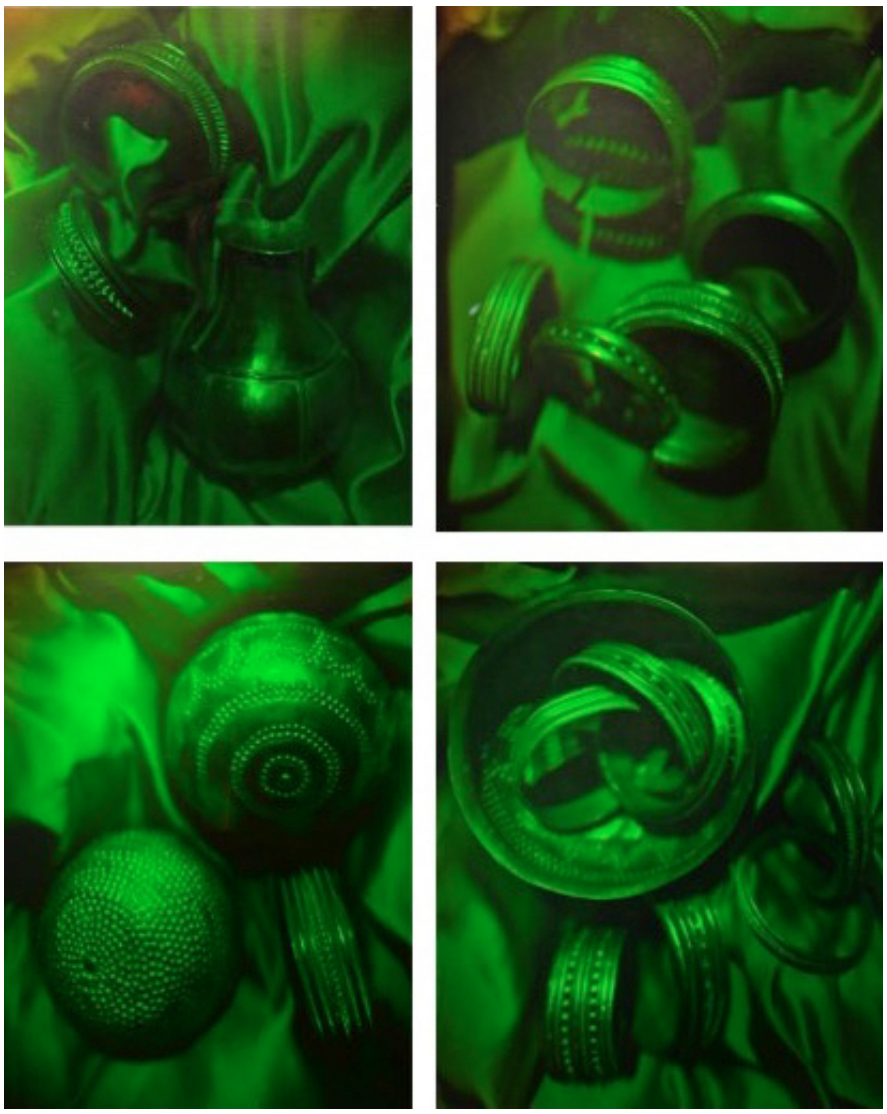
International Year of Light Blog

Challenges Faced by Optics

MARCH 31, 2015MARCH 30, 2015 LIGHT2015 LEAVE A COMMENT

Optics is the branch of physics that deals with visible light and other electromagnetic waves. Light has a "dual personality" since it sometimes behaves like a wave and other times like corpuscles or discrete packets of energy called photons. This is known as its "wave-corpuscle duality". Just as the term electronics was derived from electron, in recent years the term Photonics has been coined from photon. Although the terms optics and photonics are often used indiscriminately, the latter is sometimes used to underline the corpuscular nature of light. The number of devices and systems that operate with light is constantly increasing and the many different fields in which these are used are referred to as "light-based technologies".



(https://light2015blogdotorg.files.wordpress.com/2015/03/reflection-holograms-of-the-

villena-treasure.jpg)
Reflection holograms of the Treasure of Villena made by J. A. Quintana at the University of Alicante (http://en.wikipedia.org/wiki/Treasure_of_Villena (http://en.wikipedia.org/wiki/Treasure_of_Villena)) Credit: A. Beléndez

Nowadays optics and its technologies have spread from universities and research laboratories to form part of our daily life. They may be found in hospitals and all types of industries. They are used to correct and improve our vision. With the help of optic fibres our telephone conversations are relayed, images sent to our television sets and our computers connected to the Internet. They are used in the screens of mobile telephones, barcode and QR scanners, audio and video recorders, printing, artificial vision, LED lighting and security systems such as the holograms on banknotes and credit cards. There is no doubt that light-based technologies are part of our everyday life

The laser, one of the most important and versatile scientific instruments ever invented, led to a spectacular reactivation of optics from 1960 on. This source of coherent light caused a great stir in the scientific world and made it possible to discover new optical phenomena resulting in an endless number of applications that were previously unimaginable.

Optics has become one of the scientific disciplines with the most promising and exciting future. The industries involving light are true economic engines generating three hundred thousand million euros worldwide (1). At present the main challenge faced by optics and photonics is to satisfy a wide range of human needs. It must be able to give access to information quickly, facilitate communications and ensure that the next generation of optical networks have greater bandwidth capacity. There is a need for new, more efficient sources of light that provide economical, long-lasting lighting. The applications of light-based technologies in biomedicine are opening up new possibilities in many fields such as medical diagnosis, therapy, surgery, biomedical imaging and clinical technology. Nowadays numerous optical sensors are used as pulse oximeters and it is thought to develop others, for example, to determine the blood glucose level by non-invasive methods.

Light-based technologies are expected to help preserve our cultural heritage, promote sustainable development and enhance our health and social welfare. They need to provide new solutions to world problems in fields such as energy, education, agriculture, healthcare and the environment. Already there is talk of “green photonics”, whose challenges are to develop optical systems to generate clean, renewable energy, low consumption lighting devices and the use of environmentally friendly optical components and materials.

The Horizon 2020 –the European Union Framework Programme for Research and Innovation– shows what is expected of light-based technologies since it considers photonics to be a Key Enabling Technology (KET), together with nanotechnology, micro- and nanoelectronics including semiconductors, advanced materials, industrial biotechnology and advanced manufacturing systems.

On 20 December 2013, the United Nations General Assembly 68th Session proclaimed 2015 the International Year of Light and Light-based Technologies (http://www.light2015.org) (IYL 2015) to highlight the fundamental role of light and its technologies in all human activities. We just need to look around us to verify that the numerous applications of light in science, engineering, architecture, medicine, communications, culture, art and leisure have revolutionized society. However, excessive light may sometimes have adverse consequences.

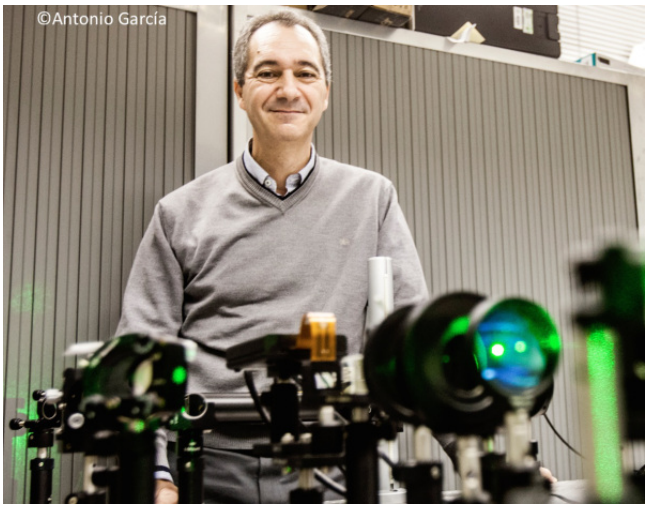
Light pollution has become one of the biggest problems in developed countries since it not only affects astronomical observations –the Milky Way is no longer visible in the night sky–, but also birds, insects, sea turtles and other nocturnal creatures, not to mention the tremendous waste of energy involved.

The study of light and its technologies has undoubtedly become a key cross-cutting discipline of science and technology in the 21st century. Just as the 20th century has been called the "century of electronics", perhaps the 21st century will be known as the "century of light", mainly due to the advances made in optics and photonics in the last fifty years.

A previous version of this text –Retos de la Óptica (http://inforuvid.com/index.php?edi=2154&comic=1)– was published in Spanish in Inforuvid Feb/15 (http://inforuvid.com/index.php?edi=2154&comic=1)

Notes

1- Towards 2020 – Photonics driving economic growth in Europe (http://www.photonics21.org/download/Brochures/Photonics_Roadmap_final_lowres.pdf) – Photonics21 Multiannual Strategic Roadmap 2014 – 2020



(https://light2015blogdotorg.files.wordpress.com/2015/03/augusto-belendez-2015.jpg)Augusto Beléndez is Full Professor of Applied Physics, leader of the Group of Holography and Optical Processing and Director of the University Institute of Physics Applied to Sciences and Technologies at the University of Alicante of Spain. He is mainly interested in holography, holographic recording materials, holographic optical elements, optical storage, and the teaching of physics and engineering. He is a member of the Spanish Optical Society (SEDOPTICA), Royal Spanish Society of Physics (RSEF), and European Optical Society (EOS). He is Senior Member of the International Society for Optics and Photonics (SPIE) and the Optical Society of America (OSA).

He is active in public outreach: he has published numerous articles in popular science journals, and in the media. In 2009 he started the blog "Física para tod@s" (http://blogs.ua.es/fisicateleco), and he have given some talks to general public on science.

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