



The Pontifical Academy of Sciences

Plenary Session on

# **TRANSFORMATIVE ROLES OF SCIENCE IN SOCIETY: FROM EMERGING BASIC SCIENCE TOWARD SOLUTIONS FOR PEOPLE'S WELLBEING**



12-14 November 2018 | Casina Pio IV | Vatican City



*“Very briefly, I would say that it falls to scientists, who work free of political, economic or ideological interests, to develop a cultural model which can face the crisis of climatic change and its social consequences, so that the vast potential of productivity will not be reserved only for the few. Just as the scientific community, through interdisciplinary dialogue, has been able to research and demonstrate our planet’s crisis, so too today that same community is called to offer a leadership that provides general and specific solutions for issues which your plenary meeting will confront: water, renewable forms of energy and food security. It has now become essential to create, with your cooperation, a normative system that includes inviolable limits and ensures the protection of ecosystems, before the new forms of power deriving from the techno-economic model causes irreversible harm not only to the environment, but also to our societies, to democracy, to justice and freedom”.*

**Pope Francis, Address to the Pontifical Academy of Sciences,  
28 November 2016**

# Introduction

The 2018 PAS plenary is guided by the ideas that

- basic sciences remain fundamental for generating a valid and evidence based model of the world
- sciences become ever more interconnected across disciplines, including the humanities
- scientists and science policy makers need to engage with society to maintain (foster) trust in science and to counter the spread of statements that are not based on scientific insights (fake news).

In the 2018 Plenary we attempt to identify emerging insights from basic science, and – where appropriate – connect new insights with visions for problem-solving strategies and related research. As Goethe said: “Knowing is not enough, you must apply; willing is not enough; you must do”.

We note that trust in science may have declined. Loss of trust in science will lead to reduced support by society and jeopardizes the transformative impact of science. Our Academy is particularly sensitive to any

such tendencies and therefore seeks the dialogue with science policy leaders at the Plenary Session 2018.

This Plenary has the following objectives:

1. To identify groundbreaking developments in the main disciplines of basic science. These shall be communicated by speakers in ways understandable by participants from different science disciplines.
2. To identify evidence based and sustainable problem-solving strategies and related research for people’s wellbeing, poverty reduction and humanity’s current problems of environmental destructions and conflicts.
3. To identify and share approaches on how to strengthen societies’ trust in science. Causes of possibly growing mistrust in science are addressed and opportunities to enhance trust in science identified, including science education and communication. In that context we shall also embrace the theme, how to foster fruitful relations between sciences and religions.

# Programme

Monday, November 12th 2018

## OPENING SESSION

Chair: **Joachim von Braun**

9:00 | **Joachim von Braun** | *Opening, Words of Welcome and Concept of the Plenary*  
**H.E. Msgr. Marcelo Sánchez Sorondo** | *Introduction to the Plenary*

## Bloc 1. Scientific assessment of a set of large global humanities issues

(population, health, ecology, and their underlying causes).

### SESSION I – Population and Science Approaches

9:10 | *World Population Change – Future Dynamics*

**Wolfgang Lutz**

9:30 | *The Complementary Nature of Scientific Experimentation and Thought Experiments*

**Werner Arber** and **Marcel Weber**

9:50 | Discussion

### SESSION II – Climate and Energy

Chair: **V. Ramanathan**

10:00 | *Energy for the Nine Billion*

**Steven Chu**

10:20 | *Energies for the Future*

**Carlo Rubbia**

10:40 | Discussion

10:45 | Coffee Break

11:15 | **Audience with Pope Francis**

13:30 | Lunch at the Casina Pio IV

14:30 | *What Must Be Sustained to Enable Sustainable Improvements in People's Well-being?*

**William C. Clark**

14:45 | *Where on Earth Are We Heading: Pliocene or Miocene?*

**Hans Joachim Schellnhuber**

15:00 | Discussion

### SESSION III – Health

Chair: **V. Ramanathan**

15:25 | *The Revolution of Personalized Medicine – Bioethical Obstacles on the Road of Technological Advances*

**Aaron Ciechanover**

15:40 | *Organ Transplants*

**Francis L. Delmonico**

15:55 | *The Three-Dimensional Architecture of the Human Genome: Understanding the Physical Mechanisms*

*Controlling Gene Expression*

**José Nelson Onuchic**

16:15 | *Next Generation Antibiotics*

**Ada Yonath**

16:30 | Discussion

16:50 | Coffee Break

### SESSION IV – Ecology and Biosystems

Chair: **Ingo Potrykus**

|       |  |
|-------|--|
| 17:20 | <i>Plant Biodiversity in Africa and its Use for Economic Development and the Environment</i><br><b>Sebebe Demissew</b> |
| 17:40 | <i>Saving Plants from Extinction: How and Why?</i><br><b>Peter H. Raven</b>  |
| 17:55 | <i>Science in a Post-Truth World: Hope for People and the Ocean</i><br><b>Jane Lubchenco</b>                           |
| 18:10 | Discussion   |

## **Bloc 2. Frontiers in science disciplines**

Science community of PAS members and guest speakers highlight science frontiers. Firstly, frontier insights are presented independently from linking them to applications or solution orientation; later and during discussions, new insights may be related to innovations with social responsibility, wellbeing of people and the planet, development of long term perspectives.

### **SESSION V – Physics**

Chair: **Theodor Hänsch**

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|-------|--|
| 18:30 | <i>Constants of Nature and Their Applications</i><br><b>Klaus von Klitzing</b> |
| 18:45 | <i>The Dilemma of Basic Research</i><br><b>Daniel Kleppner</b>                 |
| 19:05 | Discussion   |
| 19:30 | Dinner at the Casina Pio IV  |

## **Tuesday November 13th 2018**

### **SESSION VI – Physics**

Chair: **Martin Rees**

|       |  |
|-------|--|
| 9:00  | <i>Making the Revolutions of Quantum Technology Deliver for People and Planet</i><br><b>Massimo Inguscio</b>                     |
| 9:20  | <i>Science Addressing Questions Not Easily Addressed by “the” Scientific Method. The Origins of Life</i><br><b>Steven Benner</b> |
| 9:40  | Discussion   |
| 10:00 | Coffee Break   |

### **SESSION VII – Astronomy, Space**

Chair: **Martin Rees** | continued

|       |  |
|-------|--|
| 10:30 | <i>The Space Renaissance and Impacts on Humanity</i><br><b>Will Marshall</b> |
| 10:50 | <i>Exoplanets and Beyond</i><br><b>Sara Seager</b>                           |
| 11:10 | <i>On Cosmology</i><br><b>John Barrow</b>                                    |
| 11:30 | Discussion   |

### **SESSION VIII – Biology, Genetics, Bio-Chemistry, Chemistry**

Chair: **Vanderlei S. Bagnato**

|       |   |
|-------|---|
| 11:50 | <i>Enlisting Stem Cells to Rejuvenate Aged Muscle Function</i><br><b>Helen M. Blau</b>      |
| 12:10 | <i>The Role of Microscopy in Improving the Human Condition</i><br><b>Robert Eric Betzig</b> |
| 12:25 | Discussion  |
| 12:40 | Lunch at the Casina Pio IV  |

## SESSION VIII – Biology, Genetics, Bio-Chemistry, Chemistry (continued)

Chair: **Vanderlei S. Bagnato**

|       |  |
|-------|--|
| 14:30 | <i>On Gene Biology and Evolution</i><br><b>Takashi Gojobori</b>  |
| 14:45 | <i>The Dependence Receptor Paradigm: When an Original Cell Death Pathway is Used as a Therapeutic Strategy Against Cancer</i><br><b>Patrick Mehlen</b> |
| 15:00 | <i>From Basic Research on Amino Acid Polymers to the Most Used Drug Against Multiple Sclerosis</i><br><b>Michael Sela</b>                              |
| 15:15 | Discussion   |
| 15:35 | <i>Cancer Immunotherapy: Improved Treatment and Issues</i><br><b>Thierry Boon-Falleur</b>  |
| 15:45 | <i>Regulation of Protein Degradation and Endocytosis by Wnt Growth Factors</i><br><b>Edward M. De Robertis</b>   |
| 15:55 | <i>The CRISPR-Cas Technique for Gene Editing and its Impact on Society</i><br><b>Rafael Vicuña</b>   |
| 16:05 | Discussion   |
| 16:30 | Coffee Break   |

### Bloc 3. Transformative roles of science in societies

This bloc attempts syntheses from Blocs 1 and 2, with presentations and discussions on transformative roles of science in societies and implications for science policy. Discussions with science policymakers address science policy, causes of lack of trust in science and what to do about that; pressure to do translational science and to justify basic science with utilitarian rather than epistemic arguments; roles of public and private research; sharing of science across countries; policy choices and their moral dimensions; education for science and curiosity, and fruitful relations between sciences and religions. (Should this block not come later, since the following sessions are again sessions addressing frontiers in science and not a meta-view, that would engage the policy makers)

## SESSION IX – Future Science Policy | Discussion Among Leaders of Science Organizations, Policy Makers, Religious Communities

Chairs: **Wolf Singer** and **Joachim von Braun**

|       |  |
|-------|--|
| 17:00 | <ol style="list-style-type: none"><li>1. <b>Jean Pierre Bourguignon</b>   President of the European Research Council</li><li>2. <b>Wan Gang</b>   Senior Science Policy maker from China</li><li>3. <b>Georg Schütte</b>   State Secretary of Education and Science, Germany</li><li>4. <b>Lino Barañao</b>   Science Minister of Argentina</li><li>5. <b>Rev. Antje Jackelén</b>   The Lutheran Archbishop of Uppsala in Sweden and Primate (inter pares) of the Church of Sweden</li><li>6. <b>H.E. Msgr. Marcelo Sánchez Sorondo</b>   Chancellor, The Pontifical Academy of Sciences</li></ol> <p><i>Panelists' statements (10 minutes each, followed by panel interaction with ample amount of time – till 19:00, as well as over dinner)</i></p> |
| 18:30 | Panelists' Discussion with Academicians and Guest Speakers   |
| 19:30 | Dinner at the Casina Pio IV  |

**SESSION X – Transformative Roles of Science, People and Education**

Chair: **V. Ramanathan**

9:00 | *Transformative Roles of Science in Societies for Science Policy*

**Antonino Zichichi**

9:15 | *Education for a Digital Sustainable Environment*

**Antonio M. Battro**

9:25 | *Science Education & Climate Change Authors*

**Yves Quéré**

9:35 | Discussion

10:05 | Coffee Break

**SESSION XI – Conclusions of the 2018 Plenary**

Chairs: **Joaquim von Braun** and **H.E. Msgr. Marcelo Sánchez Sorondo**

10:35 | Brief introductions by teams of Blocs 1, 2, 3, and science policy implications based on a draft statement

1. **V. Ramanathan, Francis L. Delmonico**: Humanities Challenges and Sciences (Bloc 1)
2. **Martin J. Rees, Vanderlei S. Bagnato and Theodor W. Hänsch**: New Insights From Basic Sciences (Bloc 2)
3. **Wolf J. Singer, Nicole M. Le Douarin and Werner Arber**: Problem Solving Science Opportunities (Bloc 3)
4. Science Policy in Support of Trust in Science (Policy Debates Outcomes)

11:05 | General Discussion based on Final Statement

13:00 | Lunch at the Casina Pio IV

**SESSION XII – Closed Session for Academicians**

14:00 | *Self-Presentations*

1. **Helen M. Blau**
2. **Robert Eric Betzig**
3. **Steven Chu**
4. **Guy Joseph Consolmagno SJ**
5. **Mohamed H.A. Hassan**

14:50 | *Commemorations*

1. **Günter Blobel (Edward M. De Robertis)**
2. **Stephen W. Hawking (Martin Rees)**
3. **Fotis C. Kafatos (Nicole Le Douarin)**
4. **Félix Malu wa Kalenga (Vanderlei S. Bagnato)**
5. **Vera Rubin (Martin Rees)**

15:40 | Award Ceremony of the **Pius XI Medal**





# List of Participants

**Werner Arber**  
**Vanderlei S. Bagnato**  
**Lino Baraño**  
**John Barrow**  
**Antonio M. Battro**  
**Steven Benner**  
**Robert Eric Betzig**  
**Helen M. Blau**  
**Thierry Boon-Falleur**  
**Jean Pierre Bourguignon**  
**Joachim von Braun**  
**Steven Chu**  
**Aaron Ciechanover**  
**William C. Clark**  
**Guy Joseph Consolmagno SJ**  
**Francis L. Delmonico**  
**Sebsebe Demissew**  
**Edward M. De Robertis**  
**Wan Gang**  
**Takashi Gojobori**  
**Theodor Hänsch**  
**Mohamed H.A. Hassan**  
**Massimo Inguscio**  
**Rev. Antje Jackelén**

**Daniel Kleppner**  
**Klaus von Klitzing**  
**Nicole M. Le Douarin**  
**Jane Lubchenco**  
**Wolfgang Lutz**  
**Will Marshall**  
**Patrick Mehlen**  
**José Nelson Onuchic**  
**Ingo Potrykus**  
**Yves Quéré**  
**Veerabhadran Ramanathan**  
**Peter H. Raven**  
**Martin Rees**  
**Carlo Rubbia**  
**H.E. Msgr. Marcelo Sánchez Sorondo**  
**Hans Joachim Schellnhuber**  
**Georg Schütte**  
**Sara Seager**  
**Michael Sela**  
**Wolf Singer**  
**Rafael Vicuña**  
**Marcel Weber**  
**Ada Yonath**  
**Antonino Zichichi**



# Memorandum

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 Todos los periodistas y gráficos que deseen participar deben enviar una solicitud de acreditación TEMPORAL a través del módulo que está disponible online en la sección de acreditaciones de la página web de la Oficina de Prensa de la Santa Sede: [press.vatican.va/accredimenti](http://press.vatican.va/accredimenti). Los que ya dispongan de acreditación normal válida, deben enviar una solicitud de participación según la modalidad habitual. Todas las peticiones deberán hacerse al menos 48 horas antes del evento.

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