Evaluation of research and professional activity of research-oriented institutes of the Czech Academy of Sciences for the period 2015–2019

Summary Final Report

Name of the Institute: Institute of Plasma Physics of the CAS, v. v. i.

Evaluated teams and their leaders:

1. Tokamak (Martin Hron)
2. Laser Plasma (Miroslav Krůs)
3. Materials Engineering (Tomáš Chráska)
4. Pulse Plasma Systems (Petr Lukeš)
5. Plasma Chemical Technologies (Michal Jeremiáš)
6. TOPTEC (Vít Lédl)

Part A: Evaluation of the institute

Strengths:

- Restructuring has improved the competitiveness of the institute and already had an impact on the publication results.
- Generally young, dynamic and well-motivated teams (after a substantial generation exchange some years ago).
- Gradual increase of the team internationalization at all level (from PhD students to senior positions), due to the financial possibilities of the Institute (European grant projects).
- Strong inclusion of master and doctoral students in the scientific work of the teams.
- Very good collaborations with Czech universities (and also some foreign universities), which also improves the influx of highly educated and excellent students.
- Strong and well-established cooperation with leading international and domestic institutions.
- Effective project support unit to keep the administrative workload for scientists within reasonable bounds.
- Funds for support of mobility and foreign stays of the IPP students, scientists, and engineers to gain experience and new knowledge in the leading foreign institutions
- Operation of two modern large research infrastructures (COMPASS and PALS). These infrastructures attract top foreign scientists, who can then transfer the know-how to local IPP staff.
- Generally, very good experimental equipment at all the departments, significant investments in the last years and even higher investments are secured for the next 3 years.
- The timelines of research topics are good.
- Gradually improving position of the IPP in fusion research in the European structures including representatives in the key scientific committees/bodies of the main fusion international organizations (EUROfusion consortium, joint European undertaking Fusion for Energy, ITER organization, etc.).

Weaknesses:

- Scientific program is in some cases too fragmented and may need further consolidation. Shared activities with CAS-IP teams on the PALS laser are seen as very positive, but a stronger formal link might be helpful.
- High number of external projects and grants with a wide variety of narrowly defined research topics, which make the institute management difficult. Realization of some log-term plans might be also difficult.
- Need to construct new laboratory premises for the TOPTEC centre in Turnov.

Opportunities:

- Restructuring process has been started and should be continued.
- COMPASS Upgrade, if realized, may have a strong benefit for the institute to become one of few world-leading institutions in fusion research.
- Reasonably diversified portfolio of topics in plasma research, which enables investigation of complex plasma and material related problems.
- Well established collaboration between experimentalist and theoreticians (computer model designers) at some of the departments.
- Well established collaboration with industry in the field of optical and materials research, and plasma gasification.

Threats:

- Number of personnel in teams 2,4 and 5 is significantly smaller than for team 1.
- Operation and service of the PALS laser may take away personnel from scientific activities.
- The need to continuously secure the present good level of funding.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I

The institute IPP is of mid-size and comprises 4 scientific teams of quite different size, as well as an optics group (TOPTEC) and an engineering group. The biggest of the scientific departments is team 1 (Tokamak), the smallest one is team 5 (Plasma Chemical Technologies). The number of selected outputs of Phase 1 (185, of which 21 outputs were in the top decile, 84 in 1st quartile, 61 in 2nd quartile and 16 in 3rd quartile) reflects the personnel distribution and varies in a similar manner between 65 (team 1) and 20 (team 5). The overall quality of the selected outputs for IPP can be regarded as very good to excellent, with teams 2 and 4 having visibly stronger contributions in high impact journals (Q1).

The team Material engineering (22 outputs within Phase I) was evaluated inside the field Materials engineering, the team TOPTEC (35 outputs within Phase I) was evaluated inside the field Other engineering and technologies.
Since 2017 there is the strong pressure on IPP to publish high quality paper in journals with high impact factor. The scientific publications are in appropriate journals of the field.

H1.2	Contribution of workers on the outputs reached

As has been mentioned in H1.1, the number of selected outputs differs significantly between team 1 (65) and the teams 2-5 (~20). The contribution of workers to these outputs, however, reveals a different picture, if the fraction of authors is concerned. Whereas the fractional count of the IPP authors for teams 1 and 2 is found between 0.26 and 0.29, it rises significantly up to 0.61 and 0.67 for teams 4 and 5. Given that team 1 and 2 are operating the Tokamak COMPASS infrastructure and the PALS Laser centre resp. for external experiments, the number of non-IPP authors is in most cases higher, causing a natural reduction of the fractional count. The teams of the institute contributed in reasonably high amounts, ranging from 10 to 100%, to the outputs.

H1.3	Quality of all outputs and results

The list of all outputs and results contains nearly 700 scientific journal articles, 6 book chapters, 337 contributions in conference proceedings. Given the size of the Institute, this is very good. In general, the impact of these ouputs could still be somewhat improved, although this may have different implications for the teams. It may be particularly difficult to achieve this with team 1 (highest contribution of publications) being significantly absorbed within the operation of COMPASS and the planning/construction of COMPASS U. Nevertheless, efforts should be undertaken to motivate an improvement for the future.

The Institute can measure the quality of results also by the number of contractual research projects (49 projects, 512 kE) and collaborative projects (30 projects, 3 372 kE). Plus 9 patents, and 12 utility models (one licensed). From this point of view the quality of results must be regarded as a great success.
IPP is highly aware of the importance of intellectual property protection and internal processes set accordingly in order to be able to efficiently monitor the application potential of new scientific results. A similar process applies also to inventions (drafts of patent applications or utility models).

H1.4	The most valuable discoveries and findings in the fields, their importance for the field

The different departments all show very visible and valuable outputs, which are highly regarded within their fields.

Valuable discoveries include:

a) Fusion-relevant research of magnetized plasmas in Prague Tokamak,

b) Research of nonequilibrium discharges in gases and liquids, and focused shock waves,

c) Plasma chemical technologies for waste decomposition,

d) Plasma spraying of tailored materials,

e) Experimental coatings with high porosity for thermal protection,

f) Special optics for space applications (e.g. nanoparticles of abrasives as basis for next generation of ultra-smooth surface polishing tools), which opens broad application areas for space research.

H1.5	Contribution of the participation of the authors in large collaborations

From the numbers given in H1.2 it appears that the authors contribute in a different manner to large collaborations. Whereas teams 1 and 2 stay in a regime of fractional counts (<0.33) comparable to many other teams throughout CAS, the teams 4 and 5 clearly excel. However, this assessment has to be taken with some caution, since the number of co-authors for the various publications of teams may be significantly different. A high number of co-authors from other scientific institutes – which is often the case in Tokamak-related publications – reduces the fractional count, but this must not be necessarily seen as a quality criterion for the science. A similar situation is recognized for team 2, which has a significant support task for PALS.
The Institute plays a significant role in one large collaboration within the European project FUSENET (European Fusion Education Network). It is the consortium of 36 European laboratories from 18 EU countries.
The Institute plays a particular role in three large collaborations as ITER Organization (St. Paul-lez-Durance, France), CERN Geneva, European Space Agency (ESA), and US Department of Energy.

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission

The IPP covers a broad range of scientific topics from fundamental fusion research to application of laser-driven processes. In this respect the results and outputs agree fully with the CAS and IPP mission, particularly after the reorganization of the institute. It appears that IPP is already on a good way, but still has some way to go.
In particular, IPP coordinates the thermonuclear fusion research in Czech Republic, and hosts a unique facility (COMPASS tokamak) on the national level, as well as in Central and Eastern Europe, for studying the confinement of plasma for nuclear fusion research and for the development of related technologies. Thanks to this facility, the Czech Republic plays an important role in the field of nuclear fusion research in Europe as member of the EUROfusion consortium and as partner of important European projects (such as EURATOM). Next, the Institute hosts the PALS Research Infrastructure, one of the largest laser facilities in Europe, offering a highly demanded instrument for basic and applied studies of laser light interaction with matter.

H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the institute´s activity on proper practice in society in the area of social sciences and humanities

The IPP as represented by its teams has already several cooperations with industry, which should be used in the future to address topics of societal relevance. In this way the institute may deliver highly specialized services to industry and help to drive technical solutions, e.g. in waste management and energy production.

The commission is impressed by the strategic and strong knowledge transfer into the practise, documented by projects together with industry leading to process validation also on a pilot scale (mainly at the Toptec Centre).

H2.3	Relation to practice

Particularly devoted to industrial research application there are the activities carried out in the Regional Centre TOPTEC in Turnov. At present, the Centre is the only R&D facility that focuses on ultra-precision and special optics in the Czech Republic, with a promising perspective for the future. In the document *Research for practice* we can see 49 contracts (512 k€). The Commission understands that long-term projects are a necessary ingredient for successful patenting, which is then driven by the commercial partners.

H2.4	Participation in AV21 strategy

IPP actively participates in five research programmes of Strategy AV21, out of which one is coordinated directly by the Institute (Systems for Nuclear Power Industry, coordinated by prof. Radomír Pánek). The next four are: 1) New Materials based on Metals, Ceramics and Composites, 2) The efficient Conversion and Storage of Energy, 3) The Universe for Mankind, 4) Light in the Service of Society.

H2.5	Cooperation with regions of the Czech Republic

There is the strong collaboration between the part of IPP situated in Prague with Prague universities, research Institutes (Institute of Physics and Institute of Physics of Materials CAS, Research Centre Rez, Institute of Scientific Instruments CAS), and Industrial partners in various regions of the Czech Republic. (Meopta, Crytur, ELTODO).The TOPTEC centre, which represents the only institution of the Czech Academy of Sciences in the Liberec region, collaborates intensively with the Technical University of Liberec.

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the teams and the institute with similar international and national institutes

The IPP covers a wide range of topics from nuclear fusion to plasma applications and compares well with similar international institutes, such as the Max-Planck institutes or institutes of the Helmholtz Research Centres, with whom they actually have existing collaborations, which confirms the quality of the institute and its particular teams. It will have to be seen how the envisaged rearrangement of the institute is going to affect the national/international standing of IPP in the long run.

D1.2	Scope and quality of international and national cooperation and the role of the institute in such cooperation; engagement in broad international cooperation

IPP is strongly involved in both national and international cooperations. This included long-term collaborations with leading Czech institutes and universities (Charles University

in Prague, Czech Technical University in Prague, University of Chemistry and Technology in Prague, Masaryk University Brno, Brno University of Technology, Technical University in Liberec), Research institutes (Institute of Physics and Institute of Physics of Materials CAS, Research Centre Řež, Institute of Scientific Instruments CAS), and Industrial partners (Meopta, Crytur, ELTODO). On the international level the IPP contributes significantly to cooperations in Europe, the US and Asia. Most notable is the involvement in fusion reactor project ITER. The quality of activities, and the presence of the COMPASS and PALS facilities, active at European level, put the Institute in a good position in international collaborations. The main tasks in such cooperation are energy and laser plasma.

D1.3	**Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)**

The IPP and particularly its teams are considerably involved in the organization of international and national conferences, workshops and summer as well as winter schools. This engagement is quite impressive and is certainly seen overall favourably.

Within the evaluated period the departments organize of large number of events:

- 2 large conferences – each approx. 1.000 participants,
- 7 international conferences (100 –300 participants),
- 34 workshops (up to 100 participants), and
- 10 summer and winter schools.

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	**Direction in line with the perspective of the planned research directions**

According to the presentations given, the current research direction of IPP – although covering diverse topics – is in general in line with the planned research directions. Already the reorganization of IPP and the foundation of a new team on plasma chemical technologies has led to a refocussing of the scientific directions.

D2.2	**Assessment of the previous research objectives and their achievement**

The development over the last years was driven by the aim to remain a high rank player in Plasma technology, and Laser and Tokamak physics. This was very successfully achieved.

D2.3	**Assessment of implementation of recommendations from past evaluation**

The biggest part of the last evaluations recommendations has been implemented by the (new) IPP management and (new) department heads. Apart from the reconstruction of the institute, this consisted also of a generation exchange on the level of scientists and some department heads. In addition, a fundamental reorganization of administration was performed. A project support unit was established to help scientist to manage grant projects. The scientific program has been more strongly focussed, which also led to a termination of outdated experimental facilities to make room for new perspective developments.

D2.4	**Success in receiving grants**

The Institute is very successful in acquiring grants mainly from GACR and partially from MEYS, TACR, and 4 big projects from the EU. In total about 38 M€ were received in the investigated period:

- grant projects and programme projects, 74 projects, 34 355 k€,
- contractual research, 49 projects, 512 k€,

- collaborative research, 30 projects, 3 372 k€.

This must be regarded as great success. Project support unit established to help scientist to manage grants and projects. This also contains a certain danger, however, as the grants cover more than 60% of the institute's budget. In contrast to the opinion of the institute, the evaluation commission judges that the income sources of the institute are well balanced and are comparable to the repartition of a typical research group in mechanical, civil or chemical engineering at a university in western European countries. Competitive component of funding is important in maintaining strive for quality.

D2.5	Adequacy of instrumental equipment

The instrumental equipment is absolutely adequate and of top quality. The developments envisaged for the future, e.g. COMPASS Upgrade or PALS improvement will further shift the quality level up and may help to establish a leading international position in some fields.

In this context, the commission admires the capability to build advanced and custom-made equipment to study specific (mainly plasma) processes. For the next period the Institute is preparing the large projects (mainly for Horizon Europe) for large investments. The Institute wants to build new research premises and to start reconstruction of an experimental hall in the Tokamak building.

D2.6	Effectiveness of management

The Institute of Plasma Physics appears as well-managed as the Commission is able to judge indirectly from the really good environment for performing of research. It is reported that Prof. Radomír Pánek is leading the team very successfully and with great experience. With the measures taken already in the last evaluation period, the IPP has gone through some reorganization, which improved the international standing and the competitiveness of the institute. The institute has also grown in personnel. However, the size of the various teams still varies significantly. The reorganization measures planned for 2021 and indicated in the IPP presentation should be done and may help to stabilize the institute and balance the size of the teams. The Commissions have an overall positive impression.

D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth

IPP has 278 employees (as of January 2020), the full-time employees equivalent (FTE) is 233, the IPP team is presently relatively young with the majority of employees in the age range of 25-45 years (median is 39 years).Exchange of generations at all departments and leading positions was successfully finished. Foreign employees represented 27% in 2019, which is a significantly higher percentage than in 2014. The average salary 2019/2014 – increased by 32% (partly competitive to western countries).
The age structure of the Institute is now well balanced, enabling senior researchers to pass their knowledge and experience to the younger generation. The Institute can attract young researchers from Czech Republic as well as from abroad (due to good salary conditions). The human resources policy of the institute is based on the policies and rules used in the whole Academy of Sciences. A key part of career development is the regular evaluation of researchers.

Attention is paid on vertical mobility of researchers, which is governed by the rules of attestations within the Czech Academy of Sciences. After completing the doctoral study, attention is also paid to young researchers at the beginning of their scientific career. The Institute generally supports the mobility of young researchers in framework of 6-month internships at foreign workplaces financed from project Mobility and National susceptibility program (Ministry of EYS).

D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues

The institute took measures to support work-life balance, creating pleasant working conditions and possibility to combine work and personal life . Flexible working hours were introduced at the Institute to adapt to individual personal activities and parental responsibilities. There is a kindergarten on the institute campus. To promote teamwork and communication both within and between teams/depts./units, various team building events and joint seminars were organized, including activities for the children of the Institute's staff.

The institute lacks sufficient gender balance. An original reason is referred to the minor proportion of women in Physics and Engineering university studies in general as reason for existing misbalance within evaluated physical institutes (as well departments). Only the TOPTEC team is well gender balanced (55% man and 45% women), which can be recommended as a „better-practice“ example. It is suggested to create and implement a strategy to achieve a better gender balance in the medium to long-term.

D2.9	Relation of the institute with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.

N/A

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level

The Institute is well engaged in joint research projects together with national as well as international universities, research institutions (50 establishments are mentioned). There is a less important research interaction with universities on a national level. The education of undergraduate and postgraduate students is also the visible part of mutual operation. Several members of the various teams contribute strongly to the education of students by delivering lectures.

D3.2	Effectiveness of joint research centres

On the national level there are two engineering centres: a) Centre of excellence - Multidisciplinary research centre for advanced materials (2014-2018, ME), b) National Competence Centre - Research centre of surface treatment (2014-2019, ME. Via the TOPTEC activity, the IPP cooperates in the Framework of a National Competence Centre with the Centre of Photon and Electron Optics and is one of the major partners. This cooperation is focussed on laser-related problems and has outreach to all areas in CAS operating and using lasers. Furthermore, the Institute plays a particular role in two large research centres (ITER Organization (St. Paul-lez-Durance, France) and CERN, Geneva).

D3.3	Success rate in supervision of PhD students

There is an intensive involvement of the IPP staff in supervising Ph.D. students. IPP initiated and helped to start a dedicated PhD program at the Faculty of Nuclear Science and Physical Engineering of CTU in Prague focused on fusion research and technology. The institute reports 44 semestrial lectures for doctoral study during the evaluation period. Within the evaluation period, about 94 finished their PhD theses, with about 60 PhD students being supervised each year. Given the size of the institute, these numbers appear to be healthy and the activities should be continued.

D3.4	Participation of PhD students in the outputs
The PhD students play an important part in generating the scientific outputs of the institute and the various teams and they are co-authors of some publications.	
D3.5	**Participation of the institute in master or bachelor studies**
Intensive involvement of the IPP staff in teaching and supervising students (BSc, MSc.) at universities is reported. The list of universities contains: Charles University, Czech Technical University and University of Chemistry and Technology in Prague, Technical University in Liberec, Komensky University in Bratislava (Slovakia). IPP experts are intensively involved in teaching at these universities and in supervisions of theses. The institute reports 54 semestrial lectures for BSc. study, 201 semestrial lectures for MSc. study during the evaluation period. Typically, 50-60 students are supervised each year in IPP by means of various forms (placements, summer internships, master theses), 69 theses were defended in 2015-2019 (33 BSc. and 36 MSc.). Several bachelor and master students were incorporated into the research (in Departments). Thus, these activities ensure a reasonable influx of new students to IPP.	
D3.6	**Assessment of cooperation intensity with universities in the form of teaching**
The teaching activities of the IPP personnel on all levels from BSc. to PhD. are seen very favourably. IPP also initiated a dedicated education program on fusion research at the Faculty of Nuclear Science and Physical Engineering at CTU. This is a quite positive development. Further, it is necessary to highlight the supervision and training of foreign students via various European programmes – e.g. Erasmus Mundus. As obligatory for students of Erasmus Mundus the Fusion Master programme exists. Over 300 foreign students have passed this programme up to now. Second, each year very successful schools on fusion and plasma physics at Tokamak Dept. take place in cooperation with the Faculty of Nuclear Science and Physical Engineering of CTU in Prague.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
The Institute frequently shows various activities in public outreach for audiences with various backgrounds from Czech Republic and abroad, e.g. open lab days and exhibitions. The homepage (500 – 100 visitors per year) gives general information on the team, research fields, latest results, and ongoing projects. In the evaluation period IPP has rearranged its PR strategy and assigned a dedicated person to this task. This activity lead to a new IPP website, as well as the establishment of YouTube, Twitter and Facebook channels. Also the output of visual and printed public information material has been strongly pushed. The outcome of this strategy is a significant improvement of the public awareness of the institute‘s activities also outside the scientific community. These outreach activities might be intensified to attract more students and scientists from other institutions and it is proposed that the media strategy is to be managed across the whole institute (the 6 teams).	
D4.2	**Publishing activities and its quality**
Based on the development in D4.1 the publishing activity has been significantly increased and also improved in quality. This holds for both the publications aimed at the public, as	

well as those for the scientific community. In detail, the institute reports preparation of many press releases, interviews in TV/radio (>15) and texts in journals (>50), public presentations (>30) to bring the main interesting results to public. These publishing activities result in significant improvement in public awareness of the Institute activities even outside the scientific community. This development is seen positively and should also be continued in the future.	
D4.3	**Participation in professional organisations in the area of research and development**
All teams show strong integration in the professional organizations within their fields. Institute members are involved in a number of scientific councils, professional organisations, and evaluation panels at a local level (Czech Republic). Thus, the visibility of the Institute in professional organisations at national and international level is strong.	

Other comments of the commission:

The Institute of Plasma Physics is now a growing institution with a strong international collaboration, large long-term projects and good perspectives for the coming years. The previous reorganization of the IPP has already improved the institute's overall scientific performance and the age-distribution of the personnel. The envisaged further reorganization of the institute should be pursued. The situation of the PALS centre towards the ELI infrastructure and the involvement of different CAS institutes in the PALS operation/service has to be viewed very positive. A stronger formal link might be helpful. The commission also recommends to maintain the efforts in attracting students and researchers from other countries.

Part B: Evaluation of teams

1. Tokamak

Strengths:
Strongly motivated, young, growing team with large potential for members‘ professional growth. Strong interaction of modelling and experimental activity integrated with COMPASS, COMPASS-U, EUROfusion activities. Strong links between team and universities.

Weaknesses:
Administrative loads, relatively short-term financing schemes, simultaneous operations of COMPASS and COMPASS-U.

Opportunities:
COMPASS-U planned to come online in 2023.

Threats:
None.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
Results presented in Phase I-selected outputs are published in well-known, peer-reviewed journals (e.g. *Plasma Physics and Controlled Fusion, Nuclear Fusion, Journal of Nuclear Materials*).	
H1.2	**Contribution of workers on the outputs reached**
Team scientists are first or corresponding authors of most of the papers.	
H1.3	**Quality of all outputs and results**
The standing of journals where the Team’s results are published ensures the latter‘s high quality.	
H1.4	**The most valuable discoveries and findings in the fields, their importance for the field**
A few highlights are: transition to high confinement by turbulence suppression, pedestal studies to help understand the behaviour of the edge transport barrier (which has major effect on plasma energy confinement), measured vs. predicted ELM (energy localised models) energy fluence, a study on shoulder formation (i.e., a broadening effect of the plasma density profile) at the SOL (scrape-off layer), studies of heat flux and power exhaust aimed at assessing power-handling capabilities of future plasma-facing components, modelling of rough surfaces and sputtering and of power deposition profiles on divertor monoblocks in the upcoming ITER tokamak, COMPASS team activity within the EUROfusion work package *Plasma Facing Components* on France‘s WEST tokamak, liquid-metal divertor module tests on COMPASS; interaction of plasma with 3D magnetic perturbations, runaway electrons, disruptions caused by uncontrolled vertical movements of the plasma column, sideways forces during plasma disruptions on the COMPASS tokamak, shattered pellet injection measurements, electromagnetic loads during plasma disruptions for the Tokamak-U(pgrade) tokamak; and diagnostics development for future fusion devices such as the design of the core plasma Thomson scattering diagnostic system for the upcoming ITER tokamak.	

H1.5	Contribution of the participation of the authors in large collaborations
The team's competence encompasses fusion experimental research, fusion plasma theory and modelling, plasma diagnostics development, and technology research and development (R&D). This broad spectrum of expertise lends itself to many international collaborations. Team contributions in the research topics outlined in H1.4 are offered to collaborating institutions such as: ITER & CEA-Cadarache (St Paul-les-Durances, France), JET & Centre for Fusion Research (Culham, UK), MPI for Plasma Physics (Garching, Germany), Federal Polytechnic School (Lausanne, CH), Princeton Plasma Physics Lab (Princeton, USA), ENEA (Frascati, Italy), CREATE Consortium (Naples, Italy), Institute of Nuclear Physics (Krakow, Poland), Wigner Institute (Budapest, Hungary), DIII-D General Atomics (San Diego, CA, USA), MIT (Boston, MA, USA), Chalmers U. (Sweden), National Center for Nuclear Research (Swierk, Poland), Budapest University for Technology & Economy (Budapest, Hungary), Technical University of Denmark, Forschungzentrum Jülich (Germany), KTH Royal Institute of Technology (Stockholm, Sweden), CIEMAT (Madrid, Spain), University of California, San Diego (La Jolla, CA, USA), MEPhI (Moscow, Russia), Kurchatov Institute (Moscow, Russia), Sao Paolo University (Brazil).	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
Based on the team's expertise and results, team members are involved in: teaching activities at Czech universities with lectures, seminars, and bachelor, master, PhD student supervision; management of the national COMPASS tokamak facility with its potential energy production; and public-relation activities, e.g. public lectures and media interviews.	
H2.2	**System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team´s activity on proper practice in society in the area of social sciences and humanities**
Large series of experiments on basic understanding of the Runaway Electron beam behaviour performed on COMPASS for the EUROfusion consortium.	
H2.3	**Relation to practice**
Training of experts for research and operation of nuclear facilities. Integration of fusion reactors into the power sector	
H2.4	**Participation in AV21 strategy**
Popularization publications on the principles and advantages of fusion research, as well as its history and future prospects, were issued under the AV21 strategy.	
H2.5	**Cooperation with regions of the Czech Republic**
Involvement of local industries for specific developments.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
The CAS/IPP/Tokamak team is the largest such group in the Czech Republic. Internationally, the breadth and scope of its collaborations suggests that it positively compares with similar teams.	
D1.2	**Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation**
The team has strong national collaborations, with similarly–oriented groups of Czech universities (e.g. Prague, West Bohemia; CAS/INP), notably relative to the development of COMPASS-U. Also, it has maintained and expanded large-scale international cooperations with universities and research institutions in Brazil, Denmark, France, Germany, Hungary, Italy, Poland, Russia, Spain, Sweden, Switzerland, UK, USA.	
D1.3	**Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)**
The Tokamak Dept team has (co-)organized 5 international conferences, 14 (mostly) international workshops, and 2 training courses for students. Furthermore, team members delivered 16 invited talks/lectures, and received 3 awards.	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
Plans for the next period are clear and well-stated. They are mainly based on the expected gradual phasing out of COMPASS and coming online of COMPASS-U.	
D2.2	**Assessment of the previous research objectives and their achievement**
Team1 activities planned in 2015 developed as expected.	
D2.3	**Assessment of implementation of recommendations from past evaluation**
Recommendation from the past evolution have been fully implemented: the Theory and Modelling group has been expanded, a better integration was achieved between COMPASS-related activities and the EUROfusion program, and international cooperation has been expanded.	
D2.4	**Success in receiving grants**
The main grant, that has covered most personnel costs in 2015-2019, is an EU grant awarded to EuroFUSION.	
D2.5	**Adequacy of instrumental equipment**
In-house equipment, mainly related to COMPASS-U, seems adequate for the current needs.	
D2.6	**Effectiveness of management**
Team management is subordinate to the CAS/IPP management. Internally, it has a multi-level organizational structure in order to achieve efficient management and bureaucratic	

efficiency. In steering its programs, the team is assisted by an international advisory board that provides strategic recommendations and reviews work in progress.	
D2.7	**Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth**
The team has substantially increased in size in 2015-2019. In 2019 it was composed (in FTE units) of 31.5 researchers, 33 technical/administrative personnel, and 11.5 PhD students. This distribution, especially if it is slated to increase because of final COMPASS-U work, seems adequate to run the Tokamak Dept1. Development strategies for 2020-2024 foresee the decommissioning of COMPASS and commissioning of COMPASS-U. Recruitment strategies, subordinated to CAS/IPP rules, have been successful in balancing the age distribution. The age distribution peaks at mid-career (ages 30-35) and the bulk of people is in their early/mid careers (25-45). As for all CAS/IPP employees, Tokamak Dept. members are encouraged to systematic professional growth also through yearly assessments of their accomplishments.	
D2.8	**Creating work-life balance conditions, assessment of approach towards possible gender issues**
Women constitute 15% of personnel.	
D2.9	**Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.**
N.A.	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	**Scope of cooperation with universities on national and international level**
The scope of cooperations with universities is to attract students to work on theses projects proposed by team members. This is very important also in consideration of the generally low number of Physics students in Czech universities.	
D3.2	**Effectiveness of joint research centres**
N.A.	
D3.3	**Success rate in supervision of PhD students**
12 PhD theses were successfully defended in 2015-2019.	
D3.4	**Participation of PhD students in the outputs**
PhD students regularly participate in research activities and co-author ensuing papers.	
D3.5	**Participation of the team in master or bachelor studies**
Team1 has provided 6 Bachelor thesis supervisors, and 5 Master thesis supervisors (plus 1 consultant).	
D3.6	**Assessment of cooperation intensity with universities in the form of teaching**
Tokamak Dept.‘s staff help teaching specialized courses at Prague, Brno and West-Bohemia Universities.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
Tokamak Dept members have been very active in producing popularization and educational materials, courses and lectures for the general public, and lectures tailored for high-school and college students, and participating in open-days event at *Industry Day* and *Week of Science and Technology*.	
D4.2	**Publishing activities and its quality**
Published outreach material is electronic (media interviews, educational movies and videos spots on TV) and printed (popularization magazine articles).	
D4.3	**Participation in professional organisations in the area of research and development**
Technology R&D activities involve the design and development of COMPASS-U systems.	

Other comments of the commission:
None.

2. Laser Plasma

Strengths:
Operation of the PALS Laser, improvement in final planning state, young team, good connection with IP teams.

Weaknesses:
Operation of a large facility binds forces.

Opportunities:
The on-going enhancement of in-house research in combination with the strong connection with some of the user groups.

Threats:
The necessary work-force has to be maintained in order to manage both the facility and the research aspects. The balance with ELI Beamlines and the teams at CAS IP with similar thematics have to be maintained, a stronger formal link might be helpful.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The outputs have a very high and internationally accepted quality, but the number of papers with reprint authors from the group is low, due to the focus on the facility aspect.	
H1.2	**Contribution of workers on the outputs reached**
Outputs are covering all 4 research topics.	
H1.3	**Quality of all outputs and results**
The overall quality is excellent. Articles produced by LPD are represented mainly by collaborative papers with external users utilizing PALS RI as main authors and LPD researchers as co-authors. This has to be regarded as normal for a user-facility. Increasing output form the team members is recognized.	
H1.4	**The most valuable discoveries and findings in the fields, their importance for the field**
Contributions to proton-boron fusion, and novel particle acceleration schemes are discussed as possible new routes to fusion energy. Simulation of meteoroid descent has input to astronautic developments. Synthesis of prebiotic molecules is widely discussed in cosmology.	
H1.5	**Contribution of the participation of the authors in large collaborations**
Most of the publications are together with larger collaborations, where these collaborations are building on the quality of the PALS installation and the team. These collaborations are on a widespread national (including ELI Beamlines) and international level. The role of PALS and its teams is highly recognized. Members of the team are also participating in experiments at other research centres and universities.	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
As a facility the team is an important cornerstone for research in the Czech Republic and abroad. Results are fruitful for several research activities, including activities towards Inertial fusion within Eurofusion	
H2.2	**System functionality for knowledge transfer into practise, its usefulness for society. The impact of the institute´s activity on proper practice in society in the area of social sciences and humanities**
Development of novel laser schemes as an impulse for local industry. Research towards novel light and particle sources and inertial fusion	
H2.3	**Relation to practice**
Laser and optical system development	
H2.4	**Participation in AV21 strategy**
Contributions towards “Light for Life”	
H2.5	**Cooperation with regions of the Czech Republic**
N/A	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the teams and the institute with similar international and national institutes
The team is internationally well renown for its laser technology and science. It is in its field at level with similar institutes within e.g. Laserlab Europe like GSI, Darmstadt, Germany, HZDR, Dresden, Germany, Lund Laser Center, Lund, Sweden, or Max Born Institute, Berlin, Germany.	
D1.2	**Scope and quality of international and national cooperation and the role of the institute in such cooperation; engagement in broad international cooperation**
The team is an established partner in the Laserlab Europe and Eurofusion networks, and strongly cooperates with Czech institutes. It has a strong interconnection with ELI Beamlines, the CAS IP and universities.	
D1.3	**Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)**
Organization of the International summer school on Advanced quantum mechanics.	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	**Direction in line with the perspective of the planned research directions**
The new projects fit very well with the direction of the institute and will enhance the visibility in the future.	
D2.2	**Assessment of the previous research objectives and their achievement**
The team was very successful.	
D2.3	**Assessment of implementation of recommendations from past evaluation**
The team defined a clear line in the complementarity with the ELI institutes.	
D2.4	**Success in receiving grants**
The team was successful in receiving grants from Czech Republic as well as from European sources.	
D2.5	**Adequacy of instrumental equipment**
The standard of the equipment is on a high international level, and the team is steadily improving the scope.	
D2.6	**Effectiveness of management**
The team is well organized and managed.	
D2.7	**Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth**
The team has succeeded to assemble high quality professionals, with about 30% of foreign personnel and a good portion of students and young scientists.	
D2.8	**Creating work-life balance conditions, assessment of approach towards possible gender issues**
The team seems to be well balanced.	
D2.9	**Relation of the institute with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.**
N/A	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	**Scope of cooperation with universities on national and international level**
There is a wide range of very active national and international cooperations.	
D3.2	**Effectiveness of joint research centres**
There is no defined research centre, but a clear line of collaboration with the ELI and CAS institutes and several universities.	

D3.3	Success rate in supervision of PhD students
The team is very active in teaching and presently lists 2 PhD theses.	
D3.4	**Participation of PhD students in the outputs**
The PhD students are active in the research and participate in the publications.	
D3.5	**Participation of the institute in master or bachelor studies**
6 bachelor degree projects, 5 master degree projects	
D3.6	**Assessment of cooperation intensity with universities in the form of teaching**
Very active: 6 researchers are teaching	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
Organization of the International summer school on advanced quantum mechanics	
D4.2	**Publishing activities and its quality**
Besides the papers reports at Laserlab Europe, Eurofusion, and presentations at international conferences.	
D4.3	**Participation in professional organisations in the area of research and development**
Represented in Laserlab Europe and Eurofusion	

Other comments of the commission:

The strong links to teams in the CAS-IP, and partly the ELI teams, is seen very positive, and should be supported. A stronger formal link might be helpful.

3. Materials Engineering

Strengths:

- Young creative team (38 years as a median age).
- Broad research experience of the older (senior) researchers.
- Strong international and domestic network of cooperating institutions.
- Knowledge of the real-world materials engineering needs.

Weaknesses:

- Possible lack of focus and atomization of research efforts into numerous smaller projects given by the need for external funding. Research proposals for relatively small funding grants are submitted to several funding agencies.
- Lack of equipment for high temperature mechanical testing that would be relevant to planned applications (future research).
- Resolution of the available scanning electron microscope (SEM) is not sufficient for analysis of nano-materials.
- Low gender diversity, which is not unfrequent in the materials engineering field.

Opportunities:

- Research of the plasma facing materials (components) is integrated within the Eurofusion consortium.
- Mostly up-to-date experimental facilities. Usually two of the key experimental facilities were successfully upgraded each year during the evaluation period.
- The ME team carries out research activities in dynamically developing fields of liquid thermal spraying, materials for plasma facing components, and high entropy alloys.
- Significant engineering ability of several team members that helps to overcome technical obstacles or enables in-house development and validation of new devices as the potential for all of the experimental results.

Threats:

- Modelling and simulations of material properties and material processes. So far, some modelling and simulations are done in cooperation with other research institutes.
- Lack of qualified technicians that would maintain the proper running of laboratories. It is partially related to the lack of funding.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The quality of the majority of selected (22) outputs (Phase I) is from good to average. Most of them are in the 2nd group and in the 3rd group (Reports_of_the_ I_phase_ IPP_3). In terms of journal ranking: from selected outputs two outputs were in the top decile, 1 in 1st quartile, 12 in 2nd quartile, and 5 in 3rd quartile. The focus of the ME team is to prepare materials for other teams within IPP. It was evaluated (Phase I) within 15 other teams of the field Materials Engineering. The average rating was 2,77 and the score 15th of 16.	

The department performs internationally recognized research in the broad field of plasma physics materials. The outputs of Phase I are of average quality (within the field Materials Engineering). Since 2017 there is the strong pressure in IPP to publish high quality paper in journals with high impact factor. The scientific publications are in appropriate journals of the field.

H1.2	Contribution of workers on the outputs reached

The workers (researchers, technicians) contributed in reasonably high amounts, ranging from 15 to 100%, to the outputs (it is extracted from the list of publications: 3-8 Outputs_evaluated_within_Phase_I). This percentage indicates about degree of collaboration as well as interdisciplinarity of the research done.

H1.3	Quality of all outputs and results

The list of all outputs and results contains 225 items. Total number of evaluated results was 176. Two outputs were in the top decile, 2 in 1st quartile, 33 in 2nd quartile, 47 in 3rd quartile, and 49 in the 4th quartile. These results are in terms of journal ranking.

The commission took into consideration that the thermal spray and plasma facing materials are important ones for plasma applications but they are relatively minor fields in the broad field of Materials Engineering. The main scientific journals with thermal spray coverage do not belong to the top journals in general materials science. Therefore, these results are appropriate with the position of the team within the whole Institute.

H1.4	The most valuable discoveries and findings in the fields, their importance for the field

Valuable discoveries have been reached and published. They cover the development of materials and processes as

Promising W-10Cr-1Hf alloy successfully prepared by SPS (spark plasma sintering) powder metallurgy method.

Developed fine-grained W material for divertor regions of tokamaks.

Unique preparation method of dielectric materials by plasma spraying.

Tailoring microstructure and properties of coatings deposited from liquids.

Deposition of multi-layered TBCs (thermal barrier coatings).

H1.5	Contribution of the participation of the authors in large collaborations

There were two large collaborations: 1) Centre of excellence - Multidisciplinary research centre for advanced materials (2014-2018) and 2) Competence Centre - Research center of surface treatment (2014-2019). The ME team was recognized as a strong research partner in these centres.

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission

Advanced materials engineering represents nowadays a key and determining tool in modern technologies of surfaces. Plasma is an important topic of scientific research due to its unique properties and wide-ranging utilization of its technology - up to the fabrication of new materials.

As the conclusion, the research of the Department of materials engineering follows the institute mission and has significant societal relevance by means of modern technologies of surfaces (expected widely in the near future).	
H2.2	**System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team´s activity on proper practice in society in the area of social sciences and humanities**
The most of results of the ME team is used for nuclear fusion research and for the development of related technologies (cooperation inside of the Institute PP). The transfer of knowledge into practice is average (measured by the number of projects). See also paragraph H2.3.	
H2.3	**Relation to practice**
During the evaluation period, the department has demonstrated the following applied research and development (as the relation for practice): - Development of ceramic thermal spray coatings for carbon/carbon composite materials for one Czech SME. - Development of a protective coating on a prototype part for shielding block in a nuclear power plant for UJP PRAHA a.s. - Special self-supporting thin-walled ceramic tubes prepared by WHS-H plasma spraying for DEPRAG CZ a.s. and other SMEs - Development of alumina protective coatings for key components (e.g. molybdenum stirrers) of glass furnaces for KAVALIERGLASS, a.s.	
H2.4	**Participation in AV21 strategy**
The ME department actively participates in two programs: New Materials based on Metals, and Systems for Nuclear Energy. The ME department took places on a regular basis in annual Workshops AV21 (open to public audience, attendance 20-50 colleagues).	
H2.5	**Cooperation with regions of the Czech Republic**
The department cooperates with universities, research institutions, and companies in several regions of the Czech Republic, namely the Central-Bohemia Region (establishments in Prague), the Pilsen Region (University of West Bohemia in Pilsen), and the South-Moravia Region (Brno University of Technology).	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	**Comparison of the team with similar international and national institutes**
The researchers of the department perform good and useful research focusing on fundamental knowledge as well as on industrial applications. From the summary graphs reported in concerning the team scientific publications (Phase I), the Commission validates that the team position in an international context is good.	

D1.2	Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation

The ME team maintains a lively and active cooperation with many domestic and international universities and research institutions. There is a very close cooperation with the local universities. It is necessary to highlight two broad collaborations: a) Centre of excellence - Multidisciplinary research centre for advanced materials (2014-2018), and b) Competence Centre - Research centre of surface treatment (2014-2019). The ME team was recognized as a strong research partner in these centres.

There are several running bilateral cooperation with universities abroad especially in the field of materials for fusion devices and plasma sprayed materials. The main team tasks in such cooperations are the preparation and testing materials. The researchers are proud that the team was well recognized as a strong research partner also internationally.

D1.3	Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)

The Department is very active in the scientific community in terms of organizing conferences and workshops. Within the evaluated period the department organized several International workshops and seminars (9 is reported). There were also 5 invited lectures (Jiří Matějíček and Radek Mušálek) and 9 awards.

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions

The followed directions of the Department agree with the planned research directions of the whole Institute (the plasma physics research is the type of long-lasting research).

The ME team plan for the period of 2015-19 focused on two major topics: Development and characterization of tailored materials prepared by the unique materials processing equipment and research and characterization of materials for fusion applications. This plan has been carried out.

D2.2	Assessment of the previous research objectives and their achievement

The previously planned research objectives were assessed and main research directions are followed and partially intensified for very promising research (sub)directions.

D2.3	Assessment of implementation of recommendations from past evaluation

The recommendations after the last evaluation have been taken and implemented seriously. The frequency and overall quality of publications of the ME team has indeed improved as recommended in the past evaluation. Several new researches, who joined the team during the current evaluation period, have proved to be a great asset for the research efforts.

Programs for the equal opportunity of gender are more difficult for the ME team because of the low representation of female students at universities in the field of materials science and engineering.

D2.4	Success in receiving grants

The ME team is very successful in acquiring grants mainly from GACR and partially from TACR, MEYS, MIT, and 1 big project from the EU. In total about 2 118 kE were received in

the investigated period:
- grant projects and programme projects, 15 projects, 2 016 kE,
- contractual research, 10 projects, 92 kE,
- collaborative research, 3 projects, 10 kE.

This must be regarded as a success.

D2.5	Adequacy of instrumental equipment

The department owns adequate state-of-the-art equipment. In this context, the commission admires the capability to build advanced and custom-made equipment to study specific (mainly plasma) processes (in the period 2015-2019 for total of 1.2 ME).

For the next period the department is preparing projects the following investments: Thermal Gravitational Analysis with oxidation and new SEM with higher resolution (see weaknesses at the very beginning).

D2.6	Effectiveness of management

This ME team appears as efficiently managed, as the Commission is able to judge indirectly from the really good environment for performing of research. Specific attention is laid on the qualification of team members in management of grant projects to ensure a smooth processing. It is reported that Prof. Tomáš Chráska is leading the Department very successfully and with great experience.

D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth

The ME team has a stable core of members and is relatively young (38 median age). In the evaluation period, the team was composed on average of 12-13 researchers, usually 2 postdocs, 3-5 PhD students (partially employed at IPP), and around 6 technicians. Approximately 10 university students became periodically part of the ME team for varying lengths of time. A major generational change was successfully finished before the year 2015.

In comparison with some other depts. at the Materials Engineering Department there are not so good conditions for international recruitment (lack of EU grant projects).

D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues

The work-life balance conditions are appropriate. The department actively supports parental leave and part-time jobs. Working hours are as flexible as possible to allow work-life balance especially for female researchers and there is a kindergarten in the institute campus.

The team lacks sufficient gender balance. They attribute it to the minor proportion of women in Physics and Engineering university studies.

D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.

Not relevant for the ME team.

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
The team is well engaged in joint research projects together with national as well as international universities, research institutions. The education of undergraduate and postgraduate students is also the visible part of mutual cooperation. At present almost half of the scientists of ME are involved in regular or casual teaching (Czech Technical University in Prague, University of Chemistry and Technology, ...). Recently students from University of Limoges and EcoleNational (France) and Stony Brook University (USA) performed their internships in the ME department.	
D3.2	**Effectiveness of joint research centres**
The team participated in two research centres during the evaluation period: a) Centre of excellence - Multidisciplinary research centre for advanced materials (2014-2018), and b) Competence Centre - Research centre of surface treatment (2014-2019). The effectiveness of these research centres was recognized as a versatilely advantageous.	
D3.3	**Success rate in supervision of PhD students**
In the period 2015 – 2019 two doctoral students graduated. At present 6 doctoral students are preparing their theses under guidance of ME researchers.	
D3.4	**Participation of PhD students in the outputs**
The Department expects that the participation of PhD students in the research activities of the ME team is beneficial for both sides. Each PhD student is encouraged by his/her advisor/mentor (from within the ME team senior researchers) to carry out their research independently and publish results. It is reflected in their participation in most of the papers published by the ME team.	
D3.5	**Participation of the team in master or bachelor studies**
The main educational cooperation is with the Czech Technical University Prague. At present almost half of the scientists of ME is involved in regular or occasional teaching. Several researchers are members of various committees at universities (doctoral studies, state examinations, …). At present 7 MSc students and 5 Bc students from various faculties of Czech Technical University and Charles University are preparing their diploma theses under guidance of ME researchers. Master students were also incorporated into the research at the department. Approximately 10 university students became periodically part of the ME team for varying lengths of time.	
D3.6	**Assessment of cooperation intensity with universities in the form of teaching**
Intensive involvement of the ME team in teaching and supervising students (Bc, MSc., PhD.) at universities is reported, see the paragraph D3.5.The Commission can evaluate the intensity of cooperation as better-than-average.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
The Department frequently shows various activities in public outreach for audiences with various backgrounds from Czech Republic and abroad, e.g. open lab days and exhibitions. The homepage (500 – 1000 visitors per year) gives general information on the team, research fields, latest results, and ongoing projects. These outreach activities might be intensified to attract more students and scientists from other establishments. The Commission can confirm that the media outputs of the team are useful and adequate (based on the results reported).	
D4.2	**Publishing activities and its quality**
The team members took place in the Institute report preparation, in press releases, interviews in TV/radio and public presentations to bring the main interesting results to public (in cooperation with the IPP PR office). Annual participation of the ME team members is reported at Open days, Scientific Fairs, and Weeks of Science and Technology (for general public and high school students). The Commission can evaluate that the publishing activities of the team are useful and adequate (based on the accessible web presentations).	
D4.3	**Participation in professional organisations in the area of research and development**
Mainly two members of the ME team participated in professional organizations and bodies (Jiří Matějíček and Radek Mušálek).	

Other comments of the commission:

The Department of Materials Engineering is evaluated as a good and well oriented research team within the Institute of Plasma Physics.

The commission recommends to maintain the efforts in realization high quality research and publishing scientific paper in top journals and in teaching activities as guest lectures at Czech universities as well as abroad.

The management of the department should attract students and young researchers from other countries together with highly qualified experts to improve the research potential and also to enlarge the PhD study scope.

The members of the department should focus to technological transfer of the obtained scientific results towards the industry/society. The commission recommends to be more active in receiving larger international cooperative projects and individual projects.

4. Pulse Plasma Systems

Strengths:
The team has undergone a successful restructuring and a reshaping of the science program. It is successful in further juvenation by actively attracting PhDs/Post-Docs

Weaknesses:
The team is very active in a field between applications and basic research. This could be used also for more technical outputs

Opportunities:
The team has a wide international connection

Threats:
Besides the medical application of shockwaves not yet close to technical use.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The number of outputs in indexed publications is high, and shows a reasonable number of high-ranking publications with strong input from the team.	
H1.2	**Contribution of workers on the outputs reached**
The share of the team members to the outputs is well distributed. However, only in less than half of the high index papers the reprint author is from the team.	
H1.3	**Quality of all outputs and results**
The number of excellent outputs is well above average, and involves a reasonable number of group members. Besides this there are also numerous conference contributions.	
H1.4	**The most valuable discoveries and findings in the fields, their importance for the field**
Observation and modelling of non-equilibrium kinetics of the ground and excited molecular states on short timescale. Organic micropollutant degradation in water.	
H1.5	**Contribution of the participation of the authors in large collaborations**
Member of International Consortium on Bioelectrics	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission
High potential, but not yet reached.	
H2.2	**System functionality for knowledge transfer into practise, its usefulness for society. The impact of the institute´s activity on proper practice in society in the area of social sciences and humanities**
N/A	

H2.3	Relation to practice
Research towards water pollution control, plasma medicine, and organic synthesis.	
H2.4	**Participation in AV21 strategy**
Research program “Diagnostic methods and techniques” and „Efficient energy conversion and storage“	
H2.5	**Cooperation with regions of the Czech Republic**
Contract with commercial partner on a custom DBD based plasma system as gas treatment and disinfection unit for indoor air purification at TRL4-5 stage.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the teams and the institute with similar international and national institutes
The team is on the same international level as the partners in their COST networks.	
D1.2	**Scope and quality of international and national cooperation and the role of the institute in such cooperation; engagement in broad international cooperation**
COST network programs: COST TD1208 (Electrical discharges with liquids), COST MP1101 (BioPlasma), COST MP1203 (XUV Optics and Applications)	
D1.3	**Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)**
P. Lukeš: Senior Member of IEEE (2017), member of Boards of Directors of International Plasma Chemistry Society (2017) and of International Society of Plasma Medicine (2018), leader of WG2 , member of the Council of International Affairs of the CAS (2017), SI Guest Editor (2015, 2018), plenary lecture at IEEE ICOPS2018, 13 invited lectures in the period 2015-2019	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
The research plan consists of a moderate and adequate development of the present research.	
D2.2	**Assessment of the previous research objectives and their achievement**
Reduced scope of research subjects has lead to good results.	
D2.3	**Assessment of implementation of recommendations from past evaluation**
The transition according to the recommendations has been applied successfully.	
D2.4	**Success in receiving grants**
The team has been successful in receiving national grants. 6x Czech Science Foundation, 1x TACR, 4x MEYS (COST, INGO, OPVVV Mobility), 2x CAS projects, 3x PPPLZ (postdocs support from CAS) and access to European COST initiatives.	

D2.5	Adequacy of instrumental equipment
The instrumental equipment is adequate.	
D2.6	**Effectiveness of management**
The management seems to be effective.	
D2.7	**Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth**
The team structure has been continuously improved, e.g. by a strong effort in the PhD program and good use of COST projects to include foreign young researchers.	
D2.8	**Creating work-life balance conditions, assessment of approach towards possible gender issues**
The team has a dynamic structure.	
D2.9	**Relation of the institute with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.**
N/A	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
The team has strong collaborations with Czech universities as well as several bi-lateral connections with international university partners.	
D3.2	**Effectiveness of joint research centres**
N/A	
D3.3	**Success rate in supervision of PhD students**
7 supervisors/advisors, 4 Ph.D. students defended their dissertations within 2015-2019.	
D3.4	**Participation of PhD students in the outputs**
4 journal papers from PhDs plus 5 papers from STSMs	
D3.5	**Participation of the institute in master or bachelor studies**
1 bachelor and 2 master students worked on their theses within 2015-2019. Joint projects with Charles University, University of Chemistry and Technology, Czech Technical University Prague, Masaryk University Brno	
D3.6	**Assessment of cooperation intensity with universities in the form of teaching**
Members of board of the doctoral study programs Plasma Physics at the Czech Technical University, Prague (Dr. Lukeš, Dr. Člupek) and Plasma Physics at Masaryk University in Brno (Dr. Lukeš, Dr. Šimek).	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
Organization of workshops and conferences within the Czech Republic.	
D4.2	**Publishing activities and its quality**
Lecturers at international Training/Summer Schools – COST TS 2015 Greifswald, FiRBaC 2017 Rostock, ISPC 2019 Napoli (Dr. Lukeš), advisors of international PhD students staying at IPP within COST STSMs Exchange program (Dr. Lukeš).	
D4.3	**Participation in professional organisations in the area of research and development**
International Consortium on Bioelectrics, IEEE (2017), International Plasma Chemistry Society (2017) International Society of Plasma Medicine (2018).	

Other comments of the commission:
None.

5. Plasma Chemical Technologies

Strengths:
- an ambitious team with experienced researchers and technicians, and a good age structure
- well equipped laboratories with a number of modern diagnostic devices
- research activities of the team having a great application potential

Weaknesses:
- world-leading outputs of the team are below the average productivity of the field

Opportunities:
- exploitation of the application potential of research activities
- utilization of the team potential to produce more world-leading outputs

Threats:
- the number and complexity of activity plans compared to the size of the team

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The quality of selected outputs is good. The productivity in internationally excellent outputs is well above the average productivity of the field, however, the productivity of world-leading outputs is below the average.	
H1.2	**Contribution of workers on the outputs reached**
The contribution of team members on the outputs reached is high, according to Phase I of evaluation it is about 67 %. High is also the ratio of reprint authors from the team which is about 77 %.	
H1.3	**Quality of all outputs and results**
The quality of all outputs is satisfactory: from all outputs (26) by journal ranking is 1 in quartile (decil) Q1*, 1 in quartile Q1 and 5 are in quartile Q2.	
H1.4	**The most valuable discoveries and findings in the fields, their importance for the field**
The team significantly contributed to the progress of (1) - gasification and pyrolysis of organic waste materials for the production of hydrogen and high-quality syngas , (2) - decomposition of perfluorinated compounds and fluorinated ozone-depleting substances in thermal plasma jets, and (3) - diagnostics and modelling of the water-argon arc plasma jet.	
H1.5	**Contribution of the participation of the authors in large collaborations**
The team was part of the TAČR project NCK MATCA (National Centre of Competence: Materials, Advanced Technologies, Coatings and their Applications) in which it solved the subproject “Safe and ecologic destruction of the waste“.	

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission

The team performs internationally excellent research, supervises bachelor, master and PhD students, and has intensive application and outreach activities.	
H2.2	**System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team´s activity on proper practice in society in the area of social sciences and humanities**
The team performs research with a big application potential and makes steps for its transfer into practice. As an example of it can serve the TAČR project NCK MATCA (National Centre of Competence: Materials, Advanced Technologies, Coatings and their Applications) in which the team is responsible for the subproject “Safe and ecologic destruction of the waste“.	
H2.3	**Relation to practice**
The team has a vivid relation to practice. In the years 2015-2019 it had, e.g., a cooperation with ExxonMobil (USA) in the project dealing with thermal plasma pyrolysis of methane and natural gas for hydrogen and carbon black production, and a cooperation with Millenium Technologies and Millenium Plasma (CZ), which should lead to the building of a plasma plant for energetic utilization of waste and syngas production.	
H2.4	**Participation in AV21 strategy**
Since 2018 the team is participating in Strategy AV21 program - Effective Conversion and Accumulation of Energy.	
H2.5	**Cooperation with regions of the Czech Republic**
There is no direct cooperation with regions of the Czech Republic.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	**Comparison of the team with similar international and national institutes**
This plasma physics team has a high standard, comparable with most other similar-sized research teams internationally and nationally.	
D1.2	**Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation**
The team has an intensive and fruitful cooperation with many academic and industrial institutions abroad as well as in the Czech Republic. These mutual collaborations help to raise the level of the teams‘ basic and applied research.	
D1.3	**Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)**
Team members had rich scientific community activities. They organized 3 international conferences and within the evaluated period had 8 invited talks.	

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	**Direction in line with the perspective of the planned research directions**
The current team research is in line with the perspective of the planned research directions.	

D2.2	Assessment of the previous research objectives and their achievement
The previous research objectives have been fully met.	
D2.3	**Assessment of implementation of recommendations from past evaluation**
There were a few recommendations. The recommendation related to the remediation of the age structure of the team was fulfilled, as well as the recommendation to maintain the research on steam plasma treatment of biomass and organic waste and on reforming of gas. The recommendations also mentioned the utilization of the new cylindrical plasma reactor, which should guarantee promising research results. However, only a limited number of experiments has been performed on this reactor up to now. Therefore, this recommendation remains valid.	
D2.4	**Success in receiving grants**
The team has been successful in receiving research funding to support its activities. Most support has been secured from national funds (mostly Czech Science Foundation and Technological Agency). Nevertheless, the team should make more attempts to also obtain international funding.	
D2.5	**Adequacy of instrumental equipment**
The instrumental equipment of the team is currently at an appropriate level.	
D2.6	**Effectiveness of management**
The new management of the team is effective, this is well reflected in results of the team.	
D2.7	**Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth**
The structure of the team is very favourable, the majority of researchers is below 45 years. The team has all of the classic predispositions to be successful in the future.	
D2.8	**Creating work-life balance conditions, assessment of approach towards possible gender issues**
The team management creates a balance for work-life conditions, and makes approaches towards possible gender issues.	
D2.9	**Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.**
N/A	

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level
The team cooperates intensively and successfully with universities on national and international level (e.g., with Czech Technical University and University of Chemistry and Technology, Prague, University Ghent, Belgium, Tohoku University, Japan, etc.).	

D3.2	Effectiveness of joint research centres
Team members have established a close collaboration with above mentioned Czech universities which enables to create an effective combination of high-quality science and high quality education.	
D3.3	**Success rate in supervision of PhD students**
The success rate in supervision of PhD students is satisfactory but could be increased. In the evaluation period the team supervised 2 PhD students, these two also defended their theses successfully.	
D3.4	**Participation of PhD students in the outputs**
The supervised PhD students made – according to the report – essential contributions to the research and outputs of the team in the evaluated period.	
D3.5	**Participation of the team in master or bachelor studies**
In the evaluated period, team members have not supervised master or bachelor students.	
D3.6	**Assessment of cooperation intensity with universities in the form of teaching**
Members of the team had semestrial lectures for bachelor (1 lecture) and doctoral (2 lectures) students.	

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation
The team members were actively involved in research popularization in many directions.	
D4.2	**Publishing activities and its quality**
The publishing activities of the team and its quality were at a high level.	
D4.3	**Participation in professional organisations in the area of research and development**
Team members participated actively in several domestic and international professional organizations in the area of research and development.	

Other comments of the commission:
None.

6. TOPTEC

Strengths:

- Highly experienced and educated team.

- Advanced know-how as the main asset of the team.

- A strong position and good reputation developed due to cooperation with industrial partners and the ESA (regarding team´s professionalism and expertise).

- Their ability to reach TRL8 in TOPTEC.

Weaknesses:

- Wide range of topics solved (of research and development).

- Low level of system approach.

- Limited career growth for workers.

Opportunities:

- The whole process (from design to production) can be implemented without a need for outsourcing.

Threats:

- Unsatisfactory laboratory premises in Turnov.

Main criterion: 1. Quality of results (H1.1-H1.5)

H1.1	Quality of selected outputs of Phase I
The quality of the majority of selected (35) outputs (Phase I) is good. Most of them are in the 2nd group and in the 3rd group (Reports_of_the_ I_phase_ IPP_6). In terms of journal ranking: from selected outputs two outputs were in the top decile, 1 in 1st quartile, 11 in 2nd quartile, and 4 in 3rd quartile. The focus of the TOPTEC Centre is more application-oriented compared to the other teams. It was evaluated (Phase I) within 6 teams of the field Other engineering and technologies. Average rating was 2,6 and the score the 3rd of 6.	
H1.2	**Contribution of workers on the outputs reached**
The workers (researchers, technicians) contributed in reasonably high amounts, ranging from 10% (3 papers) to 100% (16 papers), to the outputs (it is extracted from the list of publications: 3-8 Outputs_evaluated_within_Phase_I).	
H1.3	**Quality of all outputs and results**
The list of all outputs and results contains 225 items. Total number of evaluated results was 109. Two outputs were in the top decile, 3 in 1st quartile, 14 in 2nd quartile and 6 in 3rd quartile. These results are in terms of journal ranking. The focus of the Toptec Centre	

is more application-oriented compared to the other teams. Therefore, these results are along the lines of the current team situation.

The team can measure the quality of results also by the number of Contractual research projects (19 projects) and Collaborative projects (22 projects). Plus 7 patents, and 8 utility models (one licensed). From this point of view the quality of results must be regarded as great success.

Nevertheless, the team understands the need to work hard on selected fundamental research topics as it helps them to open new application areas. Therefore, the task is to strengthen the fundamental research at TOPTEC.

H1.4	The most valuable discoveries and findings in the fields, their importance for the field

Many valuable results have been reached/published during the evaluated period which are important for the research field, e.g.:

Ultra-soft crystalline material polishing of complex nonperpendicular prisms (Manufacturing processes branch).

Complex deposition processes of nonstandard materials with smart system of feedback controlling (Thin film layers branch).

Refractive index distribution in hard laser crystal used as an input for freeform polishing meant to achieve wavefront compensation (Metrology methods for nonstandard quantities branch).

Optical elements of the coronograph on the SOLAR ORBITER mission (Space project).

H1.5	Contribution of the participation of the authors in large collaborations

We can consider the space programmes as large cooperations. The aim is to build up corresponding abilities and reputation that by 2024 the team will be able to carry out the role of a principal investigator of an entire satellite apparatus.

Main criterion: 2. Societal relevance (H2.1-H2.5)

H2.1	Societal relevance of outputs and results pursuant to CAS and institute mission

High-end instrumentation represents nowadays a key and determining tool in the process of understanding the universe. Originally devoted to industrial research applications there are now also strong research activities carried out. At present, the TOPTEC Centre is the only R&D facility that focuses on ultra-precision and special optics in the Czech Republic, with the perspective of becoming one of the five best R&D centres for ultra-precision optics in Europe. For all of these reasons, the results of the team research and activities could strong impact the Czech and the European economy, if well addressed.

As the conclusion, the research of the TOPTEC team follows the institute mission and has significant societal relevance with contributions in the appropriate fields.

H2.2	System functionality for knowledge transfer into practise, its usefulness for society. The impact of the team´s activity on proper practice in society in the area of social sciences and humanities

The commission is impressed by the strategic and strong knowledge transfer into the practise, documented by projects together with industry. See also paragraph H2.3

H2.3	Relation to practice
The TOPTEC Centre is a part of the network of application centres of the CAS. Therefore, the focus of the Centre is more application-oriented compared to the other teams/workplaces of the CAS institutes. Application Centres are characterized by very close cooperation with industry in the Czech Republic and abroad, and TOPTEC ranks among the top ones both in terms of quantity and quality. The Centre is a co-investigator of four European Space Agency (ESA) projects and actively cooperates with top companies in the optical industry and related branches such as OHB, Airbus, Leonardo, Micos, Elecom, Applic, Meopta, Rigaku, FEI, Tescan, Varroc, Preciosa, Siemens, Crytur, Asphericon, etc.	
H2.4	**Participation in AV21 strategy**
The whole Institute actively participates in five research programmes of The AV21 strategy. The TOPTEC team has participated in three of these programmes, namely: Diagnostic Methods and Techniques (VP6), Space for the Mankind (VP16), and Light at the Service of Society (VP17).	
H2.5	**Cooperation with regions of the Czech Republic**
The TOPTEC centre, which represents the only institution of the Czech Academy of Sciences in the *Liberec Region*, collaborates intensively with the Technical University of Liberec, the TOPTEC centre staff are heavily involved in teaching, training Bc., MSc., and PhD students and providing expert support to local industry. The head of the TOPTEC centre, Vít Lédl, was also a member of Council for Science, Research and Innovation of the Liberec Region (2015-2021) and member of National Research and Innovation Strategy for Smart Specialization.	

Further criterion: 1. Position in international and national context (D1.1-D1.3)

D1.1	Comparison of the team with similar international and national institutes
Thanks to the versatile cooperations, the TOPTEC Centre has gained the European-scale reputation as a top centre for applied research.	
D1.2	**Scope and quality of international and national cooperation and the role of the team in such cooperation; engagement in broad international cooperation**
The team cooperates closely with a broad spectrum of scientific R&D departments in the Czech Republic, both in the academic (Technical University in Liberec, Czech Technical University in Prague, Institute of Thermomechanics of the ASCR, Institute of Physics of the ASCR, Institute of Scientific Instruments of the ASCR, Medical Faculty of Charles University), and the application sphere (Meopta optika, Polpur, Diaz). Over the past five years, TOPTEC significantly widened its international cooperation (mainly international R&D projects for space applications, also exchange of students, and cooperation on fundamental research with various partners).	
D1.3	**Participation of the workers in scientific community activities (organizing of conferences and workshops, invited lectures, awards)**
The team members are very active in scientific community activities - organizing of conferences (two actions stand biannually) and workshops. Awards: Frantisek Prochaska – the best application project. Karel Zidek – The Wichterles Award for the best young scientist.	

Vit Ledl and TOPTEC – The Turnov award for regional development of science and technology.

Further criterion: 2. Vitality, sustainability and strategy (D2.1-D2.9)

D2.1	Direction in line with the perspective of the planned research directions
The followed (research and development) directions agree with the planned research directions. The long-term strategy of TOPTEC focuses on achievement of excellence in selected key areas such as the development of complex optical surface treatment technology, the transition from simple optical elements to complex optical systems, hyperdimensional analysis, advanced spectroscopy, or development in the field of infrared optics. This future strategy in the field of research activity/directions is real and will bring new scientific knowledge and applications.	
D2.2	**Assessment of the previous research objectives and their achievement**
The previously planned research objectives were assessed and main research directions are followed and partially intensified for very promising research (sub)directions.	
D2.3	**Assessment of implementation of recommendations from past evaluation**
In the last evaluation (2015) the team was evaluated in the physical sciences panel, which recommended to focus on the fundamental research. The recommendations have been taken seriously and the heads decided to split the team into two (collaborating) groups - one dealing with fundamental research and the other one deeply focussed on the applied research – the second group is larger. Within this new strategy of the TOPTEC Center, they support development of both main directions, nevertheless, a higher emphasis is put on the applied research and collaboration with industry.	
D2.4	**Success in receiving grants**
The department is very successful in receiving grant projects (as GAČR 5, TAČR 5; MIT 4, MEYS 2, MI 2, EC 1), total 19 projects, 5 981 kE. Contractual research: 19 projects. Collaborative research: 22 projects. This must be regarded as great success.	
D2.5	**Adequacy of instrumental equipment**
The department is equipped with adequate state-of-the-art equipment as 1) Processing and manufacturing technologies, 2) Measurement/characterization equipment, 3) Simulation and computation tools. Since 2011 the team had a strong focus on equipment exchange and laboratory modernization (all-in-one-house). In this context, the commission admires the capability to build the advanced and custom-made equipment for optics and optoelectronics. For the new period large projects are in preparation, this may bring large investments (e.g. a new building with laboratories – see the S.W.O.T. analysis at the very beginning).	
D2.6	**Effectiveness of management**
The team is efficiently managed, creating a good environment for performing research and development as the Commission is able to judge indirectly from the really good environment for performing of research. Specific attention is laid on the qualification of team members in management of grant projects to ensure a smooth processing. It is reported Mr. Vít Lédl is leading the team very successfully and with great experience.	

D2.7	Assessment of professional structure, development strategy and the strategy of keeping best scientists, age structure, career and qualification growth

The team has (2020) 54 employees (34 FTE), 16 scientific workers with Ph.D., 18 master students, and 12 doctoral students (partially employed at Toptec). Nearly all the scientific workers are in age group 30 to 45 years – young team. The Commission can confirm the good age structure of the team.

The department can attract young researchers from the Czech Republic who are driven by the interesting content of the work and the prestige associated with participating in the Centre's projects.

D2.8	Creating work-life balance conditions, assessment of approach towards possible gender issues

The selection of staff in all the aforementioned activities and plans is guided by an equal-opportunity policy. For female researchers, the procedure provides for the possibility to combine work and maternal responsibilities. The management of the Centre is flexible and seeks mutual agreement suitable for both parties. The Commission appreciates the high percentage of women-researchers within the team, probably the highest one in the frame of Engineering teams.

D2.9	Relation of the team with regard to the integration, development and sustainability of the research centre funded by the National Programme of Sustainability II.

Not relevant for the TOPTEC team.

Further criterion: 3. Cooperation with universities and participation in education (D3.1-D3.6)

D3.1	Scope of cooperation with universities on national and international level

The main educational cooperation is with the Technical University of Liberec. It covers bachelor, master as well as doctoral studies.

For the rest of cooperation (non-educational) see the paragraph D1.2.

D3.2	Effectiveness of joint research centres

In 2019, the TOPTEC team started a cooperation with the Centre for Photon and Electron Optics, under the National Competence Centre. The cooperation is of large-scale, as the Centre has nearly 20 members from universities, companies, and institutes of the CAS. The overall budget of the project is over €8 mil.

The TOPTEC is one of the most important members in terms of budget and also in terms of the amount of activity undertaken in cooperation with industry. The TOPTEC team is dealing with 3 topics (a) Laser rod polishing in a controlled manner, b) Superstable etalon for laser stabilization for standards of time and frequency, c) Setup for measurement of laser induced damage in blue and UV lasers).

The Commission can confirm the strong effectiveness of the joint research centre CPEO (based on the web presentation).

D3.3	Success rate in supervision of PhD students

In the period 2015-2019 there were 6 Ph.D. students (with supervisors from the TOPTEC team), but none of them successfully defended yet his/her doctoral theses yet.

D3.4	Participation of PhD students in the outputs

The Centre´s research teams include approportionate number of PhD students – six in total in 2019. This number has been more or less constant over recent years. Most of the students come from the Technical University of Liberec, where the scientific workers of TOPTEC are teaching a substantial part of subjects in the field of Applied Science for the Engineering program. Thus, the TOPTEC team has a valuable opportunity to inform students about TOPTEC and its activities and to arouse their interest in becoming involved in projects.

The PhD students participate in all scientific activities, development processes, and also in the management of partial projects. In order to establish a strong connection between the TOPTEC application centre and industry, PhD students frequently spend part of their PhD studies at research centres of our industrial partners. This is facilitated both as internships (Zeiss, Crytur, Asphericon) and as long-term part-time jobs (Crytur).

D3.5	Participation of the team in master or bachelor studies

The main educational cooperation is with the Technical University of Liberec. The teachers are: Vít Lédl, Pavel Psota, František Procházka, Ondřej Matoušek, Pavel Mokrý, Miroslav Šulc, Jan Václavík, Karel Žídek.

Several bachelor and master students were also incorporated into the research at the department.

D3.6	Assessment of cooperation intensity with universities in the form of teaching

Number of supervisors: 1 for bachelor study,4 for master study, and 6 for doctoral study.

Number of teachers (see also paragraph D3.5): bachelor study – 3 subjects, 11 lectures, master study – 7 subjects, 75 lectures, doctoral study – 3 subjects, 7 lectures.

The intensity of teaching is appropriate with the size of the team and students at the Technical University of Liberec are in close contacts with the real research and development.

Further criterion: 4. Outreach activities (D4.1-D4.3)

D4.1	Sufficiency of media strategy and activities in the area of research popularisation

TOPTEC team members are working in three areas of the popularization of science in general and of the team in particular:1) Regularly organized Open door days, as well as various excursions for university and high-school students. 2) Lectures (the popularization of physics, astronomy, and optics) at the local Astronomical observatory. 3) Fairs for young people interested in science and the participation in the Czech Space Week. The Commission can confirm that the media outputs of the team are adequate.

The Commission proposes that the media strategy is to be managed across the whole Institute.

D4.2	Publishing activities and its quality

The department has been regularly involved in publishing activities in the press, several TV or radio reportages or interviews. See also the paragraph D4.2.

The Commission can confirm that the publishing activities of the team are professional and adequate (based on the accessible web presentations).

D4.3	Participation in professional organisations in the area of research and development
Mainly Mr. Karel Žídek, Pavel Mokrý, Miroslav Šulc, and Vít Lédl are members in professional organisations and others bodies.	

Other comments of the commission:

The TOPTEC has established itself as a regional technology powerhouse. Long-term and in-depth focused research of selected research topics has helped the TOPTEC team to open a number of fruitful collaborations with a large number of industrial partners in the Czech Republic and abroad.

The commission recommends to increase the efforts in realization high quality research and publishing scientific paper in top journals. The commission recommends to maintain or even increase the teaching activities as guest lectures at Czech universities as well as abroad. At the moment we do not recommend any type of re-organisation of the internal structure of the department.

Final report was elaborated by:

Commission 2 - Physical sciences
Evaluated teams No.: 1, 2, 4, 5

Commission Chair: Prof. Martin Stutzmann
Commission Deputy Chair: Karol Flachbart
Commission Members:
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- Ingo Dierking
- Niall English
- Stefano Forte
- Peter Grabmayr
- Sebastian Hoenig
- Thomas Kuehl
- Massimo Persic
- Juergen Reif
- Jochen Schieck
- Claus Schneider

Commission 7.1 - Engineering and technology
Evaluated teams No.: 3, 6

Commission Chair: Dr. János Lábár
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- Frank Gronwald
- Stefan Haase
- Oliver Kastner
- Vladislav Musil
- Ryszard Pohorecki