SPECIAL ISSUE
PHYSICS AND ITS CURRENT AND FUTURE APPLICATIONS

Christophe Rossel and Markus Nordberg, Guest Co-editors – DOI: https://doi.org/10.1051/epn/2018501

The importance of scientific research and innovation to the development of our economy is a well-established fact. A study made in 2013 for the EPS by the Centre for Economics and Business Research (Cebr) assessed the value generated by physics-based industries to the economic prosperity of Europe. A new report will update this study with a more recent analysis over the 2011-2016 period for the 28 EU countries including also Iceland, Norway and Switzerland.

The aim of this EPN focus issue is to present a few topics where physics has and will continue to contribute to the development of new technologies and applications. The choice of the 6 articles is somewhat subjective and certainly doesn't cover the whole spectrum of scientific research but it should give the reader a good flavour of the actual important trends.

The first contribution addresses the role of materials science in our modern society confronted with grand challenges such as the global population growth or climate change. The authors discuss how scientists and urban planners need to work together to design materials for smarter and more energy efficient homes, and how research on new materials can provide low-carbon, low-consumption solutions in energy, transportation, consumer electronics, or healthcare issues. The second article entitled 'from classical optics to nanophotonics' shows how the development on micro- and nanoelectronics makes it possible to control both spectral and spatial properties of light by using materials with well-defined 2D or 3D structures. Some recent advances in nanophotonics applications are presented, demonstrating the impressive impact of this field on novel information and communication techniques. The semiconductor industry is experiencing a paradigm shift. For years microelectronics has become more and more performant thanks to the progress in the design and fabrication of basic components such as the transistor. But today scaling alone cannot feed the growing needs for mobile and power electronics, automotive and healthcare applications. Further innovation will be needed, including new device concepts, new materials and system-level architectures with integrated functionalities. The authors of the third paper describe also the emergence of new disruptive neuromorphic computing architectures where memory and processing units are co-located, and working in a similar way to the synaptic and neuronal functions in the brain. This work introduces us directly to another topic, namely Artificial Intelligence with its spectacular breakthroughs in the last ten years and its future impact on various sectors of human activities. The author discusses how AI technologies are likely to reshape completely many aspects of our society and presents a few examples. But, as he claims, AI will affect our lives for the better and the worse, with machines being able to make decisions, but still being far from our human intelligence. Other emerging fields of interest in science are quantum computing, quantum communication, quantum simulation and quantum sensing and metrology. The European Quantum Flagship, which is a 10-year, 1 billion Euro initiative, is expected to bring quantum technologies from the lab to the market. In this fifth article, the authors describe the history of this initiative, the implementation of its governance and the start of the first funded research projects. Finally, last but not least, the sixth contribution explains how particle physics has played an important role in healthcare since the advent of radiation-based medicine after the discovery of X-rays and radioactivity. Today, state-of-the-art techniques derived from particle accelerators, detectors and computing tools are routinely used in clinical practice and for far-reaching medical and biomedical research.

We wish you an enjoyable and interesting reading.