

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 Physics of the CAS, v. v. i.

Fields, in which the Institute registered its teams:

Materials engineering, materials science and nanotechnology

Observer representing the Academy Council of the CAS: Jiří Chýla

Observer representing the Institute: Jan Kočka, substitute observer Milada Glogarová

Commission No. 8: Engineering and technology

Chair: em Prof.DI.Dr.Dr.hc. Hans Peter Nachtnebel

Date(s) of the visit of the Institute: October 12 - October 21, 2015

Programme of the visit of the Institute: see attached Minutes from the visit

Evaluated research teams:

No. 10 - Nanocrystals and Grain Boundaries; No. 11 - Nanodiamond and Biointerfaces; No. 12 - Shape memory materials and composites

EVALUATION OF THE INSTITUTE OF PHYSICS (IP)

1. INTRODUCTION

1.1 Location of the institute and its dept., labs. & sub units.

Institute of Physics of the CAS
Pod vodárenskou věží 1, Prague 8

1.2 Brief history of the institute

The Institute of Physics was initially established in 1954 and gets its present shape in 1979. Since 2007, the Institute has become a public research institution.

1.3 Mission and research topics

The present research programme of the Institute is focused especially on the physics of elementary particles, condensed systems, solid state, plasma physics, and classical and quantum optics. Basic research prevails.

1.4 Staff size and full time equivalents age distribution

The Institute has currently 1156 employees, 410 from which are researchers. Continually increasing number of employees during the evaluation period is obvious from graph in Fig. 1.

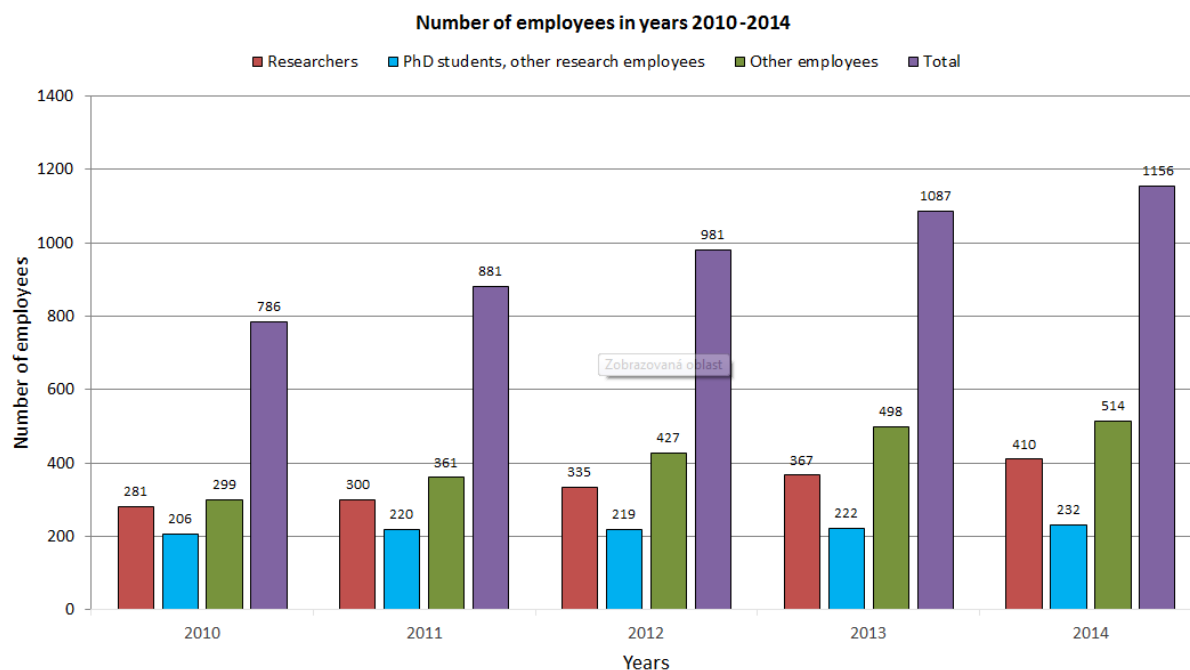


Figure 1: Total numbers of Institute employees in the evaluation period

Age structure of all Institute employees is summarized in the Table 1.

Table 1: Age structure of the Institute employees

Age category	< 25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	≥ 70
No. of members	69	188	184	142	99	65	67	73	84	94	71

2. STRENGTHS AND OPPORTUNITIES

2.1 Timeliness of research topics

Most of the institute research topics are very exacting and perspective both from the theoretical and application point of view. They represent top research areas in the current physics, engineering and material sciences.

2.2 Budget: Ratio of institutional budget, grants and contractual resources, international funds

Institute budget is composed of 60 % institutional money, 35 % national grant money and 5 % foreign grant money. This composition is reasonable.

2.3 Intensity of collaboration among teams and among institutes, national collaboration and international involvement

Research topics of the individual research teams of the Institute are miscellaneous and thus the collaboration among them depends on the current needs and possibilities, e.g., utilization of the special instruments, joint participation on the projects etc. Cooperation of the Institute with other research subjects and universities both in the Czech Republic and around the world is very intensive and fruitful.

2.4 Position of the institute within the Czech scientific community and its international position

Position of the Institute within the Czech scientific community in the aforementioned research areas in the top level and many of the research results obtained are original and essential on an international scale.

2.5 The overall capacity of staff

The Institute has 410 researchers, 232 Ph.D. students etc. and 514 other employees,

2.6 Reasonability of the structure of the institute and the departments

The Institute consists of 6 scientific divisions with 23 departments. This structure is reasonable; it is based on the heterogeneity of the main individual research topics.

2.7 Comments on the age structure

Age structure of all Institute employees is summarized in the table above. Thanks to the historical reasons, there is the gap in the age period 45-60. Very positive and perspective is relatively high number of young peoples (about 39 % employees are under 35 years) and continually increasing ratio of foreign research employees during the evaluation period.

2.8 Frequency and quality of publications

Publication activity of the Institute researches is on the high level both from quantitative and qualitative point of view. During the 2010-2014 period, over 3000 various outputs were published; most of them in top decile (1*) and quartiles 1-2 by AIS of journals. In the Evaluation Phase I, 111 selected publications were classified as world-leading and 246 as internationally excellent.

3. WEAKNESSES AND THREATS

3.1 Budget: Ratio of institutional budget, grants and contractual resources, international funds

Contractual financial resources are so far very limited. Also rather higher percentage of foreign grant money would be beneficial.

3.2 Comments on the age structure

Percentage of the employees over 65 years (14 %) is rather high.

3.3 Patents and role in contractual work

Although the basic research dominates in the Institute activity, it is needful to looking for other available financial resources from the applicable research results.

4. RECOMMENDATIONS

4.1 Identification of new research topics

The Institute must be prepared to solve new research topics in future. For these purposes it is desirable to looking for other adequate personal and financial sources. May be some re-organisation of the internal structure of the Institute enabling the better utilization of current personal and technical equipment potential of the Institute will be needful.

5. DETAILED EVALUATION

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

Characterisation of the main research activities (experiments, theoretical areas)

The main research activities of the Institute have very complex character and they include both very exacting theoretical approaches and sophisticated experimental research.

Relevance in the national and international context

Research activities of the Institute have undoubtedly very import relevance not only in the national, but also in international context.

Overall quality of publications

Scientific outputs of the Institute researchers have generally very good quality, most of them are published in top decile (1*) and quartiles 1-2 by AIS of journals. This fact was fully confirmed in the Evaluation Phase I, when 68 % of 526 selected publications were classified as world-leading or internationally excellent. Also intensity of citations of these publications is on very high level.

5.2 Declaration on the involvement of students in research

In the framework of various national projects, many doctoral and undergraduate students are introduced into the joint research team. They can do very useful scientific work and help their advisors in their research tasks. Collaboration with doctoral and undergraduate students often results in publications co-authored by the students. This kind of collaboration with Universities is very beneficial for the both contracting parties.

Number of defended PhD students in relation to students involved (success rate)

In 2012-2014, 118 Ph.D. theses had supervisors from the Institute, in the same period 85 Ph.D. theses were successfully defended, i.e., about 72 %. This success rate is very good.

Employment of former Phd students (career options)

Institute in collaboration with Universities has participated on Ph.D. students education. Leading researchers are often supervisors of Ph.D. thesis. The defended students are strongly encouraged to find a postdoctoral position abroad. PhD training has served the Institute as a hiring tool; Institute systematically tries to increase jobs openings for young scientists.

5.3 Declaration on societal relevance

Research activities and their results have very strong impact on the Institute economy – both institutional and grant parts of the budget depend on the quantity and quality of the outputs. High level of the scientific work, experience of the researchers and many unique experimental instruments offer very good opportunities for many students.

The Institute is also very active in the area of research popularization, e.g. it collaborates with high and elementary schools. The Institute participates on the interesting program organized by the Academy of Sciences called “Otevřená věda” that enables for selected students to collaborate on some Institute research projects the results of which are presented and evaluated on the annual fair. The Institute researchers serve also as reviewers, judges and consultants in competitions „ Středoškolská odborná činnost”, “The International Physical Olympiad” and “International Young Physicist Tournament”. Very intensive is also the collaboration with various mass media, e.g., radio, TV, popular science magazine “Vesmír”, national astronomical magazine “Astropis” etc.

5.4 Declaration on the position in the international and national context

Position of the Institute in both national and international scientific community is very important. Research activities of the Institute have undoubtedly very import relevance not only in the national, but also in international context. The research work at the Institute is attractive also for foreigners. This fact is supported by the graph in Fig. 2, where increasing number of foreign research employers during the evaluation period is evident.

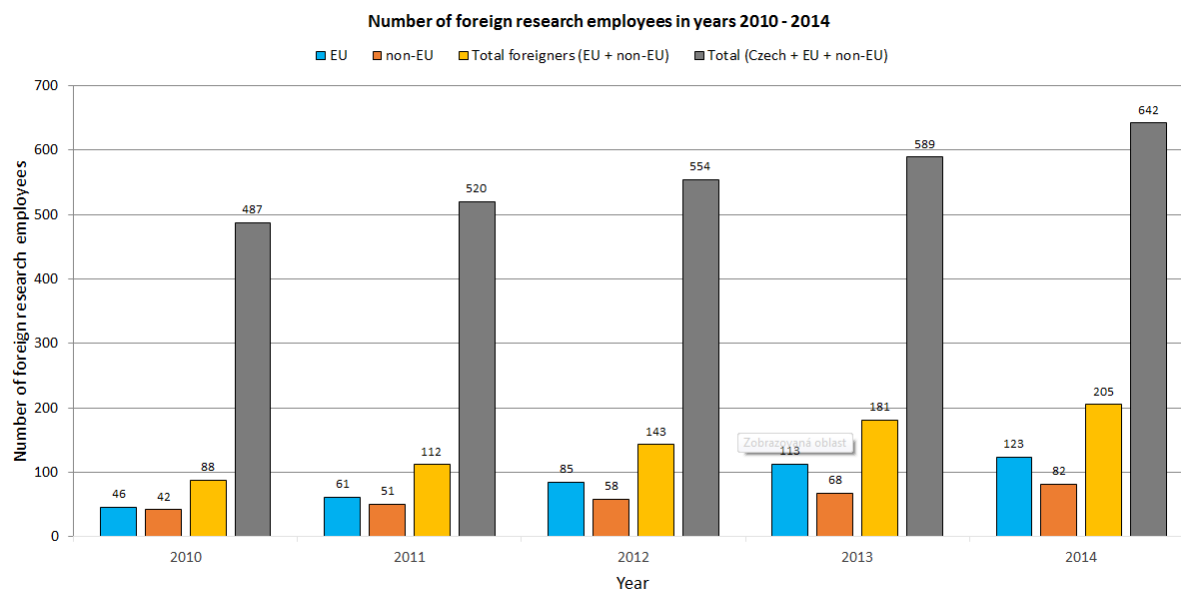


Figure 2: Number of foreign research employees from EU and outside EU during 2010-2014

The Institute has very extensive and fruitful cooperation with many prestigious research institutions and universities around the world.

5.5 Declaration on the vitality and sustainability

Age structure of the Institute employees is given in Table 1. From this view are clear both advantage and disadvantage of current situation: the high ratio of young employees (about 39 % under 35 years) on one side, and relatively high ratio of the employees over 65 years (about 14 %). But this situation has undoubtedly one positive aspect – immediate contact of beginners in the research with very experienced and highly qualified experts and scientists of international stature. Female members of the Institute staff are in minority.

The Institute provides financial incentives to research teams successful in solicitation research funding or contractual research.

5.6 Declaration on the strategy and plans for the future

Detailed research plan of the Institute for 2015-2019 is very responsibly prepared. Plan of the Institute is especially rely on its human resources and budget. The Institute will continue in participation of research team activities in CERN, Fermilab, Auger, CTA, etc. The basic policies of the Institute will be focused mainly on institutional support of grant applications, careful selection and efficient use of expensive experimental equipment, conversion of the Institute into a modern PhD training institution, support for the rising interdisciplinary research, openness towards commercialization of research results, supporting research

excellence etc. According to society-wide need, the Institute would support Czech Small and Medium Enterprises in the field of applied research.

EVALUATION OF THE INSTITUTE OF PHYSICS (IP)

Team No 10: Department of Nanocrystals and Grain Boundaries (DNGB)

1. INTRODUCTION

1.1 Location of the institute and its dept., labs. & sub units.

Institute of Physics of the CAS
Pod vodárenskou věží 1, Prague 8

1.2 Brief history of the institute

The Institute of Physics was initially established in 1954 and gets its present shape in 1979. Since 2007, the Institute has become a public research institution.

1.3 Mission and research topics

Research activities of the Team are focused especially on traditional studies of extended defects in crystallographically defined samples with focus on grain boundary engineering and on the newly started studies of the role of grain boundaries in production and behaviour of ultra-fine-grained and nanocrystalline materials, mainly prepared by severe plastic deformation.

1.4 Staff size and full time equivalents age distribution

Currently the Team has 6,23 researchers and 6,33 other workers in full time equivalents.

2. STRENGTHS AND OPPORTUNITIES

2.1 Timeliness of research topics

Generally, main research topic of the Team is materials-science investigation of the behaviour of extended defects in metallic-based materials. Problems under study are actual, scientific activity of the Team in this area is very beneficial and results obtained have very promising perspective of application in materials engineering practice.

2.2 Intensity of collaboration among teams and among institutes, national collaboration and international involvement

Cooperation with other research institutions and universities is very intensive; especially on the national level (e.g., Charles University, Institute of Chemical Technology, Institute of Metals Research etc.). Integral part of a scientific work is collaboration on various problems with external subjects and shares both knowledge and instrumental background.

2.3 Position of the institute within the Czech scientific community and its international position

Position of the research team within both Czech and international scientific community is important, many research results obtained are original, essential and they have high impact.

2.4 Comments on the age structure

High percentage of young peoples participated on the research activity of the Team in the form of part time job is very promising and perspective.

2.5 Frequency and quality of publications

Despite the very limited staff, publication activity of the Team is very impressive: total number of outputs in the evaluation period is 87, 60 of them are articles in journals with impact factor. In the Phase I, 12 selected publications were evaluated; 10 of them were classified as world-leading or internationally excellent. Both frequency and quality of the publications are very good.

3. WEAKNESSES AND THREATS

3.1 Comments on the age structure

Number of senior and junior members of staff is very good balanced but there is the total gap in the age period 45-60. This fact would result in some troubles after seniors' retirement in some next years.

3.2 Frequency and quality of publications

Both frequency and quality of the research outputs is outstanding; the contribution of the Institute researchers in their acquisition was predominant.

4. RECOMMENDATIONS

4.1 Identification of new research topics

Adequate solution of the personal question would be probably necessary during the next years. There is potential treat of deficiency of experienced top scientists with international reputation which will be able to lead the Team and to define new perspective research topics to be solved.

5. DETAILED EVALUATION

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

Characterisation of the main research activities (experiments, theoretical areas)

Research activities of the Team are focused on two areas in the field of materials-science investigation of the behaviour of extended defects in metallic-based materials:

1. study of extended defects in crystallographically defined samples with focus on grain boundary engineering,
2. study of the role of grain boundaries in production and behaviour of ultra-fine-grained and nanocrystalline materials, mainly prepared by severe plastic deformation.
3. The mentioned research activities have complex character and include both exacting theoretical and sophisticated experimental approaches.

Relevance in the national and international context

Research activities of the Team have very good relevance both in the national and international context. The Team is joined into much beneficial collaborations. The research results and outputs of the Team members have very good impact in the relevant professional community.

Overall quality of publications

Publication activity of the Team is outstanding; most of outputs are articles in journals with impact factor. One of the proofs of the quality of the publications may be result of the Evaluation Phase I, where 10 of 12 selected publications were classified as world-leading or internationally excellent.

Specification of the main achievements

The most important results obtained in the evaluation period are following:

1. Summary of the present knowledge on grain boundary segregation in metals.
2. Introduction of a new thermodynamic variable in segregation studies – segregation volume.
3. Explanation of the reversed anisotropy of grain boundary properties on basis of the enthalpy-entropy compensation effect.
4. Interpretation of the effect of stacking-fault-like interfaces on plastic deformation of B2 intermetallics.
5. Explanation of the behaviour of interfaces in disilicides, materials for applications at ultrahigh temperatures.
6. Generalization of displacive processes forming dislocations to diffusionless phase transformations.

Specification of the contributions of the team to publications

Quality of the research outputs presented in the evaluation period is very good. Although some of the papers had co-authors from external institutions, the share and research contribution of the Institute workers to these outputs were decisive and substantial.

5.2 Declaration on the involvement of students in research

Involvement of students (doctoral, undergraduate) into research

Presently, 1 PhD student as well as 2 master students permanently cooperate with the Team. The students of all levels participate at research or work in laboratories within the cooperation on joint research projects with the universities (especially Faculty Chemical Technology of the Institute of Chemical Technology in Prague; Faculty of Nuclear Science and Physical Engineering) of the Czech Technical University in Prague and Faculty of Mathematics and Physics of the Charles University, Prague). In the evaluation period, 3 Ph.D. students performed their Theses mainly at this Team and partially during their study abroad and have a member of the Team staff as a supervisor. All these students successfully defended their Theses at the Faculty Chemical Technology of the Institute of Chemical Technology in Prague and they were implemented in solution of the research problems in the projects. They were authors or co-authors of 7 papers in impacted journals, 3 papers in periodic registered by Thomson-Reuters and 7 contributions in conference proceedings. Possibilities of employment of former Ph.D. students in the Institute are restricted for financial reasons.

5.3 Declaration on societal relevance

The members of the Team participate in the following popularization activities: Periodic (3 times per year) organization of presentation for undergraduate students from 3 universities, Periodic presentations on Public days in the scope of a Week of Science and Techniques, Audio-visual records dealing with the various applications of electron microscopy, etc.

5.4 Declaration on the position in the international and national context

Position of the research team within both Czech and international scientific community is important, many research results obtained are original, essential and they have high impact.

The Team participates on many research projects with national and international partners. These collaborations are for the Team very beneficial both from scientific and financial point of view. Very important parts of the Ph.D. students' education are their stays at the research institutions abroad.

5.5 Declaration on the vitality and sustainability

High percentage of young peoples participated on the research activity of the Team is very promising and perspective. Currently, the numbers of senior and junior members of staff are very good balanced, but there is the total gap in the age period 45-60. This fact would result in some troubles after seniors' retirement. Adequate solution of the personal question would be probably necessary during the next years. There is potential treat of deficiency of experienced top scientists with international reputation which will be able to lead the Team and to define new perspective research topics to be solved.

Effectiveness of research assessed on the comparison of Team staff size with financial funding and achieved outputs is very good.

Possibilities of recruitment of talented young researchers are rather restricted for financial reasons.

5.6 Declaration on the strategy and plans for the future

In the next period, the Team plans to continue in both the development of the instrumental park and the stabilization of the staff. The research activity will be focused especially on the severe plastic deformation of difficult-to-work alloys. This research will be supported by the running Project of Excellence (CSF, P108/12/G043, 2012–2018). The Team will be continue to work in the field of systematic 3D EBSD measurements of fine-grained materials and developing subsequent mathematical simulations of the structures with the help of stochastic mathematics. For these purposes, top experimental technique combines scanning electron microscope, focused ion beam and EBSD will be applied. The Team will also intend to develop the software for automatic evaluation of transmission electron microscopy images. Some activity activities will be focused on demanding and very helpful experimental technique: in situ characterization of materials in both TEM and SEM.

Detailed description of the future individual research topics is given in evaluation materials presented for the evaluation purposes.

The Team plans to continue in fruitful collaboration with external subjects to share the knowledge base as well as the experimental techniques.

EVALUATION OF THE INSTITUTE OF PHYSICS (IP)

Team No. 11: Department of Nanodiamond and Biointerfaces (DNBI)

1. INTRODUCTION

1.1 Location of the institute and its dept., labs. & sub units.

Institute of Physics of the CAS
Pod vodárenskou věží 1, Prague 8

1.2 Brief history of the institute

The Institute of Physics was initially established in 1954 and gets its present shape in 1979. Since 2007, the Institute has become a public research institution.

1.3 Mission and research topics

Research activities of the Team are focused on the combination of variety of theoretical approaches and experimental techniques to explore the interaction between physical and chemical state of the nanomaterials (particularly diamond) and biomaterials for innovative applications.

1.4 Staff size and full time equivalents age distribution

Currently the Team consists of 4,79 researchers, 5,98 other workers and 2,77 Ph.D. students in full time equivalents. Age distribution of the employees is presented in Tab. 2.

Table 2: Age structure of the Institute employees

Age category	< 25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	≥ 70
No. of members	0	3	3	1	3	1	0	2	1	0	0

2. STRENGTHS AND OPPORTUNITIES

2.1 Timeliness of research topics

Research activities of the Team are focused on the study of the interaction between physical and chemical state of the nanomaterials (particularly diamond) and biomaterials for innovative applications. These research topics are actual and perspective.

2.2 Intensity of collaboration among teams and among institutes, national collaboration and international involvement

In various joined research projects and education area, the Team has extensive and fruitful cooperation with universities, other research institutions and commercial companies both in the Czech Republic and abroad.

2.3 Position of the institute within the Czech scientific community and its international position

In the research topics under study, the Team have very good position both within the Czech and international scientific community. Impact of the Team research is very high.

2.4 The overall capacity of staff

The overall capacity of staff is almost under-critical – total number of employees is 14 and only little less than 5 of them are researchers, but scientific effectiveness of the Team is outstanding.

2.5 Comments on the age structure

Composition of the Team staff is very good balanced both from age and gender structure point of view.

2.6 Frequency and quality of publications

Number and quality of publications and other outputs of the Team is outstanding. This fact is evident, e.g., from the results of Evaluation Phase I, where 7 of 8 selected publications were classified as world-leading or internationally excellent. Apart from many papers in journals with IF, 2 books were published.

2.7 Patents and role in contractual work

Contractual research work represents very meaningful part of the Team activities. Cooperation with industrial partners has very positive impact on the research and economy of the Team. One of the most important outputs of the Team is EU and Czech patent.

3. WEAKNESSES AND THREATS

3.1 Budget: Ratio of institutional budget, grants and contractual resources, international funds

Composition of the budget is reasonable, but rather higher ratio of grant money, especially from international projects, would be beneficial for potential increasing of staff number.

3.2 The overall capacity of staff

The overall capacity of staff is almost under-critical – total number of employees is 14 and only a little less than 5 of them are researchers. This fact would result in some capacity problem in the next years.

4. RECOMMENDATIONS

4.1 Re-organisation of the internal structure of the institute and departments, laboratories, teams and groups considering the critical mass of each unit, the overlap of units

Problem with the critical mass of the research unit would be partially solved by the involvement of some foreign researchers in part-time. But this possibility is very restricted by the extent and stability of the Team budget.

5. DETAILED EVALUATION

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

Characterisation of the main research activities (experiments, theoretical areas)

Research activities of the Team are focused on the combination of variety of theoretical approaches and experimental techniques to explore the interaction between physical and chemical state of the nanomaterials (particularly diamond) and biomaterials for innovative applications.

Relevance in the national and international context

Professional activities of the Team have very good relevance both in the national and international context. The research results and outputs have very good impact; they are highly cited. The research activities of the Team were appreciated by the Czech society, e.g., nomination for award Czech head 2014, award Cooperation of the Year 2014 etc.

Overall quality of publications

Publication activity of the Team is outstanding; most of outputs are articles in journals with impact factor. High quality of the publications was proved in the Evaluation Phase I, where 7 of 8 selected publications were classified as world-leading or internationally excellent.

Specification of the main achievements

Some examples of top research results in the evaluation period:

- a) Construction of worldwide unique device LA MW PECVD reactor and highly qualified and experienced staff result in top position of the Team in nanodiamond area.

Cooperation with various industrial national and international partner, e.g., Solartech, Precioza, Fill Factory s.r.o., Westinghouse. Both Czech and EU patents have been submitted.

b) Development of original method of remote monitoring of chemical processes in biological environments which represents an important contribution to understanding the nanodiamond luminescence phenomenon. Related publication was selected to A Contribution in II Pillar Board by Czech Council for Research, Development and Innovation.

c) New recombinant vaccine against Lyme boreliosis was prepared and certified. Thanks to this excellent output, members of the Team were nominated for award Česká hlava 2014 and obtained award Cooperation of the Year 2014.

Specification of the contributions of the team to publications

Contribution of the Team members to the outputs published in the evaluation period was quite decisive.

5.2 Declaration on the involvement of students in research

Involvement of students (doctoral, undergraduate) into research

Involvement of Ph.D. students into research projects and into other activities of the Team was very significant and beneficial.

Particular contributions of students to research, Number of defended PhD students in relation to students involved (success rate)

Education and training of the Ph.D. students play in the activities of the Team substantial role. In the evaluation period, 8 Ph.D. students had their supervisors from the Team staff, 3 of them successfully defended their Theses in cooperation with Czech technical university in Prague or Institute of Chemical Technology in Prague.

Employment of former PhD students (career options)

Employment of former Ph.D. students would be very welcomed, but the budget of the Institute is restricted and financial possibilities depend especially on the success of project proposals.

5.3 Declaration on societal relevance

Impacts of the results and other activities on economy

The excellent outputs result in good success rate in grant project applications and in cooperation with industrial partners. This fact has very positive impact on the budget of the Team, because institutional money is restricted.

Impacts of the results and other activities on education

Research activities of the Team are closely related to the education of both undergraduate and doctoral students. Number of BSc., MSc. and Ph.D. theses under supervision of the Team members in the evaluation period is summarized in Tab. 3.

Table 3: Supervising students in 2010-2014 period

Type of study	No. of supervisors (theses, dissertations)	No. of consultants and co-supervisors	Theses defended in 2010-2014
<i>Bachelor</i>	2	1	2
<i>Master</i>	5	3	5
<i>Doctoral</i>	8	4	3

Popularisation and similar activities

As a part of popularisation activities, the Team prepared a lecture on absorption and Raman spectroscopy at an annual workshop for high school students with interest in natural sciences. The lecture covered the principles of light absorption and scattering, as well as experimental methods based thereon. It was followed by an excursion to a laboratory of vibrational spectroscopy, where the students could see various spectroscopic instruments used in actual research. The workshop was organized by “Arachne”, a civic organization under the auspices of Faculty of Science that focuses on scientific education and personal development of youth.

5.4 Declaration on the position in the international and national context

Comparison of the position, recognition, outputs and impacts with leading and international teams, Role and position in international collaboration, Breadth/completeness of the research activities compared to world leading teams of comparable size

Position of the Team within both national and international scientific community is eminent. This opinion is supported by very good quality of dozens publications, their positive response, international patent etc. Team members were responsible persons or leaders of 15 Czech and European projects.

Ability to attract foreign researchers at different levels

Objective assessment of the ability of the Team to attract foreign researchers on the basis of supplied materials is not possible because of lack of adequate information.

5.5 Declaration on the vitality and sustainability

Composition of staff with respect to age and gender, qualification, international experience, Attraction of research programmes for young people, Effectiveness of research (based on comparing size of groups, funding and output)

The number of staff members is very restricted (only about 14 employees including researchers, other workers and Ph.D. workers, but achieved scientific results proved vitality of the Team; its research effectiveness is outstanding. Composition of this small Team is very good balanced both from age and gender structure point of view. Very positive aspect of the Team activity is effort given to education and training of young perspective peoples.

Funding (structure of the resources and its comparison with the outputs, grants and project activity)

Institute budget is composed of 60 % institutional money, 35 % national grant money and 5 % foreign grant money. This composition is reasonable, but rather higher ratio of grant money, especially from international projects, would be beneficial

Organisational structure, recruitment methods, career system, incentives for females, young researchers, international researchers

The Institute provides financial incentives to research teams successful in solicitation research funding or contractual research.

5.6 Declaration on the strategy and plans for the future

Some examples of the new research activities in the next years are following:

- deposition high boron and phosphorus doped nanocrystalline diamond layers with potential applications in electrochemistry,
- developing of new processes for fabrication of porous doped diamond layers to boost electrochemical properties of diamond electrodes,
- Detailed characterization of pure or doped nanocrystalline diamond multilayers or composites and deposition of functional nanostructured layers, etc.

•

Apart from the mentioned new topics, the Team will continue in their current special research areas in which it achieved already many original results and has had long time experience.

The Team will continue in cooperation with Czech and abroad universities (e.g., Charles University in Prague, Czech Technical University, Technical University in Brno, University in Hasselt, Belgium, Palacký University Olomouc, and University of Wyoming, U.S.A.) in education and training students and with some other research institutions in the frame of various research projects.

Detailed description of the plans and strategy of the Team for the future is given in materials provided for the evaluation.

Relevance of the out lined strategy and research plans, Adequacy of available means and human resources to achieve these plans

Out lined strategy and research plan are relevant to the other development. While the current equipment and technical means of the Department are appropriate, some problems with adequate human resources would be pressing in the next years.

EVALUATION OF THE INSTITUTE OF PHYSICS (IP)

Team No. 12: Department of Shape Memory Materials and Composites (DSMMC)

1. INTRODUCTION

1.1 Location of the institute and its dept., labs. & sub units.

Institute of Physics of the CAS
Pod vodárenskou věží 1, Prague 8

1.2 Brief history of the institute

The Institute of Physics was initially established in 1954 and gets its present shape in 1979. Since 2007, the Institute has become a public research institution.

1.3 Mission and research topics

The Team involved especially in the research of martensitic transformations and shape memory alloys.

1.4 Staff size and full time equivalents age distribution

Currently the Team consists of 8,55 researchers, 5,77 other workers and 1,08 Ph.D. students in full time equivalents. Age distribution of the employees is presented in Tab. 4.

Table 4: Age structure of the total employees of the Team

Age category	< 25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	≥ 70
No. of members	0	7	4	7	3	1	1	1	0	1	2

2. STRENGTHS AND OPPORTUNITIES

2.1 Timeliness of research topics

Research activities of the Team are focused especially on the study of shape memory alloys, special composites, coatings, etc. Important part of work is development of and/or adjustment of special instruments and techniques. Both current and future topics are hot and represent high-tech research area; orientation on smart engineering materials and technologies is very perspective.

2.2 Budget: Ratio of institutional budget, grants and contractual resources, international funds

High quality of the research outputs result in success both in grant project applications and in cooperation with industrial partners. These two additional sources are very substantial for the Team, because institutional part of the budget is limited.

2.3 Intensity of collaboration among teams and among institutes, national collaboration and international involvement

Both in the research and education, the Team has extensive and fruitful cooperation with universities, other research institutions and commercial companies in the Czech Republic and abroad.

2.4 Position of the institute within the Czech scientific community and its international position

In the research topics under study, the Team have very good position both within the Czech and international scientific community. The outputs of the team members have very good impact; they are highly cited (over 3000 citations).

2.5 The overall capacity of staff

Number of the Department staff members is relatively low, but effectiveness of their research activities is very good.

2.6 Comments on the age structure

Currently the age structure of the Team is very good balanced. Very positive is relatively high ratio of young researchers and involvement of undergraduate and doctoral students into research activities.

2.7 Frequency and quality of publications

Publication activity of the research Team in the evaluation period was exceptional. Researchers published 156 papers in journals with impact factor. High quality of the publications was proved in the Evaluation Phase I, where 16 of 19 selected publications were classified as world-leading or internationally excellent. Impact of the Team research is very high.

2.8 Patents and role in contractual work

The team has been involved in commercialization activities, it has 3 awarded national patents, 3 international patent applications and 1 national patent applications.

3. WEAKNESSES AND THREATS

3.1 The overall capacity of staff

The overall capacity of staff (27 employees) seems to be enough but number of researchers in full time equivalent (currently 8,55) would be rather higher because of wide variety of the of the topics under study and equipment potential of the Team. But of course, solution of this problem is closely related on the capacity and stability of the budget. Unusual is gender structure of the Team – currently there is no women between researchers.

3.2 Intensity of collaboration among teams and among institutes, national collaboration and international involvement

On the basis of data dealing with the education and supervision of Ph.D. students, low success rate is evident: in the evaluation period, 12 Ph.D. students in all were trained by the supervisors from the team, but only 1 of them successfully defended their Theses.

4. RECOMMENDATIONS

4.1 Re-organisation of the internal structure of the institute and departments, laboratories, teams and groups considering the critical mass of each unit, the overlap of units

Some enlargement of the staff will be suitable because of very perspective research topics and promising potential of the Department. Higher capacity of the staff would contribute among other things to the higher success rate in Ph.D. students training – but these possibilities are of course limited by the quality, responsibility and volition of the students.

5. DETAILED EVALUATION

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

Characterisation of the main research activities (experiments, theoretical areas)

Research activities of the Team are focused mainly on the characterization and exploitation of properties of functional materials derived from martensitic phase transformation. The research covers not only theoretical and experimental studies and characterization of physical properties, but also modelling of thermomechanical behaviours and development of engineering applications.

Relevance in the national and international context

Research activities of the Team have very good relevance both in the Czech Republic and abroad. In the evaluation period 2010-2014, the team participated in 12 national and 6 international research projects. The outputs of the team members have very good impact; they are highly cited (over 3000 citations).

Overall quality of publications

Publication activity of the research Team in the evaluation period was exceptional. In the evaluation period, researchers published 156 papers in journals with impact factor and 7 national and/or international patents or patent applications. High quality of the publications was proved in the Evaluation Phase I, where 16 of 19 selected publications were classified as world-leading or internationally excellent. The Team has been also effectively involved in commercialization activities.

Specification of the main achievements

There are many valuable and seminal research achievements, e.g.:

- electropulse treatment of shape memory alloys filaments,
- in-situ TEM analysis of mobile interfaces in shape memory alloys,

- research of deformation and transformation processes in NiTi alloys,
- in-situ synchrotron X-ray and neutron diffraction studies of phase transforming solids,
- thermomechanical modelling of shape memory alloys and numerical simulations for application design,
- study of environmentally assisted fatigue of NiTi stents,
- research of lattice softening in shape memory alloys,
- concept of modulated martensite as an adaptive phase,
- hierarchy of martensitic structures and explanation of high twin mobility,
- non- destruction testing of ferromagnetic steels,
- study of superconductivity, etc.

Specification of the contributions of the team to publications

The Team have decisive contribution to presented publications - most of paper authors are staff members.

5.2 Declaration on the involvement of students in research

Involvement of students (doctoral, undergraduate) into research, Particular contributions of students to research

Involvement of Ph.D. and undergraduate students into research projects and into other activities of the Team was very significant and beneficial.

Number of defended PhD students in relation to students involved (success rate)

Education and training of the Ph.D. students play in the activities of the Team substantial role. In the evaluation period, 12 Ph.D. students were trained by the supervisors from the team, but up to now only 1 of them successfully defended their Theses. Currently there are 8 PhD students under supervision of the Team members.

Employment of former Phd students (career options)

Some of the former Ph.D. students trained at the Institute are already members of the Team staff; possibilities of involvement of others are rather restricted by the limited budget.

5.3 Declaration on societal relevance

Impacts of the results and other activities on economy

High quality of the research outputs result in success both in grant project applications and in cooperation with industrial partners. These two additional sources are very substantial for the Team, because institutional part of the budget is limited. And vice versa, money from the grants and industrial cooperation has positive influence on the research activities of the Tea.

Impacts of the results and other activities on education

Research activities of the Team are closely related to the education of both undergraduate and doctoral students. Number of BSc., MSc. and PhD theses under supervision of the Team members in the evaluation period is summarized in Tab. 5. In relation to the very restricted possibilities of the Team because of low number of staff, the characteristics dealing with the educational activities are very positive.

Table 5: Supervising students in 2010-2014 period

Type of study	No. of supervisors (theses, dissertations)	No. of consultants and co-supervisors	Theses defended in 2010-2014
<i>Bachelor</i>	2	0	4
<i>Master</i>	5	0	5
<i>Doctoral</i>	8	3	1

Popularisation and similar activities

Activities of the Team in the area of research popularization are numerous; e.g., the Team members participate on the public actions like “Open Days of the Academy of Science” and “Open Science”, various presentation for high-school or university students, etc.

5.4 Declaration on the position in the international and national context

Comparison of the position, recognition, outputs and impacts with leading and international teams, Role and position in international collaboration, Position of the team in the national context

Position of the Team within both national and international scientific community is very important. This fact is based on high quality of publications, positive response of them, wide contacts, cooperation etc. In the evaluation period 2010-2014, the team participated in 12 national and 6 international research projects.

Ability to attract foreign researchers at different levels

The Department collaborates with large number of foreign academic as well as industrial partners. Researchers from many countries (e.g., France, Belgium, Germany, Finland, Slovakia, India, etc.) have participated on the staff activities in the form of exchange stays or seminars, joint publications, collaboration in national and EU projects, development of special equipment, etc.

5.5 Declaration on the vitality and sustainability

Composition of staff with respect to age and gender, qualification, international experience

From the age structure point of view, composition of the Team is very good balanced. The Team is vital and its research effectiveness is outstanding. Both scientific and educational activities of the Team are beneficial and considerably contribute to the sustainability.

Attraction of research programmes for young people

Substantial role in the activities of the Team have young researchers.

Funding (structure of the resources and its comparison with the outputs, grants and project activity)

Budget of the Department strongly depends on the grant project money; about half of the staff salaries is financed from these sources. Success in the national and international grant project application is crucial for the Department.

Effectiveness of research (based on comparing size of groups, funding and output)

Comparison of the staff size and both quantity and quality of the research outputs gives evidence on very good effectiveness of the research activities at the Department.

5.6 Declaration on the strategy and plans for the future

Apart from continuation of the research in the current topics, the Team will start to work on some new projects. The main research topics planned for next years are following:

1. fatigue of NiTi,
2. superelastic thin film NiTi technology,
3. collaboration on construction of the diffractometer BEERat European Spallation Source in Lund, Sweden,
4. basic research on martensitic transformation in multiferroic Heusler alloys,
5. research on robust magnetically driven actuators.

The presented research problems will be solved in the frame of some new both national and international projects.

The Team will continue in participation on the activities of “Centre of Excellence of Advanced Materials” established for interdisciplinary collaboration among six teams from universities and academic research institutes active in material engineering field and Ph.D. training.

Detailed description of the plans and strategy of the Team for the future is given in materials provided for the evaluation.

Relevance of the out lined strategy and research plans, Adequacy of available means and human resources to achieve these plans

This strategy and presented research plans are relevant. The Department has adequate both technical equipment and human resources to achieve the out lined plans for next years.

Date: February 28, 2016

Commission Chair: em Prof.DI.Dr.Dr.hc. Hans Peter Nachtnebel