

With the power of science - for the betterment of the world

**The Institute of Physics (HIP)
strategy implementation plan for 2022 in the period
2021–2024**

(5.10.2021)

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1 STRATEGIC FRAMEWORK

1.1 CHANGING ENVIRONMENT

The Finnish Institute of Physics, whose English name is Helsinki Institute of Physics (HIP), is a joint national institute of five universities, of which the Radiation Protection Center STUK acts as a temporary associate member. The structure as a joint institution of universities provides a functional and financial framework for utilizing large international research infrastructures, which would not be possible as an individual university. HIP's national role gives the opportunity to work in international research institutes in the bodies that guide their activities and make decisions. The research institute takes care of Finland's cooperation with the European Organization for Nuclear Research (CERN) and the European Antiproton and Ion Research Institute (FAIR).

HIP receives funding from the national mission of the Ministry of Education and Culture, earmarked for international activities and its support activities. The funding of the national mission in the period 2021–2024 is 26% lower than in the previous strategy period. The decrease will be compensated by the increasing funding of HIP's contracted universities. In the period 2021–2024, the funding of the national mission covers approximately 60% of the basic funding, and the funding of the contracted universities approximately 40%.

Additional funding can be obtained e.g. From the Academy of Finland, Business Finland and the EU.

HIP's operations are guided by HIP's long-term strategy (November 16, 2020) and the strategies of the member universities. Finland's national CERN strategy (SA 13/02) and the update of the European particle physics strategy announced on June 19, 2020 provide a backbone for long-term and versatile work for the development of research, researcher training, technological development and technology transfer, and social impact. At the international level, references are also CERN's Medium-Term Plan for the period 2021–2025, as well as NuPECC's Long Range Plan 2017 and ApPEC's Euro-pean Astroparticle Physics Strategy 2017–2026.

In the strategy period 2021–2024, the focus of CERN construction activities is the construction of the High Luminosity LHC, along with Run 3. HIP coordinates Finland's part in the construction of FAIR 2011–2027 and in FAIR research activities.

HIP's most significant challenge is securing long-term funding. Operational risks are unexpected events of large international projects and delays in the construction and operation of research equipment. In relation to long-term international operations, sudden changes in the financial situation and changes in exchange rates are a significant threat.

1.2 MISSION

The Physics Research Institute is a joint institution of the University of Helsinki, the University of Jyväskylä, the University of Tampere, the Lap-peenranta-Lahti University of Technology and Aalto University, which handles national tasks. HIP works in connection with the University of Helsinki.

The mission of the research institute is to carry out and promote basic and applied research in theoretical and experimental physics, technology development related to particle accelerator centers, and to participate

for research training. The research institute takes care of Finland's cooperation with CERN and participates in other international research cooperation. The department also takes care of Finland's participation in the construction and research activities of the international laboratory Facility for Antiproton and Ion Research (FAIR), which will be built in Darmstadt between 2011 and 2027. The research institute can also take care of other international cooperation projects in subatomic physics that are of interest to Finland.

1.3 Profiles and areas of emphasis

HIP's main task is based on Finland's state memberships in CERN and FAIR, and their full utilization. The main goals of CERN and FAIR activities are:

1. Visible participation in international cooperation in cutting-edge basic research in high-energy physics and nuclear physics.
2. Promotion of applied research related to accelerators, radiation detectors and data processing.
3. Physics and new technology research training in a project-based challenging international research environment.
4. Promotion of technological know-how of Finnish companies and commercial utilization of CERN and FAIR projects.
5. Utilization of CERN and FAIR in science education and promotion of general science education.

HIP's activities and research questions are closely related to the European Particle Physics Strategy and other strategies and plans mentioned in section 1.1. The operations of the Physics Research Institute are also guided by the strategies and focus areas of the member universities.

The effectiveness is increased by strengthening the industrial cooperation between Finland, CERN and FAIR, by promoting open science and science activities in schools, and by actively working with new partnerships to utilize research results.

1.4 STRATEGIC CHOICES AND GOAL STATES

HIP's strategy map 2021–2024 (*HIP's target areas in bold and italics*):

SCIENCE AND LEARNING BELONG TO EVERYONE

- 1. An international, respected interdisciplinary partner.**
2. Research information for social decision-making.
- 3. High-quality and up-to-date research infrastructures.**
- 4. Open science - research infrastructures and materials openly available.**
- 5. Analytics and data management of open materials.**
6. Appropriate premises.
- 7. A strong connection between research and teaching.**
- 8. An attractive trainer for Masters and PhDs.**
9. Smooth progression of studies.
- 10. Significant science educator and communicator.**
11. A well-known, desired and accessible continuous learning environment.

OPENNESS STRENGTHENS SCIENCE AND COOPERATION

- 12. A strong global influencer.
- 13. Activity and participation regardless of language and cultural background.
- 14. *Virtual and physical international mobility.***
- 15. *A significant influencer in society.***
- 16. *Business cooperation and innovation activities.***
- 17. Academic freedom and community spirit.

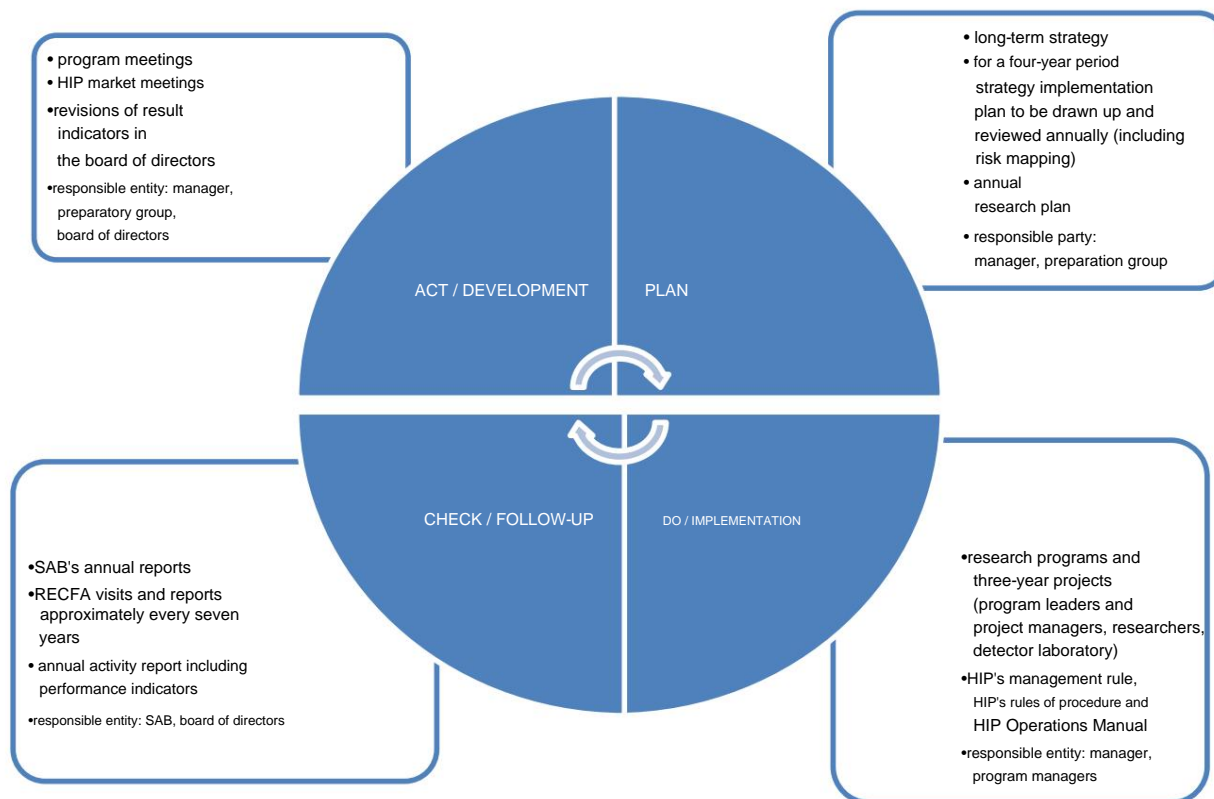
THE BEST PLACE TO STUDY AND WORK

- 18. *A prosperous work and study community.***
- 19. *Attractive employer.***

THE FORErunner OF RESPONSIBILITY AND SUSTAINABILITY

- 20. *Responsibility and sustainability as part of the operating culture.***
- 21. International center for sustainability research and teaching.
- 22. *Strengthening financial room for maneuver.***

1.5 Quality management



The quality system supports the achievement of the goals set for the Institute of Physics. Their implementation is monitored in the enterprise resource planning process with the help of reporting and unit-specific feedback. HIP's operations are governed by HIP's management rules (January 8, 2020), work order (October 7, 2020) and operating manual (September 2, 2021).

The director is responsible for the quality of the institution's operations and results. The directors of the research programs are responsible for the scientific content of the programs. The research coordinator acts as the quality contact person of the Institute of Physics, whose task is to coordinate the institute's quality management. The director and the board of directors are supported by a 6-10-member international scientific advisory board, *the Scientific Advisory Board (SAB)*, which monitors the progress and scientific level of research projects. SAB meets at least once a year, and in addition, SAB members can be consulted on special issues.

Research activities are organized into projects (generally three-year projects), which are evaluated by an expert or a group of experts before a decision is made to approve or continue the project. The reports of external evaluators will also be available to SAB. The board takes SAB's recommendations into account when deciding on new projects.

HIP's research activities are also evaluated in the member universities' own research evaluations. In the evaluation of the University of Helsinki's research in 2019, the University of Helsinki's share of HIPs received the best grade of *excellent (scientific quality, societal impact, research environment and unit viability)* out of all the evaluated areas .

RECFA (*Restricted Committee for Future Accelerators*) evaluates research related to particle physics nationally, in Finland last time in 2017.

The main part of the activity takes place in international accelerator laboratories, especially CERN. They apply quality systems such as the ISO9000 system. Kumpula's campus detector laboratory has a quality manual according to the ISO17025 standard.

Publishing in peer-reviewed journals guarantees the maintenance of research quality. Monitoring in international joint projects guarantees added value in maintaining the quality of research. An example of this is CERN's scientific evaluation committees.

1.6 Risk assessment and management

In a separate Excel sheet. The detector laboratory has its own risk management plan.

1.7 National special tasks, international and university special responsibilities, coordination of networks

Coordination responsibility for Finland's CERN activities

Start date: 1 September 1996

Term:

Resourcing: Funding of the national mission, basic funding of member universities and construction investments with supplementary funding

Description:

CERN is the world's leading versatile research center for particle and nuclear physics. Its 23 member countries jointly participate in the study of the basic structure of matter and the basic interactions of nature in global projects, which no European country would have the opportunity to do alone. CERN's major project, the world's largest scientific instrument LHC, i.e. the Large Hadron Collider, started its research activities in 2010 and it is, among other things, brought clarity to the origin of the mass of elementary particles (the Higgs particle). CERN's other experimental activities include e.g. The ISOLDE laboratory, a leading developer of radioactive ion jets, and the CLOUD experiment investigating climate change. CERN is also a significant technological development platform.

OKM allocates significant national funding to the Research Institute of Physics for CERN activities as part of HY's funding. CERN is on Finland's national research infrastructure roadmap. The upgrade of the LHC accelerator HL-LHC (*High Luminosity LHC*) is also an ESFRI Landmark project.

Coordination responsibility for Finland's FAIR

activities Start date: 1 January 2008

Term:

Resourcing: Funding of the national mission, basic funding of member universities and construction investments with supplementary funding

Description:

FAIR (Facility for Antiproton and Ion Research) is a particle accelerator laboratory established in Darmstadt, Germany, where high-energy and high-intensity ion and anti-proton jets will be produced. Ion jets enable cutting-edge research in four different physics research fields. The accelerator complex contains storage and cooling rings for the particle jets and enables the use of internal points in research. Two superconducting synchrotrons give the possibility of primary ion jets up to uranium nuclei, as well as a wide selection of radioactive ion jets.

The task of the Physics Research Institute is to coordinate Finland's share in construction and research activities. The Ministry of Education and Culture has granted construction funding of 5 M euros for the project. In addition, the Academy of Finland's Research Infrastructure Committee (TIK) made a principle decision in September 2015 on reserving funding for FAIR's construction costs due in 2019 and 2022. In December 2018, TIK granted 840,000 euros of funding for the first installment. FAIR's first research phase, Phase-0, started in 2019, taking advantage of GSI's infrastructure. FAIR is on Finland's national research infrastructure roadmap. It is also an ESFRI Landmark project.

2 DEVELOPMENT MEASURES 2021–2024

The most important development measures in 2022 are:

2.1 STRATEGIC CHOICE 1: SCIENCE AND LEARNING BELONG TO EVERYONE

Goal state 1. An international, respected interdisciplinary partner.

Carrying out national duties

Finland's CERN and FAIR state memberships are coordinated and fully utilized. The main task of the Fysiikan tutkimuskeskus (Fy-siika) research institute is to take care of the cooperation between Finland and CERN. The assignment is based on Finland's national CERN strategy (Academy of Finland 13/02). The Institute of Physics coordinates Finland's share in the construction and research activities of the FAIR research infrastructure.

Full-scale research activity of CERN's experiments

The focus of the research during the operating period is physics research with the LHC collider and the full utilization of the results. The next phase of the LHC experiments – Run 3 – when particles are collided, is between 2022 and 2025. In physics analyses, the determination of the properties of Higgs particles, the study of jets, frontal physics and relativistic heavy-ion collisions in the CMS, TOTEM and ALICE experiments are central.

In CERN's ISOLDE laboratory, radioactive ion beams are produced to study the nuclear structure.

HIP continues its successful participation in CERN's CLOUD experiment, which studies climate change. The ten-year plan of the CLOUD experiment extends to 2030.

Increasing utilization of FAIR state membership

The construction of the research facility in Darmstadt, Germany is underway, and the planned completion date is 2027. FAIR's research activities have started gradually already during the construction period. Finland participates strongly in the construction of the research facility and in the Phase-O physics experiments.

The utilization of FAIR is measured by the number of in-kind deliveries during the construction phase and, as the research facility is completed, increasingly by the publications of FAIR experiments and the responsibilities of the experiments.

Participation in ESA's Euclid mission

The Euclid mission of the European Space Agency ESA is in preparation and the satellite is in the construction phase. The launch of the Euclid satellite is planned to take place in 2023. Starting in 2023, the data obtained from the mission will be analyzed and measured. One of Euclid's nine data centers in total is located in Finland. HIP's researchers are central to the preparation of the mission.

Utilization of ApPEC membership and the synergy of particle and astrophysics

Since the beginning of 2019, HIP has joined Ap-PEC (Astroparticle Physics European Consortium) on the recommendation of its scientific advisory board, and acts as Finland's national representative in ApPEC. Membership brings Finnish particle and astrophysicist communities closer to each other and creates synergies. Membership of ApPEC opens up new international connections and increases Finland's opportunities for influence in the international strategic work of astroparticle physics related to major science projects.

HIP participates in the preparation of the LISA mission of the European Space Agency ESA and the North American Aeronautics and Space Administration NASA. LISA is a space antenna used to study gravitational waves. According to the preliminary schedule, the satellite will be launched in 2034.

In 2021, HIP has become a member of the COSINUS experiment. COSINUS is a dark matter search experiment to be built at the Italian Gran Sasso laboratory, the first results of which are expected in 2024. HIP participates in the theoretical simulations of dark matter and the preparation of the experiment analysis.

Indicators:

Participation in CERN's and FAIR's experiments requires a high level of research and technical talent and financial investments. Peer-reviewed publications and physics exam assignments serve as the main result indicators.

Target status 3. High-quality and up-to-date research infrastructures.

Design, construction and upgrade of CERN and FAIR large detectors

The upgrade of the first phase of CERN's ALICE experiment has been completed in 2018.

The research and development required by the 2016–2025 update of the second phase of the CMS and ALICE trials will be concretized in cooperation with trial collaborations. In January 2018, they received research infrastructure funding from the Academy of Finland for the period 2019-2021.

After Run 3, starting around 2025, the LHC experiments (CMS, ALICE, TOTEM) and the LHC accelerator will be updated for the HL-LHC phase.

Detector and accelerator components are built and/or delivered to the FAIR accelerator center, where possible in cooperation with Finnish companies.

In the strategy period 2021–2024, HIP's FAIR activities will expand with the start of Phase-0 trials in 2020.

The operation of the detector laboratory as an independent infrastructure supporting research programs in a cost-effective and professional manner is further developed.

The computing systems required by the LHC experiments are further developed in cooperation with CSC and NeIC, moving more and more to cloud resources.

Target facilities 4. and 5. Open science - research infrastructures and materials openly available; Analytics and data management of open materials.

As a pioneer in open science

HIP researchers have played a pioneering role in publishing open data from CERN's CMS experiment. HIP supports the opening and scientific and social utilization of CMS data, as well as long-term storage. Kati Lassila-Perini, HIP's Education and Open Data project manager, led CERN's CMS experiment as the person responsible for the Data Preservation and Open Access project.

Opening CMS data strengthens the connection between theoretical and experimental research. Theoreticians outside experimental collaborations can use open, experimental data in their research.

Almost all of HIP's publications are published openly. The key indicator is the share of open publications among peer-reviewed publications and the opening of new datasets.

Target spaces 7 and 8. Strong connection between research and teaching; An attractive trainer for master's and doctorates.

Guiding students to a research-based way of working in an international environment

The research institute offers excellent opportunities for research training in a challenging international project-based environment. In accordance with the national CERN strategy, the research training related to the CERN and FAIR research institutes will be enhanced together with the research schools of the member universities. The scope of research training includes both basic research and research-related device and method development and applications. The research staff of the Institute of Physics actively participates in research training.

CERN's Accelerator Schools are organized in Finland in cooperation with HIP. HIP is active in organizing Nordic instrumentation laboratory work courses. HIP researchers coordinate participation in ESIPAP – European School of Instrumentation in Particle & Astroparticle Physics.

Training and teaching as a collaboration between higher education institutions at CERN

Approximately 15 students from Finnish universities and colleges participate in HIP's summer internship program at CERN and ESRF each year. Summer interns typically get a three-month international work experience and get to participate in orientation-supported, scientifically high-level lectures for summer interns.

The CERN Bootcamp project intended for master's students has been organized in cooperation with three universities of applied sciences in the summer of 2018 and 2019, and *the Bootcamp* for the summer of 2022 is being planned. In the project, student groups try to solve current social problems, often related to sustainability.

Goal status 10. Significant science educator and communicator.

School activities and use of open data (see also target state 20)

The Institute of Physics annually organizes continuing education courses for Finnish subject teachers at CERN and science camps for Finnish high school students at CERN. HIP's three-year project *Education and Open Data* is responsible for the operation and its further development. The project utilizes CERN's open data in elementary and high school teaching, and trains Finnish teachers in different parts of Finland to use open data and tools.

Before the CERN science camp, high school students visit the University of Helsinki or the University of Jyväskylä to listen to lectures and visit laboratories. About 370 high school students and about 60 teachers are taken to the camps annually. Due to the corona situation, visits have not been possible since spring 2020. Visits will start again as soon as the corona situation allows it. Numerous groups of schoolchildren visit the detector laboratory every year, and HIP researchers visit schools to read and write.

In Finland, HIP researchers organize international MasterClass courses coordinated by CERN every year for high school students. HIPs also organize TET training every year.

Outreach

HIP researchers actively and versatily participate in public activities aimed at the general public.

2.2 STRATEGIC CHOICE 2: OPENNESS STRENGTHENS SCIENCE AND COOPERATION

Target state 14. Virtual and physical international mobility.

Utilization of digital technology in a geographically distributed research institute

Mobility is emphasized in HIP's decentralized organizational model. HIP offers researchers working in Finland access to top international research centers such as CERN and FAIR. Digital tools are used appropriately to strengthen research synergies and community spirit and to reduce the research institute's carbon footprint.

Goal status 15. A significant influencer in society.

Social effectiveness of STUK cooperation

STUK's participation in HIPs brings a new contact surface to society and increases the effectiveness of operations. Joint research and operational areas with STUK are radiation detector development and instrumentation, technology transfer and accelerator-based therapy.

HIP cooperation is important in terms of STUK's main themes – Safety, Security and Safeguards –: the prerequisites for the social acceptability of the use of nuclear energy and radiation are safety (sa-fety), security against illegal activities (security) and peacefulness (safeguards).

Target state 16. Business cooperation and innovation.

Promotion of corporate cooperation and CERN/FAIR purchases

HIP promotes technology development and transfer also in the period 2021–2024. Thanks to HIP cooperation, several Business Finland Co-Creation and Co-Innovation projects related to CERN have started and are being prepared at Finnish universities.

In 2022, the project started the previous year to commercialize research will continue. Business Finland's Research to Business project (formerly TUTLI) Detector for Nuclear Safety, Decommissioning and Diagnostic Applications is implemented in cooperation with HIP's detector laboratory and LUT.

HIP develops Finland's industrial cooperation with CERN and FAIR and promotes their technological and commercial utilization. HIP supports efforts to have a national *industrial liaison officer* for CERN and FAIR acquisitions. Finnish industry's in-kind deliveries could increase significantly with support measures. The industry feedback factor is a clear indicator of Finnish industry's deliveries to CERN.

The operation of HIP's technology program supports the experiments and accelerator development of CERN and FAIR, and it also has application possibilities for other major science projects, such as ESRF, ITER and XFEL. External funding and new partners, such as IAEA, CEA and VTT, are actively sought for the projects.

2.3 STRATEGIC CHOICE 3: THE BEST PLACE TO STUDY AND WORK

Target status 18. A prosperous work and study community. (see also target state 20)

Measures of the occupational well-being group

Goals and measures of the Kumpula campus physics work well-being group for the period 2021–2024:

By 2024, the well-being of the members of the university community has improved and progress has been made in terms of equality, non-discrimination and opportunities for participation and influence.

In order to strengthen the feeling of well-being and security, the well-being group comes

- to offer the community an easily approachable welfare group and designated mat-lan threshold contact persons
- to inform about the group's services and people who can be contacted in various situations in the making
- to implement and promote the Code of Conduct:
<https://www.helsinki.fi/en/faculty-of-science/faculty/kumpula-campus-code-of-conduct>
- to promote equality and ethnic equality in the community.

Based on the results of the stress survey conducted by the occupational well-being group, the group proposes the following concrete measures:

1. open discussion sessions are organized in which good practices and experiences are shared and the aim is to improve the working atmosphere of individual groups;
2. building a positive group spirit in HIPs by organizing various social events such as physics colloquiums, spring boating, research group social events such as mushroom picking, exercise, yoga, board game and movie nights;
3. welcome meetings are organized for new members of the community, also in cooperation with others with welfare groups;
4. actively participate in the welfare events of the Faculty of Mathematics and Natural Sciences of HY and cooperate with other welfare groups to create a friendly and warm atmosphere on the Kumpula campus.

Implementing measures and spreading general human values in the scientific community require cooperation with HR and financial support, which is used to conduct surveys, invite speakers and organize small-scale events. The implementation of the measures will be measured by the participation activity of the HIP community in events and surveys, which will be carried out in the middle and at the end of the strategy period, in 2022 and 2024.

Target state 19. Attractive employer.

Access to sq. to major projects and research infrastructures

HIP offers researchers working in Finland access to top international research centers such as CERN and FAIR.

National research cooperation at the core of HIP

As a joint research institute of five universities, HIP offers its researchers the opportunity for close research cooperation and the use of research infrastructures at its member universities and research institutes. HIP actively invests in joint projects between universities, a good example of which are the theory program projects that started in 2020. National cooperation increases research synergy between universities. HIP's research activities are fundamentally networked, so even a new employee can directly utilize existing national and international networks.

2.4 STRATEGIC CHOICE 4: FORECAST OF RESPONSIBILITY AND SUSTAINABILITY

Target state 20. Responsibility and sustainability as part of the operating culture (see also target states 7, 8, 10, 14 and 18).

Responsibility and sustainability in research and other activities

In HIPs, research is conducted on the themes of responsibility and sustainability. These include material research related to energy production technologies and CERN's CLOUD experiment related to atmospheric sciences, which studies the processes of atmospheric activity and the mechanisms affecting climate change.

Open access to research results is the responsibility and sustainability of science. Research results and data are openly available and usable by everyone, which maximizes the research's impact. The principles and practices of open science have been central to the research activities of the research institute since the establishment of HIP. Ways to process and store open data are constantly being developed. In CERN's CMS experiment, data is opened and worked into an easily usable form, so that it can be used in addition to research, for example in Finnish school education. HIP researchers train Finnish teachers in the use of open science tools.

The operating culture is changed so that consideration of responsibility and sustainability is always included in all operations. This is done, for example, when organizing events that require mobility. HIP's events, such as seminars, will continue to be organized with the possibility of remote participation. Remote work opportunities are increasing.

In responsible personnel management, the emphasis is on equal and fair treatment of personnel, responsible decision-making, interactive managerial work, as well as the well-being of personnel at work and the development of skills. The research institute's personnel policy pays attention to equality and diversity. In addition, we invest in high-quality internal information and open interaction between management and personnel as well as in the working community in general.

The focus of social sustainability is community, participation and the attachment of individuals to the research community.

Target status 22. Strengthening financial room for maneuver.**A sound financial structure and the right indicators**

The goal is a sustainable economy based on long-term national funding and the commitment of member universities. The goal is a significant increase in the level of national funding, because HIP's international and national responsibilities have grown and are still growing, for example with the completion of the FAIR research institute and the gradual start of operations.

The aim is to increase supplementary funding by supporting applications for funding from the Academy of Finland, Business Finland and the EU, etc. The quality of applications will be improved through mentoring and the use of research services.

Indicators concerning HIP's operation are monitored and developed continuously, taking into account HIP's long-term strategy and the strategies of the member universities. The results of HIP's operations are reported annually in the activity report and the annual report.

3 RESOURCES**3.1 Personnel plan**

The general goal of the research institute's personnel plan is to create the conditions for successful and internationally visible research activities. The basis is equality
personnel recruitment development and advancement in the research career. HIP has a work well-being group together with the physics department of the University of Helsinki. The priorities of developing well-being at work are career development, balance between work and free time, internal communication, and working conditions. HIP is committed to the work well-being group's activities and the promotion of work well-being. The goals and measures of the Kumpula campus physics work well-being group for the years 2021–2024 are described in chapter 2.3 (goal status 18).

The career development of young researchers is invested in through support, advice and project responsibilities. The Institute of Physics is a significant platform for scientific merit, whose researchers have often moved on to university professorships.

The research activities of the Physics Research Institute are organized into fixed-term research projects, which are constantly monitored. The scientific advisory board evaluates HIP's operation annually.

High-level research personnel are recruited for research projects according to the needs and resources of the project, mainly using international recruitment through an open application procedure. The research institute supports international mobility.

The integration of international researchers is supported by personnel policy measures. The research staff working in Hankkeis-sa have fixed-term employment contracts, which are aimed at the duration of the entire project. Research support staff placed alongside the rest of the staff are sought to be employed in permanent employment. In September 2021, the size of the permanent staff will be nine people.

In long-term personnel planning, HIP cooperates with the responsible units of universities that are parties to the agreement.

3.2 Spatial plan

The Physics Research Institute operates in established premises in the Physicum building on the Kumpula campus of the University of Helsinki and at CERN. Kumpula's facilities include the detector laboratory shared by HIP and the Department of Physics. In addition, the research institute's researchers work at other member universities. The research institute proactively plans the efficient use of facilities.

3.3 Budget

The budget will be decided at the board meeting in 3/2021.

4 MONITORING AND REPORTING

4.1 Responsibilities and roles of monitoring and reporting

The director of the department is responsible for the implementation and reporting of the implementation plan. The manager discusses the achievement of goals with the unit's operators.

The director reports on the implementation of the strategy and implementation plan to the executive board and the international scientific advisory board, which monitor and evaluate HIP's operations.

HIP prepares an annual report on its activities. The activity report reports on the previous year's activities qualitatively and with quantitative indicators.