PROSPECTUS

An International

Year of Light

and Light-based Technologies

2015

Education and Outreach in Light for Society and the World

Science – Technology – Nature – Culture – Development – Sustainability – Education – History

INTERNATIONAL
YEAR OF LIGHT

UNESCO

International Year of Light Partnership
December 2013

A resolution welcoming and endorsing an International Year of Light in 2015 was adopted by the UNESCO Executive Board at its 190th session which took place at the UNESCO Headquarters in Paris from the 3rd - 18th October 2012, and by the UNESCO General Conference at its 37th session, on the 19th November, 2013

The resolution was placed before the 190th Session of the Executive Board held in Paris from 13-18 October 2012 by Ghana, Mexico, and the Russian Federation (Board Members) and New Zealand (UNESCO Member State). UNESCO delegates from Ghana and Mexico introduced the proposal to the Executive Board, explaining the motivation and mission underlying the International Year of Light. The resolution was adopted by the Executive Board joined by co-signatories from a further 28 Board Members: Angola, Bangladesh, Brazil, Burkina Faso, China, Congo, Cuba, Djibouti, Ecuador, Ethiopia, Gabon, Gambia, Kenya, Indonesia, Italy, Malawi, Nigeria, Peru, the Republic of Korea, Saudi Arabia, Spain, Thailand, Tunisia, the United Arab Emirates, the United States of America, Venezuela, and Zimbabwe. Other Member States of UNESCO who declared support for the initiative were Hungary, Serbia and South Africa. This impressive list of co-sponsoring nations reflects the truly international and inclusive nature of the theme of an International Year of Light.

Contents

Young and old around the world are inspired and united by the beauty of light in Nature. The rainbow is a striking illustration of both the scientific and cultural aspects of light.

Executive Summary

The International Year of Light is a cross-disciplinary educational and outreach project with more than 100 partners from over 85 countries, accompanied by the UNESCO **International Basic Sciences Programme (IBSP)**. A resolution welcoming and endorsing an International Year of Light in 2015 was adopted by the UNESCO Executive Board at its 190th session which took place at the UNESCO Headquarters in Paris from 3-18 October, 2012 and by the UNESCO Executive Board at its 190th session which took place at the UNESCO Headquarters in Paris from 3-18 October, 2012 and by UNESCO General Conference at its 37th session, on 19 November, 2013. The United Nations General Assembly Second Committee adopted the International Year of Light on 3 December 2013.

An International Year of Light will contribute to achieving the aims of the UNESCO 36 C/5 Major Programme II in Natural Sciences, especially the biennial sectoral priorities Strengthening science, technology and innovation (STI) systems and policies for sustainable development, poverty eradication, and a culture of peace and non-violence, as well as **mobilizing science for the sustainable use of natural resources**, renewable energy and energy efficiency, and for natural disaster reduction and mitigation. In addition, the areas where an International Year of Light will bring especially strong focus are: (i) the advancement of science and technology for sustainable development; (ii) the promotion of UNESCO's **Priorities for Africa** with focus on **Education for All and Gender Equality**; and (iii) the harnessing of international cooperation for science and technology capacity-building.

Light science is one of the most accessible themes to promote cross-disciplinary education. Light has been a major factor in the evolution of humankind and our biosphere. People worldwide benefit from the advances in the fields of light science and applications, which help in achieving and in going beyond the **United Nations Millennium Development Goals.**

Light-based technology, often referred to as photonics, describes a range of applications aimed at directly raising the **quality of life worldwide** by reducing child mortality, improving maternal health, and combating disease. The field of Green Photonics studies ways to apply light technology to generate energy and yield environmentally sustainable outputs. Light-based technology is a major economic driver with potential to revolutionize the 21st century as electronics did in the 20th century.

The Proclamation of an International Year of Light by the United Nations will ensure the importance of light and its potential applications are appreciated by all.

Mission

The International Year of Light is a global initiative that will highlight to the citizens of the world the importance of light and optical technologies in their lives, for their futures, and for the development of society.

The International Year of Light will consist of coordinated activities on national, regional and international levels.

Activities will be planned so that people of all ages and all backgrounds from all countries enjoy and appreciate the central role of light in science and culture, and as a cross-cutting scientific discipline that can advance sustainable development.

The International Year of Light is planned for the year 2015.

Background

The International Year of Light project includes over 100 partners from over 85 countries, including scientific societies, museums, universities and other organizations. The partnership has been working since 2010 to prepare the groundwork for a coordinated series of activities throughout the world during 2015.

The project has received endorsement from the International Council for Science (ICSU) and unions representing many different branches of science: IUPAP (Pure and Applied Physics); IUPAB (Pure and Applied Biophysics), IUTAM (Theoretical and Applied Mechanics), IUHPS (History and Philosophy of Science); IAU (Astronomy); ISPRS (Photogrammetry and Remote Sensing); URSI (Radio Science). The partnership also includes the International Center for Theoretical Physics (ICTP) and SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East).

The society partners have extensive and successful track records in international outreach and joint ventures such as the 2005 International Year of Physics and long-term educational programmes in both developed and developing countries. The Partnership possesses the resources and experience to ensure tremendous impact and success for an International Year of Light.

The project is accompanied by the UNESCO International Basic Sciences Programme (IBSP).

Partners

The project partnership is growing rapidly, with new participants being added almost daily. A selection of the partners is listed below to illustrate the broad international representation within the project.

Learned Societies, Academies etc

AfPS	African Physical Society
APS	American Physical Society
AAPPS	Association of Asia Pacific Physical Societies
AOS	Australian Optical Society
CAP	Canadian Association of Physicists
COS	Chinese Optical Society
CPS	Chinese Physical Society
DPG	Deutsche Physikalische Gesellschaft
EOS	European Optical Society
EAS	European Astronomical Society
EPS	European Physical Society
F2S	Fédération Française de Sociétés Scientifiques
FEIASOFI	Federación Iberoamericana de Sociedades de Física
GAAS	Ghana Academy of Arts and Sciences
ICO	International Commission on Optics
IEEE	IEEE Photonics Society
IOP	Institute of Physics
NZIP	New Zealand Institute of Physics
OSA	The Optical Society
OSK	Optical Society of Korea
RAS	Russian Academy of Sciences
RSNZ	Royal Society of New Zealand
SFP	French Physical Society
SIF	Società Italiana di Fisica
SPIE	International Society for Optics and Photonics
WFS	World Federation of Scientists
UPSRF	United Physical Society of the Russian Federation

Partner Platforms, International Centers, etc

African Laser Center; Universidad Nacional Autónoma de México (UNAM); Museo de la Luz (Museum on Light); Centre for International Light Art; the Institute of Photonic Sciences (ICFO); Diamond Light Source; Education and Training in Optics Conference (ETOP); International Center for Theoretical Physics (UNESCO-ICTP); European Technology Platform Photonics 21; B-PHOT Brussels Photonics; Institute of Optics Rochester; Laserlab Europe Integrated Initiative of European Laser Research Infrastructures; European Centers for Outreach in Photonics (ECOP); American Association of Physics Teachers (AAPT); Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME); Chandra X-Ray Center; International Association of Physics Students (IAPS); the Commission Internationale de l´Eclairage (CIE); the International Society for Photogrammetry and Remote Sensing (ISPRS); the International Committee on Ultra-High Intensity Lasers (ICUIL); the European Society for Photobiology (ESP); The Lightsources source facility network; European Photonics Industry Consortium (EPIC); African Laser, Atomic, Molecular and Optical Sciences (LAM) Network; The European Network of Science Centres and Museums (ECSITE).

Motivation

Light plays a central role in human activities. On the most fundamental level through photosynthesis, light is necessary to the existence of life itself, and the many applications of light have revolutionized society through medicine, communications, entertainment and culture. Industries based on light are major economic drivers, and **light-based technologies directly respond to the needs of humankind** by providing access to information, promoting sustainable development, and increasing societal health and well-being. As light becomes the key cross-cutting discipline of science and engineering in the 21st century, it is essential that the brightest young minds continue to be attracted into careers in this field.

All fields of science are based on the theories of light and its interaction with matter, and light is one of the main messengers in our understanding of the Universe and the subatomic world. The history of the study of light spans centuries, and has involved virtually all the major figures of science. And it was the 20th century that saw the birth of the modern theory of light, the invention and application of lasers, the widespread deployment of photonic devices to improve society, and the full appreciation of the fundamental place that light occupies in the fabric of space and time. The spectrum of light from X-rays to infrared lasers provides technologies that underpin our lives, optical technologies have revolutionized medical diagnostics and treatment, and light and photonics are poised to become the key enabling technologies of the future.

Light is the means by which human beings see themselves, each other, and their place in the Universe. Light is an essential part of culture and art and is a unifying symbol for the world. An International Year of Light is the ideal instrument to ensure the necessary **increased worldwide awareness of the central role of light** in the present and in the future of us all.

Goals

An International Year of Light will coordinate international and national activities in order to achieve the following goals.

- Improve the **public understanding** of how light and light-based technologies touch the daily lives of everybody, and are central to the future development of the global society.
- Build **worldwide educational capacity** through activities targeted on science for young people, addressing issues of gender balance, and focusing especially on developing countries and emerging economies.
- Enhance **international cooperation** by acting as a central information resource for activities coordinated by learned societies, educational establishments and industry.
- Focus on particular discoveries in the nineteenth and twentieth centuries that have shown the **fundamental centrality of light in science**.
- Highlight the importance of research both into the fundamental science of light and its applications, and **promote careers in science** in these fields.
- Promote the importance of lighting technology in **sustainable development**, and for improving quality of life in the developing world.
- Highlight and explain the **intimate link between light and art and culture**, enhancing the role of optical technology to preserve cultural heritage.
- **Maintain these goals and achievements** in the future beyond the International Year of Light.

An International Year of Light will contribute significantly to fulfilling the missions of UNESCO to the building of peace, the alleviation of poverty, to sustainable development and intercultural dialogue through education, science, culture, and communication.

Themes& Activities

Context

Light is a subject that cuts across science and culture.

- Through biology and photosynthesis, light is at the very origin of life. The science and technology of light are essential for the future development of humankind, and in the search of solutions to **solve global problems in sustainability and healthcare through international cooperation.**
- Through studies in fundamental science ranging from particle physics to cosmology, **light provides a window on the universe**, and our efforts to understand the properties of light have led to revolutions in many different areas of science and engineering.
- **An International Year of Light is not only about science and technology.** Light is the means by which humanity sees itself, and the many ways that light has impacted on society have inspired art, music, literature and philosophy across the centuries.
- **Light is a subject that unifies humanity.** All nations and all peoples see the same Sun rise and fall on the horizon, and all cultures throughout history have expressed the same wonder at the natural beauty of light seen in effects such as the rainbow.

An International Year of Light will allow the universality of light and the variety of its applications to be appreciated via many and varied themes covering broad areas of interest, supported by cross-cutting themes addressing essential issues to be included in all activities. Actions will be implemented on national, regional and international levels. The main structure of these activities is illustrated below.

Thematic coverage

The activities of an International Year of Light will be structured around four broad thematic subject areas and important cross-cutting actions addressing central elements of sustainability, education and history.

Science of Light

Studying the fundamental scientific properties of light has impacted widely on all fields of science, technology and engineering. From early attempts to understand the motion of stars and planets to the appreciation of the importance of light in photosynthesis, efforts to understand the nature and the characteristics of light have revolutionized nearly every field of science. Light from the Big Bang provides us with a vision of the origin of the Universe. The spectrum of light from X-rays to infrared lasers provides technologies that underpin our lives, and the interaction of light with the human body provides valuable techniques for diagnosis, imaging and treatment in medicine. Advanced research in areas such as nanophotonics, quantum optics and ultrafast science are inspiring new fundamental discoveries and opening new scientific frontiers.

This theme will highlight the fundamental scientific properties of light and why it is essential to continue research in this field for the future.

Light Technology

The science of light is applied in the technological field known as photonics, and this theme addresses the important ways that photonic devices impact on areas such as medicine, communications and energy.

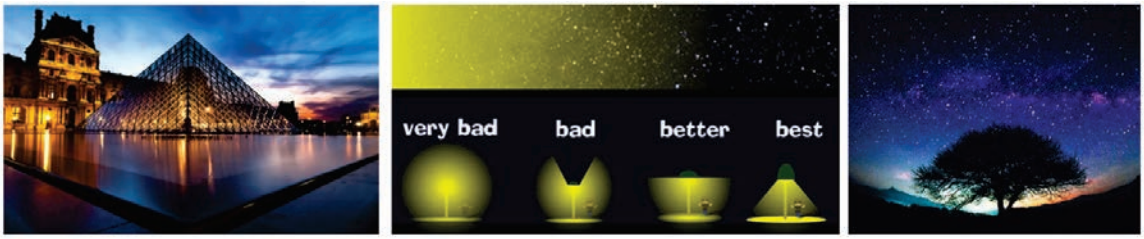
Light plays a crucial role in modern life and in shrinking the modern world that is often unknown and unappreciated. Light pulses and advanced optical fibre cables form the backbone of the global internet, and satellite telephones and wireless technologies allow even the most remote areas of the world to have access to communications, information and even advanced medical care. Light Technology is essential to improve society's energy independence through devices that efficiently convert sunlight to other energy forms, and new forms of low cost green lighting. In a similar way, understanding the Earth's environment increasingly relies on optical and photonic techniques for sensing and measurement.

These examples are of course state-of-the-art feats of engineering. But at the same time, optical technologies that are simple and that have existed for centuries are tremendously important for our daily lives! Corrective eyeglasses for improved vision are familiar to us all, and simple optical instruments such as microscopes form a cornerstone of modern medical diagnostics. This theme will describe light technology and its many applications, and will focus on how optics is placed to be a key driver of innovation in the 21st century.

Light in Nature

The wonder of light and colour is revealed spectacularly in effects such as sunsets, rainbows, halos, and shadows to cite just a few examples of the rich variety of optical phenomena which can be found in nature. This theme will raise awareness of the beauty and accessibility of science through activities that will encourage and support observation of light and colour in the Natural world. No matter where one lives and no matter what one's age, it is easy and delightful to understand Nature through light: from ice crystals near the artic to mirages in the desert to shadows in the forest to shifting images on water, the wonder and beauty of natural optics is everywhere. And of course, this theme provides a natural place to consider how observing light in nature often means turning off the lights from modern society. Whilst modern lighting provides important and crucial opportunities and advantages in improving quality of life, raising awareness of the issue of light pollution will also be an important feature of this theme.

Overall, in these days where downloading images of nature from the internet has largely replaced direct observation, activities in this theme will encourage outdoor observation in all-weathers and at all-latitudes, aiming to inspire a new generation of scientists to open their eyes.

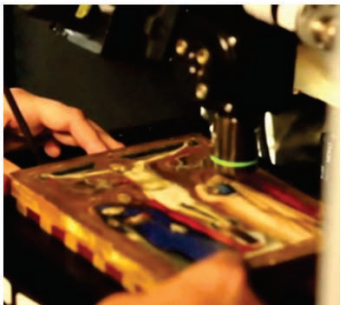


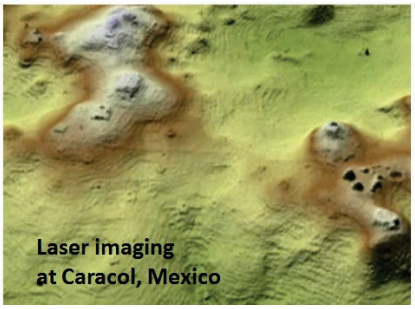
Smart lighting can both highlight culture and reduce light pollution

Light and Culture

Activities in this theme will highlight the myriad ways in which light has influenced and continues to influence human culture. From the early artists and scientists of Antiquity to the development of perspective and the understanding of light and shadow during the Renaissance, to impressionism and modern artistic techniques, this theme will describe how the study of light and art is central to understanding and appreciating our cultural heritage. Describing the continuous links between light and culture throughout history will provide valuable insights into the interactions between science and art and the humanities in general.

In a contemporary context, this theme will also describe ways in which light can be used to improve our appreciation of cultural heritage in ways such as applying optical techniques to image paintings, the use of modern technology in museums to experience culture in an interactive environment, and the use of natural light and low-pollution lighting to illuminate architecture, monuments and public spaces.





Optical technologies give new impetus in many areas of study - from art to archaeology

Light has influenced and continues to influence the visual and performing arts, literature and human thinking. This theme will provide an important bridge between science and culture and will aid in breaking down the boundaries between these fields that are becoming increasingly separated in the modern world

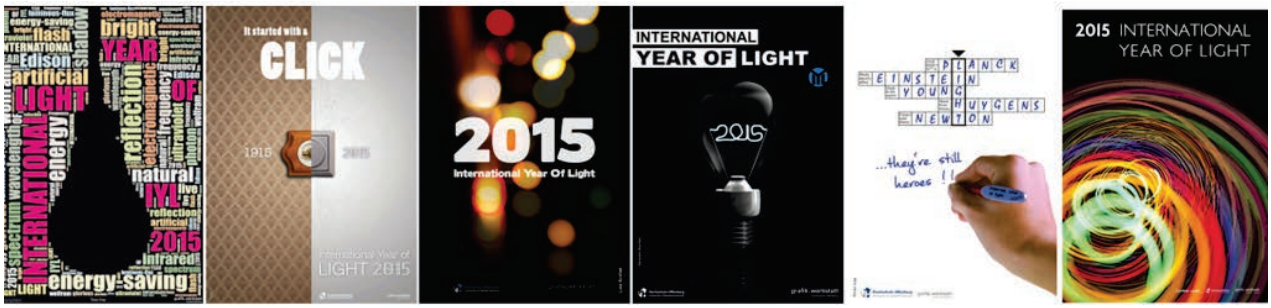
Cross-Cutting Themes

Several important themes of the International Year of Light will cut across, and be central to, all the activities described above.

Ensuring that science and technology are relevant to **development and sustainability** is essential, and modern optical technologies can play a vital role through low carbon emission solar lighting, and in areas such as agriculture, disease prevention, and water purification.

Light is an inspiring subject in both art and science, and **promoting education for young people** in these fields is a natural lever towards promoting higher education and encouraging careers in multidisciplinary fields in general. Addressing gender imbalance will be an essential part of this action as well.

A particular aspect of educational activities that can highlight the complex way in which science and society develops internationally is through the **history of the science of light**; this has involved virtually all the major figures of science over 2000 years and from all continents. Highlighting their often unknown human stories will be an inspiring educational and outreach activity for a new generation.



Light is an inspiring theme that can promote education for all.

Examples of Activities

Each theme will include outreach and educational activities at all levels: international, national and local. A Steering Committee will provide oversight and ensure coordination. General planning began in 2010, and detailed activity planning has been underway since 2012. The broad scope of an International Year of Light can be seen below by providing some examples of planned activities.

A Year of Pioneers

A twelve month calendar will associate each month with a particular scientist, and his or her contribution to the science of light. Classroom kits for schools will provide biographical and scientific information. Calendars will be made for international and regional dissemination.

Bright Futures

This activity will be a yearlong program of educational activities linking specifically to careers in science. Addressing gender issues and promoting science careers for women in developing countries will be a priority.

Light in the Universe

Particular celebrations will focus on the advances of 1815, 1865, 1915 and 1965 that established light's place at the centre of modern science, 200 years of the wave theory of light, 150 years of the theory of electrodynamics, 100 years of general relativity and 50 years since the discovery of the Cosmic Microwave Background will provide key scientific focal points.

Light for Change

The availability of inexpensive and energy-efficient lighting can revolutionize the quality of life in the developing world. Partners will support and develop initiatives promoting lighting of this sort worldwide.

A LightDay for Earth

To illustrate the unifying nature of light around the world, one particular day of the year will focus internationally on the role of light in nature, light conservation, and means of reducing light pollution. We will coordinate with existing annual events of this nature.

The Daily Scientist

Volunteer scientists - from PhD students to Professors - will communicate their day-to-day experiences to the public at large using social media such as blogs, Facebook, YouTube. This will place a very human face on the scientific and engineering community.

The Light Touch - Hands-On Optics

Building on existing partner activities, we will develop educational kits illustrating the principles of optics appropriate to the needs of institutions in both the developed and developing world. Focusing on instruments such as eye-glasses and microscopes etc will ensure societal relevance.

Capturing Light

Nature provides many beautiful and inspiring examples of optical effects such as mirages, rainbows and so on. A year-long international competition amongst schools will solicit photographs of natural optical phenomena that will be posted on a centralized website. Winners will be announced monthly.

2015

The year 2015 is a natural candidate for the International Year of Light, commemorating a number of important milestones in the history of the science of light dating back 50, 100, 150, 200 years and even further.

In 1815, Fresnel published his first work introducing the theory of light as a wave and in 1865, Maxwell rigorously described the dynamic electro-magnetic theory of light. In 1915, the theory of General Relativity developed by Einstein showed how light was at the centre of the very structure of space and time. In 1965, Penzias and Wilson discovered the Cosmic Microwave Background, an electromagnetic echo of the very creation of the universe.

These discoveries changed physics profoundly when they were made, and continue to have tremendous impact on science and technology. The wave theory of light and the laws of electrodynamics have led to developments ranging from lasers and DVDs to mobile phones to wireless internet to radio astronomy. The laws of general relativity and the study of the Cosmic Microwave Background have impacted on areas from the design of the global GPS satellite system to fundamental questions concerning the origin of the Universe.

Even more generally, the year 2015 also celebrates 1000 years since the great works on optics by the pioneering scientist Ibn Al-Haytham, and represents 400 years since the invention of the first solar powered technology through the 1615 invention of a prototype solar-driven engine. Highlighting these anniversaries will provide valuable educational and historical perspectives.

Scientists from every culture have contributed to light science.

Contacts & Organization

Steering Committee

John Dudley	President, European Physical Society University of Franche-Comté, France
Francis Allotey	President of the African Physical Society IUPAP Vice President at Large Member of UNESCO National Commission, Ghana
Kenneth Baldwin	Australian National University, Australia
Ana María Cetto	Director, Museo de la Luz Universidad Nacional Autónoma de México, México
Luisa Cifarelli	University of Bologna and INFN, Italy
Ndumiso Cingo	Director of the African Laser Center Pretoria, South Africa
Martial Ducloy	President of Physics & Society Forum, European Physical Society Initiator of the 2005 International Year of Physics, France
Zohra Ben Lakhdar	2005 L'Oreal-UNESCO Award Laureate University of Tunis, Tunisia
Michèle Leduc	President of the Fédération Française de Sociétés Scientifiques Ecole Normale Supérieure and CNRS, France
Duncan Moore	President, International Commission of Optics Institute of Optics, Rochester, USA
Shoji Nagamiya	Japan Proton Accelerator Research Complex Past-President, Association of Asia-Pacific Physical Societies
Joseph Niemela	UNESCO Optics Education Programme Abdus Salam ICTP, Trieste, Italy
Lluis Torner	Institute of Photonic Sciences ICFO and European Centres for Outreach in Photonics Alliance ECOP. Spain

Secretariat

The acting Secretariat for the International Year of Light is located within the offices of the European Physical Society, 6 Rue des Frères Lumière 68200 Mulhouse, France. An International Secretariat will operate from 2014.

Advisory Board

In addition to the Steering Committee members listed above, the International year of Light project is supported by a large and inclusive International Advisory Board that will ensure links with other learned societies (APS, IEEE, OSA, SPIE, EOS, etc), with regional centres of science and science education, and which contains representatives spanning broad areas of science, history of science, technology, art history, cultural heritage and education etc.