Evaluation of the Research and Professional Activity of the Institutes of the Czech Academy of Sciences (CAS) for the period 2010–2014

Final Report on the Evaluation of the Institute

Name of the Institute: Institute of Biophysics of the CAS, v. v. i.

Fields, in which the Institute registered its teams:

Biochemistry and molecular cell biology, biophysics, virology

Observer representing the Academy Council of the CAS: Karel Aim
Observer representing the Institute: Antonín Lojek

Commission No. 6: Biochemistry and molecular cell biology, biophysics, virology
Chair: Professor emeritus Morten Kielland-Brandt

Date(s) of the visit of the Institute: November 13, 2015
Programme of the visit of the Institute: see attached Minutes from the visit

Evaluated research teams:
No. 1 - Department of Molecular Biophysics and Pharmacology; No. 2 - Department of Biophysical Chemistry and Molecular Oncology; No. 3 - Department of Molecular Epigenetics; No. 4 - Department of Molecular Cytology and Cytometry; No. 5 - Department of Cytokinetics; No. 6 - Department of Free Radical Pathophysiology; No. 7 - Department of Structure and Dynamics of Nucleic Acids; No. 8 - Department of CD Spectroscopy of Nucleic Acids; No. 9 - Department of Plant Developmental Genetics

A. Evaluation of the Institute as a whole

1. Introduction

The Institute of Biophysics of the CAS (IBP) is performing the research (mainly the basic one) focused on the structure, function and dynamics of biological systems as biomolecules, cell components, cells and cell populations. It has been organized into nine departments, which were evaluated by the Commission; one department (Cell Biology and Radiobiology) has been created recently and was evaluated together with the team of which it was a part formerly (Mol. Cytol. And Cytometry). The Institute is of moderate size (with average of 150 FTE). The scientific output of the Institute and specific activities as e.g. the involvement in pedagogical activities are impressive. Institute now runs six core facilities, among them, it shares one core laboratory (on biophysical methods and computers) with the CEITEC (Central European Centre of Technology, EC supported) and one core facility (selected biophysical methods and imaging) with the ICRC (Intl. Clinical Research Centre).

2. Strengths and Opportunities

The strength of the IBP can be seen in the relatively well focused research oriented to perspective directions in the applications of biophysical approaches in life sciences. This has brought the IBP excellent results published during 2010-2014 in the prestigious journals (742 impacted publications and 6 647 citations). The most important point is that there are younger researchers either working as Principal Investigators or as young co-workers. Apparently this stems from the well-organized cooperation of the IBP with Universities and can be taken as good opportunity for the IBP in future.

3. Weaknesses and Threats

There are no apparent weaknesses or threats.

4. Recommendations

The IBP should be supported.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition

Quality of the scientific output of the IBP is excellent; according to the data presented there were 23 publications in world leading media and 63 in the internationally excellent ones out of 136 evaluated; out of 539 papers evaluated by bibliography, 92 were in the top decile and 199 published in the 1st quartile of journals by quality and impact. This gives the IBP one of the leading positions in the Academy as per the FTE. The share in their acquisition is also very good.

Declaration on the involvement of students in research

The involvement of students in research is given by the numbers of PhD theses in which the IBP was a tutorial institution and which were successfully defended in the period evaluated (61) and in the total number of PhD students supervised at the IBP (72). The students hence co-authors of the papers published (e.g. from the team No. 1 of IBP, 34 full length papers were co-authored by the PhD students). Another example of the involvement of students in research may be the 10th Intl. PhD Students´ Conference on Experimental Plant Biology organized by the IBP team No. 9 in 2012.

Declaration on societal relevance

Societal relevance of the research pursued at the IBP is high as it involves studies on mechanisms of cancer initiation and on the related changes in the structure and function of nucleic acids incl. repair processes, on mechanisms of cancer proliferation,

on new anticancer drugs and on the signalling mechanisms related to processes as inflammation. Societal relevance is also reflected in numerous presentations of the work of the IPB teams in media.

Declaration on the position in the international and national context
Position of this Institute in the international and national milieu is strong and reflects the significance of the work of the IPB teams and members. The researchers from the IBP are partners of research projects involving researchers from USA, Great Britain, Germany; to lesser extent, from Slovakia, Sweden, Spain, France, Bulgaria, Belgium, and even less projects were studied with partners from The Netherlands, Italy, Switzerland and Finland. In the national context, fruitful cooperation is mainly with Masaryk University (Brno), then with Palacky University (Olomouc) and Charles University (Prague). The IBP researchers also cooperate with colleagues from the Inst. Org. Chem. Biochem. (CAS Prague).

Declaration on the vitality and sustainability
The Institute has, thanks to the young or relatively young research teams, a very good position in the vitality of the majority of the teams. The grant support was large in the past, however, seems to be even stronger in the coming period; the focus on international grants will be appropriate.

Declaration on the strategy and plans for the future
Strategic plans for the future research were presented by the team leaders. Each group has prepared a plan for its future, as to the IBP as a whole, there is a development of human resources planned as well as development of the instrumental infrastructure (new advanced instruments for superresolution microscopy and for fluorescence techniques).

B. Evaluation of the individual teams

Evaluation of the Team No. 1: Department of Molecular Biophysics and Pharmacology

1. Introduction

This is a relatively small group, presently consisting of 6 researchers, is remarkably productive on the field of basic research on metal containing pharmaceuticals. They are conducting successful research on the molecular mechanisms of anticancer metallo drugs with particular attention to DNA-metallation and their effects on nucleic acid condensation properties, interaction of metallo-helices with DNA in relation to their anticancer and antimicrobial effects, as well as the cross-linking ability of photoactivable Pt-compounds. The group uses a multidisciplinary approach, ranging from molecular and structural biology to nanotechnology and cancer research, with emphasis on biophysical techniques and approaches, including the determination of thermodynamic parameters, AFM, and molecular spectroscopy. The group shows high profiles both on the international scene and Czech science, and plays important roles in higher education and popularization of science.

2. Strengths and Opportunities

This is a strong group, which on the field of cancer research, with their excellent background in biophysics and international links and programs; they will most certainly have ample opportunities.

3. Weaknesses and Threats

The group, dominated by experienced scientists, probably has no real weak points.

4. Recommendations

The group should be supported. The group should recruit some of their excellent PhD students to optimize the age structure of the Department. With this excellent scientific output the Department should try to obtain international grants in addition to national grants.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition
The productivity of this group is excellent (56 papers) on international level: 12/10 and 28/9 papers in the first decile/quartile in journal/citation ranking. With just a few exceptions, in the publications in high profile and high standard journals (e.g. Nat Chem, Angew Chem Int Ed, Chem Eur J, BBA, NAR, Biochem Pharmacol), the group members played dominant roles.

Declaration on the involvement of students in research
Outstanding: 35 papers with the involvement of students. 10 PhD theses defended (in addition 8 MSc and 5 BSc were also awarded.)

Declaration on societal relevance
High profile, marked by newspaper articles and television and radio interviews.

Declaration on the position in the international and national context
The position of the group – based on their publication records - is strong both on the international and national levels. They show high activities in different European and Czech scientific/grant committees; participate editing 4 journals and regularly review papers.

Declaration on the vitality and sustainability
The group – for its modern and important medical research orientation with a niche in biophysics, excellent productivity, good age-tree, expertise, (apparently) very good infrastructure – possesses high vitality and sustainability.

Declaration on the strategy and plans for the future
The plans – essentially stemming from their previous research show a clear vision and strategy "to continue in establishing basic principles of molecular pharmacology and medicinal chemistry of metal based compounds that will allow the rational screening of future metallo-pharmaceuticals." This is broken into 5 tasks/work packages on: (i) proteomics-based signatures, (ii) epigenetic modifiers, (iii) delivery by nanoparticles, (iv) DNA condensates and (v) thermodynamics of RNA structures. Some of the tasks have financial support till the end of 2016.

Evaluation of the Team No. 2: Department of Biophysical Chemistry and Molecular Oncology

1. Introduction
The research team had relatively stable number of researchers during the whole evaluated period (15) in very favourable age structure (about 10 in the age 25-30 years). The research is of basic character and involves wide range of studies of the electrochemical behaviour of proteins, sugars, nucleic acids, nucleoids and their mutual interaction. The electrochemical studies of proteins are derived from the tradition started by Nobel Prize winner professor Heyrovský. The electrochemical analysis of sugar residues was a logical continuation of the research activities due to the importance of the glycosylated proteins. The studies of electrochemical properties of nucleic acids and their interaction with proteins was a logical answer to the expansion of the knowledge of the role of these important biomolecules in life sciences.

2. Strengths and Opportunities
The research of the team is well described and documented; 91 original papers in well recognized impact journals together with 11 papers in conference proceedings as well as in 1 book chapter. The publication activity proves high quality of the research.

3. Weaknesses and Threats
No weaknesses and threats were found.

4. Recommendations
The group should be supported.

5. Detailed evaluations
Declaration on the quality of the results and share in their acquisition
The quality of the research has been proven by publication in acknowledged impacted journals.

Declaration on the involvement of students in research
The pedagogical activity of the team members is very high. They had lectures at three Brno universities (Masaryk University, Technical University, University of Veterinary and Pharmaceutical Sciences), in Ostrava and Bratislava. The students of Brno universities took part in the team research.

Declaration on societal relevance

Team members participate in many scientific organizations, editorial boards of 3 international journals.

Declaration on the position in the international and national context
The team members are well recognized both at national and international level.

Declaration on the vitality and sustainability
The team has good perspective from the point of vitality and sustainability.

Declaration on the strategy and plans for the future
The research strategy and plan for future is constructed as a logical continuation of their achievements.

Evaluation of the Team No. 3: Department of Molecular Epigenetics

1. Introduction

The team includes 4 researchers. Two PhD students are currently supervised.
The team investigates the evolution of allopolyploidy, gene dosage control, epigenetic programming using *Nicotiana tabacum* plants. The publication record of the team is good. The majorities of publications are in plant specific or epigenetic journals.

2. Strengths and Opportunities

The team is strongly contributing to the understanding of epigenetic changes in genomes which is of major importance with respect to gene regulation, differentiation and development. Plants are very suitable model organisms to study epigenetic changes.

3. Weaknesses and Threats

No obvious weaknesses or threats.

4. Recommendations

The evolutionary aspect could be considered stronger in the Department name.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition
Most publications are based on chromosome and sequence analysis. The publication record of the team is good.

Declaration on the involvement of students in research
Six students successfully defended PhD theses as stated in the material from the group. Two PhD students are currently supervised. Team members take part in teaching at various Universities in Brno.

Declaration on societal relevance
Investigation of epigenetic changes in plants is of high societal relevance.

Declaration on the position in the international and national context
The international visibility of the team needs to be improved.

Declaration on the vitality and sustainability
Group seems to be vital and sustainable in the future.

Declaration on the strategy and plans for the future

The future plans should possibly consider the molecular events which are reasonable for epigenetic changes.

Evaluation of the Team No. 4: Department of Molecular Cytology and Cytometry

1. Introduction

The main research focus of the Department of Molecular Cytology and Cytometry is the analysis of DNA structure, damage and repair. The size of the Department is relatively high, the age structure looks optimal. The Department is well embedded into the structure of Institute of Biophysics. In 2014, the Department was split, and a new Department, the Department of Cell Biology and Radiobiology was established.

2. Strengths and Opportunities

The research program of the Department is realistic and well founded. The Department has national and international collaborations. Realistic research plan for 2015-2019, a new Department (Department of Cell Biology and Radiobiology) was established in 2014, and a larger portion of the research topics will be pursued by this new Department. The number of students involved in the research is relatively high. The pedagogical activity of the team is impressive.

3. Weaknesses and Threats

The scientific output of the Department is very good. Although only limited number of PhD degrees was awarded in the evaluation period, the report clearly shows that the students are highly involved in the research. (The master and bachelor degrees were obtained at much higher number during the evaluation period.)

4. Recommendations

Taking into account the high level of research of this team, the papers should be published in more recognized journals.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition
The scientific output of the Department can be judged to be very good.

Declaration on the involvement of students in research
The number of students involved in the research work is relatively high. The pedagogical activity of the team is impressive.

Declaration on societal relevance
Little activity in the area of research popularization was listed.

Declaration on the position in the international and national context
The Department has a very good position in this regard as the team members are invited to give lectures at many international as well as national conferences (e.g. FEBS Meeting St Petersburg 2012).

Declaration on the vitality and sustainability
The department has a good perspective as it is composed also of younger coworkers with clear plans; grant support both national and international is very good.

Declaration on the strategy and plans for the future
The Department has realistic research plan for 2015-2019.

Evaluation of the Team No. 5: Department of Cytokinetics

1. Introduction

This fairly large team works on an array of projects that all have strong relevance for cancer. They range from studies of carcinogenesis over tumour biology to cancer therapy resistance. They also range from basic studies of, e.g., signal transduction via cytokines to studies of direct clinical relevance.

2. Strengths and Opportunities

The number of outputs of very high quality is impressive. Furthermore, the report describes convincingly that the team has the major share in the acquisition of the most important results. The relatively large breadth of fields could under other circumstances be considered a threat because of a risk of diluting efforts, prohibiting prioritizing in-depth studies, but the outputs show that this is definitely not the case. The breadth is explicitly described as part of a strategy to ensure scientific space for young investigators in the team to develop optimally. In view of the outputs we can only praise that strategy. The wide international network, the good involvement of students, the extensive contribution to university teaching, and the active outreach to the general public are all additional expressions of scientific strength.

3. Weaknesses and Threats

None are obvious to us.

4. Recommendations

We recommend the team to stick to its strategy and practices.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition
Even on a per-person basis, the team is very productive. Importantly, the number of outputs of very high quality is impressive. In view of this high number, we find it less important that the average rating from Phase I and in citations are less outstanding. Furthermore, the report describes convincingly that the team has the major share in the acquisition of all the most important results.

Declaration on the involvement of students in research
Students at all three levels are involved to a good extent. However, a team this strong should take even more PhD students, who will then benefit from the strong scientific environment.

Declaration on societal relevance
The research has obvious medical relevance, and it should be stressed that the involvement of students will have longer-term impact, as will also the strong contribution to teaching at the Masaryk University.

Declaration on the position in the international and national context
The team has a wide international network and a strong position therein. It has thus participated in very competitive EU projects. Nationally, the situation is similar, with many collaborative grants. Student involvement, teaching, and outreach to the general public strongly contribute, particularly in the national context.

Declaration on the vitality and sustainability
Productivity and the number of high-quality outputs make it highly probable that the team can maintain a good granting situation. In addition, the strategy for young

investigator development contributes strongly to long-term sustainability of the group and to maturation of future team leaders.

Declaration on the strategy and plans for the future
The range of fields is expected to provide scientific space for young investigators in the team to develop optimally. The plans for the future make strong sense.

Evaluation of the Team No. 6: Department of Free Radical Pathophysiology

1. Introduction

Team is focused on the study of mechanisms leading to the generation of reactive oxygen and nitrogen species formed by phagocytes and related phenomena as damage of endothelium by inflammation. There are 10.45 FTE with fifteen workers altogether; eleven below 35 years of age.
Scientific productivity of the team is excellent as it is represented by 62 contributions with 60 papers published in journals with known impact factors, and two papers in other peer-reviewed journals. The journals are of very good quality as to their IF´s (e.g. Blood, IF over 9) and are leading in the field (seven journal papers in leading media according bibliography, one in top decile as to the citations).

2. Strengths and Opportunities

The team is relatively young and focused on several highly interesting subjects including radical formation and the ROS involved. The scientific production of this group is very good. There are of course many opportunities as to which the group may focus its work. This group is involved in a lot of pedagogical activities and in popularization of the work pursued. The group is also active in cooperation with industry.

3. Weaknesses and Threats

There are no obvious weaknesses or threats.

4. Recommendations

The group is very promising and should be supported; the strength and opportunities of this group is outlined above. In principle, very high success can be achieved here providing the group will not defocus its activities.

5. Detailed Evaluations

Declaration on the quality of the results and share in their acquisition
The number of original scientific papers (60) published in journals with known impact factors documents the quality of the research. Seven papers were published in journals in the top decile of quality; also the citation record is very good.

Declaration on the involvement of students in research
Overall, 28 papers coming from this group were published with participation of students of the Masaryk University, Brno. Ten students defended successfully their PhD theses. The members of this Department teach 4 courses at the Masaryk University Brno (lectures are delivered exclusively by them). This group is excellent concerning the involvement of students in the research.

Declaration on societal relevance
The relevance of the studies realized in this laboratory is great as it involves many research directions which are in the focus of contemporary science spanning from inflammation, to the antioxidant properties of the food components and protection against civilization diseases.

Declaration on the position in the international and national context
The position of this group in the scientific community is well recognized, department members were involved in actions of European Science Foundation activities COST and are still involved in this form of cooperation. According to the publications, the laboratory has lively contacts with other institutions as University of Hamburg and the researchers are members of various international societies.

Declaration on the vitality and sustainability
The team has a very good perspective as to the continuation of their work in the next period as there are young members but also the more experienced ones. The main task will apparently be the search for funding at both the national and international level. The cooperation with industry may also help; in this respect, the team is actively cooperating with two Czech enterprises in a rather significant extent.

Declaration on the strategy and plans for the future
The research plan involves five directions stemming from the actual directions of research: Chronic inflammation (with a cooperation from Germany), Myeloid cell function (also supported by COST), Prevention of bowel inflammation, Mechanisms of serotoninergic system and Detection of NO production. The strategies and plans are realistic, correct, well focused and the only matter is to get a financial support.

Evaluation of the Team No. 7: Department of Structure and Dynamics of Nucleic Acids

1. Introduction
The team includes 3 researchers. Two PhD students are currently supervised.
The team uses computational chemistry to investigate the formamide-based RNA synthesis. Furthermore they developed methods for microsecond-scale simulation of protein/RNA interactions and computer hardware for large-scale quantum chemical methods to calculate nucleic acid building blocks. Furthermore, they improved force fields for molecular simulations of RNA and DNA studies, synthesis of RNA molecules and the folding pathways of G-quadruplex. The publication record of the team is excellent with some outstanding publications in highly recognized journals.

2. Strengths and Opportunities
The team is internationally well acknowledged and their predictions are experimentally verified by international collaborators.

3. Weaknesses and Threats
No obvious weaknesses or threats.

4. Recommendations
The group should be supported.

5. Detailed evaluations
Declaration on the quality of the results and share in their acquisition
The results are reported in internationally highly acknowledged journals.

Declaration on the involvement of students in research
Students are very well incorporated in the team. The researchers are actively teaching.

Declaration on societal relevance

The societal relevance of the research of this team is high as it deals with basic questions of molecular biology.

Declaration on the position in the international and national context
The team members are internationally and nationwide well acknowledged and visible.

Declaration on the vitality and sustainability
The team is vital and sustainable as it is relatively young with good support.

Declaration on the strategy and plans for the future
The strategy and plans for the future are straightforward.

Evaluation of the Team No. 8: Department of CD Spectroscopy of Nucleic Acids

1. Introduction

Team No. 8 of the Institute of Biophysics has been working on structures of nucleic acids for a long time. There are 4.90 FTE-s with 7 workers altogether. The distribution of younger and experienced workers is good.
Scientific productivity of team No. 8 (in last five years) is excellent as it is represented by 19 contributions with 18 papers published in journals with known impact factors (IF), and one contribution (chapter) to a scientific book. The journals are of very good quality as to their IF´s and are leading in the field.
The group is oriented to nucleic acid structure for long time and its position in national as well as international milieu is well recognized. The research is performed in two directions: (i) conformational properties of telomere quadruplex, (ii) on the effects of altered bases or nonstandard ones to the structure of DNA. Both directions of research have brought interesting results which are cited in the literature. The group members were asked to write three review papers in prestigious journals and the review in a book on chiroptical spectroscopy.

2. Strengths and Opportunities

The strength of the team No. 8 of the Institute of Biophysics is given by the fact that the team is focused on highly interesting subjects with great importance in molecular biology.

3. Weaknesses and Threats

There are not many weaknesses, the group probably should focus to the main tasks, and keep the high level of research.

4. Recommendations

This small group is doing high quality research and should be supported; the strength and opportunities of this group are outlined above. In principle, an effort to make the results better known to the society might be helpful also in getting an appropriate funding.

5. Detailed Evaluations

Declaration on the quality of the results and share in their acquisition
The number of original scientific papers (18) published in journals with known impact factors plus one book chapter in five years document the quality of the research of this group (4.90 FTE). Four papers were published in journals in the top decile of quality; also the citation record is relatively good with three citations in leading journals. The papers with participation of other coworkers were done with significant contribution of the IBP.

Declaration on the involvement of students in research
Four papers authored by this group were published with participation of students of the Masaryk University, Brno; two more are in the reviewing process. The members of this Department participate in teaching of two courses at the Masaryk University Brno. Also, they took part in two projects with practical courses. In evaluation period, eight students participated in the research.

Declaration on societal relevance
The relevance of the studies realized in this laboratory for society is high as the group solves questions intimately connected with fundamental processes of molecular biology.

Declaration on the position in the international and national context
The position of this group in the scientific community is well established nationally as well as internationally. However, this is not very much reflected in memberships in learned and other relevant bodies.

Declaration on the vitality and sustainability
The team certainly has a perspective as the continuation of this work in the next period is necessary for the progress in this field; however, the group should orient even more to involvement and recruiting of young coworkers and in the search for funding.

Declaration on the strategy and plans for the future
The research plan is stemming from the actual research directions. It involves studies on DNA quadruplexes in telomeres, G- and C- rich motifs with application of this line of research also in reprogramming the differentiated cells back into the multipotent stem cells. The group will also continue in studies on anomalous conformations of the nucleic acids. The strategies and plans are realistic and well-focused. The financial support might be the main problem.

Evaluation of the Team No. 9: Department of Plant Developmental Genetics

1. Introduction
The team includes 7 researchers. During the evaluation period, 6 PhD students received their PhD. The researchers investigate sex chromosome evolution, the structure of sex chromosomes and roles of transposable elements in evolution, using *Silene* species as model organisms. Furthermore, horizontal gene transfer in evolution is studied.

2. Strengths and Opportunities
The team has a strong experience in evolutionary studies. Good opportunities for using this experience exist in the ongoing work on transposable elements and in the planned work within epigenetics. Understanding epigenetic changes in genomes is of major importance with respect to gene regulation, differentiation and development. Plants are very suitable model organisms to study epigenetic changes.

3. Weaknesses and Threats
No obvious weaknesses or threats.

4. Recommendations
The team should be supported.

5. Detailed evaluations

Declaration on the quality of the results and share in their acquisition
Most publications are based on chromosome and sequence analysis. The number of outputs in high-profile journals is good.

Declaration on the involvement of students in research
Six PhD students successfully finished their studies. The team organized PhD students´ conference in 2012.

Declaration on societal relevance
This basic research is expected to have good societal relevance, but not in a foreseeable way and not in any near future.

Declaration on the position in the international and national context
The international as well as national visibility of the team is very good.

Declaration on the vitality and sustainability
This team has a good perspective as it is also composed of relatively young and active researchers. The grant projects are available also for the future to support the sustainability of this group.

Declaration on the strategy and plans for the future
The future plans are sensible and include consideration of molecular events in epigenetic changes.

Date: December 16, 2015

Commission Chair: Professor emeritus Morten Kielland-Brandt