis Laboratory won second place.

Congratulations!

04 Invitation to the VI-HPS Tuning Workshop (Germany)

05 In July 2018, we are hosting the International HPC Summer School.

06 Updated Acceptable Use Policy of HPC Resources at IT4Innovations

IT4Innovations and World Water Day at the Institute
of Geonics of the Czech Academy od Sciences, March 2017

# A LOOK BACK AT 2017 AT IT4INNOVATIONS

The year 2017 has gone by, and we are proudly presenting you a brief review of the events that took place in our centre and the results we achieved.

## New projects

During the last year, we ventured into several new national and international projects. Three new projects, which will support modernization and upgrade of the current Anselm and Salomon supercomputers, modernization of the Computational Sciences PhD study programme and creation of a joint doctoral school with the Faculty of Mathematics and Physics at Charles University in Prague and the Institute of Mathematics of the Czech Academy of Sciences, and the building of the new IT4Innovations Educational Training Centre, will be supported by the Operational Programme Research, Development and Education.

As far as international projects are concerned, three new projects were approved for funding within the EU framework programme for Research and Innovations Horizon 2020. The projects will facilitate the education of a new generation of mechanical engineers and scientists in the research and development of turbines, and lead to provision of new innovative technologies for European industry as well as productivity optimization for enterprises using HPC/cloud technologies.

## Supercomputing services

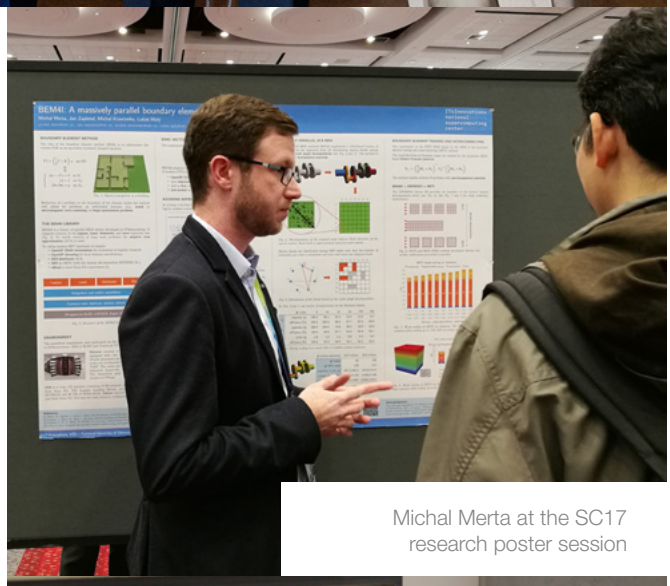
Last year, applicants from Czech academic and other research institutions applied for a total of more than 200 million core hours within the Open Access Grant Competitions. More than 160 million core hours were allocated to successful applicants. Upgrade of the current high-performance computing systems, which is expected at the end of 2018 and 2020, will help us satisfy the ever increasing demand for computational resources.

## Nominations and awards of our colleagues

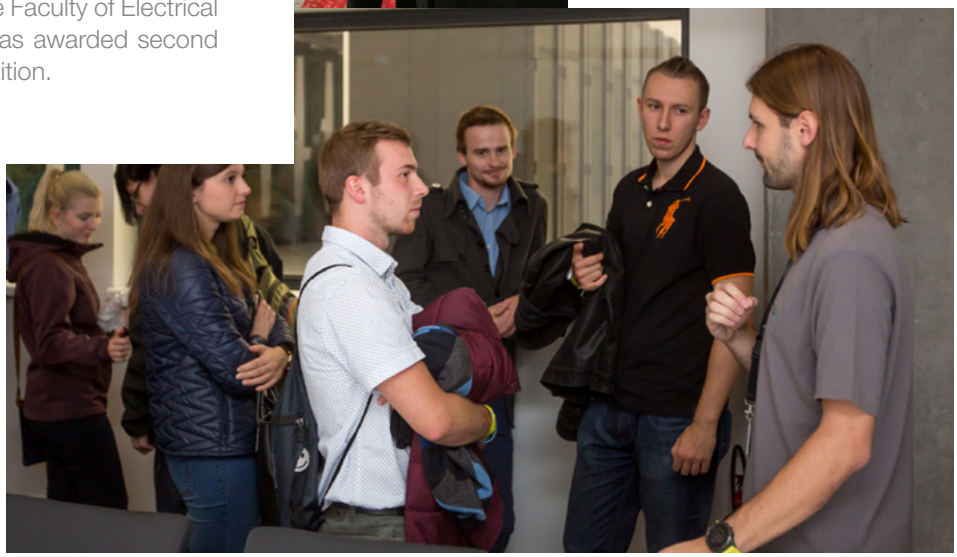
We dare not miss any important European or world conferences, so as to keep up with the rest of the world of high performance computing. In 2017, our colleagues received several nominations and awards. Two poster contributions of our colleagues from the Parallel Algorithms Research Laboratory and the Advanced Data Analysis and Simulations Laboratory


Jan Zapletal won first place in the nationwide Joseph Fourier Prize in 2017

were among the top nine Best Poster nominations at the largest supercomputing conference: SC17. The ESPRESO software for solving problems of structural mechanics was nominated for the European Commission's 2017 Innovation Radar Prize. Our colleague and a student of the Computational Sciences PhD study programme Milan Jaroš was awarded the Best Student Research Presentation Prize at the International Conference on Computer Graphics and Digital Image Processing. Jan Zapletal, an IT4Innovations researcher and graduate at the Faculty of Electrical Engineering and Computer Science at VŠB – Technical University of Ostrava, won first place in the Joseph Fourier Prize competition for the Best Research within PhD studies in the field of computer sciences as well as first place in the Prof. Babuška Prize competition. Moreover, Martin Hasal, our colleague from the Big Data Analysis Laboratory, and also a student at the Faculty of Electrical Engineering and Computer Sciences, was awarded second place in the Prof. Babuška Prize Competition.



Michal Merta at the SC17 research poster session



The Researchers' Night at IT4Innovations, October 2017

## Organization of workshops, conferences, and public events

We are open to share our know-how. Last year, our colleagues led three public workshops focused on the tools used on our supercomputers. Two of these workshops were sponsored by the Partnership for Advanced Computing in Europe (PRACE) research infrastructure. Moreover, we were awarded the status of PRACE Training Centre last year. Another 6 of our workshops were led by experts from abroad. In total, 227 participants took part in the workshops organized by IT4Innovations last year. In the summer, we also organized a week-long training schedule for participants of the PRACE Summer of HPC programme led mainly by lecturers from IT4Innovations.

Not only did we participate at conferences and workshops but we also organized a few of them last year. In January and September, for example, HPC for Small and Medium-sized Enterprises seminars were held. In February, we hosted the very first Czech workshop of the international HiPEAC network gathering European experts in high performance computing and embedded systems. In May we organized the 3rd High Performance Computing in Science and Engineering conference, and in November we organized the 1st IT4Innovations Users Conference, where the IT4Innovations Users Council was established. In addition, our centre is also open to the general public. Last year, our centre was visited by almost 1700 visitors, who participated mainly in excursions and science popularization events.

The year 2017 was a successful one for us, and we are looking forward to facing new challenges in 2018!

Visit of the Ambassador of Switzerland in the Czech Republic, H.E. Marcus-Alexander Antonietti, March 2017

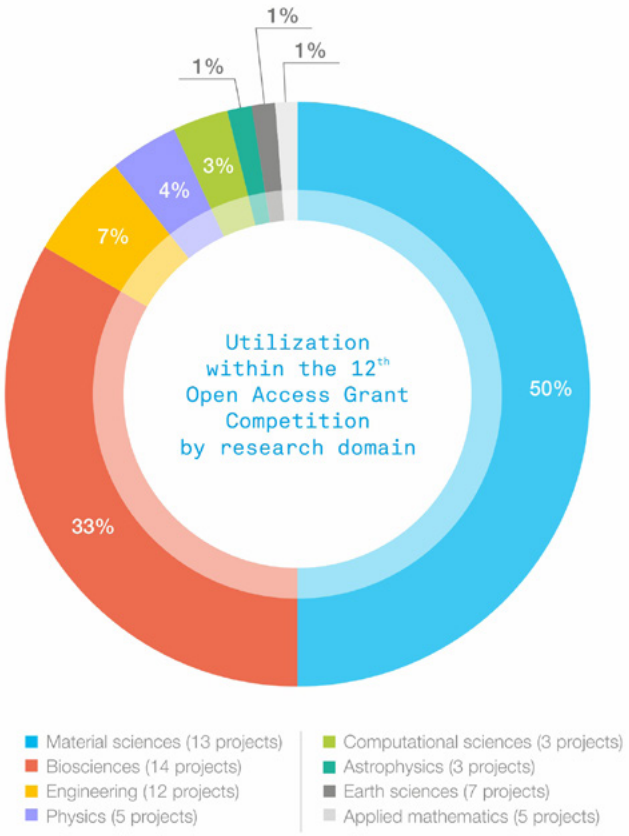
# RESULTS OF THE 12TH OPEN ACCESS GRANT COMPETITION

Within the 12th Open Access Grant Competition, the results of which were announced in January 2018, applicants applied for almost 85 million core hours. The demand for computational resources exceeded the reserved capacity for the Open Access Grant Competition, which amounts to 48 million core hours, by 76 %. With respect to the enormous interest in computational resources in relation to those available, the allocation committee agreed to decrease the original allocation of most of the evaluated projects. In January 2018, almost 59 million core hours were eventually distributed across 62 successful projects. The allocated computational resources are available to the users from January to October 2018.

Seventeen projects of scientists from VŠB – Technical University of Ostrava, and from the university institute of IT4Innovations, were allocated 15 million core hours, which makes one-fourth of the allocated computational resources in this Open Access Grant Competition. The largest amount of computational resources (13.8 % from the total amount) was allocated to projects in the field of material sciences. For instance, the project of Dr. Dominik Legut, focused on optimization design of functional materials in a new type of lithium-based battery, was awarded 8 million core hours.

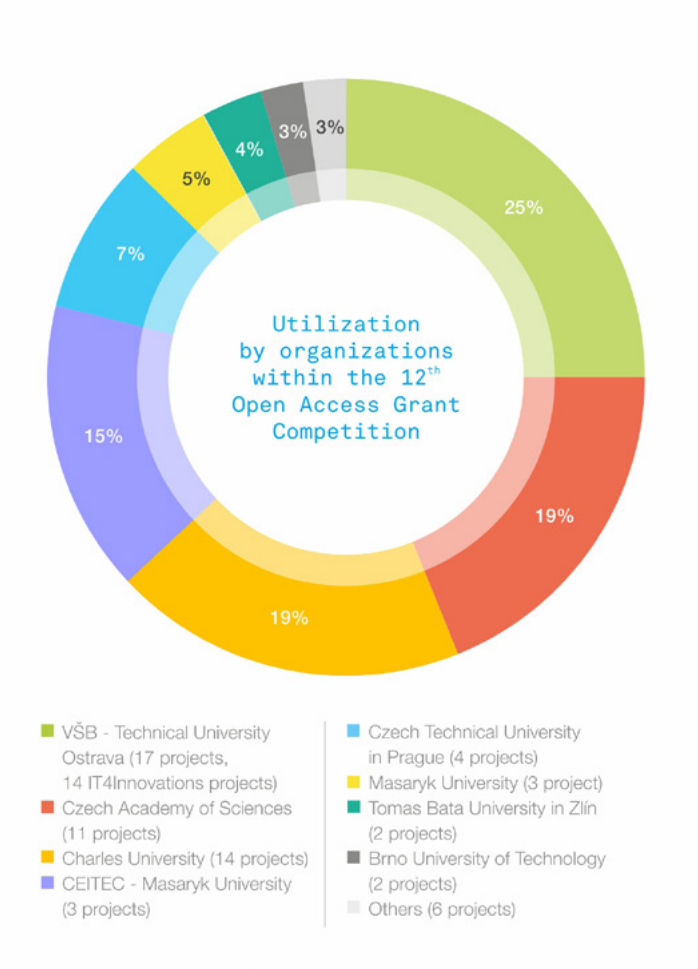
The majority of successful projects from VŠB-TUO, precisely seven, are in the field of engineering. Only two of these projects are in the field of biosciences. Dr. Michal Krumnikl and Dr. Pavel Tomančák were awarded more than 1.5 million core hours for development of the Fiji platform to be deployed on HPC systems. Dr. Stanislav Polzer from the Department of Applied Mechanics of the Faculty of Mechanical Engineering will focus on computational modelling of abdominal aortic aneurysm (enlargement of the abdominal aorta to greater than 3 cm), which presents a degenerative disease with potentially fatal progression. The allocated computational resources of 150 thousand core hours will be used for analysis of conditions leading to aneurysm development and probability of rupture.

Eight institutes of the Czech Academy of Sciences (CAS) were awarded almost 11 million core hours, which is approximately one fifth of the computational resources allocated in this Open Access Grant Competition. The first three largest allocations were awarded to scientists from the Institute of Organic Chemistry and Biochemistry. For instance, prof. Pavel Hobza was awarded 5 million core hours for in silico drug design. Dr. Martin Culka was awarded over 2 million core hours for his study of the mechanism regulating protein folding. It is assumed that some neurodegenerative diseases are caused by the aggregation of misfolded proteins. The project of




Dr. Ota Bludský was awarded almost 1.5 million core hours for research of new molecular sieves, in particular for developing methodology for evaluation of the properties of hypothetical zeolites using the ADOR synthesis (A-assembly, D-diassembly, O-organization, R-reassembly), the mechanism of which was described by scientists of the CAS.

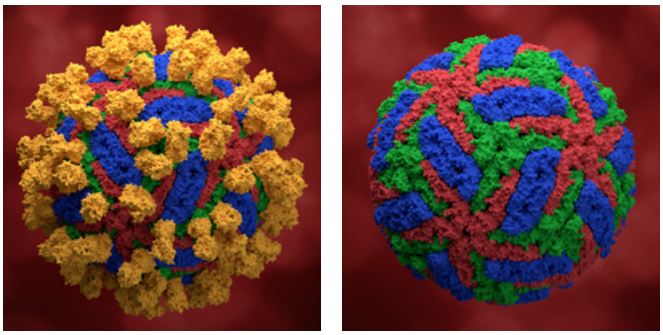
The third institution, the projects of which were awarded most of the computational resources, is Charles University in Prague. Almost one fifth of the computational resources allocated in the 12th Open Access Grant Competition, a total of 11.5 million core hours, were distributed across fourteen projects. 81 % of the computational resources allocated to the projects of Charles University in Prague were awarded to six projects in the field of material sciences with five of them being led by scientists from the Faculty of Mathematics and Physics. Dr. Jan Kuriplach was awarded 300 thousand core hours for his research of high entropy alloys, which are relatively new materials of great research interest at present. Dr. Ondřej Maršálek was awarded over 2.5 million core hours for research of dynamics and spectroscopy of charges in aqueous solutions, for which he also received a special grant from Charles University, awarded to very promising scientists. Similarly, the grant of Charles University, elite grant of the European Research Council, and computational resources of IT4Innovations supercomputers totalling nearly 800 thousand core hours were awarded to Dr. Jiří Klimeš, who develops methods for more accurate computer simulations of molecular crystals, which has an application in the pharmaceutical industry.
Almost 9 million core hours were awarded to three projects from the Central European Institute of Technology at Masaryk University (CEITEC MU). Two of these projects are focused on the field of bioscience. Dr. Pavel Plevka was awarded more than 2 million core hours for his research of picornavirus, flavivirus, and bacteriophages. Doc. Robert Vácha was awarded more than half a million core hours for his research focused on the vital regulation of genome transcription, one of the most crucial processes of life.




## An introduction to selected projects awarded computational resources within the 12th Open Access Grant Competition:

**Dr. Pavel Plevka (CEITEC MU):**
**Structural studies of human and animal viruses**

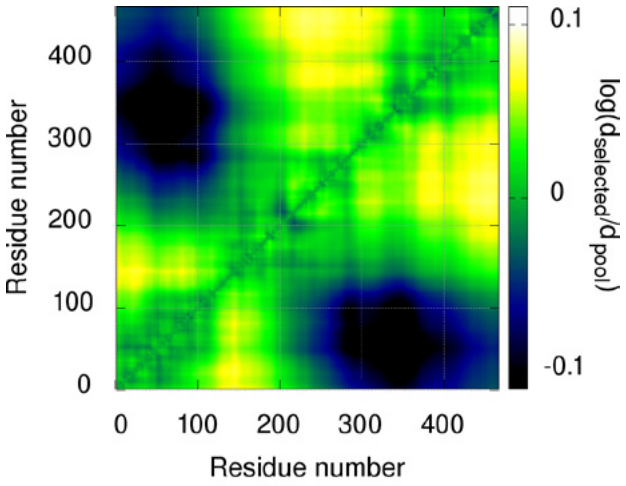
The project of Dr. Pavel Plevka from CEITEC at Masaryk University was awarded 2,213,000 core hours for his research of picornaviruses, flaviviruses, and bacteriophages. Our supercomputers and the allocated computational resources will be used for processing and analysis of micro images created by state-of-the-art electron microscopes.
Picornaviruses cause not only common cold but also serious diseases such as encephalitis and respiratory inflammation. Scientists determine the structure of virus particles (virions), by means of which the virus spreads from one cell to another, and describe viral replication in infected cells. Flaviviruses, including Zika and encephalitis viruses, cause potentially fatal neurological diseases. Scientists will focus on an encephalitis virus causing hundreds of potentially fatal infections in the Czech Republic every year. The results of the project shall provide scientists with a detailed description of the viral replication mechanism.



Reconstruction of encephalitis virus using cryo-electron microscopy

**Prof. Lukáš Žídek (Masaryk University):**
**Structural characterization of intrinsically disordered proteins**

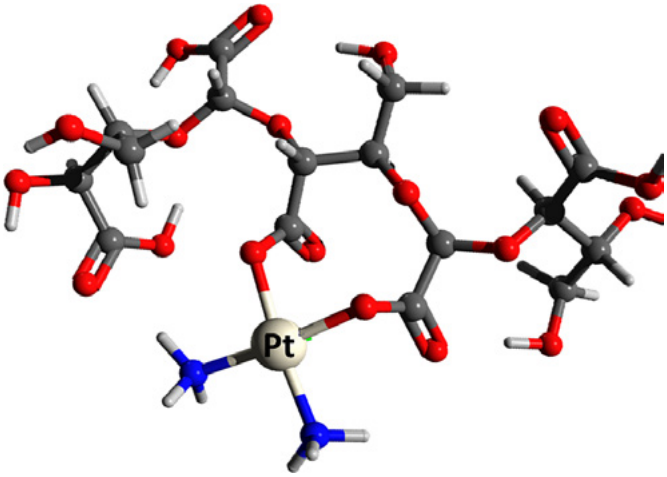
Intrinsically disordered proteins (IDPs) are macromolecules lacking a stable and well defined tertiary structure. They have no stable structure and hence no thermodynamic minimum determining their function. During the course of the last decade, they have attracted wide attention due to their important role in a vast number of cellular processes. They include, for example, transcription of genetic information as well as their potential connection with neurodegenerative diseases. Recent research findings have shown that the main role in the protein function is not in their structure but their dynamic behaviour.
The project of prof. Lukáš Žídek from Masaryk University, which was awarded 1,480,000 core hours, is aimed at a more detailed study of the conformational behaviour of selected IDPs using a combination of state-of-the-art extensive computer simulations with their own prediction codes and advanced experimental methods (e.g., nuclear magnetic resonance spectroscopy, or small angle X-ray scattering.




Distance matrix of the non-structured MAP2c protein, which regulates formation of microtubules in neurons during prenatal brain development after phosphorylation by the protein kinases A enzyme. The dark colours represent short-term contact of amino acids detected by computer analysis of experimental data.

**Dr. Jan Vícha (Tomáš Baťa University in Zlín):**
**Development of Relativistic Spectroscopy (ReSpect) computational code for study of heavy metal anticancer complexes**

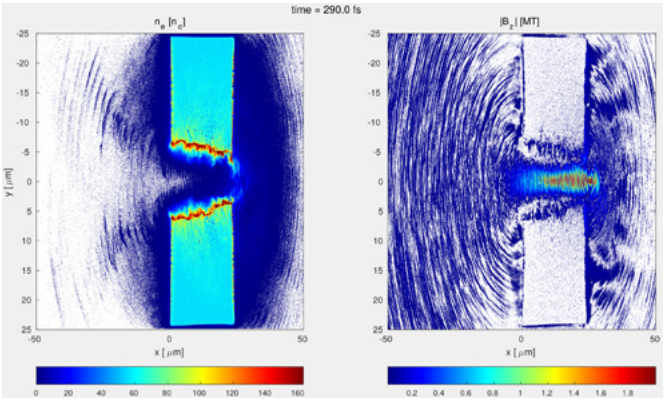
One of the cancer medical treatment methods is chemotherapy. The most frequently used chemotherapeutics are platinum-based drugs. The key step for their further development is a more detailed study of their structure, properties, dynamics, and reaction mechanisms. The project of Dr. Jan Vícha from Tomáš Baťa University in Zlín carries on his previous research project, as well as the results of his project, which was awarded computational resources within our 9th Open Access Grant Competition. The objective of the new project, which has now been awarded 1,134,000 core hours, is to enhance prediction ability and the accuracy of computation of complex platinum-based alloys spectroscopic properties using the ReSpect program developed by the project partner organization - Arctic University of Norway. The newly modified code of the program will first be tested using magnetic resonance parameter computations of simple platinum chemotherapeutics, such as cisplatin and oxaliplatin in solution. The scope of the research activities will then be extended to simulations of new advanced carriers of platinum drugs, which is also the main topic of the Advanced Carriers for Platinum Drugs project supported by the Grant Agency of the Czech Republic, also implemented by Dr. Vícha.
The allocated computational resources will be used in testing the modified code and for relativistic quantum chemical computations performed by the ReSpect program for prediction and analysis of magnetic resonance parameters for heavy metal complex compounds.




Simulation of the structure of a platinum-based drug bound to a macromolecular carrier

**Martin Matys (Czech Technical University in Prague): Proton acceleration via laser interaction with plasma micro-bunches produced by cryogenic hydrogen ribbon**

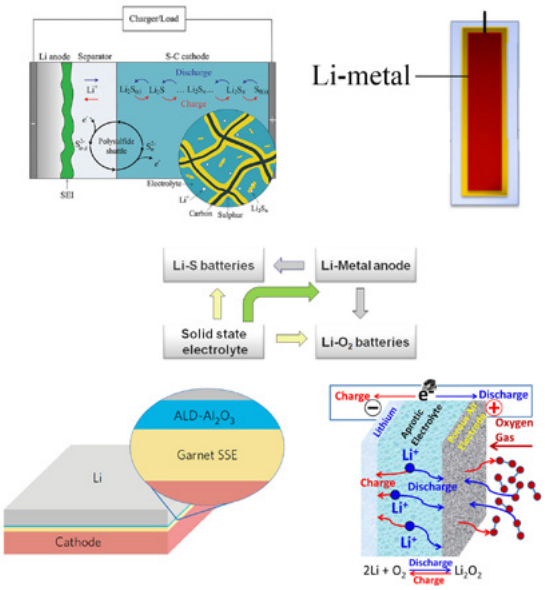
Being also involved as researchers in the ELI Beamlines project, Ing. Martin Matys and Dr. Jan Pšikal from the Czech Technical University in Prague were awarded 800,000 core hours for their project focusing on ion accelerator development. In particular, they are involved in research of proton acceleration induced by high power laser impulse interaction with a cryogenic hydrogen ribbon.
Laser based ion accelerators have the potential to replace the extremely expensive conventional accelerators in the future, thereby, for example, lowering the costs of proton therapy for treatment of oncological diseases as well as the production costs of medical isotopes for positron emission tomography.
Scientists are particularly interested in the interaction when a laser pulse burns through the target and then interacts with the remaining plasma micro-bunches of much lower density than the initial target. Such a mechanism is capable of accelerating protons to energy ranges of hundreds of millions of electron volts. The project objective is deeper study of this mechanism using numerical three-dimensional simulations, which is significantly cheaper in comparison to real experiments.




2D simulation results visualization of a laser pulse interaction (corresponding to ELI Beamlines L4 laser parameters) with a cryogenic hydrogen ribbon at 290 fs after the start of the interaction. On the left: the target electron density (n_e), normalized to critical density (n_c). On the right: a laser pulse using the absolute value of the magnetic field in the z axis (| B_z |). The laser pulse bursts through the ribbon and interacts with plasma at a much lower density.

**Dr. Dominik Legut (IT4Innovations): Optimization design of functional materials in a new type of lithium based battery**

Our colleague Dr. Dominik Legut is involved in the research of lithium-based metal batteries. Unlike lithium-ion batteries, these batteries have higher energy density and are capable of storing ten times more energy. However, lithium anodes face many of the challenges associated with their lower charging efficiency, change of volume while charging/ discharging, and especially with dendritic growth.
In 2017, Dr. Legut, together with his colleagues from the USA, China, and Singapore, published an article about protective films for lithium-based metal batteries in the Advanced Energy Materials journal with an impact factor of 16. Special protective two-dimensional films with a thickness of a few atoms are capable of preventing electrodes connecting (and the subsequent dangerous short-circuit), which can potentially occur as a result of dendritic growth on lithium-based anodes.
This time, Dr. Legut was awarded 8 million core hours for his research of the optimal structure of lithium-based anodes. Together with other colleagues, he will aim at designing optimal materials for lithium-based anodes using prediction algorithms, chemical stability and mechanical properties calculations.

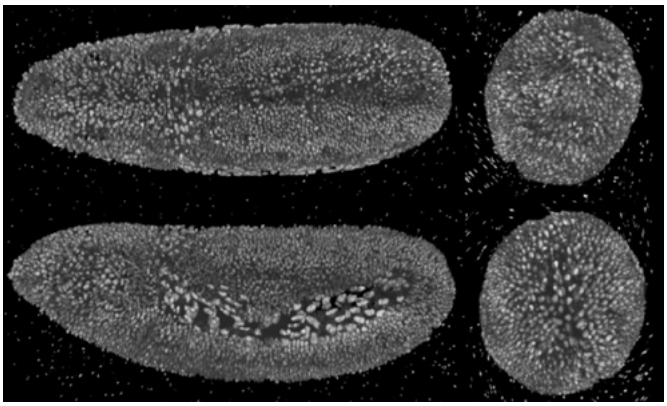



Battery scheme

**Dr. Michal Krumnikl (IT4Innovations):**
**Fiji Bioimage Informatics on HPC - “Path to Exascale”**

The IT4Innovations National Supercomputing Center – path to exascale project, which supports the research in the area of biological image analysis using HPC, allows IT4Innovations to participate in the research of large bioimage dataset processing using high performance computing (HPC) systems. This research is focused on parallelization of key steps in, for example, light sheet microscopy data processing. Light sheet microscopy has become popular for scanning living cells and organisms for its speed and low photo toxicity, which allows complex living systems such as embryos to be microscopically scanned three-dimensionally with high resolution and for their entire development period.
The main objective of the project is to extend the options of the Fiji platform, which is used by tens of thousands of users worldwide for the processing of large image datasets. The development team led by Dr. Krumnikl in collaboration with Dr. Pavel Tomančák from Max Planck Institute in Dresden (Germany) will modify each data analysis method for seamless running on HPC systems. Development and deployment of the Fiji platform on HPC systems shall allow its users to fully exploit its potential on large bioimage datasets.

Image of the Fruit fly (Drosophila) embryo imaged by light sheet microscope



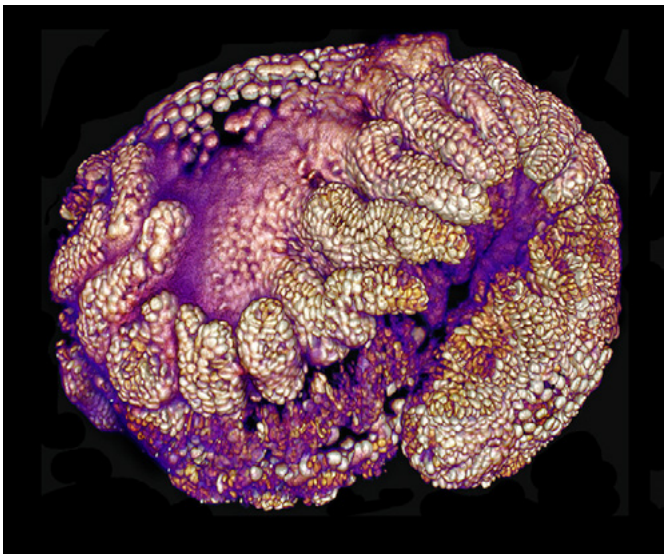
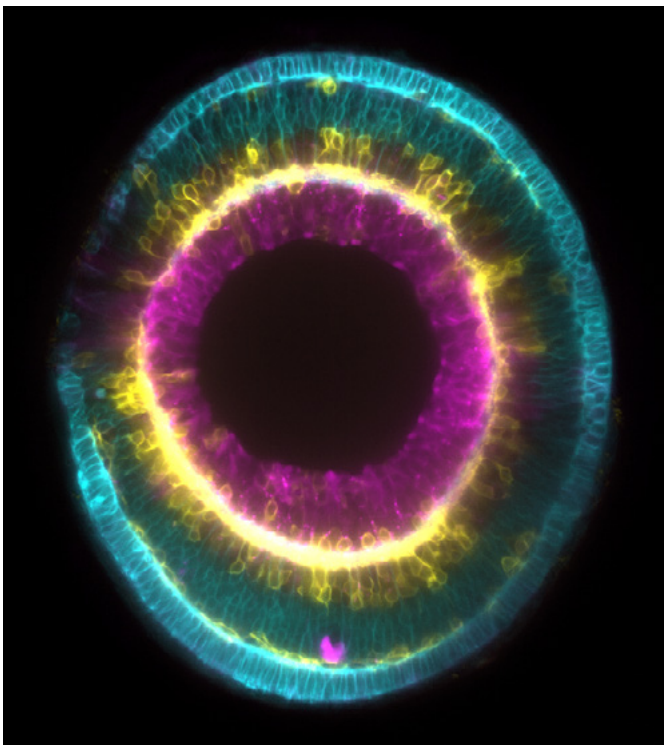


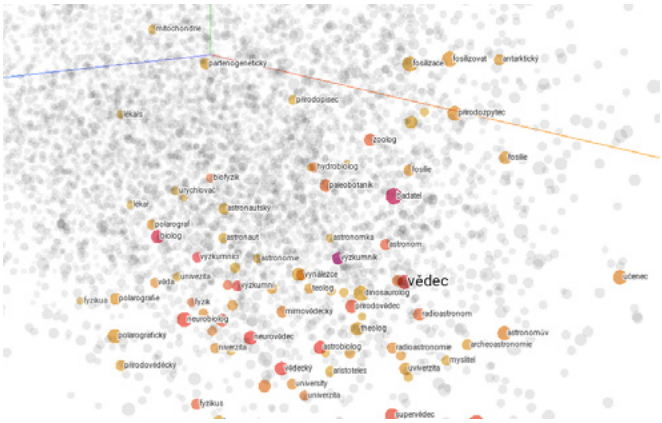
Image of the Crustacean (Parhyale) embryo imaged by light sheet microscope



Light sheet section through developing zebrafish eye

**Martin Fajčík (Brno University of Technology):**
**Experimental comparison of word embedding methods**

Numeric representation of words used in natural language processing is referred to as word embedding. It consists in creating a vector for each word. Advanced word embedding methods have applications in various areas associated with, for example, speech recognition and translation.
The objective of the project by Ing. Martin Fajčík from Brno University of Technology, which was awarded 850,000 core hours, is to experiment with state-of-the-art word embedding methods (count-based and prediction methods) by training them on large data sets. The team of scientists aim to identify the drawbacks of different methods, and find ways for their further improvement. The project activities also include developing deeper understanding of the relation between the vectors of words and their real meaning. Other interesting research topics will be processing of homonyms, synonyms, antonyms, and hyponyms.
The models allow not only the relation between words they "learned" to be predicted but also the dimension of these relations to be represented. Moreover, they enable lexical arithmetic (e.g., the similarity between words).



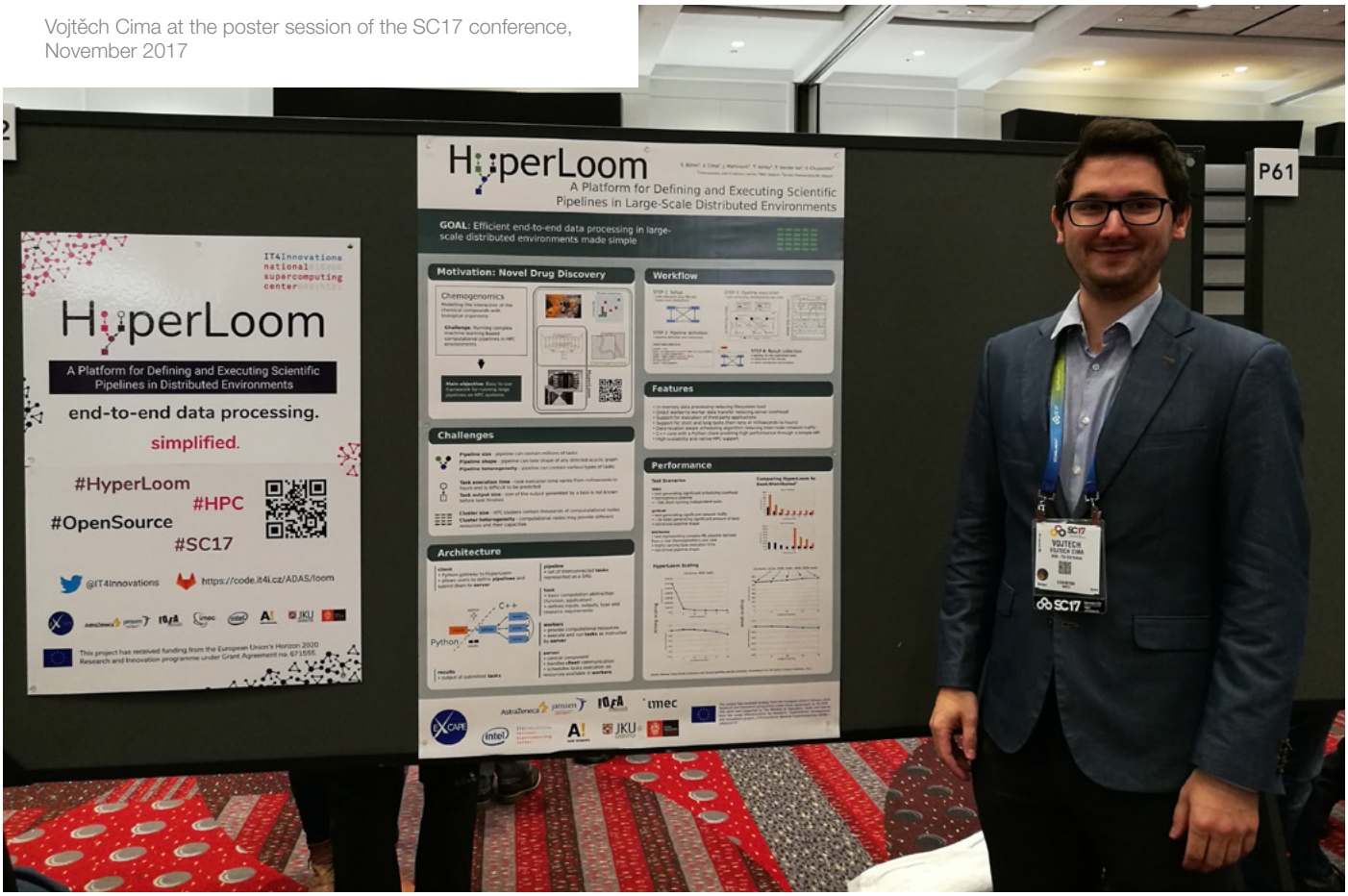

Visualization performed using the online Embedding Projector tool

# HYPERLOOM: DATA PROCESSING USING HIGH PERFORMANCE COMPUTING SYSTEMS MADE SIMPLE

The tasks of machine learning finding its application in various human activities ranging from the energy industry, industrial automation, robotics, the automotive industry, and biomedicine usually include a series of interconnected data-processing steps.

For defining and executing such complex computational pipelines containing large numbers of interconnected tasks on supercomputers, scientists can currently use the HyperLoom software, which is being developed by the Advanced Data Analysis and Simulation Laboratory team.
Using the HyperLoom software, its users are able to easily define dependencies among computing tasks and create a pipeline, which is then executed using a high performance computing system. The software allows pipelines containing a wide range of task types to be executed. These tasks range from the native ones providing basic functionality, user-defined tasks, and tasks wrapping third party applications, including combinations of these.

Vojtěch Cima at the poster session of the SC17 conference, November 2017




HyperLoom was designed to minimize the pipeline and run-time overhead as well as efficiently process different computationally demanding tasks. Its C++ core enables dynamic execution of tasks using available computational resources taking into consideration the demands of individual tasks, which are defined by users themselves. The core itself consists of a server component and several workload components. The server component is responsible for scheduling and executing tasks on workload components in nodes. Pipelines are then defined and sent to a server using the Python interface.

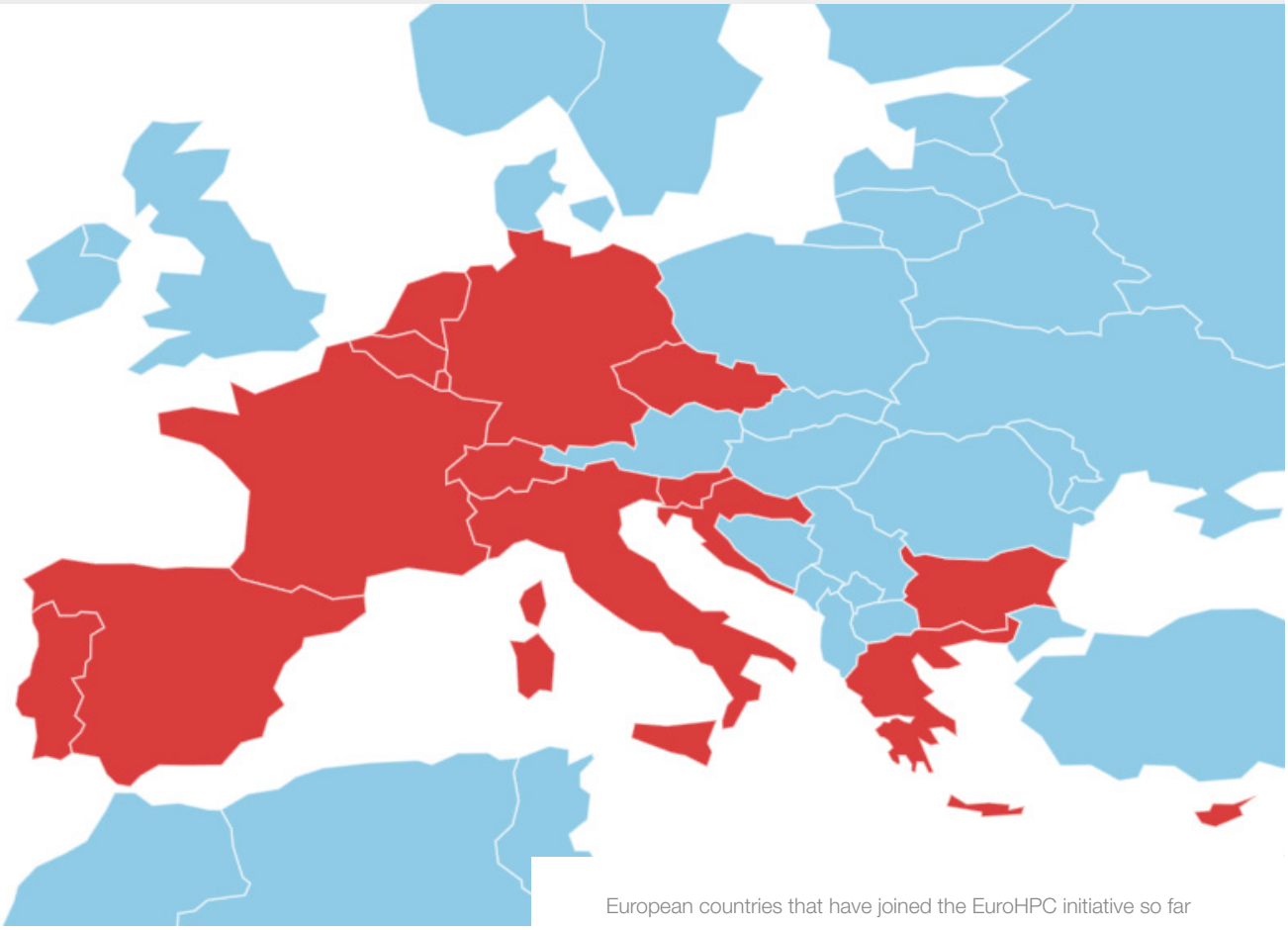
The performance tests proved that HyperLoom enables pipelines containing hundreds of thousands of tasks with unknown execution times to be executed on tens or even hundreds of nodes. HyperLoom is used in solving the international ExCAPE project for choosing the parameters of machine learning models for predicting the bioactivity of chemical entities.

HyperLoom is an open source product available on the GitLab of IT4Innovations including the documentation and benchmarks under the BSD3 licence.
See https://code.it4i.cz/ADAS/loom

The HyperLoom software development is supported by the Ministry of Education, Youth and Sports by the IT4Innovations infrastructure which is supported from the Large Infrastructures for Research, Experimental Development and Innovations project „IT4Innovations National Supercomputing Center – LM2015070“ and by the the ExCAPE project - the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 671555.

# THE CZECH REPUBLIC HAS JOINED THE EUROPEAN UNION‘S EUROHPC INITIATIVE, THE OBJECTIVE OF WHICH IS TO BUILD NEW TOP EUROPEAN SUPERCOMPUTERS

Despite its effort and investment so far, the European Union fails to have the most powerful supercomputers in the world. In June 2012, four of the European Union‘s computer systems ranked among the ten TOP500 most powerful supercomputers in the world, namely SuperMUC and JUQUEEN from Germany, Fermi from Italy, and Curie from France. At present, the EU‘s most powerful supercomputer is Marconi having been in operation by the CINECA consortium since 2016. Thanks to its theoretical peak performance of 7.5 petaflops (Linpack), it has maintained its position among the first fifteen supercomputers in the TOP500 list since its launch.



European countries that have joined the EuroHPC initiative so far

As far as the European states and their computational performance are concerned, with the exception of Switzerland, they are behind China, Japan, and the United States of America. China operates a total of 202 supercomputers ranking in the TOP500 to date, followed by the USA and Japan having 143 and 35 such supercomputers, respectively. More than one third and almost one third of the global supercomputing power is concentrated in Asia and the USA, respectively. In Europe, it is about one fifth of the global supercomputing power.
However, the United States is planning to improve their current situation in the supercomputing world, trying to catch up with the Asian systems. In the National Oak Ridge Laboratory, installation of a brand-new 200-petaflop Summit supercomputer is coming to an end. Similarly, in the Argonne National Laboratory, the one-exaflop A21 supercomputer is planned to be installed by 2021. China is not sitting idle, and is planning to put its first one-exaflop supercomputer into operation a year earlier. (Note: exascale computing systems are in theory capable of calculating at least $10^{18}$ floating point operations per second.)
It might appear as if it was an arms race for supercomputing supremacy among the global leaders. However, it should be noted that supercomputers are used in all scientific domains. Let´s name just a few of those concerning all of us and vital for the whole of society, such as design of drugs, novel materials, aircrafts, and vehicles. Instead of performing frequent laboratory experiments, it is faster and cheaper to carry out computer simulations first and then verify their results experimentally.

## What is the current situation and future plans in Europe?

The leading European countries according to the TOP500 list are currently Germany with 20, France with 18, and the UK with 15 supercomputers. Moreover, a new supercomputer with a theoretical peak performance of 12 petaflops and funded by the Ministry of Culture and Science of North Rhine – Westphalia is to be installed in Germany. It aspires to be the fastest supercomputer installed in the European Union.
Despite substantial national as well as EU investment in high performance computing technologies, these are apparently not sufficient. Moreover, the computing power available in Europe cannot satisfy the ever-growing demand on the side of European scientists and industry. Besides, processing of data outside Europe might cause problems related to, for example, data protection, trade secrets, and data ownership.
Solution to this problem is offered by the **EuroHPC initiative**. Gathering resources and rationalizing the effort of the EU member states under the EuroHPC initiative, entirely new top supercomputers with the potential for becoming the most powerful ones in the world will be built, and in doing so Europe will become markedly more competitive in the field of high performance computing.
**In May 2017,** the European Commission confirmed its plan to invest in high performance computing technologies. Given the fact that the current financial instruments for supporting such extensive collaboration are limited, the EuroHPC initiative is best implemented through a new legal and financial structure – Joint Undertaking. The EuroHPC Joint Undertaking will enable co-participation in the public procurement procedures and ownership of the supercomputers. Its activity is expected to start in **2019** and will continue to the end of **2026**.
The EuroHPC initiative is stipulated in the **declaration**, the subject of which is to define the main principles of the future cooperation of the European countries participating in the development of HPC in Europe.

Within EuroHPC four new supercomputing systems will be built. Two of them will be petascale (pre-exascale) supercomputers and are expected to be put into operation by the end of 2020. The other two will be exascale supercomputers and are most likely to be put into operation by the end of 2023. The newly built computing infrastructure will address the ever-increasing needs of the scientific community. Along with that, it will search for ways to make these computational resources available for users from both industry and the public sector, and guarantee their most efficient use in order to sustain scientific excellence, innovation, and increase in competitiveness of European industry.
EuroHPC will most likely have a global budget of about EUR 1.4 billion. The financial contribution of the European Union of almost half a billion EUR will cover administration and operating costs. The countries participating in the EuroHPC initiative will mutually contribute to the funding, i.e. about half a billion EUR. Moreover, European industry (private entities) is also supposed to invest in the initiative.
**In March 2017**, the EuroHPC Declaration was signed by seven membership countries (France, Italy, Luxembourg, Germany, the Netherlands, Portugal, and Spain). **During the last year**, other countries, namely Belgium, Slovenia, Bulgaria, Switzerland, Greece, and Croatia joined the EuroHPC initiative. In **January 2018** the Czech Republic joined the initiative, becoming its 14th member, followed by Cyprus in **February 2018**. Providing financial contribution, other countries may join the initiative at any time as well. The amount of investment of each European country will have a bearing on the influence over the decision-making process in the Joint Undertaking as well as on the extent to which the particular country will be able to use the supercomputers. At this point, for instance, the Austrian and Polish governments are currently negotiating their potential participation in the initiative. EuroHPC is to be established during the year 2018.

Declaration of the EuroHPC initiative.