



## [INTRODUCTION]

# Grand Challenges for physics

**O**ur developed society is based on science and technology but only a minority of the general public has an understanding of how they work. Equally unknown are the opportunities opened by fundamental research and their impact in our daily lives.

The history of science offers a wide range of examples of discoveries with unforeseen social value. The discovery of the delicate mechanism by which ozone is naturally produced and destroyed in the stratosphere is a good example. It illustrates how vulnerable the Earth actually is under human stewardship, while at the same time illustrates the human capability to address challenges making use of basic science with a mixture of scientific curiosity and a touch of environmental awareness. Scientific endeavour means very often exploring unknown territories. Here its strength lies in its capability for developing self-correcting strategies based on available evidence to explore the limits of science and the science of limits.

Historically scientific breakthroughs have been steady but slow, occurring over a span of centuries. Leonardo da Vinci [1452-1519] was a true Renaissance person. His artistic talent is comparable to his genius to dream the future. Leonardo da Vinci's greatest ambition was to fly. Centuries later, flying like a bird was still a dream in Goya's time [1746 – 1828]. Fly has been a driver of creativity and fantasy - to go where no one has gone before, to overcome human limits, to fulfil high and demanding goals. It took more than 500 years to

build a flying machine that would allow humans to get a unique view of our planet. A photograph, snapped from the Voyager 1 in 1990 at a distance of about 6 thousand million kilometres, showed our planet as a lonely pale blue dot in the great enveloping cosmic dark. A unique image taken by scientists that exceeded Leonardo's and Goya dreams a few centuries latter.

Today the pace of innovation has accelerated drastically. Over the last decades, the European Physical Society community has been promoting and examining some of the biggest problems humankind faces right now and the role physics to address them. But what about the big challenges in physics that are brewing for the future?. In the Horizon 2050, what challenges might be on the world's physics agenda to solve? Predictions are difficult to be made but we can get clues from how current trends in science and technology may play

▼ Leonardo Da Vinci's first attempt to fly was in the late 15<sup>th</sup> century. He never succeeded to make his dream reality.





▲ In one of Goya's most striking prints, a series of people are flying through an endless night (Goya, El Prado Museum). They are like new Icaruses, assisted by broad wings. The story of Icarus is one of the most famous tales from Greek myth that is often interpreted as a metaphor for human's overreaching their limits.

out, and where physics has a key role to play. This is the purpose of the *EPS Grand Challenges: Physics for Society at the Horizon 2050 project*, exploring our ability to imagine and shape the future using modern day scientific tools and methods. The project is designed to address the social dimension of science and the grand challenges in physics with two pillars: (i) *physics as global human enterprise for understanding nature*; and (ii) *physics developments to tackling major issues affecting the lives of citizens*. A fascinating journey, from the smallest scale that we have ever explored – quarks particles that are of the scale of  $10^{-18}$  m – to the largest things we have ever measured – the greater breadth of the universe at the scale of  $10^{27}$  m. A project highlighting the key role of interdisciplinarity to address some of the grand scientific and social challenges that lay ahead us, such as the climate change or understanding life.

An editorial board and chapter coordinators from different European institutions played a key role in the development of the project and the preparation of a book. More than ten Editorial Board meetings were held during 2019 – 2021 to approve terms of

reference and topics to be covered in seven chapters of the book: (i) Physics bridging the infinities; (ii) Matter and waves; (iii) Physics for understanding life; (iv) Physics for health; (v) Physics for environment and sustainable development; (vi) Physics for secure and efficient societies; (vii) Science for society.

All these topics are widely recognised today as the most important global challenges in physics. Interdisciplinarity allows interconnections between many areas of knowledge, involving physics, mathematics, biology and chemistry, in such a way that the whole body of connected ideas might suddenly expand due to small advances within the islands of specialised knowledge. In the project, we have looked at all these aspects to explore what makes us, human beings, really unique in nature: our ability to shape the future by making use of science and technology.

This EPN special issue provides a glimpse of the *EPS Grand Challenges in the Horizon 2050 project* addressing world's physics agenda to solve in science and technology. The resulting book will be published by IOPP under the umbrella of the EPS in early 2023. The most up to date information will be published here: <https://www.eps.org/page/GrandChallengesInPhysics>.

The essays, prepared by a panel of more than 70 leading scientists, are based on detailed and in-depth analyses to illustrate the strong links between basic research and its social impact. Reports are expected to reach a broad audience that is willing to explore a future shaped by science. ■

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## THANK YOU!

The EPN Editors are very grateful to Carlos Hidalgo, who as Guest Editor introduced us to the 'EPS Grand Challenges for Physics' project. Together with the many coordinators of the project and with an excellent introduction together with David Lee, an attractive overview is given of the many chapters in the project, that will be published as a book by IoP. We highly appreciate your work and endeavour for EPN. Thanks a lot to all of you!