International Year of Light and Light-based Technologies

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The International Year of Light and Light-based Technologies (IYL 2015) is a global initiative adopted by the United Nations to raise awareness of how optical technologies promote sustainable development and provide solutions to worldwide challenges in almost all areas. The proposal for celebrating 2015 as International Year of Light was first brought by United Nations Educational, Scientific and Cultural Organisation (UNESCO) delegates from Ghana and Mexico to the UNESCO Executive Board. Supported by 28 Board members, the resolution proposing IYL 2015 was placed before the 190th session of the UNESCO Executive Board held at Paris in October 2012. Recognising the importance of light and light-based technologies in the lives of the citizens of the world and for the future development of global society on many levels, the resolution was finally adopted by the UN in the 68th session of its General Assembly held in Paris in December 2013 (see Fig.1). Endorsed by a number of international scientific unions, IYL 2015 has partnership from more than 85 countries. Its global secretariat is located at the International Centre of Theoretical Physics (ICTP), TRIESTE, Italy, in collaboration with the UNESCO International Basic Sciences Program. In its resolution for adopting the IYL 2015, the General Assembly also considered that the light-based technologies and designs can play an important role in the achievement of greater energy efficiency, in particular by limiting energy waste, and in the reduction of light pollution, which is a key to preservation of dark skies.

Fig. 1: The IYL 2015 (*http://www.epsnews.eu* and *http://www.Light2015.org*)

Light is essential for the most basic and the most advanced human activities. It is a source of life. Without sunlight, life on our planet earth, as we know it today, would not exist.

Why 2015? The year 2015 coincides with the anniversaries of a series of important milestones in the history of the science of light. Probably the most important one is the work on optics by Ibn Al-Haytham, also known as Alhazen (965 – 1040), in the year 1015. He wrote a seven-volume treatise, *Book of Optics* (Arabic: *Kitab al-Manazir*), the first book on optics (Fig. 2). Other major scientific anniversaries to be celebrated in 2015 include the notion of light as a wave proposed by Fresnel (Fresnel Theory of Diffraction) in 1815; Electromagnetic Theory of Light Propagation proposed by Maxwell in 1865, Einstein's Theory of the Photoelectric Effect in 1905 and Embedding of Light in Cosmology through General Relativity in 1915; the discovery of cosmic microwave background by Penzias and Wilson in 1965; and achievements

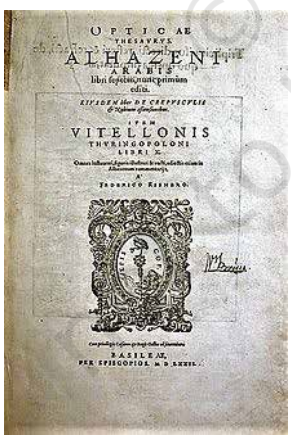
OPTICAE
THESAVRVS
ALHAZENI
ARABIS
libri septem, nunc primùm
editi.
IPSIVS
VITELLONIS
THVRINGOPOLONI
LIBRI X.
A
FRIDERICO RISNERO.
BASILEAE,

Fig. 2: Cover page of the translated version of the first book on optics by Ibn Al-Haytham (taken from *https://en.wikipedia.org/wiki/Book_of_Optics*)

of Charles Kao concerning the transmission of light in fibers for optical communication in 1965.

Celebration of anniversaries of these important discoveries and IYL 2015 is believed to provide an important opportunity to highlight the continuous nature of scientific discovery in different contexts, with particular emphasis on women's empowerment in the science sector and on promoting science education among young people, especially in developing countries. During this year many activities related to light and light-based technologies have taken place worldwide including an exhibition and a conference titled 'The Islamic Golden Age of Science for the Knowledge-based Society,'hosted by the UNESCO. India has also organised a national level competition on 'Golden Age of Science'. Amazingly, the two 2014 Nobel Prizes in Physics and Chemistry, awarded just before the IYL started, were in the area of optics and photonics. The 2014 Nobel Prize in Physics was awarded jointly to Isamu Akasaki, Hiroshi Amano and Shuji Nakamura for the invention of blue light emitting diodes. The 2014 Nobel Prize in Chemistry was awarded jointly to Eric Betzig, Stefan W. Hell and William E. Moerner for their work in fluorescence microscopy.

Sir Isaac Newton showed that white light is made of different colours – VIBGYOR. In early 20th century, Max Planck and Einstein proposed light behaves both as a particle and a wave. This duality in nature of light was experimentally verified later. The word Photonics was coined nearly 50 years ago, when the first laser was invented by T.H. Maiman in 1960.

The branch of science and technology that deals with the generation, control, and

detection of particles of light— photons— is called Photonics. That is, Photonics is the science of light. We can only see a very small part of the electromagnetic spectrum— the visible region. However the invisible light waves are also indeed part of everyday life. Photonics is everywhere. It supports technologies that we use in our everyday life ranging from smartphones to laptops to the internet to the lightning technology to medical diagnosis and treatment procedures to education to manufacturing industries to entertainment to agriculture to defence and security to exploring universe to solve crimes to art and culture, etc. Photonics opens a world of unknown and far-reaching possibilities often limited by lack of imagination. It is believed that the 21st century will depend, if not more at least as much, on Photonics as the second half of the 20th century depended on electronics.

Solar energy can be converted into heat and electricity, and worldwide efforts are being made to develop affordable, productive and clean solar energy technologies. Another *round the corner* technology to use the powerful lasers to create fusion under controlled conditions, is awaiting, and can indeed make our energy future quite bright. Harnessing heat from the sun rays using technologies like solar photovoltaic panels, solar heating, solar thermal electricity, etc., can solve our problems coupled with architecture and urban planning; agriculture and horticulture; transportation; desalination and water recycling; climate change, etc. Business, in the field of light-based technologies— including the photonics, depends on solving key societal challenges, such as energy generation and energy efficiency (or productivity), healthy ageing of the population, climate change, and security.

Low-cost phone calls, video conferencing and e-commerce are some examples of how the internet allows people around us to feel so close than ever before. Miraculously, all this is possible due to light! The light data in the form of nanosecond pulses propagate in extremely thin, flexible, and transparent optical fibers. These hair-like optical fibers made of silica or plastic propagate signals from one end to another, often long distances as long as thousands of kilometres, practically without any loss, even unaffected by any electromagnetic interference. The use of ultrashort light (or infra-red) pulses of modulated signals propagating in these fibers have revolutionised the way we interact nowadays. These optical fibers have similar useful and exciting applications in other areas too, like in measuring strain, temperature, pressure, etc. For security systems, the installation of optical fibers along a fence helps in monitoring disturbances and also to trigger alarms in case of intrusions. Using a photovoltaic cell, fiber optics can be used to transmit power by converting light into electricity.