# SELF-EVALUATION REPORT FOR MODULE 3

## THE NAME OF THE UNIT BEING EVALUATED: Faculty of Nuclear Sciences and Physical Engineering

## FORD: 1 - Natural sciences

### SOCIAL CONTRIBUTION OF THE EVALUATED UNIT

**3.1 Introductory information about the unit under evaluation**

The evaluated unit will describe its mission and vision and provide a general self-reflection of the societal contribution of R&D&I, along with its long-term goals in the fields it develops. The distribution of research activities by type of research will also be commented on.[1] The evaluated unit will describe its organisational structure and size (staffing, number of students, number of study programmes implemented, etc.) based on the data provided in annex tables 3.1.1 to 3.1.6.

*Maximum 1000 words.*

This is a non-rated indicator that serves as an introduction to the evaluated unit, providing context for data in indicators 3.2-3.7.

**Self-assessment:**

The main purpose for which the Faculty of Nuclear Sciences and Physical Engineering (FNSPE) of the Czech Technical University (CTU) in Prague was founded in 1955, was to educate nuclear engineers in the Czech Republic (former Czechoslovakia), to foster and develop nuclear sciences in the country, and to maintain knowledge related to nuclear fields. Although we have approached many new areas of science and education since then, we remain faithful to this original purpose. It is as important as ever, due to the renaissance of nuclear energy in the Czech Republic.

The mission of FNSPE is to educate highly skilled professionals equipped with a robust foundation in mathematics, physics, and computer science, enabling them to excel in various sectors, including science, technology, informatics, medicine, and environmental policy. The faculty emphasizes interdisciplinary problem-solving and actively involves students in scientific and research teams early in their studies and academic career, fostering their personal and professional development.

In alignment with its mission, FNSPE envisions itself as an internationally competitive, research-oriented faculty with an international reputation based on long term excellence in science and engineering and for research and development outcomes that significantly contribute to scientific knowledge and societal well-being. The faculty is committed to conducting research in strategic areas of vital importance to society, to design and develop state-of-the-art technologies with

[1] Basic, applied, contract, artistic research (see Definition of Terms in Methodology HEI2025+).

particular emphasis on environmental aspects, safety, and security, and in collaboration with top national and international partners face the contemporary challenges of the modern world.

FNSPE's research, development, and innovation activities have a profound societal impact, particularly in the following areas:

1. Energy Sector: The faculty plays a pivotal role in the energy sector by focusing on nuclear engineering and the development of advanced nuclear technologies. This includes research on fusion nuclear reactors and new generations of fission nuclear reactors, contributing to the global pursuit of clean, sustainable and environmentally friendly energy solutions. By training experts in nuclear engineering and fusion, FNSPE addresses the growing demand for clean energy and the need for a new generation of nuclear professionals, thereby supporting efforts to combat climate change.
2. Quantum Technologies: Recognizing the transformative potential of quantum technologies, FNSPE has established dedicated study programs and research initiatives in this field. Faculty collaborates with leading academic institutions, government bodies, and industry partners to explore and implement practical applications of quantum computing, communication, and cryptography. These efforts aim to revolutionize sectors such as cybersecurity, defence, and information processing, positioning the Czech Republic as a significant contributor to the global quantum technology landscape.
3. Radiological Physics and Environmental Monitoring: FNSPE's research extends to medical physics, where it develops advanced diagnostic and therapeutic techniques, and to environmental monitoring, focusing on the detection and analysis of radioactive substances. These contributions improve public health and safety by improving medical treatments and ensuring effective environmental protection measures.

The faculty operates a training light water zero power reactor VR-1. Its design satisfies the requirement of easy access to the reactor core to provide education to students and training to qualified staff in the nuclear industry. In 2023, a new nuclear facility (VR-2 reactor) was constructed and commissioned at the FNSPE. This subcritical assembly controlled by a neutron generator will also be used in the teaching of laboratory tasks for BSc, MSc, and PhD student theses, and, in addition to teaching activities, it will be used to carry out research experiments. Since 2020, the faculty has offered a doctoral study programme Safety and Security of Nuclear Installations and Forensics Analyses of Nuclear Materials with an ambition of global reach.

FSNPE is a significant player in the fusion community due to the combination of education and research with strong international involvement. FSNPE has full fusion curriculum on the national level (BSc, MSc and PhD), moreover is involved in the European Master programme Fusion EP, and has a Joint PhD Degree with the Gent University (since 2020). The students are involved in and getting familiar with all aspects of fusion technology since the very first year. Having programmes on the national level plus being part of the international degrees is a combination which covers the needs of Czech student, attracting students from abroad, and creating a multicultural environment. Students are supported by the international association for fusion education FuseNet, and the consortium EUROfusion, the key entities for fusion research and education in Europe. Faculty has its own fusion facilities, the Golem tokamak and the laboratory PlasmaLab@CTU, which places it among the best equipped universities for experimental training. Very important is a vivid connection with the Institute of Plasma Physics (IPP) of the Czech Academy of Sciences (CAS): many students

get trained at the CTU, working on their BSc, MSc and PhD thesis topics at the IPP, and are directly involved in high level international research including facilities such as ITER.

Since 2019, the faculty has offered a doctoral study programme Quantum Technologies, which is a multidisciplinary study programme and aims to educate top experts in the fields of quantum technologies, especially quantum physics based applications to information and communication, quantum optics, lasers, solids, nanomaterials, nanostructures and advanced methods of their characterisation and modelling, who will be involved in research and scientific and technical practice. This programme is closely linked to many faculty's research projects in the concerned fields.

Looking ahead, FNSPE has outlined several long-term goals to boost its impact on these fields:
- **Progress in Nuclear Technologies**: The faculty aims to continue its research into innovative nuclear reactor designs and fuel cycles, enhancing the safety, efficiency, and sustainability of nuclear energy production. This includes exploring fusion and next-generation reactors that promise cleaner and more efficient energy solutions.
- **Leadership in Quantum Research**: FNSPE aspires to be at the forefront of quantum technology research, focusing on developing practical applications and integrating quantum solutions into existing technological infrastructures. By fostering a collaborative network, the faculty seeks to drive innovation and maintain a competitive edge in the rapidly evolving field of quantum technologies.
- **Enhancement of Interdisciplinary Collaboration**: Recognizing the value of interdisciplinary approaches, FNSPE is committed to strengthening partnerships across various scientific domains and industries including space, medical and economic research. Emphasis is on developing various mathematical models for a wide range of applications to help understand and predict the behaviour of complex systems in these areas. This strategy aims to address multifaceted societal challenges through comprehensive research and knowledge-based teaching.

The faculty recognizes that it must align research and innovation and their outcomes with the values, needs and expectations of modern society. This means, naturally, conducting activities in a way that supports science education and top research through transparent management, commitment to gender, racial and ethnical equality, equal opportunities, ethical behaviour and open access to knowledge and data.

Through their initiatives, the FNSPE continues to contribute significantly to scientific advancement and societal progress, preparing its students and young researchers to become leaders and innovators in their respective fields.

Table 3.1.1 - Staffing per FTE[2]

| Academic/ Professional position | Total / Of which women | | | | | |
|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | 2023 | Total |
| Professor | 24.3/3.0 | 24.3/3.0 | 24.3/3.0 | 26.0/3.0 | 28.2/3.0 | 127.0/15.0 |
| Associate Professor | 33.2/1.0 | 36.2/1.0 | 38.5/1.0 | 42.5/1.0 | 39.8/1.0 | 190.2/5.0 |
| Assistant Professor | 97.0/21.0 | 96.0/22.0 | 89.9/21.0 | 82.9/22.0 | 83.6/22.0 | 449.3/107.8 |
| Assistant | 1.0/0.0 | 1.0/0.0 | 1.0/0.0 | 1.0/0.0 | 1.0/0.0 | 5.0/0.0 |
| R&D Personnel[3] | 21.4/10.5 | 22.5/11.3 | 24.0/12.5 | 25.7/12.7 | 28.1/12.0 | 121.7/58.9 |
| Researchers in other categories[4] | 113.0/29.9 | 110.7/29.8 | 109.6/27.9 | 113.7/31.0 | 113.2/31.5 | 560.2/150.2 |
| Technical and economic staff[5] | 64.9/50.5 | 71.1/54.7 | 70.6/55.3 | 66.0/50.9 | 66.5/50.6 | 339.1/261.9 |
| Scientific, research and development staff involved in teaching activities | 153.5/24.0 | 154.5/25.0 | 150.7/24.0 | 149.4/25.0 | 149.5/25.0 | 757.4/122.8 |
| Early career researchers[6] | 141.3/33.6 | 135.5/34.1 | 129.9/30.7 | 123.3/32.6 | 111.4/32.2 | 641.3/163.3 |
| Total[7] | 354.8/115.8 | 361.7/121.7 | 357.9/120.7 | 357.8/120.5 | 360.3/120.0 | 1792.4/598.7 |

Note: The categories professor, associate professor, assistant professor, assistant, other scientific, R&D personnel, researchers in other categories and technical and economic staff are mutually exclusive, i.e. one staff member is reported under one category only. Scientific, research and development staff involved in teaching activities, as well as early career researchers are reported collectively for all the above-mentioned categories.

[2] The average number of hours worked is calculated as the ratio of the total number of hours actually worked during the reference period, from 1 January to 31 December, by all staff (including agreement on work activity, excluding agreement on work performance) to the total annual working time pool per full-time employee. The full- time status of the worker in the evaluated unit is always reported. If an employee holds more than one type of full-time job within the evaluated unit, the total sum of the two shall be reported.

[3] The category "R&D Personnel" includes technical and professional personnel who are not directly involved in R&D&I but are indispensable for the research activity (e.g. operators of research facilities).

[4] The category "Researchers in other categories" includes all other staff who cannot be classified under any of the above categories (e.g. independent researcher/scientist).

[5] Who participates in the management and support of R&D&I in the institution.

[6] See Definition of Terms in Methodology HEI2025+.

[7] Total is the sum of the categories: professor, associate professor, assistant professor, assistant, R&I personnel, researchers in other categories and technical and economic staff.

### 3.1.2 Age structure of R&D&I personnel of the evaluated unit and their structure by job title and gender in the year 2019 (numbers of physical employees and personnel)[8]

| Academic/ professional position | Under 29 years | | 30-39 years old | | 40-49 years old | | 50-59 years old | | 60-69 years old | | 70 years and older | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Women | Total | Women | Total | Women | Total | Women | Total | Women | Total | Women |
| Professor | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 0 | 11 | 1 | 16 | 1 |
| Associate Professor | 0 | 0 | 5 | 1 | 12 | 0 | 7 | 0 | 7 | 0 | 8 | 0 |
| Assistant Professor | 2 | 2 | 44 | 6 | 37 | 9 | 8 | 0 | 12 | 6 | 8 | 1 |
| Assistant | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| R&D Personnel[9] | 18 | 8 | 8 | 5 | 3 | 2 | 7 | 2 | 2 | 1 | 1 | 0 |
| Researchers in other categories[10] | 90 | 29 | 78 | 18 | 20 | 5 | 4 | 1 | 6 | 1 | 5 | 0 |
| Technical and economic staff[11] | 1 | 1 | 1 | 1 | 4 | 3 | 2 | 1 | 0 | 0 | 0 | 0 |
| Scientific, research and development staff involved in teaching activities | 2 | 2 | 49 | 7 | 50 | 10 | 20 | 0 | 30 | 7 | 32 | 2 |
| Early career researcher[12] | 92 | 31 | 127 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total[13] | 111 | 40 | 136 | 31 | 77 | 20 | 33 | 4 | 38 | 9 | 38 | 2 |

Note: The categories professor, associate professor, assistant professor, assistant, other scientific, R&D Personnel, Researchers in other categories and Technical and economic staff are mutually exclusive, i.e. one staff member is reported in only one category. The categories of scientific, research and development staff involved in teaching activities and early career researchers are reported collectively for all the above-mentioned categories.

### 3.1.3 Age structure of R&D&I personnel of the evaluated unit and their structure by job title and gender in the year 2023 (numbers of physical employees and personnel)[14]

| Academic/ professional position | Under 29 years | | 30-39 years old | | 40-49 years old | | 50-59 years old | | 60-69 years old | | 70 years and older | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Women | Total | Women | Total | Women | Total | Women | Total | Women | Total | Women |
| Professor | 0 | 0 | 0 | 0 | 5 | 1 | 4 | 0 | 9 | 1 | 17 | 1 |
| Associate Professor | 0 | 0 | 0 | 0 | 21 | 1 | 6 | 0 | 9 | 0 | 8 | 0 |
| Assistant Professor | 0 | 0 | 25 | 6 | 43 | 11 | 12 | 2 | 10 | 5 | 4 | 1 |
| Assistant | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

[8] The total number of employees/workers as of 31st December of the calendar year in question is to be entered, irrespective of the level of time worked, but only in an employment relationship (including agreement on work activity, excluding agreement on work performance). Other types of contractual relationships under the Civil Code that involve purchase of services are not included.

[9] The category "R&D Personnel" includes technical and professional personnel who are not directly involved in R&D&I but are indispensable for the research activity (e.g. operators of research facilities).

[10] The category "Researchers in other categories" includes all other staff who cannot be classified under any of the above categories (e.g. independent researcher/scientist).

[11] Who participates in the management and support of R&D&I in the institution.

[12] See Definition of Terms in Methodology HEI2025+.

[13] Total is the sum of the categories: professor, associate professor, assistant professor, assistant, R&I Personnel, Researchers in other categories and technical and economic staff.

[14] The total number of employees/workers as at 31.12. of the calendar year in question is to be entered, irrespective of the level of time worked, but only in an employment relationship (including agreement on work activity, excluding agreement on work performance). Other types of contractual relationships under the Civil Code that involve purchase of services are not included.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R&D Personnel[15] | 17 | 8 | 19 | 9 | 4 | 2 | 3 | 0 | 3 | 2 | 2 | 1 |
| Researchers in other categories[16] | 62 | 20 | 89 | 24 | 33 | 7 | 6 | 1 | 1 | 0 | 5 | 1 |
| Technical and economic staff[17] | 2 | 1 | 0 | 0 | 1 | 0 | 3 | 3 | 1 | 0 | 0 | 0 |
| Scientific, research and development staff involved in teaching activities | 0 | 0 | 25 | 6 | 69 | 13 | 23 | 2 | 28 | 6 | 29 | 2 |
| Early career researcher[18] | 62 | 20 | 114 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total[19] | 81 | 29 | 133 | 39 | 107 | 22 | 35 | 6 | 33 | 8 | 36 | 4 |

Note: The categories professor, associate professor, assistant professor, assistant, other scientific, R&D personnel, researchers in other categories and technical and economic staff are mutually exclusive, i.e. one staff member is reported under one category only. Scientific, research and development staff involved in teaching activities, as well as early career researchers are reported collectively for all the above-mentioned categories.

Table 3.1.4 – Students

| Type of study | 2019 | | 2020 | | 2021 | | 2022 | | 2023 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Women | Total | Women | Total | Women | Total | Women | Total | Women | Total | Women |
| Undergraduate | 628 | 227 | 706 | 251 | 691 | 230 | 889 | 275 | 792 | 226 | 3706 | 1209 |
| Master's[20] | 195 | 74 | 208 | 68 | 211 | 68 | 204 | 67 | 206 | 62 | 1024 | 339 |
| Doctoral | 273 | 62 | 287 | 72 | 281 | 78 | 273 | 79 | 264 | 81 | 1378 | 372 |
| Lifelong Learning Courses | 28 | 17 | 105 | 52 | 96 | 44 | 64 | 32 | 107 | 38 | 400 | 183 |
| Total | 1124 | 380 | 1306 | 443 | 1279 | 420 | 1430 | 453 | 1369 | 407 | 6508 | 2103 |

Table 3.1.5 - Study programmes in Czech/English

| Type of study programme | Total[21] / Of which professional study programmes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | 2020 | | 2021 | | 2022 | | 2023 | | Total | |
| Undergraduate | 2/0 | 0/0 | 11/0 | 0/0 | 13/0 | 0/0 | 16/3 | 0/0 | 16/3 | 0/0 | 58/6 | 0/0 |
| Master's | 2/1 | 0/0 | 17/2 | 0/0 | 18/1 | 0/0 | 20/3 | 0/0 | 17/1 | 0/0 | 74/8 | 0/0 |
| Doctoral | 4/2 | 0/0 | 9/4 | 0/0 | 15/7 | 0/0 | 15/7 | 0/0 | 22/9 | 0/0 | 65/29 | 0/0 |

[15] The category "R&D Personnel" includes technical and professional personnel who are not directly involved in R&D&I but are indispensable for the research activity (e.g. operators of research facilities).
[16] The category "Researchers in other categories" includes all other staff who cannot be classified under any of the above categories (e.g. independent researcher/scientist).
[17] Who participates in the management and support of R&D&I in the institution.
[18] See Definition of Terms in Methodology HEI2025+.
[19] Total is the sum of the categories: professor, associate professor, assistant professor, assistant, R&I personnel, researchers in other categories and technical and economic staff.
[20] All master's degree students are listed, regardless of the length of their programme of study.
[21] The total number of study programmes for which admissions have been announced in a given academic year.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lifelong Learning courses | 1/0 | 0/0 | 13/0 | 9/0 | 20/0 | 17/0 | 16/0 | 14/0 | 23/0 | 16/0 | 73/0 | 56/0 |
| Total | 8/3 | 0/0 | 37/6 | 0/0 | 46/8 | 0/0 | 51/13 | 0/0 | 55/13 | 0/0 | 197/43 | 0/0 |

Note: For each SP type, enter the number of SPs in Czech language in the first cell and insert the number of SPs in English language after the slash in the same cell (e.g. 15/3), enter the number of professional SPs in Czech language in the second cell and insert the number of professional SPs in English language after the slash. Follow a similar procedure in the last column of the table (Total).

### 3.1.6 – R&D&I capacities

| R&D&I field | FORD | FORD share [%] | Predominant type of research | Total share of industry group [%] |
|---|---|---|---|---|
| 1. Natural Sciences | 1.1 Mathematics | 10.8 | Balanced basic and applied research | 80.5 |
| | 1.2 Computer and information sciences | 1.7 | Applied Research | |
| | 1.3 Physical sciences | 57.9 | Balanced basic and applied research | |
| | 1.4 Chemical sciences | 8.6 | Balanced basic and applied research | |
| | 1.5 Earth and related environmental sciences | 0.7 | Applied Research | |
| | 1.6 Biological sciences | 0.4 | Applied Research | |
| | 1.7 Other natural sciences | 0.4 | Balanced basic and applied research | |
| 2. Engineering and Technology | 2.1 Civil engineering | 0.2 | Applied Research | 18.2 |
| | 2.2 Electrical engineering, Electronic engineering, Information engineering | 4.6 | Balanced basic and applied research | |
| | 2.3 Mechanical engineering | 4.4 | Balanced basic and applied research | |
| | 2.4 Chemical engineering | | | |
| | 2.5 Materials engineering | 6.2 | Balanced basic and applied research | |
| | 2.6 Medical engineering | 0.2 | Applied Research | |
| | 2.7 Environmental engineering | | | |
| | 2.8 Environmental biotechnology | | | |
| | 2.9 Industrial biotechnology | | | |
| | 2.10 Nanotechnology | 2.1 | Balanced basic and applied research | |
| | 2.11 Other engineering and technologies | 0.5 | Applied Research | |
| 3. Medical and Health Sciences | 3.1 Basic medicine | | | 0.9 |
| | 3.2 Clinical medicine | 0.4 | Applied Research | |
| | 3.3 Health sciences | | | |

| | | | | |
|---|---|---|---|---|
| | 3.4 Medical biotechnology | 0.5 | Applied Research | |
| | 3.5 Other medical sciences | | | |
| 4. Agricultural and veterinary sciences | 4.1 Agriculture, Forestry, and Fisheries | | | |
| | 4.2 Animal and Dairy science | | | |
| | 4.3 Veterinary science | | | |
| | 4.4 Other agricultural sciences | | | |
| 5. Social Sciences | 5.1 Psychology and cognitive sciences | | | 0.3 |
| | 5.2 Economics and Business | 0.1 | Applied Research | |
| | 5.3 Education | 0.2 | Applied Research | |
| | 5.4 Sociology | | | |
| | 5.5 Law | | | |
| | 5.6 Political science | | | |
| | 5.7 Social and economic geography | | | |
| | 5.8 Media and communications | | | |
| | 5.9 Other social sciences | | | |
| 6. Humanities and the Arts | 6.1 History and Archaeology | 0.1 | Applied Research | 0.1 |
| | 6.2 Languages and Literature | | | |
| | 6.3 Philosophy, Ethics and Religion | | | |
| | 6.4 Arts (arts, history of arts, performing arts, music) | | | |
| | 6.5 Other Humanities and the Arts | | | |
| | Total | 100 % | - | 100 % |

## RECOGNITION BY THE RESEARCH COMMUNITY

### 3.2 Recognition by the research community

The evaluated unit will briefly comment on its position in the research community. It shall consider individual and other prestigious R&D&I awards, participation of its academic staff in the editorial boards of international scientific journals, elected membership in professional societies, major invited lectures given by the evaluated unit's academic staff abroad or by foreign scientists and other relevant guests at the evaluated unit. Additionally, it will address the involvement of staff in the evaluation of national or European project/programme calls over the period of 2019–2023 based on the data provided in annex tables 3.2.1 to 3.2.5 (max. 10 most relevant items). If necessary, the evaluated unit shall list any additional services to the scientific community that it considers relevant.

*Maximum 1000 words.*

**Self-assessment:**

The faculty is highly research-oriented and is closely collaborating with the Academy of Sciences and other Czech and international research universities and institutes, both through research collaboration and the involvement of their scientists in teaching. The organization of lectures and short and/or long research stays for invited foreign guests is one of the traditional enrichments of both teaching for students and everyday scientific life of the faculty staff.

The faculty aims not only on fundamental research but also on mathematical solutions of engineering problems; the development of novel mathematical algorithms, new physical methods of measurements, control, and modelling; and the development of new technologies used, for example, for lasers, semiconductors, materials, physical chemistry, cosmic research, biomedicine; etc., which allows the faculty to be well integrated into international research networks.

Faculty members are very active in the international scientific community. The scientific level of the faculty staff is also reflected in the fact that they are often invited to international collaborations, including positions of high responsibility. Among the most prestigious collaborations is certainly the participation in CERN, but other collaborations are also very important, such as the participation in Brookhaven National Laboratory, Fermilab, ITER via EuroFusion, FuseNet, COST or the cooperation with EUROATOM, International Atomic Energy Agency and many others.

The contributions of the faculty members are also recognized by invitations to serve the community in various roles in editorial boards, committees and supervising bodies as well as in evaluation panels. Serving on these committees, editorial boards, and panels is highly encouraged and is also reflected in career advancement and upgrading at the faculty (e.g., during habilitation procedures and professorships).

Dissemination through publication in scientific journals and presentation of the latest results at conferences is an integral part of scientific work. Faculty encourages the publication in high-impact journals and high-end conferences by supporting the participation. The outputs of faculty members are often recognized both by awards for the best paper/presentation/poster and by the very fact that faculty members are often among the invited speakers at prestigious conferences.

The faculty also cares about and emphasizes the involvement of young research staff and students at all levels of study, which is reflected in numerous awards received. The awards received are announced every year in the annual reports and communicated to the public via the faculty web pages and social media.

All of this can only be possible through the connection between science and teaching and through the consistent involvement of students at all levels of study from undergraduate, through master's and doctoral (postdoctoral) in cutting-edge research performed at the faculty.

Table 3.2.1 - Prestigious R&D&I awards granted during the evaluation period

| Name, surname and title(s) of the evaluated unit's staff member | Name of the award | Awarding institution |
|---|---|---|
| Tomáš Čechák Prof. Ing., CSc. | Extraordinary award for his contribution to the development of the Czech Metrology Institute and the national metrology system of the Czech Republic, 2023 | Czech Metrology Institute |
| Igor Jex, Prof. Ing. DrSc.,<br>Craig Hamilton, Ph.D. | Award of the Rector of the CTU in Prague for the best scientific result, 2020 | Czech Technical University in Prague |
| Petr Hauschwitz, Ing. Ph.D. | Werner von Siemens award 2021 – best dissertation thesis | Siemens |
| Igor Jex, Prof. Ing. DrSc. | Member of Academiae Europae 2021 | Academiae Europae |
| Jaroslav Klusoň, doc. Ing. CSc, Tomáš Urban, Ing. Ph.D. | Award of the Minister of the Interior for extraordinary results in the field of security research for the year 2020 | Minister of the Interior of the Czech Republic |
| Monika Kučeráková, Ing. Ph.D. | Otto Wichterle Prize for outstanding young scientists, 2022 | Academy of Sciences of the Czech Republic |
| Marek Matas, Ing. Ph.D. | Henri Becquerel Prizes for Nuclear Research, 2020 | French Embassy, EDF, ATMEA |
| Jana Matoušková, Ing. Ph.D. | Henri Becquerel Prizes for Nuclear Research, 2023 | French Embassy, EDF |
| Martin Ševeček, Ing. Ph.D. | Nuclear Innovation Prize, 2023 | EURATOM, European Commission |
| Vojtěch Vaněček, Ing. | Milan Odehnal award 2022 | Czech Physical Society |

Note: Provide up to 10 examples.

Table 3.2.2 Participation of academic staff of the evaluated unit in editorial boards of international scientific journals during the evaluation period

| Name, surname and title(s) of the evaluated unit's staff member | Name of scientific journal, ISSN |
|---|---|
| Michal Beneš, prof. Dr. Ing. | IAENG International Journal of Applied Mathematics, ISSN: 1992-9978 |
| Pavel Exner, prof. RNDr. DrSc. | Journal of Mathematical Analysis and Applications, ISSN: 0022-247X<br>Reports on Mathematical Physics, ISSN: 0034-4877<br>Complex Analysis and Operator Theory, ISSN: 1661-8254 |
| Helena Jelínková, prof. Ing. Dr.Sc. | Progress in Quantum Electronics, ISSN: 0079-6727 |
| Jan John, prof. Ing. CSc. | Radiochimica Acta, ISSN: 0033-8230<br>Journal of Radioanalytical and Nuclear Chemistry, ISSN: 0236-5731 |
| Václav Klika, prof. Ing. Ph.D. | Continuum Mechanics and Thermodynamics, ISSN: 1432-0959<br>Journal of Nonequilibrium Thermodynamics, ISSN:1437-4358 |
| Ján Kozempel, doc. Ing. Ph.D. | Artificial Cells, Nanomedicine, and Biotechnology, ISSN: 2169-1401 |
| Zuzana Masáková, prof. Ing. Ph.D. | Acta Polytechnica, ISSN: 1805–2363 |
| Ladislav Musílek, prof. Ing. CSc. | Radiation Physics and Chemistry, ISSN: 1879-0895 |
| Tomáš Urban, Ing. Ph.D. | Radiation Physics and Chemistry, ISSN: 1879-0895 |
| Jan Vybíral, prof. RNDr. Ph.D. | Journal of Complexity, ISSN: 0885-064X |

Note: Please provide up to 10 examples of academic staff participation in editorial boards of international scientific journals (e.g. editor, editorial board member, etc.).

Table 3.2.3 The most important invited lectures delivered by the academic staff of the evaluated unit at foreign institutions during the evaluation period

| Name, surname and title(s) of the evaluated unit's staff member | Invited lecture title | Name of host institution, or name of conference or event | Year |
|---|---|---|---|
| Michal Beneš, prof. Dr. Ing. | Mathematical Modelling of Interface Motion in Material Science | Invited lecture at Mathematical Aspects of Surface and Interface Dynamics 18 Conference, Tokyo, Japan | 2019 |
| Jana Bielčíková, doc. RNDr. Ph.D. | Experimental results from Heavy Ion collisions | Invited lecture at ICHEP 2022: International Conference on High Energy Physics, Bologna, Italy | 2022 |
| Pavel Exner, prof. RNDr. DrSc. | Topologically induced spectral behavior: the example of quantum graphs, a distinguished lecture | Invited lecture at 8th International Congress of Chinese Mathematicians, China | 2019 |
| Petr Haušild, prof. Dr. Ing. | Some remarks on the indentation size effect at small indentation depths | Invited opening lecture at Indentation 2021 Colloquium, Lorient, France | 2021 |
| Igor Jex, prof. Ing. DrSc. | Quantum networks and open system dynamics | Invited lecture at PQE 2023, Snowbird, USA | 2023 |
| Ján Kozempel, doc. Ing. Ph.D. | Nuclear recoil effect in targeted alpha therapy - do we need to concern about it? | Invited lecture at ORNL ARIA workshop November 2-3, 2022 Oak Ridge TN, USA | 2022 |
| David Krejčiřík, prof. Mgr. Ph.D. DSc. | The virial theorem and the method of multipliers in spectral theory (Paris) | Invited lecture at WAVES 15th International Conference on Mathematical and Numerical Aspects of Wave Propagation; Palaiseau, France | 2022 |
| Zuzana Masáková, prof. Ing. Ph.D. | Infinite words connected to numeration: β-integers and Erdös spectrum | Invited lecture at WORDS'21, 13th International Conference on Words, Rouen, France | 2021 |
| Martin Štefaňák, doc. Ing. Ph.D. | Survival probability and quantum transport in Grover walk on finite graphs | Invited lecture at Symmetries: Algebras and Physics, Centre de recherches mathématiques, Montreal, Canada | 2022 |
| Jan Vysoký, Ing. Ph.D. | Introduction to Graded Manifolds | Invited lecture at Workshop on Quantum Geometry, Field Theory and Gravity, Corfu, Greece | 2021 |

Note: Provide up to 10 examples.

Table 3.2.4 - The most important lectures by foreign scientists and other guests relevant to R&D&I at the evaluated unit during the evaluation period

| Name, surname and title(s) of the lecturer | Lecturer's employer at the time of the lecture | Invited lecture title | Year |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Prof. Olaf Post | Universität Trier, Germany | Spectral gaps, discrete magnetic Laplacians and spectral ordering | 2019 |
| Prof. Xiaolin Hou | Technical University of Denmark, Center for Nuclear Technologies | Analysis of environmental radionuclides and its application for tracing environmental processes | 2019 |
| Prof. Barry Barish | University of California, Riverside, USA | Understanding our universe with gravitational waves | 2020 |
| Prof. Stephen M. Barnett | School of Physics and Astronomy, University of Glasgow, UK | Introduction to optical angular momentum | 2021 |
| Dr. G. Ivan Maldonado | University of Tennessee, Department of Nuclear Engineering, USA | Fuel Cycle Reload Analysis of US LWRs | 2021 |
| Prof. Dr. Rainer Heintzmann | Leibniz Institute of Photonic Technology, Institute for Physical Chemistry, Friedrich Schiller University Jena, Germany | Structured Illumination and the Analysis of Single Molecules in Cells | 2022 |
| Prof. Christine Silberhorn | University of Paderborn, Germany | Quantum optics and information science in multi-dimensional photonics networks | 2022 |
| Prof. Jeremy Faupin | Université de Metz, France | Spectral decomposition of some non-self-adjoint operators | 2022 |
| Prof. Ram Band | Israel Institute of Technology | Dry Ten Martini Problem for Sturmian Hamiltonians | 2023 |
| Prof. Julien Royer | Université de Toulouse, France | Local energy decay for the Schrödinger equation | 2023 |

Note: Provide up to 10 examples.

Table 3.2.5 - Involvement in the evaluation of national/European research project/programme calls relevant to the R&D&I area at the unit during the evaluation period

| Name, surname and title(s) of the evaluated unit's staff member | Name of the research project/programme call | Name of the contracting authority/guarantor of the project/programme call | Year |
|---|---|---|---|
| Michal Beneš, prof. Dr. Ing. | Member of the jury for Barrande Fellowship Programme | French Embassy | 2019-2023 |
| Tomáš Čechák, prof. Ing. CSc. | Member of the Committee for Cooperation of the Czech Republic with CERN | Ministry of Education, Youth and Sports of the Czech Republic | 2019-2023 |
| Petr Haušild, prof. Dr. Ing. | Panel member of the Horizon Euratom Programme:<br>H2020-Euratom -NFRP-2019-2020 call<br>HORIZON-EURATOM-2021-NRT-01 Fission call<br>JRC Ex Post panel member (Ex post evaluation of the activities of the Joint Research Centre under Horizon 2020 and Euratom 2014-2020) | European Commission | <br>2019<br>2021<br>2022 |

| | | | |
|---|---|---|---|
| Igor Jex, prof. Ing. DrSc. | EU Structural Funds Unit for Scientific Research | Research council of Lithuania | 2019-2023 |
| Ondřej Klimo, doc. Ing. Ph.D. | Member of the ERC Advanced Grant Panel 2022 (Fundamental Constituents of Matter) | European Research Council | 2022 |
| Jiří Kunz, prof. Ing. CSc. | Member of the expert advisory body for THETA programme | Technology Agency of the Czech Republic | 2019-2023 |
| Jiří Mikyška, prof. Ing. Ph.D. | Member of the panel 105 - Structural Mechanics and Construction, Fluid Mechanics and Geotechnics | Czech Science Foundation | 2023 |
| Ladislav Musílek, prof. Ing. CSc. | Member of the external examiner council of the Inter Action Programme of the Inter-Excellence II | Ministry of Education, Youth and Sports of the Czech Republic | 2019-2023 |
| Ivan Richter, prof. Ing. Dr. | Member of the QuantERA Scientific Evaluation Panel | QuantERA - collaborative initiative of Quantum Technologies in Europe, European Union's Horizon Research and Innovation Programme | 2021, 2022 |
| | Member of the panel 102 - Electrical Engineering and Electronic Engineering | Czech Science Foundation | 2019-2023 |
| Pavel Šťovíček, prof. Ing. DrSc. | Member of the panel 202 - Mathematics and Informatics | Czech Science Foundation | 2021-2023 |

Note: Provide up to 10 examples.

## RESEARCH PROJECTS

### 3.3 Research projects

The evaluated unit shall list at most 10 (considered most significant by the evaluated unit) research projects/activities (regardless of whether they are supported by public funds or based on contract research[22]) that it has implemented or participated in during the period of 2019–2023[23]. This should be done from the full list in annex tables (Table 3.3.1-3.3.2)[24], regarding particularly the results achieved or the application potential of the projects. The unit should also describe how the research projects contributed to the mission and purpose of the evaluated unit. If the evaluated unit has been a participant in listed project, it shall indicate which other entities were involved and describe its contribution to the project. The interdisciplinary aspects of the projects will also be commented on, along with any collaboration with other units of the evaluated HEI.

*Maximum 300 words per project.*

**Self-assessment:**

The faculty considers the following projects to be of utmost importance for the development of its capabilities and in line with its mission:

[22] For the definition of contract research for the purposes of evaluation in the HE segments, see Article 2.2.1 of the Community Framework for State Aid for Research, Development and Innovation 2014/C 198/01.

[23] Regardless of whether the projects are completed or still ongoing, provided that at least part of the project was implemented during the evaluation period.

[24] The evaluated unit shall only fill tables that are relevant to it.

**Centre of Advanced Applied Sciences (CAAS)** funded within the Czech Operational Programme "Research, Development and Education" for the implementation of the European Social Fund (ESF) and the European Regional Development Fund (ERDF).
The CAAS (https://caas.cvut.cz/en/) established a common university platform integrating research work in advanced sciences in physics, mathematics, chemistry, nuclear engineering, material science, photonics, detector technology and several other progressive fields. For the faculty, several objectives defined in the strategic long-term plan have been achieved. The project helped to boost the potential and capacity of specialized laboratories and facilities. It helped to acquire specialized equipment in laboratories for material science, plasma physics, laser physics, particle detection and nuclear chemistry. It enhanced the collaboration with large research facilities like ELI, Hilase, the Institute of Plasma Physics and the Heyrovský Institute (a partner in CAAS). The project was instrumental in creating the infrastructure needed for new research directions like quantum information and communication. The consolidated team successfully applied for EU funded projects like CZ.QCI (CTU is a member of the national consortium) and EPIQUE (European optical quantum computer, FNSPE is one of the partners in the EU consortium). The CZ.QCI is part of the European Quantum Communication infrastructure and is allowed to create a testing polygon at the CTU making it a technological background for quantum communication in the Czech Republic and the corresponding training and teaching infrastructure. It is also worth mentioning the contract research for the Federal Mint of Germany (Berlin). This collaboration explored the technological possibilities of quantum informatics by solving concrete problems of interest for the partner. Of particular interest are projects in particle physics detection which are described independently. The project is the fundament for further work on high-tech challenges of modern society like space-research (detection, communication), quantum enhanced computing, modern materials and many others.

The faculty was the (main and only) investigator of the project "**Strengthening and development of research at the Czech Technical University in Prague with the use of the VR-1 Training Reactor research infrastructure for research activities**". The main objective of the project was to strengthen the research activities of the faculty in three areas of nuclear engineering:

- Research on neutron transport through materials
- Research on the behaviour of neutron detection systems under the conditions of nuclear reactor core and external neutron sources
- Research on dynamics, diagnostics and monitoring of nuclear reactor cores

The project has provided not only the expansion of the faculty's research activities in the field of nuclear engineering, but also the establishment of promising research teams. Through the project, new collaborations were obtained for a large research infrastructure from industry, research and academic institutions. These include CEA in France, Westinghouse Electric Company, KAERI, KHNP, Czechatom, Aalto University in Finland, KEPCO International Nuclear Graduate School in Korea, and many others. The development of collaboration and the use of large research infrastructure operated by faculty continues to show a significantly increasing trend.
The project has significantly supported the faculty's publishing activities in nuclear engineering and has resulted in several important research results, some of which are included in the evaluation (experimental instrumentation NIFFLER, Neutron flux monitor with gamma compensation based on diamond detectors, High-density Nuclear Fuel).
As a follow-up to this project (in the framework of project CZ.02.1.01/0.0/18_046/0015833), a new nuclear facility was built at the faculty, the VR-2 subcritical reactor. Therefore, the faculty has become one of the most important nuclear education and training institutions in the world. Students from the USA, UK, Sweden, Finland, Poland, Slovakia and other countries come to the

faculty for the training courses. Training is also provided for the personnel of Czech and Slovak nuclear power plants.

**Collaboration with CERN - CERN-CZ** Large Research Infrastructure (LRI) project
Three faculties and institutes of the Czech Technical University in Prague (FNSPE, IEAP, FME) actively collaborate with CERN, the world's leading laboratory for particle physics, in cutting-edge experiments that push the frontiers of scientific knowledge and technological innovation. Through the CERN-CZ LRI project, the faculty contributes to groundbreaking research, strengthening its expertise and fostering scientific excellence. While we have strong participation in a variety of other smaller experiments at CERN (such as DIRAC), our primary focus lies in the ATLAS and ALICE experiments, two of the large experiments at LHC. These experiments explore the fundamental building blocks of matter and the forces that govern the universe, pushing the boundaries of modern physics. FNSPE's contributions span both hardware development and data analysis. Our teams play a crucial role in designing, constructing, and upgrading detector subcomponents and also in ensuring their smooth operation. Highlights of this work are the construction of the Forward Diffractive Detector (now in operation at CERN), the participation in the construction of the MFT (now in operation at CERN), the participation in the upgrade project of ATLAS and the development of new detector technologies of silicon pixel detectors with applications in other areas (Medipix, Timepix). Beyond scientific advancements, CERN provides invaluable opportunities for students and researchers, fostering collaboration with leading international experts, allowing our Ph.D. students to perform experiments to answer questions at the frontier of knowledge, and equipping the next generation of physicists and engineers with world-class expertise. By engaging in CERN's research programs, faculty gains access to a unique scientific and technological ecosystem that drives innovation and discovery. This collaboration not only enhances the university's global standing but also provides invaluable experience for students and researchers, preparing them to tackle complex challenges in particle physics and beyond.

**Participation in Brookhaven National Laboratory** – Czech Republic's participation (**BNL-CZ**)
CTU Prague, via FNSPE, is hosting the large research infrastructure BNL-CZ, which supports the participation of Czech research, engineering, and education institutions and facilitates their access to one of the world's leading research facilities, Brookhaven National Laboratory. BNL-CZ has been on the Roadmap for Large Research Infrastructures since 2016. BNL is a single-site operating research infrastructure, founded in 1947, with a primary focus on nuclear and particle physics research. The main facility at BNL is the RHIC accelerator, which is uniquely positioned to study strongly interacting QCD matter at high temperatures, as well as to map the QCD phase diagram and search for its critical point. It also allows for detailed studies of cold QCD matter properties and the origin of proton spin, thanks to the unique capability of colliding polarized proton beams. The FNSPE teams are actively involved in two international experimental collaborations based at BNL: STAR and ePIC. The STAR collaboration includes 75 institutions from 14 countries, while the ePIC collaboration consists of 173 institutions from 25 countries. We play an important role in these collaborations. For example, Jana Bielcikova has served as the chair of the STAR collaboration council for the past four years, and Barbara Trzeciak is currently the Deputy Physics Analysis Coordinator, responsible for the entire physics program of the STAR collaboration. In the ePIC collaboration, Jaroslav Adam leads the development of detector subsystems as a co-convener of the ePIC far-backward detectors group. As part of STAR and ePIC, we collaborate with many world-leading universities and research groups, with the most intensive collaborations being with Yale University, Lawrence Berkeley National Laboratory, and Ohio State University.

The **SpacePix2: Advancing Space Radiation Monitoring with First In-Orbit Deployment** project marked a major milestone in space radiation detection, culminating in its first in-orbit operation aboard the VZLUSat-2 satellite. Developed between 2019 and 2021 with funding from the European Space Agency (ESA), the project was a collaboration between FNSPE CTU in Prague, VZLU Aerospace, OHB SE (Germany), and Evolving Systems Consulting Ltd. The monolithic silicon pixel detector designed within SpacePix2 introduced radiation-hardened, low-power electronics, essential for long-term space missions. Its integration into VZLUSat-2 enabled real-time space weather monitoring, a critical step in protecting both spacecraft and future crewed missions from harmful cosmic radiation. The detector's advanced energy deposition measurement allowed it to classify electrons, protons, and heavy ions, providing valuable data on the space radiation environment in Low Earth Orbit (LEO). With its radiation-hardened ASIC technology, SpacePix2 achieved high performance in an environment where traditional electronics degrade rapidly due to Total Ionizing Dose (TID) and Single Event Effects (SEE). The low-power architecture ensured continuous operation with minimal energy requirements, making it suitable for small satellites and deep-space exploration. Rigorous testing in particle accelerators and vacuum chambers confirmed its resilience before deployment, validating its capability for future missions. The successful demonstration of SpacePix2 in orbit represents a breakthrough in miniaturized space radiation monitoring, establishing a path toward autonomous, long-duration radiation measurement systems. Its technology paves the way for next-generation space dosimetry, supporting applications from satellite mission planning to interplanetary exploration.

**Research support for the safety assessment of a deep geological repository**. This contractual research aimed to improve the knowledge about the behaviour of radionuclides in the environment of radioactive waste repositories, with a strong emphasis on the planned deep geological repository. This particular research has been carried out mainly on request and on behalf of SÚRAO (Radioactive Waste Repository Authority of the Czech Republic), the statutory duty of which is to provide safe operation of nuclear waste repositories and to verify that the waste intended for disposal complies with the strict standards set by the State Office for Nuclear Safety. Several topics were addressed, for example, "Input parameters and process models for the evaluation of radionuclide transport through engineered barriers" or "Transport of radionuclides through cement-based materials", including the consideration of changes in materials properties due to the ageing in the radioactive waste repository environment. As part of this contractual research for SÚRAO, a number of comprehensive technical reports based on laboratory results and transport modelling reviewed by the contracting authority with the participation of foreign experts. The obtained experimental results and theoretical knowledge are used as input data for modelling the behaviour of radionuclides during their potential migration from the repositories. The experts of the faculty participate in the preparation of the necessary simulation programmes and perform numerical calculations with them in order to contribute to the safety assessment of the repositories - SÚRAO uses them in the design of the deep geological repository of radioactive waste in the Czech Republic. In addition, through such projects, the faculty helps SÚRAO to familiarise the public with the technical solutions for repositories and the high level of assurance of their safety.

**A-CINCH – Augmented Cooperation in Education and Training in Nuclear and Radiochemistry**, H2020 project (https://cordis.europa.eu/project/id/945301) with 16 project partners across the Europe was coordinated by FNSPE. Nuclear and radiochemistry is of strategic relevance in the nuclear energy sector and in many vital applications - from safe nuclear power plant operation to

decontamination and decommissioning, waste management, and environmental monitoring; the non-energy fields of nuclear and radiochemistry applications are even much broader ranging from life sciences – radiopharmaceuticals, radiological diagnostics and therapy – through dating in geology and archaeology, (nuclear) forensics and safeguards operations, to radiation protection and radioecology.
The A-CINCH project primarily addresses the loss of the interest of young generation in nuclear knowledge by focussing on secondary / high school students and teachers and involving them by the "Learn through Play" concept. The A-CINCH project augmented CINCH teaching tools developed in the three previous projects – CINCH, CINCH II and MEET-CINCH – to the A-CINCH HUB – a user-friendly and easy-to-navigate single point of access (https://www.cinch-project.eu). Among the developed tools, a state-of-the-art virtual radiochemistry laboratory, virtual reality exercises, augmented reality app for radiation and shielding demonstration, Massive Open Online Courses, Hands-on Training courses, High School Teaching packages, RoboLab distance operated robotic experiments, Interactive Screen Experiments, NucWik database of teaching materials, or Flipped Classroom, CINCH videos, CINCH Talks etc. should be mentioned. All the tools are used to increase the number of students and trainees in the field of nuclear and radiochemistry, and to improve nuclear awareness in the field. After the end of the project, CINCH was transferred under Division of Nuclear Chemistry of the European Chemistry Society as Working group for education and nuclear chemistry awareness, led by FNSPE. CINCH outputs are used among European university units teaching nuclear and radiochemistry.

GAČR EXPRO project "**New challenges for spectral theory: geometry, artificial materials and complex fields**" (principal investigator: David Krejčiřík) has significantly strengthened the excellence of the faculty in its areas of interest (this type of projects is intended only for excellent scientists and their teams with the greatest potential to be part of a breakthrough in their field). This fundamental research project has achieved its goals by developing unconventional tools in spectral theory to tackle various newly born, or more classical but recently revived, open problems in mathematics and physics. Among the variety of achievements, let us point out: (1) the establishment of new uncertainty principles behind the stability of matter for discrete models in quantum mechanics; (2) the resolution of an almost 100-year old open problem about the existence of embedded eigenvalues in quasi-cylindrical domains; (3) the construction of non-semiclassical pseudomodes for the Dirac operator describing graphene; (4) the establishment of a measuring scheme to determine nanostructure surface curvature by using spectroscopy of Stark-localised states with help of microlocal methods. The latter has been shown to be feasible experimentally by numerical evidence as well as by recent contributions of experts with advanced materials.

**ELLECTRA - Efficient Low-energy Electron Cancer Therapy with Terbium-161** project (https://electtra.cz/) in KAPPA Programme (an applied research, experimental development, and innovation programme funded by the EEA and Norway Grants). Due to its expertise and long-term involvement in the field, the faculty was selected as the principal investigator and project coordinator. The ELECTTRA project was focused on the preparation of the prospective low-energy conversion and Auger electron emitter 161Tb via neutron irradiation of enriched 160Gd and the preparation of its novel targeting vectors. The main aim of the proposed project was the development of novel radiopharmaceuticals based on 161Tb and novel vectors for targeted tumour therapy. The advantage of 161Tb is in the emission of large numbers of low energy electrons followed by low energy gamma radiation allowing therapy follow-up. This will allow targeting of single cancer cells, micro-metastases and whole tumours, particularly in early stages of diseases to

increase the treatment efficiency. Project results include production methodology and production routines for 161Tb and novel 161Tb products in therapeutically relevant doses, as well as novel targeting molecules including peptides, monoclonal antibodies and advanced brachytherapy systems based on polymers and nanoparticles. The collaboration between Czech (Research Centre Řež, and Institute of Macromolecular Chemistry, Czech Academy of Sciences), and Norwegian partners (Institute for Energy Technology, and Oslo University Hospital) with extensive experience in research and development and commercialisation of the results fulfilled all prerequisites for this project to succeed and to reach all the proposed results. The achieved results are having continuous and direct impact on the applicants in terms of increased competitiveness on the market, development of Czech and Norwegian radiopharmaceutical industry together with impact on society and its benefits from innovative cancer treatment methods. In the final phase of the project, the research team was contacted through TACR by foreign partners from Switzerland and cooperation was established.

**Quantum secured communication in a critical infrastructure over lines with possible interferences**, implemented as part of the **OpenQKD** open call 2. The research team from the faculty has demonstrated the robustness of quantum key distribution (QKD) technology by testing the performance of two QKD technologies on railway trackside optical communications fibre infrastructure. Trackside fibre constitute vast networks across Europe, used for both critical transport infrastructure-related and private sector communications. Our demonstration underlines the applicability of quantum-secured communication networks over existing infrastructure even in the harsh environments represented by heavy rail traffic in close proximity. The testbed was based on a 46-km length of fibre, running within five metres of the main railway line from Prague to Beroun. The fiber experienced significant vibrations and mechanical noise due to high railway traffic, with a train typically passing every five minutes during the day. Performance of QKD solutions from Toshiba and IdQuantique were simultaneously monitored over the timespan of more than two weeks, using a remote configuration and monitoring software developed with the Faculty of Electrical Engineering of CTU. We found that the average quantum bit error rates were comparable to those measured in the laboratory, indicating that QKD keys can then be used for regular rekeying of encryptors despite the railway-induced noise.
Implementation of the project involved close collaboration with the OpenQKD consortium, the Austrian Institute of Technology, CyberSecurity Hub z.ú., Faculty of Informatics, Masaryk University, Toshiba Europe and IdQuantique. The project represents the faculty's ambition to be the central enabler of the use of quantum technologies in the Czech Republic. The experience gained in the use of QKD technology is being utilized in the construction of the Czech national QKD backbone infrastructure implemented in the CZ_QCI project with planned use-cases involving security agencies, government organizations, and private sector such as banks.

Table 3.3.1 Projects supported by public funds

| In the role of beneficiary | | | | | | |
|---|---|---|---|---|---|---|
| Provider[25] | Project name | Support (in thousands CZK/EUR)[26] | | | | |
| | | 2019 | 2020 | 2021 | 2022 | 2023 |
| **MEYS Ministry of Education, Youth and Sports** | Centre of advanced applied science | **190901 / 7531** | **107645 / 4246** | **140484 / 5542** | **90390 / 3566** | **23766 / 938** |
| **MEYS Ministry of Education, Youth and Sports** | Strengthening and development of research at Czech Technical University in Prague with the use of research infrastructure VR1 Training Reactor for research activities | **6759 / 267** | **3668 / 245** | **2659 / 105** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | VR-1 – Training Reactor for Research Activities | **1973 / 78** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | VR-1 - Support for reactor operation for research activities | **0 / 0** | **2514 / 99** | **2329 / 92** | **2299 / 91** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | The VR-1 Nuclear Experimental Hub | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **13203 / 521** |
| **MEYS Ministry of Education, Youth and Sports** | Research Infrastructure for Experiments at CERN | **10954 / 432** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Research Infrastructure for experiments at CERN | **0 / 0** | **14330 / 565** | **14240 / 562** | **13600 / 536** | **0 / 0** |
| **MEYS** | Research infrastructure for | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **13125 / 518** |

[25] If the provider is from abroad, please indicate the provider's country of origin in brackets. For the determination of the country of origin of the provider, the place of residence of the provider is decisive.
[26] Indicate the total amount expressed in thousands of CZK and the conversion of the total amount into Euro.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Ministry of Education, Youth and Sports** | experiments at CERN | | | | | |
| **MEYS Ministry of Education, Youth and Sports** | Getting new knowledge of the microworld using the CERN infrastructure | **3494 / 138** | **1604 / 63** | **2243 / 88** | **742 / 29** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Study of new properties of nuclear matter in the international experiment STAR | **2990 / 118** | **2990 / 118** | **2990 / 118** | **1963 / 77** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Facility for Antiproton and Ion Research – participation of the Czech Republic | **835 / 33** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Facility for Antiproton and Ion Research - participation of the Czech Republic | **0 / 0** | **2430 / 96** | **2989 / 118** | **3019 / 119** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Facility for Antiproton and Ion Research - participation of the Czech Republic | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **2524 / 100** |
| **MEYS Ministry of Education, Youth and Sports** | Research Infrastructure for Fermilab Experiments | **2335 / 92** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Research Infrastructure for Fermilab Experiments | **0 / 0** | **2376 / 94** | **2270 / 90** | **2300 / 91** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Research Infrastructure for Fermilab Experiments | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **2999 / 118** |
| **MEYS Ministry of Education, Youth and Sports** | Collaboration on experiments in Fermi National Accelerator Laboratory, USA | **1142 / 45** | **973 / 38** | **1278 / 50** | **1285 / 51** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Brookhaven National Laboratory – participation of the Czech Republic | **6705 / 264** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **MEYS Ministry of Education, Youth and Sports** | Brookhaven National Laboratory - Participation of the Czech Republic | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **13049 / 515** |
| **MEYS Ministry of Education, Youth and Sports** | Hadron structure in heavy ion collisions | **1371 / 54** | **1165 / 46** | **0 / 0** | **0 / 0** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Technological demonstrator - Radiation orbital monitor based on the Spacepix sensor | **1200 / 47** | **3611 / 142** | **2589 / 102** | **600 / 24** | **0 / 0** |
| **ESA** | SpacePix2 - advanced monolithic space radiation detector | **1901 / 75** | **1901 / 75** | **1901 / 75** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | New challenges for spectral theory: geometry, advanced materials and complex fields | **0 / 0** | **5040 / 199** | **6801 / 268** | **6447 / 254** | **6526 / 257** |
| **TACR Technology Agency of the Czech Republic** | Efficient Low-energy Electron Cancer Therapy with Terbium-161 | **0 / 0** | **0 / 0** | **6607 / 261** | **20577 / 812** | **21703 / 856** |
| **European Commission** | Augmented cooperation in education and training in nuclear radiochemistry | **0 / 0** | **5260 / 208** | **21042 / 830** | **21042 / 830** | **15781 / 623** |
| **European Commission** | Czech National Quantum Communication Infrastructure | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **6013 / 237** |
| **TACR Technology Agency of the Czech Republic** | Advanced mathematical-physical methods for modeling of traffic flow microstructure | **0 / 0** | **565 / 22** | **1004 / 40** | **976 / 39** | **1011 / 40** |
| **TACR Technology Agency of the Czech Republic** | Separation of radionuclides for targeted alpha particle therapy | **0 / 0** | **1387 / 55** | **3198 / 126** | **1354 / 53** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Cyclotron preparation of Tb-161 as an altervative to Lu- | **0 / 0** | **1867 / 74** | **2835 / 112** | **959 / 38** | **0 / 0** |

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|---|---|---|---|---|---|---|
| | 177 for therapy in nuclear medicine | | | | | |
| **TACR Technology Agency of the Czech Republic** | Advanced dosimetry for biological systems in near-earth space | **0 / 0** | **1889 / 75** | **4015 / 158** | **1925 / 76** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | System integration analysis of nuclear sources (SMR and / or large units) and P2G into the Czech power and heating industry | **0 / 0** | **0 / 0** | **0 / 0** | **3042 / 120** | **2835 / 112** |
| **TACR Technology Agency of the Czech Republic** | Decommissioning of research nuclear installation in the Czech Republic | **0 / 0** | **0 / 0** | **0 / 0** | **1668 / 66** | **1740 / 69** |
| **TACR Technology Agency of the Czech Republic** | Methodology for neutron and gamma spectra measurement in mixed fields especially for personnal dosimetry | **0 / 0** | **0 / 0** | **0 / 0** | **1964 / 77** | **2166 / 85** |
| **TACR Technology Agency of the Czech Republic** | Reference sites for aerial unmanned radiometric survey | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **2150 / 85** |
| **TACR Technology Agency of the Czech Republic** | Advanced Detection Systems of Ionizing Radiation | **31000 / 1223** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MoI Ministry of the Interior** | Composite filters for radioactive wash-fluids purification | **3661 / 144** | **3683 / 145** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MoI Ministry of the Interior** | Utilisation of radiation based methods for detection and identification of CBRNE materials | **3233 / 128** | **3869 / 153** | **4123 / 163** | **2007 / 79** | **0 / 0** |
| **MoI Ministry of the Interior** | Ground and airborne training center for radiation emergency preparedness teams | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **6744 / 266** |

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|---|---|---|---|---|---|---|
| **MEYS Ministry of Education, Youth and Sports** | Support of the activities in the Division of Nuclear and Radiochemistry (DNRC) EuCheMS | **77 / 3** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Study of the detection and imaging of X-rays for astrophysics | **1198 / 47** | **1417 / 56** | **1274 / 50** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Computational Models and Experimental Investigation of Fluid Dynamics, Mass Transfer and Transport, and Phase Transitions in Porous Media for Environmental Applications | **0 / 0** | **1500 / 59** | **1500 / 59** | **1500 / 59** | **0 / 0** |
| **GACR Czech Science Foundation** | Photonic Quantum Networks | **2437 / 96** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Aspects of strong interactions in extreme conditions | **1431 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Superintegrable systems in magnetic fields in three spatial dimensions | **1078 / 43** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Investigation of shallow subsurface flow with phase transitions | **2208 / 87** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | An information-theoretical perspective on complex systems | **1003 / 40** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Quantum mechanics with non-self-adjoint operators: transition from spectra to pseudospectra | **1162 / 46** | **1226 / 48** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Plasma optics for ultra-intense laser physics experiments | **2389 / 94** | **2495 / 98** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Advanced Lagrangian and ALE methods for | **992 / 39** | **936 / 37** | **0 / 0** | **0 / 0** | **0 / 0** |

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| | compressible fluids and elasto-plastic solids dynamics | | | | | |
| **GACR Czech Science Foundation** | Optimization of the solid-state laser active materials for spectral range from near- up to mid-infrared | **2334 / 92** | **2340 / 92** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Searching for signatures of saturation: energy dependence of J/Psi photoproduction with ALICE proton - lead data | **1497 / 59** | **1525 / 60** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Modeling of the color structure of the events in hadron-hadron collisions | **1190 / 47** | **1190 / 47** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Advanced functionalities in subwavelength photonic and plasmonic structures | **2325 / 92** | **2342 / 92** | **2323 / 92** | **44 / 2** | **0 / 0** |
| **GACR Czech Science Foundation** | Quantum and classical random walks | **1761 / 69** | **1715 / 68** | **1677 / 66** | **100 / 4** | **0 / 0** |
| **GACR Czech Science Foundation** | Fourier methods of special functions of affine Weyl groups | **934 / 37** | **913 / 36** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Dynamic properties of Quark Gluon Plasma | **0 / 0** | **2349 / 93** | **2181 / 86** | **2943 / 116** | **0 / 0** |
| **GACR Czech Science Foundation** | Multiscale thermodynamics: boundary conditions, integration and applications | **0 / 0** | **1194 / 47** | **1331 / 53** | **1397 / 55** | **190 / 7** |
| **GACR Czech Science Foundation** | Multiphase flow, transport, and structural changes related to water freezing and thawing in the subsurface | **0 / 0** | **0 / 0** | **2479 / 98** | **2604 / 103** | **2683 / 106** |
| **GACR Czech Science Foundation** | Nanostructured multilayers with controlled plasmonic response | **0 / 0** | **0 / 0** | **1268 / 50** | **2550 / 101** | **2562 / 101** |

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| | for sensor applications and quantum technologies | | | | | |
| **GACR Czech Science Foundation** | Matter in extreme conditions and relativistic heavy-ion collisions | **0 / 0** | **0 / 0** | **0 / 0** | **1665 / 66** | **3322 / 131** |
| **GACR Czech Science Foundation** | Signatures of saturation for future electron-ion colliders at a new level of precision | **0 / 0** | **0 / 0** | **0 / 0** | **1602 / 63** | **2136 / 84** |
| **GACR Czech Science Foundation** | Multipartite quantum dynamics on graphs and hypergraphs – theory and applications | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **3218 / 127** |
| **GACR Czech Science Foundation** | Novel approaches to surface-enhanced optical spectroscopy for the ultimate and specific biosensing | **2365 / 93** | **2363 / 93** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Nonlinear interaction of elastic waves with a single crack | **1627 / 64** | **1661 / 66** | **1766 / 70** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Brookhaven National Laboratory - participation of the Czech Republic | **6703 / 264** | **1688 / 67** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Nuclear Safety, Security and Forensics | **2610 / 103** | **1800 / 71** | **200 / 8** | **126 / 5** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Laboratories for doctoral programme Nuclear Safety, Security and Forensics | **4336 / 171** | **7000 / 276** | **3995 / 158** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Novel research-oriented doctoral program Quantum Technologies | **967 / 38** | **1000 / 39** | **500 / 20** | **116 / 5** | **0 / 0** |
| **MEYS Ministry of Education,** | Computer and technical infrastructure platform for the | **19551 / 771** | **10000 / 394** | **10000 / 394** | **5438 / 215** | **0 / 0** |

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| **Youth and Sports** | realization of novel doctoral program Quantum technologies | | | | | |
| **MEYS Ministry of Education, Youth and Sports** | International doctoral programme in high-temperature plasma and nuclear fusion | **1558 / 61** | **1060 / 42** | **786 / 31** | **1 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | High Temperature Plasma and Fusion Technology Laboratory PlasmaLab@CTU | **9589 / 378** | **3908 / 154** | **3908 / 154** | **3908 / 154** | **0 / 0** |
| **EEA and Norway Grants** | Improved skills and competences of students and academics in application of AMS in radioecology (AMSIR) | **0 / 0** | **203 / 8** | **203 / 8** | **0 / 0** | **0 / 0** |
| **IAEA (AT) International Atomic Energy Agency, Vienna, Austria** | Scientific and Education Activities on the GOLEM Tokamak in the Framework of the IAEA CRP | **254 / 10** | **254 / 10** | **254 / 10** | **254 / 10** | **0 / 0** |
| **IAEA (AT) International Atomic Energy Agency, Vienna, Austria** | Testing of Advanced Cladding Materials and Code Benchmarking | **0 / 0** | **0 / 0** | **127 / 5** | **127 / 5** | **127 / 5** |
| **Visegrad Fund (SK)** | V4 Nuclear Training Course | **0 / 0** | **867 / 34** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Asymptotic Dynamics of Quantum Markov Processes | **55 / 2** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | New challenges for extension theory of operators in modern physics | **54 / 2** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Bioconjugates of nanoparticles as new carriers of 223Ra for targeted alpha radiotherapy | **0 / 0** | **0 / 0** | **41 / 2** | **160 / 6** | **0 / 0** |

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| **MEYS Ministry of Education, Youth and Sports** | Jets in heavy ion collisions at the Large Hadron Collider | **0 / 0** | **0 / 0** | **78 / 3** | **39 / 2** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Super-resolution microscopy with topological beams | **0 / 0** | **0 / 0** | **0 / 0** | **172 / 7** | **130 / 5** |
| **MEYS Ministry of Education, Youth and Sports** | Spectral analysis of Dirac materials | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **92 / 4** |
| Total | | **322814 / 12734** | **196234 / 7741** | **235218 / 9278** | **181409 / 7156** | **125134 / 4936** |
| In the role of another participant | | | | | | |
| Provider[27] | Project name | Support (in thousands CZK/EUR) | | | | |
| | | 2019 | 2020 | 2021 | 2022 | 2023 |
| **TACR Technology Agency of the Czech Republic** | Improvement of nuclear power reactor neutron-physical characteristics using reactor operation records | **448 / 18** | **407 / 16** | **0 / 0** | **0 / 0** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Assurance of Safe and Long Term Operation of Nuclear Reactor Pressure Vessel Internals | **415 / 16** | **378 / 15** | **0 / 0** | **0 / 0** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | LPopt2 - Effective and reliable tool for optimized design of nuclear reactor loading patterns based on pareto optimality approach | **435 / 17** | **140 / 6** | **0 / 0** | **0 / 0** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Innovative methods of welding of high pressure devices using laser technologies | **1000 / 39** | **693 / 27** | **0 / 0** | **0 / 0** | **0 / 0** |
| **TACR Technology Agency of** | The Automated Atlas Segmentation of Anatomical | **580 / 23** | **610 / 24** | **0 / 0** | **0 / 0** | **0 / 0** |

[27] Ibid.

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| **the Czech Republic** | Structures for the Radiotherapy Planning Systems (RT ATLAS) | | | | | |
| **TACR Technology Agency of the Czech Republic** | ANDREA 3: Advanced SW for steady state and transient analysis of nuclear reactors | **570 / 22** | **448 / 18** | **425 / 17** | **244 / 10** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Innovative methods for nuclear plant safety evaluation based on SHM technologies and related procedures -NEMENUS (NEw MEthods for NUclear Safety) | **1124 / 44** | **1124 / 44** | **1124 / 44** | **562 / 22** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | LaTrAx - Laser Treated Axles | **1000 / 39** | **1000 / 39** | **1000 / 39** | **1000 / 39** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Material utilization of waste thermoplastics in the production of building materials for shielding of ionizing radiation | **720 / 28** | **840 / 33** | **66 / 3** | **0 / 0** | **0 / 0** |
| **TACR Technology Agency of the Czech Republic** | Multicomponent single crystal materials for solid state lasers | **0 / 0** | **585 / 23** | **585 / 23** | **585 / 23** | **585 / 23** |
| **TACR Technology Agency of the Czech Republic** | Utilization of Advanced Materials for New Types of Nuclear Fuels | **0 / 0** | **552 / 22** | **1852 / 73** | **2099 / 83** | **2195 / 87** |
| **TACR Technology Agency of the Czech Republic** | Tolerant Nuclear Fuels for Small Modular Reactors and Safety Evaluation | **0 / 0** | **0 / 0** | **0 / 0** | **1721 / 68** | **1758 / 69** |
| **TACR Technology Agency of the Czech Republic** | Ultra-fast soft X-ray sensorics for spectral monitoring of high-temperature plasmas | **0 / 0** | **0 / 0** | **0 / 0** | **2622 / 103** | **4374 / 173** |
| **TACR Technology Agency of** | Semiconductor detector systems for quality assurance of | **0 / 0** | **0 / 0** | **0 / 0** | **439 / 17** | **439 / 17** |

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| **the Czech Republic** | radiotherapy photon beams. | | | | | |
| **TACR Technology Agency of the Czech Republic** | Critical analysis of strategies of decommissioning of nuclear facilities | **0 / 0** | **0 / 0** | **0 / 0** | **162 / 6** | **396 / 16** |
| **TACR Technology Agency of the Czech Republic** | Joint Cooperative Research on Technology Familiarisation and the Development of the Accident-Tolerant Fuel for New Nuclear Power Plant | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **2046 / 81** |
| **TACR Technology Agency of the Czech Republic** | IIS medic-patient | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **2307 / 91** |
| **TACR Technology Agency of the Czech Republic** | R&D of Radiation Tolerant Semiconductor Solutions | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **3714 / 147** |
| **TACR Technology Agency of the Czech Republic** | Advanced methods for diagnostics and interpretation of power distribution measurement using Self Powered Neutron Detectors (SPND) | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **437 / 17** |
| **TACR Technology Agency of the Czech Republic** | Criteria Basis for Evaluation of Research Reactors Safety | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **595 / 23** |
| **TACR Technology Agency of the Czech Republic** | Development of procesess for the solidification of high level radioactive wastes after NPP sever accident and evaluation of their disposal in radioactive waste repository | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **570 / 22** |
| **TACR Technology Agency of the Czech Republic** | Center of Advanced Nuclear Technology II | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **17151 / 677** |

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| **MoH Ministry of Health of the Czech Republic** | New multistage nanodiagnostics for cancer imaging and prediction of antiangiogenic therapy efficacy | **1260 / 50** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MoH Ministry of Health of the Czech Republic** | Analysis of flow character and prediction of evolution in endovascular treated arteries by magnetic resonance imaging coupled with mathematical modeling | **962 / 38** | **1443 / 57** | **1444 / 57** | **1493 / 59** | **0 / 0** |
| **MoH Ministry of Health of the Czech Republic** | Development of terbium-161-labelled biomolecules as theranostic tools in nuclear medicine | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **841 / 33** |
| **MoI Ministry of the Interior** | More accurate prediction of radiological consequences of severe accidents at NPP aimed in identification of their risks | **2250 / 89** | **1092 / 43** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MoI Ministry of the Interior** | Multicriteria operational radiation protocol | **0 / 0** | **0 / 0** | **0 / 0** | **441 /17** | **309 / 12** |
| **MIT Ministry of Industry and Trade** | New laser rods and discs for modern diode pumped lasers | **650 / 26** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Research and development of new tungsten pseudoalloys for industrial applications and manufacturing technology optimalisation | **1200 / 47** | **400 / 16** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Recyclable decontamination solution for decommissioning of nuclear facilities | **900 / 36** | **225 / 9** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MIT** | Material and process capability of thin Al foil | **700 / 28** | **700 / 28** | **0 / 0** | **0 / 0** | **0 / 0** |

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| **Ministry of Industry and Trade** | | | | | | |
| **MIT Ministry of Industry and Trade** | Dose Guided Radiotherapy System | **1637 / 65** | **2455 / 97** | **2401 / 95** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Lightweight Orbital Radiation Detection System | **2860 / 113** | **2920 / 115** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Monolithic pixel detector for the detection of ionizing radiation | **3548 / 140** | **4225 / 167** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Research and development of technological methods for radiation-induced production of advanced nanomaterials | **1022 / 40** | **1022 / 40** | **253 / 10** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Multilayer, Large-Area, Mosaic, Pixel Detector for Cosmic Radiation Measurement | **300 / 12** | **1200 / 47** | **1400 / 55** | **1580 / 62** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Cooperation of the Czech Republic with JINR Dubna in the theoretical and nuclear physics and application of nuclear methods in other fields | **299 / 12** | **299 / 12** | **319 / 13** | **323 / 13** | **0 / 0** |
| **GACR Czech Science Foundation** | Thermal Energy Storage Materials: Thermophysical Characteristics for the Design of Thermal Batteries | **692 / 27** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Synthesis, characterization and tailoring the properties of luminescent nanocomposites | **952 / 38** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Processing of innovative iron-based intermetallics by mechanical alloying and spark plasma sintering | **951 / 38** | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** |

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| **GACR Czech Science Foundation** | Large structures in the boundary layers over complex surfaces in high Reynolds numbers | **837 / 33** | **857 / 34** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Radiation processes generated by runaway electrons in tokamaks | **1202 / 47** | **1100 / 43** | **0 / 0** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Study of electron densities and spontaneous magnetic fields by means of multi-channel complex interferometry | **731 / 29** | **696 / 27** | **725 / 29** | **7 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | High temperature preparation of advanced refractory materials by inductively coupled plasma in controlled atmosphere | **975 / 38** | **935 / 37** | **972 / 38** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Nonlinear interactions and information transfer in complex systems with extreme events | **1035 / 41** | **895 / 35** | **1063 / 42** | **0 / 0** | **0 / 0** |
| **GACR Czech Science Foundation** | Low dimensional scintillating structures for biomedical applications. | **0 / 0** | **1183 / 47** | **1196 / 47** | **1196 / 47** | **0 / 0** |
| **GACR Czech Science Foundation** | Design of nanocrystalline composite alloys with high entropy and controllable properties | **0 / 0** | **0 / 0** | **1090 / 43** | **1114 / 44** | **1102 / 43** |
| **GACR Czech Science Foundation** | Simulation of meteoroid and asteroid explosion event by terawatt-class laser | **0 / 0** | **0 / 0** | **330 / 13** | **330 / 13** | **330 / 13** |
| **GACR Czech Science Foundation** | New perspectives in magnetic fabric interpretation through 3D microstructural analysis, numerical modelling and quantum | **0 / 0** | **0 / 0** | **0 / 0** | **699 / 28** | **946 / 37** |

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| | mechanical description | | | | | |
| **GACR Czech Science Foundation** | Fine properties of functions, operators and function spaces | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **1238 / 49** |
| **GACR Czech Science Foundation** | Scintillating multimodal materials and quantum heterostructures. | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **1648 / 65** |
| **GACR Czech Science Foundation** | Study of quark-gluon plasma with hard probes and limits of its formation | **0 / 0** | **0 / 0** | **0 / 0** | **0 / 0** | **1911 / 75** |
| **MEYS Ministry of Education, Youth and Sports** | Ultra-trace isotope research in social and environmental studies using accelerator mass spectrometry | **16958 / 669** | **5454 / 215** | **5511 / 217** | **4837 / 191** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Facility for Antiproton and Ion Research - participation of the Czech Republic - OP II. | **0 / 0** | **0 / 0** | **0 / 0** | **1914 / 76** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Research of methods for high-precise measurement, and development of instrumentation for evaluation of nuclear-physical quantities and safe control of critical processes. | **5308 / 209** | **1348 / 53** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MIT Ministry of Industry and Trade** | Development of an automatic device for high-capacity scanning of surfaces by digital radiography | **0 / 0** | **0 / 0** | **199 / 8** | **317 / 13** | **367 / 14** |
| **European Commission** | GEN IV Integrated Oxide fuels recycling strategies | **534 / 21** | **534 / 21** | **267 / 11** | **0 / 0** | **0 / 0** |
| **European Commission** | Fuel recycle and experimentally demonstrated manufacturing of | **0 / 0** | **0 / 0** | **0 / 0** | **777 / 31** | **777 / 31** |

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| | advanced nuclear solution for safety | | | | | |
| **European Commission** | PRE-DISposal management of radioactive waste | **0 / 0** | **361 / 14** | **361 / 14** | **361 / 14** | **361 / 14** |
| **European Commission** | European Nuclear Experimental Educational Platform (ENEEP) | **1893 / 75** | **1893 / 75** | **1893 / 75** | **1893 / 75** | **0 / 0** |
| **European Commission** | Scintillating Porous Architectures for RadioacTivE gas detection | **0 / 0** | **1741 / 69** | **1741 / 69** | **1741 / 69** | **1741 / 69** |
| **European Commission** | Building European Nuclear Competence through continuous Advanced and Structured Education and Training Actions | **0 / 0** | **0 / 0** | **0 / 0** | **501 / 20** | **501 / 20** |
| **European Commission** | DigiQ | **0 / 0** | **0 / 0** | **0 / 0** | **1025 / 40** | **1025 / 40** |
| **European Commission** | Implementation of activities described in the Roadmap to Fusion during Horizon Europe through a joint programme of the members of the EUROfusion consortium | **0 / 0** | **0 / 0** | **500 / 20** | **500 / 20** | **500 / 20** |
| **European Commission** | A Modular European Education and Training Concept In Nuclear and RadioCHemistry | **1249 / 49** | **1249 / 49** | **0 / 0** | **0 / 0** | **0 / 0** |
| **MEYS Ministry of Education, Youth and Sports** | Time-Frequency Representations for Function Spaces (TIFREFUS) | **0 / 0** | **0 / 0** | **20 / 1** | **20 / 1** | **0 / 0** |
| Total | | **82049 / 3238** | **71220 / 2809** | **57237 / 2257** | **54012 / 2130** | **74825 / 2952** |

Table 3.3.2 - Contract research activities

| Client[28] | Activity name | Revenue (in thousands CZK/EUR) | | | | |
|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | 2022 | 2023 |

[28] If the client is from abroad, indicate in brackets the country of origin of the client.

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| **ÚJV Řež** | Research Support for Safety Assessment of a Deep Geological Repository | **1613/64** | **114/4** | | | |
| **TrisKem International** | Materials for Chromatography | **71/3** | | | | |
| **WITS JAR Škoda** | WITS JAR | **130/5** | | | | |
| **SÚJB (The State Office for Nuclear Safety)** | Independent Assessment of Unusual Events in the Operation of the Temelín Nuclear Power Plant | **154/6** | | | | |
| **NUVIA a.s.** | Performing Simulations and Calculations to Verify the Shielding Structures of the Cyclotron Vault | **67/3** | | | | |
| **Škoda Auto** | Mathematical-Stochastic Model for Optimizing the Inspection Process of the Engine Compartment on KB8 | **1733/68** | | | | |
| **ČEZ a.s.** | Ensuring Biomonitoring of Atmospheric Deposition of Radionuclides Using Bioindicators around the Temelín Nuclear Power Plant | **280/11** | | | | |
| **ČZ Strakonice** | Fractographic Analyses of Damaged Turbochargers | **182/7** | | | | |
| **CHARVÁT AXL, a.s** | Diffraction Tensometric Measurements of Surface Residual Stress of Two Cylinder Samples | **86/3** | | | | |
| **JRC Petten** | Fractographic Analysis in a Special Environment | **366/14** | **525/21** | **599/24** | **705/28** | **276/11** |
| **UJP Praha a.s.** | Evaluation of Fracture Surfaces Using SEM and Determination of Nanohardness Gradient on Metallographic Sections of Oxidized Zr-Alloys | **150/6** | | | | |
| **Škoda JS a.s.** | Preparation of an Opponent's Report on Calculation Reports for Type Approval of the OS Škoda 1000/19M Packaging Set | **459/18** | | | | |
| **ÚJV Řež, a.s** | X-ray Diffraction Analysis of Residual Stresses in Test Samples of Austenitic Superalloys Based on Chromium and Nickel | **150/6** | | | | |
| **UJP Praha** | Evaluation of Fracture Surfaces Using SEM | **80/3** | | | | |
| **ALVEL a.s.** | Tritium Production Calculations Using the ORIGEN Code | **69/3** | | | | |
| **CHARVÁT AXL, a.s** | X-ray Tensometric Measurements of Surface Residual Stress of Ground Surfaces | **92/4** | | | | |
| **UJP Praha a.s.** | Contract Research on Optimization of Protective Coating Application, Experimental Verification, and Modeling of Coating Behavior on Coating Material | **116/5** | **658/26** | | | |

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| **CHARVÁT AXL** | X-ray Tensometric Measurements of Surface Residual Stress of Ground Surfaces of Two Samples "Wheel Axis XL 3211006-2" | **63/2** | | | | |
| **ÚJV Řež a.s.** | X-ray Diffraction Analysis of Residual Stresses in Test Samples of Austenitic Superalloys Based on Chromium and Nickel | **56/2** | | | | |
| **SÚRO** | Independent Assessment of Unusual Events in the Operation of the Temelín Nuclear Power Plant | **181/7** | **316/12** | **155/6** | **585/23** | **347/14** |
| **UJP a.s.** | Study of Fracture Surfaces and Polished Sections of Zr-Samples after Corrosion Transition Experiment on E110 Alloy ETE | **100/4** | | | | |
| **CHARVÁT AXL a.s** | X-ray Tensometric Measurements of Surface Residual Stress of Ground Surfaces of Two Samples "Wheel Axis D1" | **60/2** | | | | |
| **ŠKODA AUTO a.s.** | X-ray Tensometric Analysis in the Field of Camshaft and Camshaft Lifespan Solutions for 1.0 MPI EVO Engines | **106/4** | | | | |
| **SÚJB (The State Office for Nuclear Safety)** | Testing and Comparison in the Field of Personal Dosimetry, Contract 141500024 | **248/10** | | | | |
| **SÚRO** | Measurement of Chemical Purity | **145/6** | | | | |
| **Elements Materials Technolog** | X-ray Diffraction Analysis of Residual Stresses in Four Test Specimens | **72/3** | | | | |
| **TEDIKO** | Analysis of Fractures of Damaged Turbine Bolts | **86/3** | | | | |
| **SÚJB (The State Office for Nuclear Safety)** | Issues of Proton Therapy | **83/3** | | | | |
| **ŠKODA JS a.s** | Assessment of Reports for Type Approval of OS Škoda 1000/19, 1000/19M | **99/4** | | | | |
| **Česká zbrojovka a.s** | Analysis of Residual Stresses on Delivered Samples | **106/4** | | | | |
| **CHARVÁT AXL,a.s.** | X-ray Tensometric Measurements | **76/3** | | | | |
| **CHARVÁT AXL, a.s** | X-ray Tensometric Measurements | | **115/5** | | | |
| **Element materials Technology** | Residual Stress Measurements | | **81/3** | | | |
| **Rail Safety Inspection (Drážní inspekce)** | Fractographic Analysis of a Damaged Switch Tongue No. 10b | | **50/2** | | | |
| **JE Temelín** | Biomonitoring of the Environmental Impacts of the Temelín Nuclear Power Plant | | **280/11** | | | |
| **VUJE a.s.** | Measurements with SNM-18 and CC-83 Chambers on the VR-1 Reactor | | **145/6** | | | |

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|---|---|---|---|---|---|---|
| **ŠKODA AUTO, a.s.** | X-ray Tensometric Analysis of Rollers | | **79/3** | | | |
| **SÚRO,v.v.i** | In-situ Gamma Spectrometry and Determination of Depth Profile of Natural Radionuclides within the TA CR Project | | **124/5** | | | |
| **Ústav chemických procesů AV (Institute of Chemical Process Fundamentals CAS)** | Analysis of Fatty Acids in the Delivered Sample | | **76/3** | | | |
| **ČZ a.s** | Work Execution in 2020 | | **200/8** | | | |
| **Vakuum servis, s r.o.** | Sample Analysis | | **50/2** | | | |
| **BOSCH DIESEL s.r.o.** | X-ray Diffraction Determination of Depth Distribution of Residual Stresses | | **184/7** | | | |
| **AERO Vodochody** | Analysis of Main Landing Gear Lock Failure | | **60/2** | | | |
| **SÚJB (THE STATE OFFICE FOR NUCLEAR SAFETY)** | Testing and Comparison in the Field of Personal Dosimetry | | **248/10** | | | |
| **CAN SUPERCONDUCTORS, s.r.o.** | Deposition of Thin Layers of Superconducting Material Using IJD Technology | | **92/4** | | | |
| **ÚJV Řež, a.s.** | X-ray Diffraction Analysis of a Sample for Surface Treatment Sponge Jet | | | **70/3** | | |
| **MEDICAL TECHNOLOGIES** | Characterization of Radiation Transfer Er:Glass, Er:YAG Based on the Offer from 18.12.2020 | | | **100/4** | | |
| **ČEZ a.s.** | Biomonitoring of the Environmental Impacts of the Temelín Nuclear Power Plant | | | **280/11** | | |
| **Bosch** | Scratched samples for testing OEM Number: NRI039311 | | | **255/10** | | |
| **UJP Praha a.s.** | Study of Fracture Surfaces and Polished Sections of Zr-Samples after Transition Experiment | | | **160/6** | | |
| **CHARVÁT AXL, a.s** | X-ray Tensometric Measurements of Surface Residual Stress of Ground Surfaces of Forging Samples "P" | | | **94/4** | | |
| **TRISKEM** | DGA SHEET 5x20 cm, package of 10, DGA SHEET 10x20 cm, package of 10, DGA SHEET 20x20 cm, package of 10 | | | **82/3** | | |
| **Rail Safety Inspection (Drážní inspekce)** | Fractographic Analysis and Determination of Causes of Fracture of Switch Tongue No. 32 at MU Station Kladno | | | **157/6** | | |
| **UJP Praha a.s** | Development of Methodology for Measuring Stress in Oxide and | | | **50/2** | | |

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|---|---|---|---|---|---|---|
| | Adjacent Metal of Zr-Alloys and Verification on Known Samples | | | | | |
| **MPO** | Preparation of Training Materials for Employees of Affected State Administration and Local Government Authorities Involved in the Licensing Processes of NJZ Construction in the Czech Republic | | | **299/12** | | |
| **UJP Praha a.s.** | Analysis of Residual Stresses and Structural Parameters on Oxide Layers and Adjacent Metal of Alloy from 29.4.-31.10.21 | | | **100/4** | | |
| **Multi-Wing CZ.a.s** | Analysis of Fractures of Plastic Blades Type 4HR/40/PAG | | | **50/2** | | |
| **Mondi Steti a.s.** | Analysis of Pap. According to Electron Microscopy/10 | | | **50/2** | | |
| **UAM Brno** | Analysis of Defect of Level Gauge Nozzle PG43 EDU4 | | | **50/2** | | |
| **NCK MESTEC** | Determination of the Course of Instrumental Microhardness of Structural Objects after Model Aging | | | **130/5** | | |
| **SÚJB (THE STATE OFFICE FOR NUCLEAR SAFETY)** | Testing and Comparison in the Field of Personal Dosimetry | | | **248/10** | | |
| **ÚJV Řež** | Calculation of Surface Temperature of UOS | | | **82/3** | | |
| **VZÚ Plzeň** | Measurement of Residual Stress Distribution of HVOF Sprayed Coatings Based on Hard Metals | | | **141/6** | | |
| **TU Liberec** | Research Support for Safety Assessment of Technical Solution of Deep Geological Repository VVZ 354205 | | | **79/3** | **211/8** | **60/2** |
| **ALVEL,a.s.** | Application of Thin Protective Layers for Nuclear Fuel Coating | | | | **225/9** | |
| **SÚRAO (RADIOACTIVE WASTE REPOSITORY AUTHORITY)** | Research Support for Safety Assessment of Technical Solution of Deep Geological Repository - FEPS Analysis | | | | **421/17** | **142/6** |
| **Czechatom** | Independent Computational Verification of Small Modular Reactor DAVID | | | | **681/27** | |
| **ČZ** | Material and Fracture Analyses in 2022 | | | | **290/11** | **70/3** |
| **ČEZ a.s.** | Ensuring Biomonitoring of Atmospheric Deposition of Radionuclides Using Bioindicators | | | | **280/11** | |
| **ÚJV Řež** | Research Support for Safety Assessment of Technical Solution of Deep Geological Repository - Radionuclide Research | | | | **216/9** | **248/10** |
| **TRISKEM** | DGA sheets | | | | **105/4** | **195/8** |

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|---|---|---|---|---|---|---|
| **CHARVÁT AXL** | X-ray Tensometric Measurements of Surface Residual Stress of Ground Surfaces of Cylinder Samples "D1" | | | | **77/3** | |
| **UJP PRAHA** | Study of Fracture Surfaces and Polished Sections of Zr-Samples after Corrosion Transition Experiment | | | | **200/8** | |
| **AIT** | Report on the Implementation of a Test Environment Demonstrating the Suitability of QKD in Optical Fibers Installed along Railway Tracks | | | | **513/20** | **501/20** |
| **UJP PRAHA** | Analysis of Residual Stresses and Structural Parameters on Oxide Layers and Adjacent Metal of Alloy E110M | | | | **100/4** | |
| **ÚJV Řež** | Implementation of Inventory Update and Properties of Radioactive Waste Designated for Deep Geological Repository - Part 1 Update of VJP | | | | | **783/31** |
| **ČEZ** | Analysis of Cut Sample of Feedwater Nozzle Pipe of Steam Generator at Dukovany Nuclear Power Plant | | | | **250/10** | |
| **DELTA** | X-ray Diffraction Diagnostics of Saw Blades | | | | **74/3** | |
| **SÚJB (THE STATE OFFICE FOR NUCLEAR SAFETY)** | Testing and Comparison in the Field of Personal Dosimetry | | | | **248/10** | |
| **ŠKODA JS a.s.** | Preparation of Opponent Reports for SÚJB | | | | **155/6** | |
| **ÚAM Brno** | Analysis of Delivered Pipe Section | | | | **60/2** | |
| **ÚJV Řež** | Calculation of Dose Rate and Surface Temperature of UOS | | | | **95/4** | |
| **ÚVJ Řež** | Research Reports for ÚJV Řež, a.s. | | | | | **600/24** |
| **ESC Aerospace** | Collaboration and Provision of Expert Support in the Lunar Vicinity Complex Environmental Explorer (LVICE2) Project | | | | | **825/33** |
| **ČEZ a.s.** | Ensuring Biomonitoring of Atmospheric Deposition of Radionuclides Using Bioindicators | | | | | **280/11** |
| **AEROVodochod** | Analysis of Damaged Partition 26 | | | | | **200/8** |
| **Rail Safety Inspection (Drážní inspekce)** | Preparation of Fractographic Analysis of Damaged Parts of Closing Hooks | | | | | **82/3** |
| **VZÚ Plzeň** | Residual Stress Measurement - X-ray Diffraction | | | | | **102/4** |

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|---|---|---|---|---|---|---|
| **Narran** | Development and Production of 2 Pieces of Temperature-Stabilized Crystal Furnaces with Control Electronics | | | | | **200/8** |
| **AŽD Praha** | Experiments Focused on Comparing Fatigue Behavior of Bodies from Original Cast Material and Bodies from Forged Material | | | | | **75/3** |
| **UJP PRAHA** | Fractographic Analyses of Fracture Surfaces of Zr-Alloy Samples | | | | | **200/8** |
| **SÚJB (THE STATE OFFICE FOR NUCLEAR SAFETY)** | Testing and Comparison in the Field of Personal Dosimetry | | | | | **248/10** |
| **UJP PRAHA** | Evaluation of ZrO2 and Fuel Coating Samples Using XRD | | | | | **186/7** |
| **IFE** | Radiation of 10 pellet Tantilium | | | | | **201/8** |
| **SÚJB (THE STATE OFFICE FOR NUCLEAR SAFETY)** | Update of Educational Publication "Radiation from Natural Radiation Source" | | | | | **70/3** |
| **JRC (EUROPEAN COMMISSION)** | Fractographic analysis | | | | | **319/13** |
| **ÚJV Řež** | Climate Change Calculations | | | | | **94/4** |
| **ČEZ** | Analysis of Damaged Blade from NT1 TG 11 | | | | | **50/2** |
| **AERO Vodochody** | Analysis of Damaged Suspension Forging | | | | | **90/4** |
| **SÚRAO (RADIOACTIVE WASTE REPOSITORY AUTHORITY)** | Independent Assessment of Operational Events at the Temelín Nuclear Power Plant for 2023 | | | | | **157/6** |
| **ZČU Plzeň** | Diffraction Analysis of Macroscopic Residual Stresses in Laser-Treated Fillet Welds | | | | | **97/4** |
| **SÚRO** | Independent Assessment of Operational Events at the Temelín Nuclear Power Plant for 2024, 2025, 2026, 2027 | | | | | **124/5** |
| **IRSN** | Provision of Services and Research Work for IRSN | | | | | **126/5** |
| **UJP PRAHA** | Research and Development of Radiation-Resistant Chip for Signal Processing from Silicon Sensor | | | | | **1000/39** |
| **TÚ Liberec** | Research Support for Safety Assessment of Technical Solution of Deep Geological Repository | | | | | **414/16** |
| **OHB Czechspac** | RocketRoll-Preliminary European Reckon on Nuclear Propulsion for Space Applications | | | | | **1357/54** |

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| **SÚJB (THE STATE OFFICE FOR NUCLEAR SAFETY)** | Preparation of Documentation on the Issue of Increased Concentrations of Radon Volume Activity in the Vicinity of Heaps and Dumps | | | | | **314/12** |
| **Bundesdruckerei** | Hardware efficient Consensus in Quantum Networks for Consistency Checks in Distributed Applications | | | | | **446/18** |
| **Ministry of Defence** | Undisclosed | | | | | **690/27** |
| **Contract research under 50 000 CZK** | Various titles | **396/16** | **316/12** | **302/12** | **528/21** | **144/6** |
| Total | | **7675/302** | **3713/146** | **3533/140** | **6019/238** | **11313/446** |

Note: List and describe contract research activities with a revenue in a given calendar year, regardless of the amount of financial revenue.

### 3.4 Research results with existing or prospective impact on society

The evaluated unit shall briefly comment on a maximum of 10 (considered most significant by the evaluated unit) research results already applied or realistically heading towards application during the period of 2019–2023, based on the overview annex table 3.4.1 (it is recommended to indicate results with a link to projects listed in indicator 3.3). The evaluated unit must demonstrate in its description that the research results have led or will soon lead to positive impacts[29], on society (e.g. description of how the results are used by various users, the range of persons/institutions for which the result is relevant, measurable economic impacts, etc.). The evaluated entity shall indicate in its commentary whether the gender dimension is considered in these results and discuss the impacts of the results regarding sustainability.

*Maximum range 300 words/result.*

**Self-assessment:**

The faculty considers these selected results to be very important with the potential for positive impact on society*:

As part of the project „Modernization of the Large Research Infrastructure VR-1 - Training Reactor for Research Activities“ (CZ.02.1.01/0.0/0.0/18_046/0015833-1), the **VR-2 subcritical reactor** was designed, built and commissioned between 2020 and 2023. It is a new nuclear facility in the Czech Republic and the second (fission) nuclear reactor operated at CTU. The VR-2 reactor allows observing the behaviour of neutrons in fission systems under conditions of high inherent safety and was completely designed by the faculty. It is a nuclear facility operating with a combination of natural and enriched uranium fuel moderated by light water. The core is primarily controlled by a small, compact D-D neutron generator. The VR-2 reactor has been designed to be as flexible as possible and to offer a wide range of experimental possibilities. The facility allows for changes in the grid of the core (square or triangular arrangement), including changes in the fuel rod spacing, the use of an optional external neutron source (neutron generator or radionuclide neutron source), variable moderator level, and possible changes in moderator temperature (heating/cooling). The facility will significantly expand scientific research activities at the large research infrastructure and support educational activities in the field of nuclear engineering at the faculty. The facility will be used in both experimental neutron and reactor physics. Specifically, the VR-2 reactor will offer tasks

[29] See Terms definition.

for determining microscopic and macroscopic parameters of nuclear reactor cores, determining kinetic parameters of nuclear reactors, studying safety characteristics of nuclear devices, testing detection systems, and verifying computational programmes. Although the facility is in its early stages of operation, there is already considerable interest in its use. Cooperation agreements with two foreign partners have already been established. One is the Aalto University in Finland and the other is the Philippine Nuclear Research Institute.

**Experimental instrumentation NIFFLER for neutron imaging.** This functional sample of an experimental facility for neutron imaging is intended to research optically opaque objects' internal structures and material composition. The functional sample was developed over three years (2021-2023) at the large research infrastructure The VR-1 Nuclear Experimental Hub with the support of the research projects of the large research infrastructures VR-1 - School Reactor for research activity LM2018118 (2021-2022) and WCZV IV - Nuclear Experimental Center VR-1 - LM2023073 (2023) and the CTU doctoral research project Neutron radiography facility at the training reactor VR-1 SGS21/173/OHK4/3T/14 (2021- 2023). The functional sample is a unique experimental facility that has enabled research in the field of neutron imaging at very low power neutron sources. The use of neutron imaging at very low power neutron sources, such as low power research reactors, was very limited until its development. With the development, the FNSPE became one of five research institutions capable of performing neutron radiography on very low-power reactors and the only research organization in the world capable of performing three-dimensional neutron tomography. Studying the internal structure of objects of various origins and opening research opportunities for non-commercial users who do not have sufficient financial resources to conduct experiments in high-power research reactors abroad, or who have objects that cannot be transported abroad. For example, in the field of cultural heritage preservation, the facility can be used by the National Gallery Prague or the Institute of Archaeology of the Academy of Sciences of the Czech Republic, with whom FNSPE has already established cooperation in this area.

**High-density Nuclear Fuel.** This functional sample of high-density nuclear fuel for light water reactors has been designed and fabricated in cooperation with UJP Praha within the TACR Theta project “Utilization of Advanced Materials for New Types of Nuclear Fuels” that was successfully concluded and defended. The design and functional samples of high-density fuels are now being utilized within the CANUT2 – National Competence Centre for Nuclear Research framework and will be implemented into the VR-2 reactor during 2026-27. After the introduction of several fuel pins into the VR-2 core, neutronic benchmark will be measured and provided to the international community for code validation within the ICSBEP project of OECD/NEA. The concept developed, its introduction, and its experiment at VR-2 will thus lead to improved code capabilities through additional validation of new fuel designs. In addition, the developed concept can be adopted by one of the international fuel vendors (Westinghouse Electric Company, FRAMATOME, Kepco NF, GNF) and qualified for the current reactor fleet. Lower operating temperatures and higher uranium density will result in economic and safety benefits, improving the overall performance of current light water reactors, their safety, and their economy.

**A sorbent, a set and a device for the separation of 213Bi from the 225Ac mixture and its radioactive transformation products** (CZ patent). In the time of its creation, the only one 225Ac-213Bi radionuclide generator for clinical use, restricted only for research use, was commercially available. It is using strong cation exchanger in the stationary phase eluted with 0.1M HCl/0.1M NaI solution with the yield about 76%, its disadvantage is mainly limited radiation stability at longer time

scales and limited separation factor. The developed system uses inorganic absorber based on zirconium hydrogenphosphate (ZrP) incorporated into polyacrylonitrile matrix with the possibility of variable ZrP load up to 85%. Such composite absorber ZrP-PAN has an advantage of much higher radiation stability – resulting in longer use and lower contamination of the eluted product – and with the elution 0.3 M NaI in 0.0075 M HCl reaches separation factor Bi/Ac of approx. 6000. The patent protects equipment and sorption material important for the design of the 225Ac/213Bi radionuclide generator, which is used in preclinical and clinical research. The invention substantially improves the radiation stability of the sorbent and therefore the generator itself. From an economic point of view, it helps to set up a source of an unavailable medical radionuclide - 213Bi itself is a very important and socially valuable radionuclide for cancer therapy. The patent is used and continuously upgraded by its inventor FNSPE CTU to ensure appropriate reaction on the developments in the radiopharmaceutical clinical field.

The **SpacePix Radiation Monitor (SXRM)** is a next-generation space radiation instrument, developed and launched within the ESA-funded SpacePix2 project. It consists of five layers of SpacePix ASICs, separated by copper absorbers, enabling precise detection and characterization of charged-particle ionizing radiation. SXRM is capable of measuring Van Allen belt particles, galactic cosmic rays, and solar energetic particles, with an energy detection range of 0.1 to 10 MeV for electrons and 1 to 200 MeV for protons. Unlike conventional space radiation monitors, SXRM can simultaneously detect all relevant charged particles within a single instrument, enhancing its versatility for scientific and operational space missions. SXRM was successfully deployed on VZLUSat-2, a Czech satellite launched in January 2022, where it has been continuously collecting space weather data and validating its performance in Low Earth Orbit (LEO). Its superior performance, lower power consumption, and compact design surpass the capabilities of NGRM (Next Generation Radiation Monitor), a widely used radiation instrument in European satellites. Given its success, SXRM is planned for deployment onboard ESA's IoD/IoV mission, further demonstrating its potential for future space missions. SXRM integrates an onboard RISC microprocessor, performing real-time data processing, including calibration, cluster reconstruction, and track reconstruction using pattern recognition techniques based on energy deposition in multiple sensor layers. Additionally, it features a dosimetric mode, generating histograms for electrons, protons, and heavy ions, making it suitable for both real-time space weather monitoring and detailed radiation research. Building upon the technological advancements of SpacePix2, SXRM represents a new standard in space radiation monitoring, ensuring precise radiation measurements for satellites, space habitats, and interplanetary missions. Its miniaturized yet highly capable architecture is paving the way for enhanced radiation protection strategies in both commercial and scientific space exploration.

The **BICZEPS Flight Model** is the final operational version of the BICZEPS instrument, developed for precision radiation measurements in space missions. As the culmination of the BICZEPS project, it integrates advanced active and passive radiation detection technologies to monitor both charged and neutral ionizing radiation particles. In Low Earth Orbit (LEO), at the altitude of the International Space Station (ISS), neutral ionizing radiation, such as albedo neutrons, contributes to 20–25% of the total ionizing dose, making its detection crucial for radiation hazard assessment and astronaut safety. The BICZEPS Flight Model features a hybrid detection system, combining active silicon-based detectors with a suite of passive dosimeters for intercalibration. The active detectors include: SpaceDOS radiation monitor, a silicon diode-based sensor for precise real-time dose measurements. Silicon microstrip detector, offering a large detection area and broad angular coverage for accurate radiation flux mapping. A specialized variant of the SpacePix radiation monitor, optimized for

operation inside spacecraft, providing detailed particle identification and trajectory tracking. The BICZEPS project has already influenced next-generation space radiation detection, with its core technologies incorporated into SXRM detectors aboard VZLUSat-2 and its methodology applied to outlined missions such as LVICE2. The flight model was initially planned for deployment on the BION M-2 spacecraft, intended to serve as the primary radiation monitor for radiobiological experiments in microgravity. However, due to geopolitical changes, the spacecraft and launch vehicle had to be reassigned. Despite these mission changes, BICZEPS has established a foundation for future space dosimetry, with its modular and adaptable design enabling integration into various space environments, from low-Earth orbit to deep-space exploration. Its highly versatile detection technology is paving the way for enhanced radiation protection strategies for both crewed and uncrewed space missions.

**Method of decontamination of the internal surfaces of the primary circuit of a nuclear power plant and decontamination solution** (CZ patent). The subject of the patent is a decontamination medium for decommissioning based on a solution of potassium peroxydisulfate in sulfuric acid, which can oxidize the basic building components of corrosion layers in primary circuits of VVER-type nuclear power plants with the help of supplied silver ions. The medium uses the oxidative capability of peroxydisulfate in the catalytic presence of Ag+ ions on Cr(III) and Fe(II) compounds building the corrosion layers, the oxidation of which causes disruption and dissolution of the corrosion layer and releases incorporated radionuclides. The advantage is the low temperature (35-60°C) at which the process proceeds with good efficiency, which well overcomes standard decontamination procedures and thus brings economic benefits. Additionally, this medium is recyclable by electrochemical oxidation of the sulphates present to peroxydisulfate at higher electrode current densities while separating the metals and radionuclides in the cathode space, what leads also to minimizing radioactive waste. The socio-economic relevance of this work aims on growing demand on decommissioning processes and methods in nuclear industry and, when nuclear power plants are being shut down at the end of their life cycle. In addition, current properties and technology of the developed medium have potential for low-cost application, minimization of radioactive waste and relatively simple application in nuclear industry. Currently, its improvement for operational decontamination is being developed and testing it on real power plant samples is planned. In nuclear sector, the application of the new developments requires long-term testing to make them ready and validated for operational application; FNSPE and UJV are in close collaboration with the end-user to tune and fulfil all the requirements.

**Method for isolation of Ac from mixture of Radium, Actinium and Thorium** (European patent). Actinium-225 is a therapeutic radiopharmaceutical that is entering the phase of a number of preclinical and clinical studies and its current availability is very limited. The isolation procedure of Ac-225 is important in the preparation of this medical radionuclide for targeted alpha particle therapy. Ac-225 has been shown to play an important role as a therapeutic radionuclide and thus its separation from irradiated target materials, as well as reprocessing of the original irradiated target with Ra-226, is important and highly desirable. The rapid and high-quality processing of irradiated material and the recovery of the target nuclide is crucial in the production of related radiopharmaceuticals. The subject of the patent protection is the isolation of actinium from a mixture of radionuclides. The separation procedure is carried out in multiple steps on ion-exchange columns in order to obtain a pure radionuclide fraction Ac. This process finds application in the production of Ac-225 from Ra-226 after target irradiation on a cyclotron and in a nuclear reactor. This is an intensively developed area of preparation and separation of desirable radionuclides for

alpha particle therapy. The FNSPE in cooperation with the Nuclear research institute (UJV Řež) plans further use in the production of actinium-225 at the accelerator at the UJV Řež, and related commercial applications. In summary, this European patent describes and protects a method for 225Ac isolation from a mixture of radionuclides. This method is therefore crucial for its further preparation and practical use, and the result will also help in the preparation of target material for further irradiation and recycling. With regard to medical applications, the result has a potential of a broad social and economic impact related to intensification of use of 225Ac and its daughters in clinical praxis.

**Method of preparation of zirconium oxide nanoparticles** (CZ patent). The invention describes a method of preparation of nanoparticle zirconium oxide or zirconium oxide doped with at least one other metal selected from the group including Ca, Mg, Y, Nb, and Er. Synthesis is based on the photoinduced precipitation of a nanocrystalline solid phase. This method was developed directly at FNSPE, keeping the know-how and using it for various preparations, while from a worldwide perspective, radiation methods are used relatively rarely, and only for some selected materials. The main advantage of this method is that it can be transferred to a large scale, allowing hundreds of grammes of product to be prepared, and it could be economically viable for industrial production. Another advantage is the procedure itself, which allows doping of the final phase with the chosen exact stoichiometry of the doped elements and with a relatively narrow particle diameter distribution. The prepared zirconium oxide can be used for further processing, for example as a high surface area active filling of a polymer composite sorbent usable for the sorption of radionuclides during the purification of decontamination solutions (https://doi.org/10.1007/s10967-022-08598-2) or optical material. This patented method is also applicable for the analogous preparation of nanocrystalline $HfO_2$, which has been investigated as an additive that increases the light yields of organic scintillators (https://doi.org/10.1021/acs.nanolett.4c00681). This special preparation method is now also being used by patentees to prepare mainly scintillation nanoparticles on a pilot plant scale to produce materials for collaborative and applied research. The method is universal and allows the production of various materials on the basis of a specification and for various highlighted fields, from detection physics (nanoscintillators), through separation and material chemistry (sorption materials) up to radiopharmaceuticals (photodynamic therapy, carriers).

**MMG Medical Tools, 4DFlowDataProcessing** (https://geraldine.fjfi.cvut.cz/mmg-medical-tools/)
A set of tools for processing medical data was developed by the Mathematical Modelling Group at FNSPE in collaboration with IKEM Hospital in the frame of the common project financed by the Ministry of Health (Analysis of flow character and prediction of evolution in endovascular treated arteries by magnetic resonance imaging coupled with mathematical modeling).
The toolkit includes the following tools:
MOLLI Registration – A tool for registering Modified Look-Locker Inversion (MOLLI) images from magnetic resonance imaging (MRI). MOLLI sequences consist of images with varying intensity, making standard registration methods ineffective, as they typically rely on the assumption of constant brightness intensity between the corresponding pixels. To handle MOLLI sequences, a new method has been developed.
ECV Evaluation – This tool calculates the extracellular volume (ECV) of myocardial tissue based on registered MOLLI images.
Bloch Simulator – An implementation of a solver for Bloch's equations that describe the relaxation of hydrogen atoms during MRI scanning. The software also includes an inverse problem solver, which

allows the extraction of relaxation-time maps from real MRI images. These maps can be used to diagnose myocardial tissue damage.
4DFlowDataProcessing – A tool for processing 4D-flow MRI data, which consists of time sequences of 3D images from magnetic resonance imaging. This tool enables better visualisation of measured data as well as quantification of blood flow in specific regions.
The MMG medical tools were tested by IKEM and are now being used in medical practice.

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*In the natural sciences, the gender dimension does not usually affect the results of physical experiments or mathematical theories; i.e. the gender dimension cannot generally be considered in the results of fundamental research in the fields in which the faculty is involved. In applied research conducted by the faculty, the gender dimension is often inherent, for example in the development of nuclear reactor design (safety first principles) or advanced radiopharmaceuticals (targeted therapy). This applies to all the results presented. At the same time, we are strictly committed to ensuring that scientific advancements benefit everyone, regardless of gender.
The direct impacts of the results of both fundamental and applied research with regard to sustainability are difficult to quantify but undeniable. The focus on reprocessing nuclear waste, decommissioning old nuclear facilities and developing new nuclear technologies such as nuclear fusion creates a comprehensive approach to sustainability. By focusing on recycling and waste minimisation, these technologies can reduce the environmental impact of nuclear energy. This approach not only solves current problems but also supports the transition to cleaner energy sources, thereby ensuring a sustainable future for society. Space research fosters international cooperation, bringing together scientists, engineers, and policymakers from around the world to work on common goals. This collaboration promotes peace, understanding, and shared knowledge. It inspires future generations to pursue careers in science, technology, engineering, and mathematics, and encourages curiosity and innovation. It is impossible to sustain any responsible society without continuous progress in science and research.

Table 3.4.1 - Overview of research results in the period under evaluation

| Type of result[30] | Year of application | Name |
|---|---|---|
| Large-scale design and technical work | 2023 | VR-2 subcritical reactor |
| Functional Sample | 2023 | Experimental instrumentation NIFFLER for neutron imaging |
| Patent, Industrial Property | 2023 | A sorbent, a set and a device for the separation of 213Bi from the 225Ac mixture and its radioactive transformation products |
| Prototype, Functional Sample | 2022 | The SpacePix Radiation Monitor |
| Flight Model, Functional Sample | 2022 | Flight model of the BICZEPS instrument |
| Utility model, Functional Sample | 2022 | High-density Nuclear Fuel |
| Patent, Industrial Property | 2021 | Method of decontamination of internal surfaces of the primary circuit of a nuclear power plant and decontamination solution |
| European patent | 2020 | Method for isolation of Ac from mixture of Radium, Actinium and Thorium |
| Patent, Industrial Property | 2020 | Method of preparation of zirconium oxide nanoparticles |

[30] Specify the specific type of result. Add rows as needed.

| | | |
|---|---|---|
| Open source code, Software | 2019 | MMG Medical Tools |
| All results from the period under evaluation can be found on https://v3s.cvut.cz/anonymous/searching | | |

Note 1: Please list and describe the results already applied in practice or heading towards application in practice with existing or prospective impact on the society (e.g. domestic or foreign patents, sold licenses, spin-offs, prototypes, varieties and breeds, methodologies, significant analyses, surveys, expert outputs for policymaking or other forms of non-publication outputs, etc.). Indirect results of research, development and creative activities with documented societal impact, e.g. expert activities, services to the public/government/scientific community, may also be reported.

## TRANSFER OF RESULTS INTO PRACTICE

### 3.5 Transfer of results into practice

The evaluated unit shall briefly describe its system for transferring results into practice. It shall also indicate up to five of the most typical users of its results, whether in the university environment or in the non-university application/corporate sphere, detailing how it collaborates with them and how it seeks out new users (using a maximum of five specific examples).

It will also indicate whether and how it commercialises R&D&I results (e.g. selling licences, setting up start-up or spin-off companies, etc.)[31], providing brief description of the commercialisation methods used. The effectiveness of the transfer of results and the commercialisation of R&D&I results will be described using a selection of results (max. five) listed in annex table (Table 3.4.1).[32]

Additionally, the evaluated unit shall briefly comment on the funds received during the period of 2019–2023 from non-public, non-grant sources (e.g. licences sold, spin-off revenues, donations, etc.). A full summary shall be provided in annex table (Table 3.5.1).

*Maximum 500 words plus 200 words for each provided example of finding a new user of results and commercialization.*

**Self-assessment:**

FNSPE employs several methods to commercialise its research, development, and innovation (R&D&I) results:

Faculty can benefit from a dedicated Technology Transfer Office at CTU that facilitates the commercialisation of research results. Faculty and university support the patenting of results by financially supporting or fully paying for patent procedures.

FNSPE regularly participates in national and international innovation programs that support the commercialisation of research (provided by e.g., Technological agency of the Czech Republic, Ministry of Industry and Trade, or Horizon Europe). The faculty has established strong collaborations with industry partners, leading to the practical application of research findings in various sectors including joint research projects, and/or the development of innovative solutions.

Among the most important partners are those in the nuclear industry sector, such as, e.g., ČEZ, UJV, Škoda JS, UJP, Doosan Power. The faculty's revenue from non-public sources thus come also from donations from such companies e.g. to fund the Best Thesis Award, scholarships for students working on industry-related problems and the organisation of student and scientific conferences, or (last but not least) by covering the mandatory financial participation in projects.

As an example, long-term cooperation with **ŠKODA JS** can be mentioned. ŠKODA JS designed and constructed the first faculty nuclear reactor VR-1 and has been collaborating with the faculty in the

[31] In the case of military HEIs, their specific position is taken into account when evaluating the commercialisation/evaluation of R&D&I results.
[32] If the commercialisation of R&D&I results is carried out in this way.

field of research for many years. As an illustration can be cited recently completed joint research project "Optimization of the Pitch of Spent Fuel Disposal Canisters and Preliminary Thermal Analysis of the Deep Geological Depository" supported by TAČR and co-financed by ŠKODA JS. ŠKODA JS also cooperates with the faculty in the field of education by co-leading the student theses and arranging technical visits and internships for faculty students. This mutually beneficial cooperation led ŠKODA JS to decide to financially support the faculty. Since 2011, ŠKODA JS has provided the faculty with an annual donation of 100,000 CZK to support the education of students in the nuclear engineering study program.

Other significant donors include e.g. **IBM** (sponsoring the faculty's activities in the field of quantum informatics including the organisation of Quantum Day), **Korea Hydro and Nuclear Power Company** (within the framework of the agreement between KHNP and FNSPE to promote the activities in the nuclear field), **UJV Řež a.s.** (within the framework of the agreement between UJV and FNSPE on sponsoring activities for students in the nuclear field), **Czech Nuclear Society** (within the framework of the agreement between ČNS and FNSPE on sponsoring talented students in the nuclear field), **UJP PRAHA a.s.** (within the framework of the agreement between UJP and FNSPE on sponsoring activities for students in the nuclear field), **Broadcom CA CZ, s.r.o.** (within the framework of the agreement between CA CZ and FNSPE on sponsoring students talented in mathematics).

Without co-financing from industrial partners, the faculty would not be able to participate in key European or national projects such as **PREDIS** (The pre-disposal management of radioactive waste, EURATOM) or **SpacePix** (TAČR, ESC Aerospace).

In addition to the monetary donations, the faculty received from their partners for free use or as a gift expensive equipment such as Raman Spectrograph (**Institute of Biophysics**), Metallographic Microscope (**Institute of Plasma Physics**), EDS Spectrometer (**UJP Praha a.s.**), BSE Detector (**UJP Praha a.s.**), Ionization Chamber + HV Source (**UJP Praha a.s.**), Gamma-ray Probe with Scintillation Crystal (**Georadis s.r.o**.), Planmed Sophie Mammograph (**EUC Clinic Ústí nad Labem**), Nuclear Power Plant Simulator (**KHNP Central Research Institute**).

Finally, sponsorship of conferences organised by faculty is also a significant item, without which these events would have a much more limited impact and would not be accessible, for example, to students.

Table 3.5.1 - Summary of non-public revenues received during the period under evaluation

| Type of revenue | Revenue (in thousands CZK/EUR) | | | | |
|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | 2023 |
| **Gift** | **321/13** | **267/11** | **192/8** | **205/8** | **763/30** |
| **Sponsor/ Donations** | | **100/4** | | **171/7** | |
| **The co-financing of the project** | **1940/77** | **759/30** | **1798/71** | **323/13** | **429/17** |
| Total | **2261/90** | **1126/44** | **1990/79** | **699/28** | **1192/47** |

Note: Enter funds raised for R&D&I from non-public sources besides grants or contract research (e.g. licences sold, spin-off company revenues, donations, etc.) in the calendar year.

POPULARIZATION OF VAVAI

**3.6 The most important activities in the field of popularization of R&D&I and communication with the public**

The evaluated unit shall briefly describe its main activities related to the popularisation of R&D&I and communication with the public (e.g. popularisation lectures, citizen science initiatives, etc.) during the period of 2019–2023 and provide up to 10 examples that it considers the most significant.

*Maximum 500 words plus 200 words for each example given.*

**Self-assessment:**

The FNSPE has been actively involved in popularising research, development, and innovation, as well as communicating with the public. The faculty actively engages with media outlets to share research findings and innovations. This includes interviews, media appearances, press releases, and popularization articles. Researchers from the faculty regularly publish articles in popular science magazines and newspapers. These articles explain complex scientific concepts in an accessible manner, reaching a broad audience. The faculty maintains a dedicated website and active social media presence to share research updates, news, and events. These platforms allow for direct engagement with the public and provide a space for questions and discussions.
The faculty regularly organises public lectures on topics such as nuclear energy, radiation safety, and advanced materials. These lectures are aimed at both the general public and students, providing insights into the latest research and technological advancements:

**Faculty Colloquia**
This is a regular series of lectures attended by Czech and foreign experts informing attendants about the latest research findings. The Colloquium is designed for the general public, faculty academics and students, and guests and visitors outside the faculty.

**University of the Third Age (U3V)**
At FNSPE, U3V combines lectures in the history of physics and popular science lectures with visits to scientific places of work and laboratories and an offer for attendants to take part in experiments of their choice. In addition to the course programme, the course participants can also attend other FNSPE activities, like physics seminars, laboratory demonstrations, and others.

**Young Minds**
The Prague section of the European Physics Society (EPS), Young Minds associates students of FNSPE, the Faculty of Mathematics and Physics of Charles University, and other schools. Their objective is to popularize science among the young and arouse interest in science. Young Minds organize activities where students can present their research in an informal setting, but also events where students can meet experienced scientist quite informally.

The faculty intends to inform potential applicants about the study and the careers open to graduates at such traditional events as e.g., Education Fairs or Open House, and others. The faculty has established partnerships with local schools to introduce students to nuclear sciences through hands-on workshops and classroom visits. These programs aim to inspire the next generation of scientists and engineers. Faculty participates in annual open days and science fairs, where they set up

interactive exhibits and demonstrations. Together, these events attracted thousands of visitors, including families, students and educators. Notable events include (but are not limited to):

**A Day at FNSPE**
At FNSPE, there are many interesting experimental laboratories that can be visited by students from secondary schools. On agreement with the tutor, a bespoke programme may be prepared for each group of visitors.

**The Night of Scientists**
In October, during the Night of Scientists, one of the biggest scientific and popular events not only in the Czech Republic but also in Europe, the faculty opens its doors to those who want to see the GOLEM tokamak, PlasmaLab and many other facilities. On this occasion, popular science lectures are held, and amusing science-based games are organised.

**Become a Medical Physicist for a Day**
This event introduces the work of a radiological physicist or technician working in a hospital and about other possible jobs and careers for students of the Department of Dosimetry and Application of Ionizing Radiation. They attend lectures and try to operate an X-ray and a radionuclide, prepare a radiotherapy plan for oncological patients, and visit the Motol and Thomayer Hospitals.

**Become a Lady Scientist for a Day**
This event is designed especially for female students on the occasion of the International Women's and Girls' Day in Science. It is organized in cooperation with the Brookhaven National Laboratory (BNL-CZ) and CERN-CZ. Along with particle physics, the attendants will also get acquainted with other fields of study offered by FNSPE.

**Become a Reactor Physicist for a Day**
This event is designed for secondary school students aged 16 and older. They will be able to experience and carry out – in one day - some basic experiments on the VR-1 school training nuclear reactor and learn more about the operation of the fission reactor and its use - in power engineering and other uses in addition.

**Become a Particle Physicist for a Day**
This event is part of an International Master Class project that usually takes place in March. Secondary school students have a chance to work with data from the CERN laboratory and compare them online with students of other foreign universities and directly with CERN scientists.

**Science Week at FNSPE**
Science Week at FNSPE is a traditional semi-social event taking place towards the end of the academic year, during which the faculty´s staff and students prepare about 50 miniprojects, visits to the departments and laboratories, and popular scientific lectures for about 180 attendants. The programme starts on Sunday with an icebreaker session followed by the Fort Břehyard game, during which students face various tasks in mathematics, chemistry, physics and look for logical solutions to problems. From Monday onwards, the attendants work on miniprojects required by laboratories, involving instruments, or measurements outside of the faculty. To have a clearer idea of what scientific work is really like, the participants have to summarise their research results in a paper and present them at the closing session.

These activities have significantly contributed to the popularisation of research, development, and innovation, as well as enhanced communication with the public. The faculty continues to explore new ways to engage with the community and share their scientific achievements.

## IMPLEMENTATION OF RECOMMENDATIONS

**3.7 Implementation of the recommendations in Module 3**

The evaluated unit will briefly describe how it has implemented the recommendations for Module 3 from the previous evaluation period, if applicable.

*Maximum 1000 words.*

**Self-assessment:**

The most frequent recommendation in the last evaluation was to keep on track, which we have tried (and hopefully managed to do), and we hope that this is visible in the self-evaluation report especially in the sections Recognition by the research community, Research projects, Research results with existing or prospective impact on society and Activities in the field of popularization of R&D&I and communication with the public.

International visibility of the faculty's applied research results mentioned by the Panel in the last evaluation is (and will be) further enhanced by participation in prestigious international applied research collaborations under auspices of renowned institutions such as CERN's DRD projects. Results and outputs of these collaboration will become publicly accessible, without any intellectual property protection, increasing their accessibility to the broader international community.

The main criticism raised by the Panel in the last evaluation was related to the income from economic activities/technological outputs and the small contribution of the private (non-public) sector to the financing of the faculty's activities.

We have made efforts to address this difficult task and, apart from the COVID years, when the overall economy in the Czech Republic was in decline, we managed to increase the volume of contracts compared to the previous evaluation, which constitutes a non-negligible part of the faculty's income usable for financing its activities.

We have also succeeded in creating a fund for talented students from donor contributions (the fund with an initial capital of 10M CZK is currently approved at the faculty level and is in the process of being incorporated into university legislation). Besides donations from sponsors to finance prizes for the best master's/doctoral theses, fellowships for students, and the organization of student and/or scientific conferences, this fund represents an important instrument to enhance faculty excellence.

## A LIST OF SUPPORTING DOCUMENTS/LINKS FOR MODULE 3

| Document name | No. criteria | Location (link in HTML) |
|---|---|---|
| Centre of Advanced Applied Sciences (CAAS) | 3.3 | https://caas.cvut.cz/en |
| Strengthening and development of research at the Czech Technical University in Prague with the use of the VR-1 | 3.3 | https://www.vyzkumne-infrastruktury.cz/en/energy/vr-1-training-reactor-for-research-activities/ |

| | | |
|---|---|---|
| Training Reactor research infrastructure for research activities | | |
| Collaboration with CERN - CERN-CZ | 3.3 | https://www.vyzkumne-infrastruktury.cz/en/physic/research-infrastructure-for-experiments-at-cern/ |
| Brookhaven National Laboratory – participation of the Czech Republic | 3.3 | https://www.vyzkumne-infrastruktury.cz/en/physic/bnl-cz/ |
| SpacePix2: Advancing Space Radiation Monitoring with First In-Orbit Deployment | 3.3 | https://starfos.tacr.cz/en/projekty/TJ04000374 |
| Research support for the safety assessment of a deep geological repository | 3.3 | https://surao.gov.cz/en/deep-geological-repository/ |
| A-CINCH – Augmented Cooperation in Education and Training in Nuclear and Radiochemistry | 3.3 | https://cordis.europa.eu/project/id/945301<br>https://www.cinch-project.eu |
| New challenges for spectral theory: geometry, artificial materials and complex fields | 3.3 | https://nsa.fjfi.cvut.cz/david/EXPRO.html |
| ELLECTRA - Efficient Low-energy Electron Cancer Therapy with Terbium-161 | 3.3 | https://electtra.cz/ |
| Quantum secured communication in a critical infrastructure over lines with possible interferences | 3.3 | https://www.cybersecurityhub.cz/en/strategic-projects/czqci |
| Modernization of the Large Research Infrastructure VR-1 - Training Reactor for Research Activities | 3.4 | http://www.reaktor-vr1.cz/en/about-us/vr-2 |
| SpacePix Radiation Monitor | 3.4 | https://indico.esa.int/event/233/attachments/3219/4238/The__SpacePix_radiation_monitor-Matej_Vaculciak.pdf<br>https://wrmiss.org/workshops/twentyfifth/Jirsa.pdf |
| Method for isolation of Ac from mixture of Radium, Actinium and Thorium | 3.4 | https://patents.google.com/patent/WO2017157355A1/en |
| Method of preparation of zirconium oxide nanoparticles | 3.4 | https://doi.org/10.1007/s10967-022-08598-2 |

| | | |
|---|---|---|
| | | https://doi.org/10.1021/acs.nanolett.4c00681 |
| MMG Medical Tools, 4DFlowDataProcessing | 3.4 | https://geraldine.fjfi.cvut.cz/mmg-medical-tools/ |
| List of results from the period under evaluation | 3.4 | https://v3s.cvut.cz/anonymous/searching |