CENTRAL EUROPEAN SYNCHROTRON LABORATORY

Major project prepared by the Academy of Sciences of the Czech Republic

Project proposed as Center of Excellence to the Operational Programme of Research and Development for Innovations

CESLAB: project objectives

The Academy of Sciences of the Czech Republic (ASCR) proposes the electron synchrotron facility as one of the projects realized from the Structural Funds of the EU.

The main objective of the project is to establish the Central European Synchrotron Laboratory (CESLAB) based on a modern third-generation accelerator of electrons, and to create beamlines, which are to make CESLAB excellent in Europe.

As parts of the beamlines, scientific or industrial laboratories will be constructed, being distributed along the perimeter of the accelerator. In the laboratories, research and industrial activities will be conducted. The proposal of CESLAB, a synchrotron with energy of 3 GeVserving the Central Europe from year 2015, enables 33 such laboratories to be established.

Currently, 10 beamlines are being prepared, which are focused on structural biology, imaging techniques, biomedicine, structural chemistry, material sciences, nanotechnologies, and the environment research.

CESLAB is to be constructed based on the Spanish synchrotron ALBA in Barcelona, in terms of cooperation between the ASCR and the CELLS consortium (The Memorandum of Understanding has been signed by Prof. V. Pačes, President of the ASCR, and Prof. J. Bordas, Director of CELLS). The period from the proposal to the realization of the project is to be shortened from 20 to 7 years, thanks to the documentation and experience provided by the CELLS consortium. Compared to the Spanish project, CESLAB realization plan is shifted by 4 years.

Contribution to research and development of technologies

An electron synchrotron is an accelerator that serves as the most universally usable type light source. It is used for advanced experiments conduction, thanks to which unique information is possible to gain on behaviour of matter on molecular and atomic levels. Data provided by synchrotrons are important for the competitiveness of the future industry in the EU. They are to be employed, for example, at the development of new pharmaceuticals, advanced materials and nanotechnologies and in the advanced environmental analyses.

The research on synchrotrons is highly productive. A number of Nobel Prizes has been awarded for works on synchrotrons. Moreover, techniques used on synchrotrons are under continuous development, and new unexpected possibilities have emerged. In CESLAB, new techniques are to be introduced (e.g. coherent imaging methods), which have appeared recently, and which allow cutting-edge research. CESLAB construction and utilization will result in high-tech industry advancement (e.g. electronics, and vacuum, measuring and diagnostic techniques). In future, CESLAB is to contribute to the industry development based on very advanced technologies and products. CESLAB is also to improve significantly the relations between the academic sphere and the private sector. It will help to raise the attractiveness of the Czech Republic, the level of the society education, and the public awareness of the importance of knowledge.

Synchrotron radiation (SR) represents a convenient tool for research in a broad range of scientific fields: material sciences, life sciences, and even in some aspects of humanities.

a) In material sciences, structural studies showing nonhomogenities, dynamics of structure formation, and a highly sensitive analysis of chemical composition of materials are important parameters investigated. Both macro- and microscopic approaches can be applied. In addition, some techniques allow studies of material surfaces of a very high resolution, their structure and dynamics of formation. SR also allows studies of electric and magnetic properties of materials, using, for example, light polarization.

b) A standard technology applied in life sciences is a biomolecular structure determination, where approximately 80 % of known protein structures have been determined, using diffraction experiments on synchrotrons. Currently, these studies are being automated, becoming more and more complex. Structures of whole complexes of several macromolecules are being investigated, involving investigations into the formation of these structures in time. A very important direction is represented by imaging of cells or tissues. Different types of microscopes are constructed, using a broad spectrum of light wavelengths from infrared to soft X-rays in coherent imaging. X-ray microscopy enables a high resolution typical of electron microscopy with the possibility to investigate whole cells, which is typical of confocal microscopy. 3D structure and dynamics of living cells can be, in principle, investigated with a high resolution (<30 nm), which cannot be performed using standard techniques.

c) Environmental disciplines represents another important field of science where synchrotrons enable a very sensitive determination of environmental pollutants, and subsequently determination of pollutants in living organisms. Again, the results obtained by SR cannot be achieved by other laboratory means. Hence, synchrotrons have contributed significantly to the establishment of molecular environmental science.

d) In medicine, a number of diagnostic techniques using SR are being developed. For example, diffraction enhanced imaging is used for mammography with much a better resolution, as compared with standard approaches, providing a significant advantage in diagnostics of the breast cancer. The K-edge subtraction method is used in angiography again with much better results as compared with standard angiography. In cancer therapy, pharmacodynamic therapy is investigated, in which cytostatic molecules (e.g. platinum compounds) are activated in the tumour region by irradiation with precisely defined wavelength.

e) Synchrotron light can be used in archeology, e.g. for investigations into the origin of findings according to their structure or composition.

Long-term perspective

Synchrotrons are usually used in a catchment area of up to 300 km. Within the EU, there are 18 such facilities; however, in the Central and Eastern part of the EU, there are none. Therefore, the CESLAB establishment will be in accordance with the policy of cohesion and convergence, i.e. mitigation of differences between particular regions of the EU. In the EU, there are approx. 10,000 current and 100,000 potential users of synchrotrons (cited from official documents of the European Commission). The high-standard and modern facility construction is to have a positive impact on all participants (S&T institutions, universities, building companies, industry, management etc.). In numerous fields, such as biotechnologies, nanotechnologies, and microelectronics, CESLAB is to rank the Czech Republic among the most developed countries. Compared to commercially available research facilities, with the usual utilization period of 6 years, accelerators are being improved incessantly, and are utilized much longer (30–50 years). Following the CESLAB construction, other advanced facilities, such as free-electron lasers, are considered to be established.

Contribution to European research and development

The CESLAB project is to increase substantially the competitiveness of European science in a global scale. Currently, synchrotrons are being considered the most universal research tool bringing about numerous fundamental discoveries not only in scientific disciplines but also within industrial technologies. The capacity of existing European facilities capacity fails to meet the increasing demand. Hence, CESLAB is justifiably supposed to have a sufficient number of users. In Europe, those who are not granted outnumber several times the satisfied applicants for conducting research on these facilities.

CESLAB is to offer an opportunity for excellent research to scientists from those regions which belong to the less developed ones within the EU. This is a crucial circumstance since there has been no synchrotron facility established in Central and Eastern Europe so far. Hence, the project seems to contribute significantly to fulfilment of the convergence aim within the EU. Besides, the CESLAB realization is considered to be an actual fulfilment of the European Research Area ideas, not only because it is an excellent research infrastructure but also because it is focused on supraregional collaboration. This kind of cooperation plays also a key role in the phase of the project preparation. The main part of the project, the booster and storage ring, is being prepared in collaboration between scientists from South Moravian institutes of the Academy of Sciences of the Czech Republic and scientists from the Spanish CELLS consortium, which manages the synchrotron facility in Barcelona. Beamlines are being prepared by groups of experts consisting of scientists from the EU.

It is supposed, that some research facilities in CESLAB could be rare even in the EU. For instance, a beamline for coherent diffraction imaging is planned for CESLAB. The expected resolution is about 20–30 nm for cells and even lower for materials. This beamline facility will be important for molecular and cellular biology as well as for material sciences. Experience with electron microscopy development in our region will be used for construction of a cutting-edge equipment for photoemission microscopy at synchrotron light source. This is to be of high significance for the advanced studies of surfaces of material and their formation dynamics as well as for nanotechnology.

As mentioned above, the top level of research on synchrotrons is demonstrated by a number of Nobel Prizes awarded for research conducted on these facilities. Johann Diesenhofer, for example, shared a Nobel Prize with Hartmut Michel in 1988 for the three-dimensional structure determination of a photosynthetic reaction centre; Roderick MacKinnon was awarded a Nobel Prize in 2003 for his structural and mechanistic studies on ion channels; Roger Kornberg won a Nobel Prize in 2006 for his research of the molecular basis of eukaryotic transcription. In all these cases, the fundamental basis of the contributions was done on synchrotrons.

Regional significance of CESLAB

In a region where an electron synchrotron has been established, there is a rapid growth of cutting-edge R&D in numerous fields of science. Scientists come to this region not only from the wide surroundings (200–300 km) but also from more remote places, depending on what unique parameters the particular facility provides. The region becomes a junction where experience and the most up-to-date findings on research and new technology results are exchanged. These findings are absorbed by the research community concentrated around a synchrotron. The process itself of designing an accelerator and particular experimental facilities is an inherently international activity – otherwise, it is impossible for the project proposal to be formed. In addition, the significant increase in the R&D level, the electron synchrotron creates an outstanding perspective for

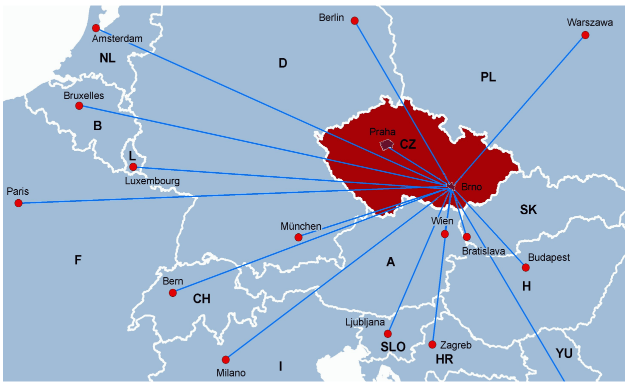

Figure 1. Geographic location of Brno with respect to the European capitals.

industrial technologies. Electron synchrotrons are considered to be a decisive power driving the future development of modern technologies, such as biotechnologies, nanotechnologies, etc.

The establishment of en electron synchrotron is in accordance with the policy of convergence, i.e. mitigation of the differences between particular regions of the EU. Whereas in old EU member countries there are 18 electron synchrotrons, none has been established in new EU member states so far.

The facility location

Brno City Municipality has provided a land for the synchrotron facility. The decision was achieved as a result of negotiations between Prof. Václav Pačes, President of the Academy of Sciences of the Czech Republic, and Mr. Roman Onderka, Mayor of the City of Brno. The land of an area of 17.6 hectar plot is a part of the industrial park Černovická terrace. A technical feasibility study is being elaborated for this location and, which is to serve as a potential development area of the ASCR.

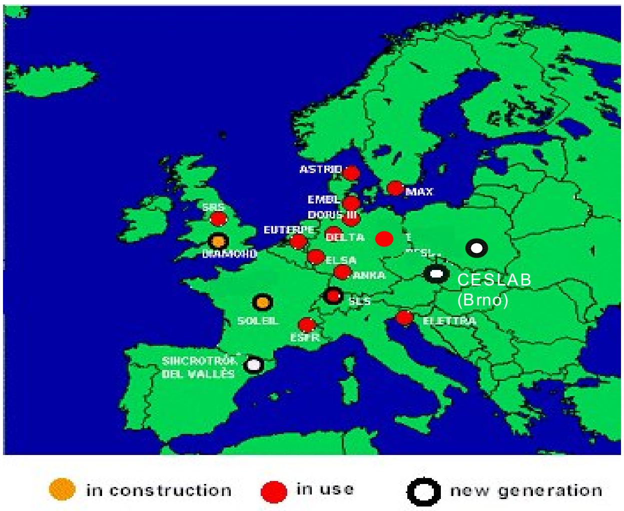

Figure 2. Location of CESLAB within the portfolio of European synchrotrons.

Impact on the environment

Synchrotrons do not have a negative impact on the environment. The danger of environmental pollution is negligible, even in case of an accident or terrorist attack. On the contrary, CESLAB is to contribute significantly to the environment research. Experiments using synchrotron light can detect even a small number of pollutants and measure their concentration. Moreover, synchrotron light can help to observe the flow of pollutants in the environment and also in organisms. Synchrotron microbeams are utilizable in analysis of small particles within living organisms or cells. Microscopic methods can monitor the spatial distribution of pollution.

CESLAB is to be involved in supranational projects, such as pollution detection, studies of atmospheric mechanisms related to the ozone layer destruction and greenhouse gases effects etc.; currently an active cooperation with foreign associations is being planned

Synchrotron facility description

A synchrotron is a circular facility with the diameter of several hundreds of meters, the backbone of which is a huge ring of a highly evacuated tube. Inside the tube, electrons move at a high speed. The electron movement along the tube is curved by means of strong dipole magnets, and another set of magnets which corrects the path of electrons and keeps them in the middle of the tube. As their path along the ring curves, the electrons produce light which has high intensity (brilliance) and can have further unique features such as precisely set wavelength in a broad range of wavelengths and required polarization. The light can be obtained in the form of very short flashes with precisely set timing or in the form of very narrow microbeams. Synchrotrons are employed in many scientific fields (life sciences, material sciences, the environment research, and social sciences), and in industry (microelectronics, nanotechnologies, micro-engineering, spectroscopy, pharmacy etc.).

The entire facility consists of a linear accelerator (LINAC), with an electron source in the first section, where the electrons are accelerated to a low energy (100 MeV at the ALBA synchrotron), and injected into a main accelerator (BOOSTER). There the electrons are accelerated to the final energy (3 GeV in the case of ALBA). Afterwards, the electrons move into a storage ring, where they circulate, emitting light.

There are a few ways how to obtain electrons. A frequently used way – which is applied also at the ALBA synchrotron – is thermoemission. Electrons are acquired in the same way as the ones in a television tube. Their source is a heated cathode which emits electrons. Applying an electric voltage between both electrodes, the electrons are initiated to move from the cathode towards the anode. Another electrode system generates an electric field, which produces a thin beam of electrons that passes through a small gap on the anode. At ALBA, the cathode surface is 0.5 cm^2, the cathode-anode distance is 3 cm, and the anode-cathode voltage is 90 kV.

Due to functional discontinuities between some components of a synchrotron, it is necessary to create bunches of electrons before the entire acceleration starts. These

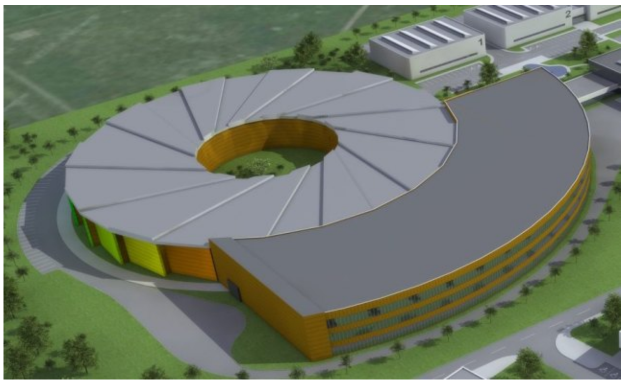

Figure 3. Architectural rendering of the CESLAB, which can accommodate beamlines up to 100 m length.

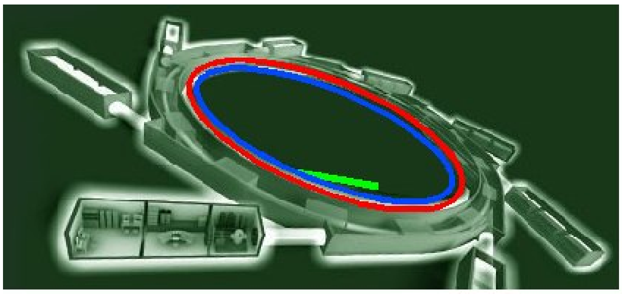

Figure 4. Scheme of the accelerator complex with the linear accelerator (green), booster (blue) and the storage ring (red), all housed in one annuloid building.

bunches are produced in a device called Buncher, where the electrodes are under an AC field, which enables the electrons to bunch. There are 3 bunchers at ALBA, producing bunches with a great yield.

A linear accelerator (LINAC) is a device for accelerating charged particles, in our case electrons. It consists of an evacuated tube containing cylindrical electrodes. At ALBA, the tube length is approximately 10 m. The electrodes are under a high-frequency voltage that causes the particle acceleration. When the particles are located within a cylindrical electrode, they are not influenced by any electric field. As they pass through the gap between cylinders, acceleration arises, depending on the electric voltage between the cylinders. A voltage frequency is tuned in order to increase acceleration during each pass through the gap. A wave carrying and accelerating electrons arises in the tube. The beam radius must be kept small, which is managed by a few magnets.

At ALBA, the electrons at the LINAC output have energy of approximately 100 MeV, and need further acceleration to the final energy of 3 GeV. That is provided by a Booster, consisting of quadrants interconnected by linear sections. There are 10 accelerating electrodes in each of the quadrants. A high-frequency voltage (500 MHz) is delivered to each electrode. The inner perimeter of the Booster is 249.6 m, The Booster injects electrons into a storage ring. There is a series of magnets along the perimeter of the Booster, keeping the beam in the centre of the tube.

3GeV electrons come into the storage ring where they circulate and cumulate until the current reaches 400 mA. Their trajectory is curved by bending magnets (32 at ALBA); they are kept in the centre of the tube by so-called quadrupoles (112 at ALBA). At light emission, electrons lose their energy (approximately 1 MeV per round). Hence

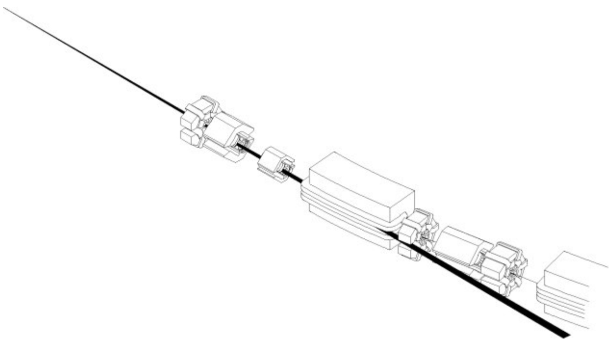

Figure 5. Extraction of light from an insertion device.

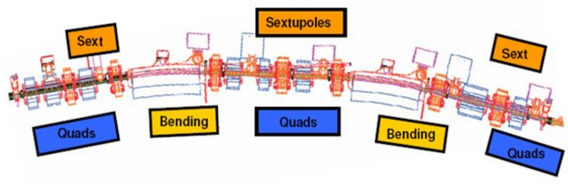

Figure 6. Arrangements of magnets within a segment of the accelerator.

a small amount of energy is added at each round in a so-called resonator (a frequency of 500 MHz, an output power of 150 kW).

ALBA is constructed as a third-generation synchrotron, which means it allows to insert special devices designed to generate light – so-called undulators and wigglers. For this purpose, there is a series of linear sections along the perimeter, where the devices can be inserted. At ALBA, there are 4 linear sections of 8 m length, 12 sections of 4.4 m length, and 8 sections of 2.6 m length, however some of them are occupied by diagnostic devices, the resonator, etc. Therefore, light is produced on the bending magnets (the electrons trajectory is curved), and simultaneously in the insertion devices (undulators and wigglers).

Undulators and wigglers are devices consisting of a series of dipole magnets. They are inserted into linear segments of a synchrotron in order to initiate an electron transversal periodic movement. In that way, very intense light is produced. Wigglers usually have a lower number of magnets generating a high-intensity magnetic field than undulators do. Wigglers produce light of a wide range of wavelengths up to very short wavelengths (high energy photons). They are used to acquire a high-energy radiation. On the contrary, undulators produce light of a very particular wavelength (which is tunable), and are used to produce monochromatic beams of a high intensity.

Industrial utilization of synchrotrons

The first historically utilization of a synchrotron for industrial purposes was probably synchrotron x-ray lithography. For this purpose, the IBM Company established their own compact superconducting synchrotron in New York. Since then, the development of microelectronics and nanoelectronics has continued very intensively.

Generally speaking, industrial technologies development is becoming more a more dependent on synchrotrons. Such branches are concerned as biotechnology, nanotechnology, microelectronics and nanoelectronics, microproduction, microengineering, spectroscopy analysis, etc.

Biotechnologies are most concentrated on development of new pharmaceuticals and improvement of the existing ones. This research is conducted by scientists from or related to pharmaceutical companies. During this research, crystallographic analysis is applied, during which an appropriate small molecule is sought, which is to inactivate a protein or protein complex important for a particular disease origination. Currently, there is a range of companies engaged in the development of pharmaceuticals through synchrotrons.

Nanotechnologies are devoted to the preparation of objects of a size of about 1–100 nm, manipulation with them, and examination of their features. Synchrotrons enable imaging of these objects with a resolution of nanometres, as well as precise analysis of their composition. Electronic nanocomponents suggest themselves as a typical example. The principles on which they are produced are similar to the principles on which ink printers work, producing micrometer objects; nanometre objects originate as a result of a self-organizing process. These processes can be effectively checked and modified on synchrotrons. Solar panels or LCD monitors represent other examples, in which organic substances with appropriate electric and optical features and sizes of nanometres are used. Porous materials, with a pore size of nanometres, are also examined intensively for energy storage purposes, hence for high-capacity batteries production. Synchrotron radiation enables the development of these materials.

Material research for industry is also of high importance. In car industry, for example, aluminium alloys are investigated with a goal to optimize their features. Besides, new-generation of high performance steels is developed in order to make the components much firmer than the existing ones are. In these branches, synchrotrons enable the microscopic features and composition of the above mentioned materials to be examined, not only after the solidification but also during this process, i.e. it is possible to take pictures of the generating structures in time intervals of milliseconds, and to search for optimal ways of influencing the mentioned process. In connection with this, it is interesting to mention that some car companies build their own synchrotrons.

Microengineering, and more generally microproduction, i.e. small electromechanical components production, is predicted to face a great future. On synchrotrons, for example, a toothed wheel of a size of micrometer can be produced as well as an electric circuit of the same size. Currently, microvalves and microsensors are being produced for medical purposes. The size of electromechanical components is to be reduced further up to the range of nanometres in future, in which features of the objects are very different from macroscopic ones. So called nanotubes, for example, which are made of carbon and a diameter of which is of nanometres, are so tense that they have no parallel in macroworld.

History of the CESLAB Project

The CESLAB project was proposed by the Institute of Biophysics of the Academy of Sciences of the Czech Republic, v. v. i., and has been prepared since 2005. At the beginning, a purchase of an Aurora 2D synchrotron (of a Japanese company Sumitomo) was considered. Nevertheless, after a visit to the Hiroshima University it was realized that the Aurora 2D is of low energy and insufficient potential. Due to these drawbacks, the CESLAB proposers contacted the CELLS consortium in Barcelona, where a modern third-generation synchrotron facility of ALBA is being built. Mr. Joan Bordas, director of this facility establishment was invited to the CR where an agreement on future collaboration was discussed. It was concluded that the colleagues from Barcelona were to help in all substantial aspects of the whole construction process, including supervision of the construction. Since 2007, the beamlines are being proposed by the interested Czech user groups.

The CESLAB project schedule

Present state of the project preparation

- a) The Czech Minister of Education, Youth and Sports sent a letter to the Spanish Minister of Education and Science, requesting a support for the construction of the synchrotron in the Czech Republic. The response was positive and the CELLS consortium proposed their support and promised all the help necessary, on the condition of neutral costs for the CELLS.
- b) A timetable of the preparation and construction (including annual costs) of CESLAB has been developed.
- c) Employees of the Institute of Scientific Instruments of the AS CR, v.v.i have been sent to Barcelona to start working on the Conceptual Design Study of the CESLAB synchrotron in cooperation with Spanish colleagues from CELLS.
- d) The preparation of the project is being performed by the Executive Committee. The CESLAB establishment is supported by Czech experts in the field of synchrotron science.
- e) There are regular meetings of the preparation team, the beamline coordinators and other interested participants.
- f) Long-term geological stability study of the provided land has been started.
- g) Spring 2008 issue of the journal "Materials Structures in Chemistry, Biology, Physics and Technology" devoted to the CESLAB project, has been published. You are just reading it.

Near future milestones

- The Conceptual Design Study will be published in March 2008. This large report will contain both the overview and technological aspects of the accelerator complex, beamlines, and their infrastructure.
- A group of researchers will be sent to Barcelona on 1st May, 2008 to take part in the construction of ALBA. This project is granted by the Academy of Sciences of the Czech Republic. The researchers will later apply their skills and experience in the construction of CESLAB.
- The first results of the geological studies on the long-term stability of the construction area are expected on October 2008; subsequent preparation of the project design will start.
- Colloquium "Struktura 2008" devoted to synchrotron methods will be organized by the Czech and Slovak Crystallography Association (CSCA) in June 2008, see its web page www.xray.cz/kolokvium.

Major project milestones

- 1. 10. 2008 30. 9. 2010: Preparation of the project design
- 1. 10. 2010 31. 3. 2011: CFT (call for tenders) for the main building and accelerators
- 1. 4. 2011 31. 3. 2013: Building construction
- 1. 4. 2011 31. 3. 2013: Construction of accelerators

- 1. 10. 2010 30. 6. 2013: Beamline construction
- 1. 1. 2013 31. 12. 2014: Installation of technologies (accelerators)
- 1. 7. 2013 30. 6. 2015: Installation of beamlines
- 30. 6. 2015: The end of investment from SF, report sent to EC
- 1. 1. 2016: The first 10 beamlines will welcome the first users for experiments

Financial issues of the project

The construction costs are expected to be 265 million Euros (prices of the 2007 year), including construction of the initial portfolio of beamlines. Further annual running costs are expected at about 23 million Euro/year. With this ratio, where the annual costs are below 10 % of the construction costs, the investments are very cost effective, compared to other facilities and centres of excellence proposed for construction from the Structural funds. Their total investments sum for the Czech Republic reaches almost 70 milliards Kč. The synchrotron, being a new national (non-local) research institution targeting many basic and applied research fields, will be a very efficient and productive investment for our knowledge society and the whole Central European region.

Beamlines proposed for CESLAB

Beamlines are the heart of results at the synchrotron facility. They provide necessary equipment for the methods applied to different fields of research, such as biology and medicine, material science, chemistry, microtechnology and nanotechnology, environmental sciences, or archeology. Czech scientists have a long tradition in research with synchrotron radiation and they have a lot of experience at running synchrotron experiments. In Europe, as everywhere in the world, the demand for measuring time is larger than currently available. A new synchrotron will help to reduce this pressure even though it will naturally promote new research interests. It will also allow our young researchers easier come-back from their temporary positions at European synchrotrons beamlines.

Let us briefly overview the beamlines currently proposed for CESLAB. *Macromolecular crystallography* is a method for structure determination of molecules from diffraction patterns. Intense X-ray radiation of 1 Å wavelength is necessary for precise determination of complicated structures of large molecules such as proteins or viruses. Synchrotron set-ups are optimized for fast measurement of many standard samples as well as for using anomal diffraction for ab-initio structure determination of complicated molecular complexes, to determine atom positions precisely, or for time-resolved studies. *Transmission microscopy methods* with soft X-rays in the water window range are used for imaging of biological samples or low-contrast materials by the phase imaging. Within hard X-rays the methods of microtomography and phase contrast are widely used for visualization of the inner structure of devices or materials with bulk characteristics. *Powder diffraction* is used for structure determination of powder materials (organic as well as anorganic), or microcrystallites and their structural changes in different environments. *X-ray diffraction methods* at small as well as large angles are widely used mainly because of the high intensity necessary for study of low-dimensional objects and nanostructures, for energy tuning and for beam size conditioning. *LEEM* and *PEEM* investigate both crystalline and electronic structure of surfaces as well as of processes connected with their dynamic phenomena by photoemission spectromicroscopy and spin polarized microscopy with slow electrons. *Spectroscopy* can be used in a whole range of methods, such as absorption or magnetic spectroscopy, synchrotron Mössbauer spectroscopy, or photoemission. At synchrotrons, it can probe samples continuously from hard X-rays through VUV downto IR radiation. *Infrared methods* for microscopy, ellipsometry and spectroscopy conducted at synchrotrons differ from those at laboratory mainly because of the high intensity and the full range of the IR spectrum. The methods allow to study conductive as well as semi-conductive materials, organics, biological tissues or piezo- and ferroelectrics. *Chemical reactions in gas phase* allow to understand reaction mechanisms and to study clusters, enzymes, etc., in (bio)organics and in analytical chemistry. The method utilizes photons from the VUV spectrum and sequent mass spectroscopy. Finally, a universal O*ptics beamline* has been proposed in order to test new devices and instruments or for metrology of optical components. Further, this beamline can be used for a wide range of atypical or new experiments, and also for education of students or new users.

Further in this journal, short scientific cases of each proposed beamline are presented by beamline coordinators.

The CESLAB project consortium

Main project proposers

The Academy of Sciences of the Czech Republic (AS CR) which is the main proposer of CESLAB was established by Act No. 283/1992 Coll. as the Czech successor of the former Czechoslovak Academy of Sciences. It is set up as a complex of 53 public research institutions. The primary mission of the AS CR and its institutes is to conduct basic research in a broad spectrum of the natural, technical and social sciences and the humanities.

The Institute of Biophysics of the Academy of Sciences of the Czech Republic, is one of the most successful academic institutes in the field of life sciences in the Czech Republic. The institute is responsible for research on the physical and chemical properties, structure and interactions of biomacromolecules, research on the biophysical properties of living systems at the molecular, cellular and organismal levels, including the effect of external environmental factors, and also theoretical research in these fields.

The Institute of Physics of Materials of the Academy of Sciences of the Czech Republic, v.v.i., has been active in the interdisciplinary field of materials science since its foundation in the year 1955. The position of the institute in this rather broad scientific field lies prevailingly in the research of metallic materials. There are two main research areas: physical nature of processes taking place in metallic materials during creep, fatigue, creep/fatigue and under other types of mechanical loading; structure of materials and selected thermodynamic, diffusion and magnetic properties.

The Institute of Analytical Chemistry of the ASCR, v. v. i. is concerned with research and development of new methods and instruments applied in chemical analysis in the fields of nanotechnologies, genomics, human health and environmental protection, state security and other scientific and industrial disciplines. Separation methods and spectrometry, and their miniaturization are very important objects of the institute research.

The Institute of Scientific Instruments of the ASCR, v.v.i. conducts research on methodology of experiments and unique instrumentation principles and components in the fields of physics and earth sciences and life and chemical sciences, especially in electron microscopy, coherence light optics, nuclear magnetic resonance and bioinformatics. The institute is also engaged in research, development and application of special technologies including nanotechnologies. In its area of work, the institute covers activities from basic theories to application of new methods in biomedicine and instrumental sciences and in industrial praxis too (especially in the industry of scientific materials).

Other project participants

The CESLAB project is supported by the Czech community of synchrotron users, i.e. those scientists currently doing experiments on foreign facilities. There are approximately 100 synchrotron scientists in the Czech and Slovak Republics, with many of them being world-wide known experts with excellent publications. They work mainly at the Academy of Sciences and at universities. There are also several Czech and Slovak post-docs at European synchrotrons. We should also mention participation of the scientists involved in running the Czech Materials Science beamline in synchrotron ELETTRA in Trieste, Italy. All these people are interested in the new CESLAB facility, and helping in the scientific case of the beamline preparation. Furthermore, the discussion about the CESLAB project has already started new interests in the synchrotron radiation utilization of groups which had never done such experiments before.

World-wide collaboration

In the project preparation (including LINAC and other devices), scientists from many countries are involved. A crucial role is played by Spanish partners from the CELLS consortium that is building the ALBA synchrotron facility localized close to Barcelona. It is intended to use the experience gained during the construction of ALBA in the Czech project realization period. Spanish support has been declared by government ministers and is sealed by a memorandum.

A number of scientists from all over the world have declared their support for the CESLAB project, with many of them taking part in the conference on "Synchrotron Facilities in the Development of Science and Technology in Central and Eastern Europe". These scientists are to discuss the project asset. The world wide synchrotron community is renown for the mutual collaboration in order to bring the latest synchrotron physics achievements into the practice.

Political support

First of all, CESLAB is supported by leaders of the Academy of Sciences. On the regional level, it is supported by the Mayor of the City of Brno, and many other politicians and officials. Brno City Municipality has provided a large area as a place for the facility construction. The project intent is also welcomed by the DG Research of the European Union – the above-mentioned conference in Brno in November 2007 on the project of the proposed synchrotron facility has been initiated and personally observed by its director Mr. Robert Jan Smits. CESLAB is understood to be the Czech contribution to the pool of big facilities in the European Research Area (ERA) and to the European Strategy Forum on Research Infrastructures (ESFRI).

S. Kozubek, P. Mikulík