



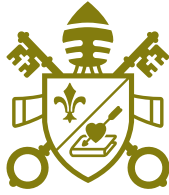
THE PONTIFICAL
ACADEMY
OF SCIENCES

PLENARY SESSION ON

THE FUTURE OF SCIENCES IN A CHANGING WORLD



24-26 September
Casina Pio IV, Vatican City



“Christian humanism does not reject science or technology, but embraces them with gratitude and realism, and grounds them within a higher vocation. The creative intelligence of humanity is a gift that can alleviate suffering and open up new possibilities, but it must remain ordered toward the common good, justice, the care of the vulnerable and creation” (n. 129)

MAGNIFICA HUMANITAS OF HIS HOLINESS POPE LEO XIV
ON SAFEGUARDING THE HUMAN PERSON IN THE TIME OF ARTIFICIAL INTELLIGENCE
Given in Rome, at Saint Peter's, on 15 May, in the year 2026

Concept Note and Rationale

The Pontifical Academy of Sciences (PAS) stands as a unique institution that bridges scientific inquiry and moral reflection, faith and reason, empirical knowledge and philosophical understanding. The Academy's 2026 Biannual Plenary Conference, to be held under the theme "The Future of Science in a Changing World," seeks to renew and deepen this mission at a time when humanity faces both extraordinary scientific opportunity and profound risks and uncertainty.

The title acknowledges the transformative power of scientific discovery, while recognizing that the future of science is not determined solely by technological capability, but also by the values, contexts, and ethical orientations that shape its trajectory. This theme is intentionally broad and inclusive, encompassing a full spectrum of scientific disciplines—from mathematics and physics to biology, medicine, and the earth sciences—and inviting interdisciplinary dialogue.

By explicitly engaging with risks and uncertainty—methodological, epistemological, and moral—the conference seeks to illuminate how science navigates the unknown and how humility, openness, and dialogue can guide scientific progress in turbulent times. The theme is an invitation to ask foundational questions:

- What kind of future does science envision and make possible?
- How does science respond to the world's changing moral, social, and environmental realities?
- How can scientific communities sustain hope, integrity, and trust in an age of complexity and doubt?

While Science has enabled unprecedented human advancement—eradicating diseases, extending lifespans, connecting societies, and revealing the universe's deepest mysteries—it also faces unprecedented scrutiny. Disinformation, ideological polarization, and technological disruption have eroded public trust in expert knowledge. The Plenary's theme, therefore, carries a dual purpose: to assess the future trajectory of science and to renew its moral and societal foundations. In doing so, we note that faith can offer ethical orientation, purpose, and humility; science offers method, discovery, and evidence. Their dialogue enriches both domains and fosters a vision of science that serves humanity rather than dominates it.

The Plenary Conference will unfold in three main parts:

PART I – OPENING SESSION: SCIENCE AND THE FUTURE

The opening session will frame the central question: How does science think about the future? It will explore how scientific disciplines use forecasting, modeling, and anticipation—not only to predict outcomes but also to inspire hope and guide responsible action. Discussions will address the philosophy of anticipation, the ethics of prediction, and the psychology of hope in scientific innovation. This session may include reflecting on the meaning of "the future" and the interplay between scientific foresight and expectation. Possible focal points include: The future as a domain of ethical responsibility; Anticipation and imagination in scientific creativity; Hope and humility as guiding virtues for the scientific enterprise

PART II – DISCIPLINARY SESSIONS: FUTURES WITHIN THE SCIENCES DOMAINS

In this central set of sessions, each scientific domain will be explored in terms of its emerging frontiers, epistemological challenges, and societal implications. Sessions will be organized by major disciplinary clusters, each led by keynote addresses and followed by specialist presentations, commentaries and discussions. However, already during these disciplinary sessions the opportunities for problem solving interdisciplinary research shall be considered.

1. Future of Mathematics, Artificial Intelligence, and Computing

This session will examine how computation, algorithms, and data-driven technologies are reshaping the foundations of knowledge. Artificial Intelligence (AI) challenges traditional understandings of reasoning, creativity, and human uniqueness. Mathematical modeling remains essential but now operates within hybrid systems of human and machine learning. Key questions include: How can AI contribute to discovery while respecting human agency and ethics? What is the role of mathematics in a world increasingly defined by data? How might engineering, a discipline often underrepresented in PAS dialogues, be re-integrated as a bridge between scientific insight and

social application? This session will also reflect on education and digital transformation.

2. Future of Physics

The physics session will explore both the continuity and evolution of the discipline—from classical mechanics and thermodynamics to quantum physics and high-energy particle research. It will reflect on how physics continually redefines the human understanding of matter, energy, and the cosmos. Subtopics may include: Advances in quantum information and their implications for computation and communication; The intersection of condensed matter physics and materials science for sustainable technologies; The role of large-scale collaborations and shared infrastructures (e.g., CERN) as models for global scientific cooperation.

3. Future of Astronomy

Astronomy exemplifies the global and collaborative nature of modern science. Progress in this field is driven by collective access to large observational infrastructures—telescopes, satellites, and data archives—whose results are shared openly. This session may highlight: How open-access astronomical data foster inclusivity and democratization of science; The role of space-based observation in Earth and planetary sciences; The philosophical and theological resonance of cosmic discovery: our place in an expanding universe and the possibility for life outside our Solar system.

4. Future of Chemistry

Chemistry remains a cornerstone discipline linking the physical and life sciences. This session will consider how new techniques in materials chemistry, catalysis, and molecular design can advance sustainability and address global challenges. Topics might include: Green chemistry and the circular economy; Synthetic biology and molecular innovation; Chemical sciences in medicine and energy transformation.

5. Future of Life Sciences I: Biological and Agricultural Sciences

This session will address the future of life and living systems, from molecular biology to ecology. Possible focus areas: Genetic and genomic revolutions; Advances in plant science, agronomy, and food security under climate change; Systems biology and the integration of life sciences with digital technologies. We also encourage speakers to address the rapidly expanding field of epigenetics as complementary mechanism to adapt organisms to the environment. Another field with complex perspectives but also considerable ethical implications is Artificial Life.

Both, the life sciences and the computational sciences are active in this field. The former attempting to obtain replicating macromolecules and then mimic evolution, the latter experimenting with self-organizing algorithms.

6. Future of Life Sciences II: Medicine and Neuroscience

This session will emphasize non-communicable diseases, such as neurodegenerative and cognitive disorders, alongside innovations in diagnostics and AI-driven medicine. Themes may include: AI in diagnosis and treatment; Neurobiology and the understanding of consciousness and cognition; Translational medicine and equitable access to innovation; Shifting from a reactive to a preventive model of healthcare; Chronic and age-related conditions. We shall consider here the attempts to expand the life span of organisms, which have numerous ethical and societal consequences and since there is a chance that some of them will work, we should discuss design and consequences of this field of research. Influences on mental health, including genetic and environmental factors (psychological traumata, education, social embedding etc.) shall be addressed. Moreover, neurobiology and AI linkages shall be considered. All these and Brain Computer interfaces (BMI) to replace lost functions and to enhance cognitive functions presents a host of ethical challenges for PAS.

7. Future of Earth Sciences

Earth Sciences hold a unique position at the intersection of data, environment, and ethics. Much of the field's current progress stems from space-based observations and global open-data networks. Themes include: The integration of geosphere, hydrosphere, atmosphere, and biosphere in climate models; The role of Earth observation in water management and land use systems; science of climate adaptation.

PART III – CROSS-CUTTING ISSUES AND A REFLECTIVE SESSION ON SCIENCE FUTURES

Beyond disciplinary boundaries, the Plenary will convene an integrative session that connects science with philosophy, society, and moral reasoning.

1. Interdisciplinary Science and Great Human Challenges

The session will address how scientific inquiry contributes to confronting humanity's greatest challenges: climate change, poverty, conflict, and inequality with an integrated perspective on how science can offer solutions.

2. Epistemology and History of Science

The session may revisit the philosophical and historical roots of scientific inquiry, exploring how concepts such as objectivity, evidence, and rationality have evolved. Possible elements are Historical reflections on key scientific milestones; Renewing epistemological reflection as a path toward unity of knowledge.

3. Trust in Science

In an age of misinformation and public skepticism, the crisis of trust in science has become a pressing issue. This session will explore causes and remedies—examining how communication, education, and transparency can rebuild credibility. It may revisit the Academy’s Statement of Concern from June 2025. Questions may include: How can science better communicate uncertainty without undermining authority? What institutional mechanisms promote integrity and accountability? How can the Academy foster dialogue between scientists, policymakers, and the public? What are responsibilities of individuals and those of national or global health systems for instance related to obligatory vaccination and screening, control of foods, etc.?

Outcome: The 2026 Plenary Conference aims at a statement with a set of recommendations to help guide the global science community and the Pontifical Academy’s future work and inform the Holy Father’s reflections on the ethical implications of scientific progress. This may include a renewed emphasis on science for the common good, reinforcing the Academy’s commitment to advancement of sciences for peace, human dignity, and ecological stewardship.

Organizational aspects: We ask speakers to give presentations of 15 minutes max. For the presentations, PPTs are welcome. We request all speakers to contribute a paper of not more than 3500 words, latest by August 30th 2026. Accepting to contribute a paper is a condition for the invitation. The papers will be published in the PAS publications series “acta” following PAS editorial guidelines: https://www.pas.va/en/about/editorial_guidelines.html

Agenda

Day 1 | Thursday 24 September 2026

08.00–08.30 OPENING SESSION

President Prof. Joachim von Braun

Welcome, Concept of Plenary in the context of PAS agendas

Chancellor Cardinal Peter K.A. Turkson

Words of Welcome

08.30–09.45 SESSION I – Future Thinking in the Sciences

Session Chair: Joachim von Braun • PAS

This opening session will explore how science conceives and anticipates the future—through foresight, modelling, and imagination in three key fields of particularly rapid change. It may examine how scientific progress is guided not only by prediction but by hope, creativity, and ethical responsibility. Scientists will reflect on anticipation as both a methodological and moral practice in shaping a humane and sustainable future

08.30–08.50 Demis Hassabis • PAS

AI and Scientific Discovery

08.50–09.10 Emmanuelle Charpentier • PAS

On genome editing futures

09.10 – 09.30 Neil Shubin • Professor of Organismal Biology and Anatomy, University of Chicago

Evolutionary biology across diverse temporal, phylogenetic, and structural scales

09.30–09.45 Discussion

09.45–10.15 Coffee Break

10.15–10.45 Moving to the Audience Hall

11.00–12.30 Audience with Pope Leo XIV

12.30–15.00 Back to Casina Pio IV and Lunch

15.00–16.40 SESSION II – Mathematics, Artificial Intelligence, and Computing

Session Chair: Mohamed Hassan • PAS

This session addresses how mathematics, artificial intelligence, and computing are redefining knowledge and discovery. It will consider the ethical use of algorithms, the balance between data and theory in an age of digital transformation. The role of engineering—linking scientific insight with human application and brain-machine interface — shall also be discussed, along with how technological innovation can serve research – and human dignity

15.00–15.20 Cédric Villani • PAS

The future of Mathematics

15.20–15.40 Daya Reddy • PAS

The Future of Mathematics and development in the global South

- 15.40–16.00** **Laure Saint-Raymond** • France
Is mathematical modelling still an effective tool for understanding complex systems?
- 16.00–16.20** **Wolf Singer** • PAS
The differences between artificial and natural intelligent systems
- 16.20–16.40** Discussion
- 16.40–17.15** Coffee Break

17.15–19.15 **SESSION III – Physics and the Foundations of Matter and Energy**

Session Chair: William Phillips • PAS

This session will explore outstanding questions in today's fundamental physics, how developments in quantum science, relativity, and high-energy research open new frontiers of knowledge. It will reflect on the cooperative and global nature of modern physics, shared infrastructures for discovery, contributions to sustainable technologies, and future energy systems

- 17.15–17.35** **Fabiola Gianotti** • PAS
Particle physics and its impact on society
- 17.35–17.55** **Steven Chu** • PAS
The future of energy science
- 17.55–18.15** **Donna Strickland** • PAS
The future of laser systems for investigations
- 18.15–18.35** **Vanderlei Bagnato** • PAS
Quantum Technology beyond the computers and communications: sensors for the Earth and for life science
- 18.55–19.15** Discussion
- 19.30–21.00** Dinner at Casina Pio IV

Day 2 | Friday 25 September 2026

09.00–10.45 **SESSION IV – Astronomy and Cosmic Collaboration**

Session Chair: Richard D'Souza SJ • PAS, Vatican Observatory

This session will focus on expanding knowledge of the cosmos and for understanding humanity's place in the universe, and the possibility for life outside our Solar system. Transformative impact of shared infrastructures—major observatories, space telescopes, and open-access data archives are considered, and highlight how collaboration and transparency in astronomy provide a model for inclusive scientific practice

- 09.00–09.20** **Martin J. Rees** • PAS  by Zoom
The future of astronomy
- 09.20–09.40** **Andrea Ghez** • PAS
Galaxies and Black Holes
- 09.40–10.00** **Surhud More** • Professor at IUCAA, Pune, India
Gravitational lensing probes of cosmology

- 10.00–10.20** **Ewine van Dishoeck • PAS**
Chemistry between the Stars: Ingredients for building New Worlds
- 10.20–10.30** **John C. Mather •** Senior astrophysicist at the NASA Goddard Space Flight Center and adjunct professor of physics at the University of Maryland
Reflections and discussion opening

10.30–10.45 Discussion

10.45–11.00 **Pius XI Gold Medal 2026 – Presentation by Prof. Karin Öberg, Harvard**

11.00–11.30 Coffee Break

11.30–13.00 **SESSION V – Chemistry and Molecular Innovations**

Session Chair: Jürgen Knoblich • PAS

This session will examine developments in organic, inorganic, and physical chemistry that enable new diagnostics and sustainable materials, and also emerging insights in genetics. It will highlight (bio-) chemistry's evolving role in explorations and in creating building blocks of a more sustainable and humane health future.

11.30–11.50 **Robert Eric Betzig • PAS**

The Future of Image-Based Biological Discovery

11.50–12.10 **Roger Kornberg •** Professor of structural biology, Stanford University School of Medicine

The future science of gene expression and gene regulation

12.10–12.30 **Aaron Ciechanover • PAS, Technion, Haifa, Israel**

The future of understanding cellular processes and related pathogenetic mechanisms of diseases

12.30–12.50 **Gary Ruvkun •** Harvard Medical School, USA

Interplanetary spread of microbial life as the origin of life on Earth

12.50–13.00 Discussion

13.00–14.30 Lunch at Casina Pio IV

14.30–16.15 **SESSION VI – Life Sciences I: Biology and the Future of Living Systems**

Session Chair: Eddy de Robertis • PAS

This session explores the future of the living systems sciences, from molecular biology and genetics to botany, agronomy, and ecology. It will reflect on the integration of life sciences with data technologies, and how these developments can enhance food security, biodiversity, and planetary health, and epigenetics, as well as genetic transformations for food (under climate change stresses) and for pharma. Emphasis will be placed on the ethical responsibilities arising from genetic and biotechnological advances

14.30–14.50 **Anming Meng • PAS**  by Zoom

Early embryonic development of vertebrates and maternal factors in developmental processes

14.50–15.10 **Olivier Pourquié • PAS**

Pluripotent stem cell models and cell therapy

15.10–15.30 **Svante Pääbo •** Max Planck Institute for Evolutionary Anthropology, Leipzig

The future of research on genomes of extinct hominins and human evolution

15.30–15.50 **Mariangela Hungria •** EMBRAPA, Brazil

Sustainable agriculture with biological seed and soil treatments

15.50–16.10 **Linda Partridge** • Max Planck Institute for Biology of Aging, Cologne, Germany
The science of aging and future of aging

16.10–16.35 Discussion

16.35–16.50 **Pius XI Gold Medal 2024: Presentation by Feng Zhang, MIT, USA**

16.50–17.20 Coffee Break

17.20–19.00 **SESSION VII – Life Sciences II: Medicine and Human Wellbeing**

Session Chair: Chen-Jen Chen • PAS

This session will examine rapid advancements in health sciences—diagnostics, therapeutics, neuroscience, and surgery—with attention to artificial intelligence in healthcare and drug development. It may focus to future pandemics, non-communicable and degenerative diseases, and explore ethical implications of medical innovation for equitable global health

17.20–17.40 **Francis Collins** • PAS  by Zoom
The Future of health sciences

17.40–18.00 **Stefano Piccolo** • PAS
The Future of Cell Science: Social Behaviour, Cellular Communities, and Cancer

18.00–18.20 **Jeremy Farrar** • Assistant Director-General (ADG) of Health Promotion, Disease Prevention and Control of WHO
The risks of future Pandemics

18.20–18.40 **Ferenc Krausz** • Frontiers Foundation, Budapest, Hungary
The Future of Healthcare: Affordable Preventive Care

18.40–19.00 Discussion

19.00–21.00 Dinner at Casina Pio IV

Day 3 | Saturday 26 September 2026

08:30–9.00 **Chair: Joachim von Braun**
Commemorations and Self-Introductions of new PAS Academicians

09.00–10.15 **SESSION VIII – Earth Sciences and the Future of the Planet**

Session Chair: Örjan Gustafsson PAS

This session considers the integration of geosphere, hydrosphere, atmosphere, and biosphere in understanding and responding to climate change. It will highlight the growing role of space-based Earth observation and open data in shaping sustainable food and water systems. The session will also discuss how the Earth sciences contribute to stewardship of planetary health

09.00–09.20 **Hans Joachim Schellnhuber** • PAS
The future of climate change and tipping points

09.20–09.40 **Artaxo Paulo** • Professor at University of São Paulo, Brazil
The future of the Amazon and the tropical forests

09.40–10.00 **Sandra Díaz** • FRS Professor of ecology, National University of Córdoba, Argentina
The future of biodiversity under global changes

10.00–10.20 **V. Ramanathan • PAS**
Global Climate Disruption: Remaining Options

10.20–10.30 Discussion

10.30–11.00 Coffee Break

11.00–13.00 **SESSION IX – On Futures of Sciences, Philosophy, and Society: Cross-Cutting Reflections**

Session Chair: Magdalena Skipper Editor in Chief, *Nature*

This integrative session includes: Epistemology, Philosophy, Faith and Science, public trust in science, and how science can help confront major global issues—AI for the human good, climate change, poverty, conflict, and inequality—through integrated and ethically guided science for innovation. Initiatives to address freedom of science, and international cooperation shall be addressed.

Panel members make brief introductory statements (4 min.) and under the guidance of the chair interact with each other and all the participants of the plenary conference

- **Theodor Hänsch • PAS Physics**
- **Tshilidzi Marwala • South Africa, Rector of UNU, AI Science and Policy**
- **Gagandeep Kang • India, Public Health**
- **Jane Lubchenco • PAS Environment**
- **Jürgen Mittelstrass • PAS Philosophy**
- **Michela Massimi • University of Edinburgh**
- **Helga Nowotny • Vienna, Complexity Science Hub**
- **Robbert Dijkgraaf • President of International Science Council (ISC)**

13.00–13.15 **SESSION X – Conclusions from the Plenary**

Co-Chairs: President Joachim von Braun and Chancellor Cardinal Peter Turkson

13.15–13.45 Coffee and light buffet

13.45 Visit of the Vatican Museum, if participants and their accompanying persons like (prior registration needed)

List of Participants

Prof. Dr. Joachim von Braun

President of the Pontifical Academy of Sciences
Distinguished Professor, Economic and Technological Change,
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Cardinal Peter Turkson

Chancellor
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Msgr. Dario E. Viganò

Vice Chancellor
The Pontifical Academy of Sciences
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Prof. Vanderlei Bagnato

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IFSC -University of Sao Paulo -Brazil and TEXAS A&M University
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Prof. Francis Collins by Zoom

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Investigator, McGovern Institute for Brain Research,
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Prof. Maria Zuber
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Presidential Advisor for Science and Technology Policy
and E.A. Griswold Professor of Geophysics
Massachusetts Institute of Technology
United States of America

Memorandum

General information

- › Dress code is business attire.
- › Please remember to bring a valid ID.
- › Please refer to www.pas.va for further information on the Academy, the Academicians, and current and past events.

Access instructions to the Vatican and the Casina Pio IV

- › Your name is already communicated to the Vatican Security. They will check your Identity and let you in. If you are bringing a guest, kindly let us know, and we shall add their name on the list.
- › You can come through the closest entrance called Perugino (Via della Stazione Vaticana, no number, it's a very short street). Instructions to the Casina Pio IV, headquarters of the Pontifical Academy of Sciences, can be found in the following link:
<http://www.casinapioiv.va/content/accademia/en/about/contacts.html>
- › For all eventualities the telephone numbers of the Academy are the following:
+39 06 69883195 or +39 06 69883451. A Mobile number is also available +39 3420026216
On travel days, the mobile phone number +393420026216 will be available.



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Password: will be available in the Casina Pio IV



**CONTACTS
AND MAPS**



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