

PROGRAM-ORIENTED FUNDING

Strategic Evaluation for Research 2021–2027



DEAR READERS,



Over the past three years, the scientific quality and strategic positioning of Helmholtz has undergone a comprehensive evaluation in accordance with the highest international standards. This process, unique in both its form and scope, was completed at the beginning of 2020.

More than 600 internationally renowned experts have had a close look at our work at the Helmholtz Centers during the initial scientific evaluation in 2017 and 2018. Based on our strategic guidelines, we used the results of this detailed evaluation to set the course for our future. In recent months, six panels comprising experts from around the world then carried out a systematic evaluation of the strategic reorganization of our research programs.

The evaluation process as a whole serves as a rigorous quality assurance measure and enables us to review whether our plans will put us on course to fulfill our mission: Our goal is to contribute to solving grand challenges with top-level research and to develop programs together with the best partners. This also includes setting up and operating large-scale research infrastructures. At the same time, the evaluation is an important tool for determining whether the considerable investments that have been dedicated to research at Helmholtz have met expectations.

We are very proud of the fact that the experts gave us an outstanding testimony in both aspects. They confirmed that Helmholtz is among the best in the world in many research areas. Moreover, they found that our research makes a significant contribution to addressing challenges such as tackling climate change, restructuring the energy system, decoding the building blocks of life, and fighting major widespread diseases.

Their detailed evaluation reports have provided us with important insights for the future. Based on these, we will adopt financing recommendations for our research programs in the coming years.

We have summarized the main results of the comprehensive recommendations for you in this brochure.

Last but not least, on behalf of Helmholtz, I would like to thank everyone who was part of this unique process: You did a tremendous job.

I hope you enjoy reading this summary of results!

Otmar D. Wiestler

A handwritten signature in blue ink that reads "Otmar D. Wiestler". The signature is written in a cursive style with a long, sweeping tail on the last letter.

HELMHOLTZ



19
Helmholtz
Centers



>40,000
employees



>4.8
billion euros
annual budget



6
research fields



>6,500
scientific staff
from other countries

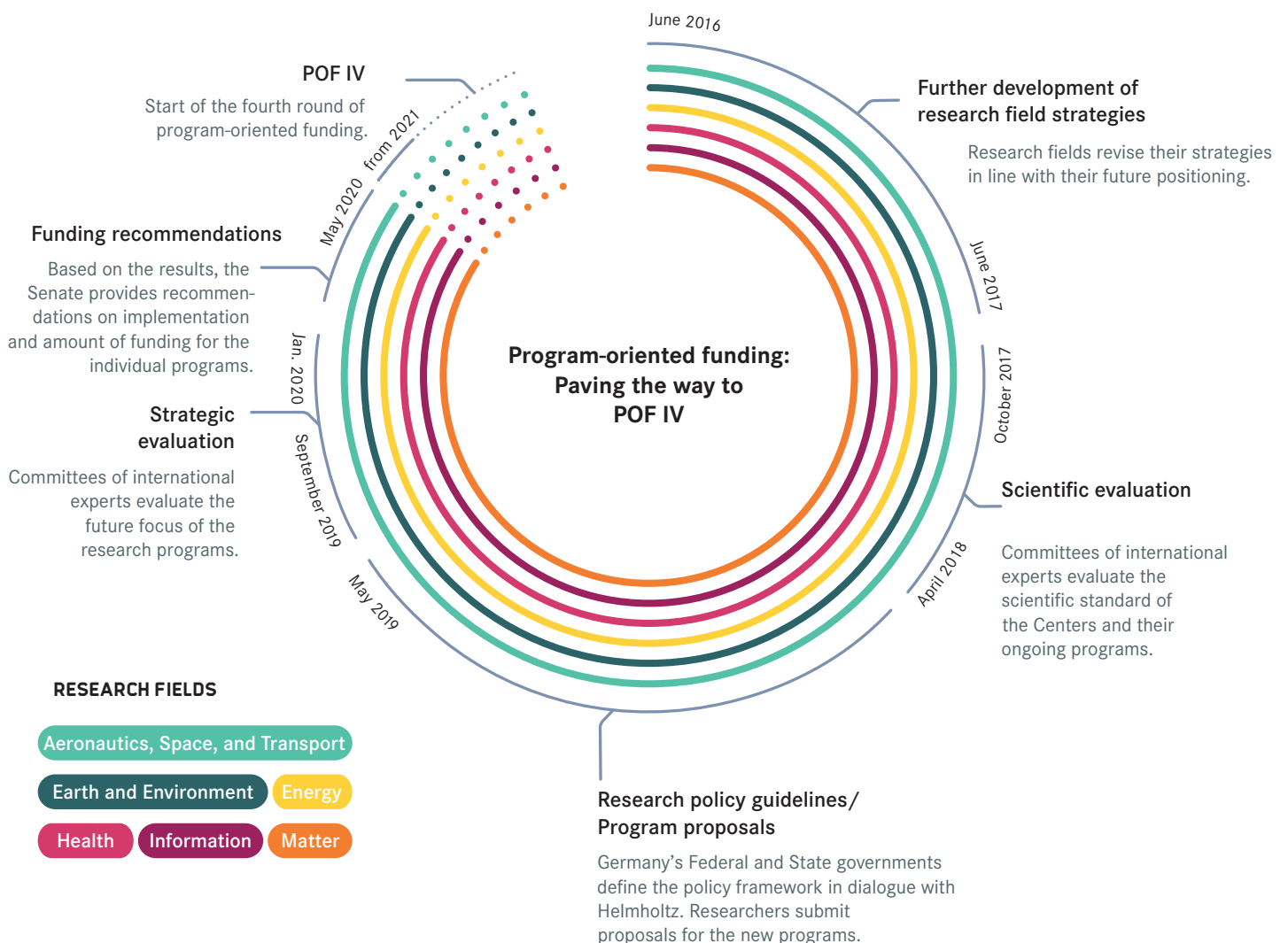
Helmholtz comprises 19 research centers that conduct scientific, medical, and biological research. Together, they have more than 40,000 employees and an annual budget of around 4.8 billion euros. The six research fields are structured around the major challenges facing society. The programs set up in the research fields pursue long-term goals and cover a broad spectrum ranging from basic research to applications.



PROGRAM-ORIENTED FUNDING

Helmholtz invests its resources in cross-center research programs rather than individual institutions. These programs focus on the research policy guidelines that were formulated together with Germany's federal and state governments. In keeping with the Helmholtz mission, their objective is to use top-level, interdisciplinary research and research infrastructure that is geared toward the future to set up relevant research fields, deliver an integrated response to complex issues emanating from academia, society, and the economy, and work with the best partners to develop system solutions. Moreover, they aim to develop future-oriented research infrastructure and make it available to researchers from around the world. Program-oriented funding (POF) functions as a balance of cooperation and competition: While Helmholtz scientists cooperate across centers and disciplines in the programs, the programs also compete for funding. POF resources are allocated based on a two-tier evaluation system. The first tier consists of a **scientific evaluation** of a program's current research, followed by a **strategic evaluation** of the activities planned for the coming years.

Between October 2017 and April 2018, the scientific performance of the Helmholtz Centers and programs in the 2015 to 2020 funding period underwent a comprehensive evaluation by internationally renowned experts from around the world. Together with the research policy guidelines adopted by the Committee of Funding Bodies, the recommendations from the scientific evaluation form the basis for the reorganization of the research programs starting in 2021. Between September 2019 and January 2020, a committee consisting of high-caliber, international experts was assigned to each research field and conducted a review of the planned programs with respect to their content and strategic direction.



SCIENTIFIC EVALUATION 2017/2018



Evaluation panel at the GEOMAR Helmholtz Center for Ocean Research Kiel

Some 600 experts from 27 countries evaluated the Helmholtz Centers between October 2017 and April 2018. During on-site evaluations, 34 panels took a close look at laboratories and research infrastructures and discussed research activities and outcomes with the researchers—from doctoral candidates to institute heads.

The scientific evaluation focused on scientific performance, and the results were used to assess both the respective Helmholtz Center and the programs in which the centers combine their competencies to jointly develop groundbreaking research areas.

SUMMARY OF RESULTS

The experts confirmed that Helmholtz conducts high-caliber, integrated, **interdisciplinary research of the highest level based on a systematic approach**. They noted that this research covers a broad spectrum of subjects that extend from basic research to applications due to the diversity and complementary nature of the participating centers. The experts also found that the research results in all areas were of the highest standard of scientific excellence.

According to the experts, the **research infrastructures** at the Helmholtz Centers are outstanding features, acting as magnets for the national and international scientific communities and serving as a key impetus for research activities within Helmholtz.

The committee members identified the expansion and coordinated development of **Information and Data Science** and the development of methodological expertise in the field of **artificial intelligence** as the key challenges for Helmholtz. They also found that sufficient scope needs to be created within the program-oriented funding structure for new ideas—that is, blue sky research—so innovative approaches and solutions can be identified and explored at an early stage.

With respect to **national and international partnerships** involving the Helmholtz Centers, the experts specifically highlighted partnerships with prestigious universities and other institutions at the regional, national, and international levels. The evaluation noted that the many joint appointments of scientists at universities and the Helmholtz institutes promoting strategic partnerships between research centers and universities serve as models for partnerships in the scientific system and should be further expanded upon.

The experts saw potential in enhancing the **transfer of knowledge** to the economy and society. Accelerating the translation of research results into applications and **communicating** scientific findings to the public were two aspects that they viewed as equally important. They likewise urged Helmholtz to continue expanding its activities in this area.

They believed that Helmholtz should play an even more prominent role as a strategic player in the individual research fields – for example by developing road maps with partners from the research area – and in doing so provide even greater support for science-based policy consulting. In the area of talent promotion, the Helmholtz graduate schools and successful programs to recruit outstanding international scientists were evaluated as very positive. The experts advised that institutions in Germany generally need to take more steps to further promote **diversity** in their organizational cultures.

STRATEGIC EVALUATION 2019/2020



Expert committee for the strategic evaluation in the Research Field Aeronautics, Space, and Transport

The strategic evaluation built on the findings of the scientific evaluation and began in September 2019. Its aim was to take a critical look at the focus of the new programs for the upcoming funding period in terms of their content and strategic direction and laid the groundwork for the allocation of funding to the programs. In this respect, the evaluation represents a comprehensive assessment of the strategic reorganization of the Helmholtz research portfolio. The six committees comprised high-caliber, independent experts from the international community, including the chairs of the preceding scientific evaluations.

The results of the scientific evaluation and the research policy guidelines developed in consultation with the federal and state governments created the framework for the strategic evaluation. Working on this basis, the experts examined whether the programs were adequately positioned to achieve their intended objectives. Their focus was the proposed programs for the upcoming funding period, which were designed in line with the research policy guidelines.

SUMMARY OF RESULTS

The committees resoundingly approved of the plans Helmholtz has made for the 2021–2027 program period. The evaluation found that the plans follow clear strategies, address the relevant challenges, formulate goals for solutions, and identify ways of reaching these goals.

The experts praised the strategic collaboration between the centers, which is demonstrated by the increasingly integrated nature of the programs. By taking this approach, the experts said, the centers are pooling their complementary competencies, which extend from basic research to applications. They found that the programs are designed to implement the strategy of the respective research field to the best possible effect, noting that this particularly applies to the fundamental changes made to the program structure in the Research Fields Energy, Earth and Environment, and Information. The committees confirmed that the recommendations of the scientific evaluation had been addressed extensively.

The experts encouraged Helmholtz to become even more closely involved in agenda setting and to develop corresponding road maps. During the program period, they likewise urged Helmholtz to continue strengthening the links between its diverse research topics and to define focal topics where it can maximize its impact. However, they emphasized that this must not come at the expense of engaging with new ideas – known as blue sky research – which is vital for research.

Their report stated that the ensemble of research infrastructures at Helmholtz is unique and facilitates top-level research for users from around the world and the association itself. They noted the importance of maintaining this exceptional standard; many aspects of the research infrastructure, including research vessels, light sources, and computing facilities, will need to be renovated or upgraded in the coming years.

The experts emphasized the significance of a comprehensive approach to promote **talent** across the board. They added that it will be important to integrate efforts to boost the **transfer** of knowledge and interactions with industry and society more closely at every level in the future.

Information & Data Sciences are becoming more and more important across all disciplines. The experts said that strong interactions between the areas of Information & Data Sciences and the individual disciplines are an essential prerequisite for the successful implementation of the programs. They viewed corresponding links within the programs and the Helmholtz Incubator as important steps in this direction.

The appraisals written by the experts served as the basis for the Helmholtz Senate's recommendation as to the amount and distribution of federal and state funding for the research programs. In addition, the reports contained numerous suggestions on how the programs and research fields could be further developed. After the Helmholtz Senate has made its final decision, the programs for the seven-year POF IV period can start on January 1, 2021.



MUCH OF THE SCIENTIFIC WORK HELMHOLTZ CARRIES OUT IN THE RESEARCH FIELD ENERGY IS VERY, VERY STRONG, AND SOME IS ABSOLUTELY WORLD-CLASS.

Steven Chu, Stanford University

MISSION AND PROGRAMS

A carbon-neutral energy supply that is economically and socially sustainable – that is the mission of the Research Field Energy. The scientists are working together to make far-reaching changes to the energy system by researching and developing innovative conversion, distribution, and storage technologies and devising solutions for a cross-sectoral energy system. The research field serves as a scientific architect and developer of key technologies for the energy transition by creating holistic concepts that incorporate all relevant energy conversion chains on a systematic basis and include future-ready technological options.

PROGRAMS IN THE 2021–2027 FUNDING PERIOD

- Energy System Design
- Materials and Technologies for the Energy Transition
- Fusion
- Nuclear Waste Management, Safety, and Radiation Research

PARTICIPATING CENTERS

- German Aerospace Center (DLR)
- Forschungszentrum Jülich
- Helmholtz-Zentrum Berlin für Materialien und Energie (HZB)
- Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- Karlsruhe Institute of Technology (KIT)

ASSOCIATE SCIENTIFIC CENTER

- Max Planck Institute for Plasma Physics (IPP)

COORDINATOR

- Holger Hanselka ▪ Karlsruhe Institute of Technology (KIT)

RESULTS

The expert panel was highly impressed by the reorganized strategy and structure Helmholtz has designed for its research. In their view, the new structure is ideally suited to addressing the most pressing challenges in the area of energy research and technological development and therefore makes a substantial contribution to achieving the goal of a carbon-neutral society by 2050.

They confirmed that the new **Energy System Design** program will play a key role in the research field and could serve as a cornerstone of Germany's strategy for implementing the energy transition.

According to the experts' evaluation, the **Materials and Technologies for the Energy Transition** program clearly focuses on the major technological challenges arising from the transformation to a sustainable energy system that is based on renewable energy and integrates innovative storage technologies. It is thus in line with Germany's strategy for the coming decades. The experts also noted that the program uses a coherent approach to addressing urgently needed technological developments by exploiting synergies across disciplines, technologies, and research teams that are embedded in a national and international research network.

The evaluation found that the **Fusion** research program tackles major challenges that complicate efforts to make fusion a primary energy source. This program is one of the most comprehensive projects in the world, according to the expert report, and delivers outstanding results that are at the very forefront of scientific and technological development in this field.

The experts concluded that the **Nuclear Waste Management, Safety, and Radiation Research** program provides an excellent scientific basis for the safe disposal of radioactive waste as well as expertise in the field of reactor safety. Robust involvement on the part of the government, maintaining the program's world-class scientific infrastructure, strategic planning, and recruiting top talent are viewed as the key factors that will determine the success of this program, even after nuclear energy has been phased out in Germany.

STRATEGIC RECOMMENDATIONS

- A Helmholtz energy transition road map should be used as a central strategy instrument in order to develop the research field in a dynamic way.
- A progressive, forward-looking culture of innovation should be established to further enhance the transfer of technology.





THE COMBINATION OF INCREDIBLY
TALENTED SCIENTISTS AND THE
RESOURCES THAT ARE CONTINUALLY
MADE AVAILABLE TO THEM FOR THEIR
RESEARCH IS GLOBALLY UNIQUE AT THIS LEVEL.

Peter Schlosser, Arizona State University

MISSION AND PROGRAM

The Research Field Earth and Environment studies the Earth system and the complex interactions between people and nature. It delivers system analyses, findings, data, and technologies that are needed to create the foundation for a sustainable future. The participating centers and their partners combine their expertise as they work to develop strategies, recommendations for action, methods, and infrastructure. These aspects are intended to play a role in efforts to use natural resources sustainably and conserve them over the long term, understand climate change, overcome natural hazards, and minimize the impact of natural catastrophes.

PROGRAMS IN THE 2021–2027 FUNDING PERIOD

- Changing Earth – Sustaining our Future

PARTICIPATING CENTERS

- Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI)
- Forschungszentrum Jülich
- GEOMAR Helmholtz Centre for Ocean Research Kiel
- Helmholtz-Zentrum Geesthacht Center for Materials and Coastal Research (HZG)
- Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences
- Helmholtz Centre for Environmental Research – UFZ
- Karlsruhe Institute of Technology (KIT)

COORDINATOR

- Antje Boetius ▪ Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI)



RESULTS

The experts were impressed by the standard of scientific excellence in this research field as well as its infrastructure, which is unique in many cases. They also praised the way the research activities have been reorganized as a single, joint program broken down into nine topics. In their view, this offers a globally unique opportunity to decisively expand our understanding of changes occurring around the world in conjunction with the natural dynamics of the Earth system. They believe this could deliver potential solutions to the most pressing challenges facing humanity.

The experts also supported plans to establish the joint **Synthesis and Communications Platform (SynCom)**. According to their evaluation, this platform could act as a vital link to promote collaboration on overarching topics—such as climate change, natural hazards, and resources—and have positive effects on both science and the dialog between research and society, businesses, and policymakers.

They stated that the success of this ambitious program largely depends on efficient coordination that works to implement the program's philosophy across all topics and centers and, in particular, promotes exchange on concepts and methods. The experts also noted that upgrading the existing **research infrastructure** and building new, cutting-edge infrastructure for observation and modeling purposes would be key to the successful implementation of the program.

The committee found that the joint program has exceptional potential to achieve key breakthroughs in basic research and applications and play a **leading role in Earth system research**. Their report asserted that this program is unlike any other in the world and places the Research Field Earth and Environment in an excellent position that offers extraordinary possibilities and involves great responsibility that extends beyond Helmholtz.



STRATEGIC RECOMMENDATIONS

- The governance structure and the SynCom platform must be set up and continually enhanced so the joint program can be successfully implemented.
- Giving the topics an even stronger thematic focus in the future should be considered. This would make it possible to boost the visibility of overarching goals such as improving the forecasting of extreme weather and its impacts.
- The exchange on concepts and methods must be stepped up and the research field should focus on jointly developing infrastructure for Earth system modeling and integrating the individual models and complex datasets.



THE EXTENT AND DEPTH OF THE RESEARCH FIELD'S EXPERTISE AND ITS CAPACITY TO CONVERT FINDINGS INTO MEDICAL PRACTICE ARE EXCEPTIONAL.

Susan Gasser, Friedrich Miescher Institute for Biomedical Research

MISSION AND PROGRAM

The Research Field Health makes significant contributions to preventing diseases, making precise diagnoses, and developing effective treatment. In doing so, it considers human beings as complex, holistic systems and aims to establish a far-reaching, comprehensive understanding of how major widespread diseases such as cancer, diabetes, cardiovascular, metabolic, pulmonary, neurodegenerative, and infectious diseases develop, as well as methods of treating them. This work is carried out by means of integrative, interdisciplinary, long-term basic research that focuses on translating research findings into clinical practice at a rapid pace.

PROGRAMS IN THE 2021–2027 FUNDING PERIOD

- Cancer Research
- Environment-related and Metabolic Diseases
- Systemic Medicine and Cardiovascular Diseases
- Infection Research
- Neurodegenerative Diseases

PARTICIPATING CENTERS

- German Cancer Research Center (DKFZ)
- German Center for Neurodegenerative Diseases (DZNE)
- Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- Helmholtz Centre for Infection Research (HZI)
- Helmholtz Zentrum München – German Research Center for Environmental Health (HMGU)
- Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC)

COORDINATOR

Dirk Heinz ▪ Helmholtz Centre for Infection Research (HZI)



RESULTS

The expert panel attested that this area's research activities are unique at the international level and validated its strategies for disease prevention, data-driven diagnostics, and innovative treatment as well as its approach for multidisciplinary research scenarios in all programs. Their report noted that the research field's programs are highly relevant and have excellent basic research and outstanding infrastructure at their disposal. Translation and clinical research in this area likewise offer enormous potential and will have a decisive impact on improving public health, medical practice, and the industries involved in the healthcare sector.

They deemed the research field's commitment to training and supporting scientists, which contributes to the diversity, openness, and international attractiveness of the centers, to be particularly noteworthy. All the programs are exceptionally well positioned, as highlighted by the following examples of forward-looking projects:

The National Cancer Prevention Center planned as part of the **Cancer Research** program represents a particularly creative and innovative initiative in terms of developing powerful approaches and reducing the burden of disease.

In the **Environment-related and Metabolic Diseases** program, the Helmholtz Pioneer Campus and its synergy effects offer brilliant young researchers a one-of-a-kind opportunity to contribute their creativity to innovative biomedical research.

The LifeTime/Cell Clinic approach, which is part of the new **Systemic Medicine and Cardiovascular Diseases** program, directly combines quantitative systemic medicine with analyses of human diseases and offers groundbreaking potential.

New approaches in research into natural substances, the development of RNA tools, and microbiome research in the **Infection Research** program offer promising potential for fighting antimicrobial resistances and are therefore of key significance for public health.

Among other things, the **Neurodegenerative Diseases** program is distinguished by first-class basic research into neuronal mechanisms and provides the opportunity to plan and carry out clinical studies using its own Clinical Studies Platform (as part of a partnership) – which represents a unique advantage for Helmholtz.

The experts noted that the research field's multi-program, cross-cutting activities in the areas of data science and technology, immunology and inflammation, aging processes, and drug research have been selected to excellent effect and enabled the researchers to benefit from expertise in the other areas. The National Cohort health study was also praised for its incredible potential for discoveries that have an impact on clinical practice.

STRATEGIC RECOMMENDATIONS

- Translational research should be promoted even more – including an additional focus on preventive medicine – with basic research serving as the foundation.
- Pressing issues facing global and public health should be addressed.
- Data-based diagnostics, early detection, treatment, and prevention should be prioritized in all areas.
- Joint approaches between the centers should be used to boost the exchange and transfer of knowledge.
- Efforts to recruit top talent and train clinician scientists should be stepped up.





OF PARTICULAR NOTE IS THE RESEARCH AIMING TO UNDERSTAND THE FUNDAMENTAL PROCESSES IN OUR BRAIN AND EVERYTHING THAT COMES WITH THE NEW POSSIBILITIES IN THE FIELD OF COMPUTING.

Bert Meijer, Eindhoven University of Technology

MISSION AND PROGRAMS

The Research Field Information studies the basic principles of information processing, the development of future data analysis and computer technologies, and innovative material development. This includes investigating natural, artificial, and cognitive information systems, new materials, and ways of integrating this new knowledge into the world's most powerful computers and algorithms of the next generation. The development of new technologies is accompanied by assessments of the related ethical and sociological consequences.

PROGRAMS IN THE 2021–2027 FUNDING PERIOD

- Engineering Digital Futures
- Natural, Artificial, and Cognitive Information Processing
- Materials Systems Engineering

PARTICIPATING CENTERS

- Forschungszentrum Jülich
- Helmholtz-Zentrum Berlin für Materialien und Energie (HZB)
- Helmholtz-Zentrum Geesthacht Center for Materials and Coastal Research (HZG)
- Karlsruhe Institute of Technology (KIT)



COORDINATOR

Wolfgang Marquardt ▪ Forschungszentrum Jülich

RESULTS

The committee emphasized that the research field employs a multi-dimensional, integrated approach to addressing the major challenges facing society. The experts noted that the research is based on the outstanding expertise of its scientists as well as on its infrastructure, which is unique and among the best in the world in many cases. They also highlighted the Joint Labs, which serve as key bridges between the programs and other research fields. Another aspect that they deemed to be particularly noteworthy was the rapid and consistent way in which the research field moved forward with the process of transitioning from the prior Key Technologies topic area to Information.

The experts' report described the **Engineering Digital Futures** program as a strong platform for computer-based research in the research field. They praised its combination of data-intensive research and scientific computing as well as the systematic approach taken in cybersecurity research. Moreover, they identified the computing infrastructure as a valuable asset on the way to exascale computing. In their view, the program's work on assessing the impact of technology – which also sheds light on philosophical and ethical issues – likewise offers substantial added value.

The panel delivered a very positive evaluation of the **Natural, Artificial, and Cognitive Information Processing** program, describing it as highly interdisciplinary. The experts identified the research field as one of the best groups in the world on the physical side of quantum computing and also found that its biological research is of a high standard, while recommending that these activities be given a stronger focus. In addition, they described the research that Helmholtz conducts in brain research as world-class, particularly with respect to imaging and image analysis as well as the development of brain atlases.

The **Materials Systems Engineering** program offers an incredible combination of new opportunities in information, machine learning, and artificial intelligence with materials sciences and is taking materials research as a whole to a new level. The research groups have access to outstanding infrastructure. The experts recommended that they enhance their skills with respect to computer-based approaches and seek out partnerships.



STRATEGIC RECOMMENDATIONS

- The research field should expand its competencies to include a special activity to develop software and algorithms in addition to stepping up partnerships with leading institutions.
- The research field could respond to current developments more rapidly and place a stronger focus on individual topics by seeking out and exploiting new opportunities on an ongoing basis.
- Stronger links should be established between the research field's information-oriented activities and other research fields.
- Partnerships with industry and the translation and the transfer of knowledge should be enhanced.

AERONAUTICS, SPACE AND TRANSPORT



WE WERE VERY IMPRESSED BY THE EXCELLENT STANDARD OF RESEARCH, THE LARGE-SCALE, UNIQUE INFRASTRUCTURE, AND THE WAY IN WHICH THE RESEARCH FIELD INTEGRATES NEW TOPICS.

Günther Hasinger, European Space Agency (ESA)

MISSION AND PROGRAMS

The Research Field Aeronautics, Space, and Transport is geared toward developing effective technology concepts and system solutions in order to address global challenges such as climate change, smart mobility, innovative communication and navigation, resource management, security, and future production technologies. It covers the entire innovation chain from basic research to applications.

PROGRAMS IN THE 2021–2027 FUNDING PERIOD

- Aeronautics
- Space
- Transport

PARTICIPATING CENTERS

- German Aerospace Center (DLR)



COORDINATOR

- German Aerospace Center (DLR)

RESULTS

The experts were impressed by the broad and coherent spectrum of topics this research field addresses in appropriate depth and with a very high standard of scientific excellence. They noted that the contributions the individual DLR institutes make to multiple programs provide new impetus across various institutes and programs. The programs have a complementary effect in addition to creating synergies with other Helmholtz activities. The panel also highlighted the fact that the research field is equipped with extensive research infrastructure unlike any other in the world. They likewise emphasized the leading role the DLR plays in national and international cooperative projects and committees, which develop the necessary standards for certain fields of technology. This makes the research field a sought-after partner for the national and international research and industry landscape.

The panel praised the system-wide approach the **Aeronautics** program applies to the air transport system throughout the entire life cycle of the aircraft. It also highlighted the significant increase in its research activities in the field of digitalization and electrification of aircraft construction and pilotless air transport. The experts also specifically acknowledged the program's world-leading competencies in the fields of aerodynamics, acoustics, and new drive concepts.

The **Space** program impressed with its expertise in Earth observation, which is of particular relevance to observing global change, and in the area of space exploration. The experts noted that the latter enjoyed particular success in its efforts to recruit leading scientists. Likewise, the program's research on robotics was very positively assessed based on its very broad spectrum of applications.

In the **Transport** program, the experts highlighted the integrated research approach linking user-oriented perspectives with top-level technological research. This program makes key contributions to the mobility transformation, with a special focus on the areas of automation, digitalization, vehicle technologies, and integral methods of observing the various modes of transport.

STRATEGIC RECOMMENDATIONS

- Basic research should be strengthened and support should be provided to disruptive research activities – particularly those that are relevant to the climate and offer a high potential to yield new findings.
- The research field should continue to research and develop new technologies such as quantum technologies and digitalization and integrate these aspects into traditional fields of research.
- A strategy to set up an integrated national competence center for the mobility transformation should be developed. This strategy must combine specialist knowledge from all three programs in this research field as well as from other Helmholtz research fields and beyond the Association.





THE SCIENCE IS OUTSTANDING, AND THE PROSPECTS THIS RESEARCH FIELD OFFERS ARE EXTREMELY INTERESTING.

Ursula Bassler, CERN

MISSION AND PROGRAMS

This research field examines the constituents of matter and the forces acting between them—from elementary particles to complex functional materials to the gigantic systems and structures found in the universe—from basic research into the quantum universe to the design of new materials and active substances in the field of applied research. To this end, Helmholtz develops and operates a diverse spectrum of research infrastructure for its own purposes as well as those of the scientific community in Germany and abroad.

PROGRAMS IN THE 2021–2027 FUNDING PERIOD

- Matter and the Universe
- Matter and Technologies
- From Matter to Materials and Life

PARTICIPATING CENTERS

- Deutsches Elektronen-Synchrotron DESY
- Forschungszentrum Jülich
- GSI Helmholtz Centre for Heavy Ion Research
- Helmholtz-Zentrum Berlin für Materialien und Energie (HZB)
- Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- Helmholtz-Zentrum Geesthacht Center for Materials and Coastal Research (HZG)
- Karlsruhe Institute of Technology (KIT)

MATTER

COORDINATOR

Helmut Dosch ▪ Deutsches Elektronen-Synchrotron DESY

RESULTS

The experts highlighted the exceptionally high standard of scientific quality and key strategic relevance of the activities in this research field. They noted that Helmholtz has an international profile in the areas of elementary particle, hadron, nuclear, and astroparticle physics, in the development of accelerators and detectors, and in computing. Its research involving photons, neutrons, ions, and high electromagnetic fields was highlighted in particular. The panel noted that the research field consequently has access to an outstanding network of activities and stakeholders in conjunction with its high-caliber research facilities and infrastructure. Its three programs have a strong impact at the international level, where the full force of the science Helmholtz conducts comes to bear.

The experts described the **Matter and the Universe** program and those involved in it as world-class. According to their evaluation, the strategy behind the three topics is excellent, and the program's work on particle physics is outstanding. They recommended that the program enhance its involvement in research into gravitational waves.

The panel rated the **Matter and Technologies** research program as excellent with respect to its scientific expertise and strategy. In particular, it applauded the program's successes and future plans in the area of accelerator development as well as the newly established area of scientific data processing. The experts recommended that a greater focus be placed on supporting sustainable career strategies in the future.

The panel likewise evaluated the **From Matter to Materials and Life** program as outstanding in terms of the research it conducts using large-scale research infrastructures and user facilities and described its profile in the field of structural biology in particular as exceptional. Moreover, it acknowledged the extraordinary significance of the program's research facilities for the national and international user community. The panel members deemed it imperative that the program continues to pursue its plans for expansion in the individual areas.

STRATEGIC RECOMMENDATIONS

- Efforts to coordinate the research community in Germany should be stepped up to more effectively support the goals of the Helmholtz Association.
- New research developments and trends should be responded to even more rapidly.
- The highly attractive nature of this research field for young researchers could be used to greater effect.
- Contacts in industry should be strengthened.
- Helmholtz should serve as a model for Germany's scientific community in the context of diversity.



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