



# The International Year of Light: Cosmic Light Programs and Beyond

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**概要** 欧州物理学会 (SPIE) が中心となって物理学者等が提唱し、2013年12月20日に国連総会で採択となった IYL2015 (国際光年2015) に、IAU も「宇宙からの光」をテーマに参加することが2014年3月に決定した。全体として IYL2015 には94か国以上、100を超える団体が参加して実施されることとなった。IAU は「光とその技術」という全般的には幅広い国際光年の活動テーマのなかで、「夜空の明るさを守る」という立場で活動を展開した。これは2009年のIAU総会での決議 B5[1]に沿った行動である (2節)。

本総括シンポ実施時は、この1年間の世界各地での取り組みすべてを掌握する段階に至っていないが、3節では、多彩な活動が各国で行われたことを紹介する。IAU は世界中から提案を募集し、4節で示す5つのコーナーストーン企画を支援した：①Galileoscope - 16000個の組立式望遠鏡を出荷した。②Light Beyond the Bulb - 30か国以上が参加し、約675箇所で行われた天体写真展を開催された。③EDU kit (宇宙からの光に関する教材集) - 40か国以上の場所で140を超えるイベントで利用された。④DARK SKY METER アプリ - この間、無料で利用可能な IYL2015 版アプリはダウンロード数が3442で、7290の報告があった。⑤Quality Lighting Teaching Kit - この光害学習キットは100セット出荷された。このほか、筆者がコーディネータを務める OAO (IAU 国際普及室) は、香港大学と協力し、Sky Quality Meter を用いた夜空の明るさの測定ネットワークを構築するため、2015年1月7~9日に国立天文台三鷹でワークシ

ョップを行い7か国・地域より25名の参加があった。構築されたネットワークでモニターされている夜空の明るさは、オンラインでどなたでも閲覧可能である (5~6節)。

また、従来は指摘されなかった問題として、青白色 LED 光の生物の1日の生活リズムへの影響にも言及した (7.2節)。

コーナーストーン企画や夜空の測定など IAU 他が IYL2015 で実施した事業の多くは、IYL2015 後も何らかの形で継続される予定である。(要約：縣 秀彦)

## 1. Background

The resolution of the International Year of Light and Light-based Technology 2015 (IYL2015) was formally adopted at the General Assembly of the United Nations held on 20 December 2013, recommended by UNESCO. This pathway for UN proclamation is exactly following the route of the International Year of Astronomy 2009 (IYA2009)

The idea of the IYL2015 was proposed by physicists, with a leadership from the European Physical Society, SPIE. The participation of IYL2015 were well received by the optics, photonics, and many other science enteritis, in particular, the International Astronomical Union (IAU) is one of the endorsing organization. For IYL2015, there were more than 100 partners participated from more than 94 countries.

## 2. IAU and IYL2015

### 2.1 Position of IAU

Astronomers are excited by the potential of new lighting technology to provide energy-efficient well-controlled outdoor illumination. More, if human beings want to continue to understand the universe, we have to keep the night sky dark in order to observe it.

Traditionally, the IAU had set up the commission to protect the astronomical observatories to safeguard from the threats of light pollution. In 2009, IAU had also passed a solution [1] affirming that access to a dark night sky is a universal human right, making quality outdoor lighting a worldwide imperative.

In the IAU 2009 Resolution B5, it stated “the intelligent use of unobtrusive artificial lighting that minimizes sky glow involves a more efficient use of energy, thus meeting the wider commitments make on climate change, and for the protection of the environment.”, “control of obtrusive and sky glow-enhancing lighting should be a basic element of nature conservation policies since it has adverse impacts on human and wildlife, habitats, ecosystems and landscapes.”

### 2.2 The Cosmic Light Program

The IAU Executive committee has assigned its commission 50 on Protection of Existing and potential observatory sites to take the leading efforts to implement a strategy for IYL2015, and hence an IAU Executive Committee working group was formed.

On March 2014, the IAU secretariat

had arranged a meeting among the new International Outreach Coordinator, the IAU commission 50 and Professor John Dudley, the chairman of the IYL2015 Steering Committee to discuss the IAU's role for IYL2015.

At the meeting, although originally we propose the name “Cosmic Light, Quality Light” to highlight the importance of light pollution protection, at the end we had agreed to use the term “Cosmic Light” as the astronomy theme for IYL2015, and also agreed that all the astronomy related activities during IYL2015 would be led by the IAU (Fig.1).



Fig.1 Cosmic Light logos in different languages

### 3. Cosmic Light Overview

The IYL2015 program is worldwide, at the time of the conference, we still do not have a complete picture of all the astronomy programs held at IYL2015. Here are some examples of the activities held – National Week of Science and Technology, Brazil; White House Astronomy Night, USA; Solar Eclipse Observation, Hungary;

Lunar Eclipse Live Broadcast, UK; GalileoMobile, Bolivia; Winter Solstice Mayan Ceremony, Mexico; Sky Light Opera, UK; Symphonies of Galaxies, Scotland; Cosmic Light stamp, Sierra Leone; Loss of the Night app and many talks about astronomy. There are much more activities than we could catch.

#### 4. Cosmic Light cornerstone projects

The IAU Executive Committee Working Group on the International Year of Light has formed and had opened for a call for proposals. The following projects were selected as the cornerstone projects.

##### 4.1 Galileoscope

Galileoscope is a high-quality, low-cost telescope kit, optimized for both optics education and celestial observation (Fig.2). As part of the 2015 Cosmic Light special programme, the International Year of Light edition of the Galileoscope began shipping in May 2015 and by 31 December had shipped 16000. Ten thousand of these kits went to US K-12 teachers via the special promotion funded by Ric and Jean Edelman (more than 1600 teachers received one case of six kits each). The remaining 6000 kits went to individuals who ordered online or to educators or outreach professionals who made bulk purchases of anywhere from 72 to 600 kits.

Galileoscope continues as a worldwide education project, with a dealer distribution network in the United States and Europe, and direct supply to educational institutions in other countries. There are opportunities to enter new

education markets, particularly in south Asia, and to expand the distribution of Galileoscope kits through science centres, science camps, and astronomy research facilities.



Fig. 2 The outlook of Galileoscope

##### 4.2 Light Beyond the Bulb

Light Beyond the Bulb finished in 2015 with approximately 675 exhibit sites around the world — in over 30 countries, with more than a dozen language translations (Fig.3). Examples of exhibit locations include the O'Hare Airport in Chicago, U.S.; the Village Baykal in Dolna Mitropolia, Bulgaria; the St. Ignatius College Siggiewi Primary School in Siggiewi, Malta; the K11 Art Mall in Shanghai, China; and the Galway Astronomy Festival in Ireland. Exhibits will continue into 2016 and well beyond. The project has greatly rejuvenated and expanded the volunteer base of organisers created in 2009 for the International Year of Astronomy, and we look forward to continuing to work with so many excellent partners. Additional topics for future similar public science projects are actively being considered.



Fig.3 A Light Beyond the Bulb exhibition

### 4.3 The Cosmic Light EDU Kit

The Cosmic Light EDU kit reached over 40 countries in more than 140 events (Fig.4). The kit was distributed to all organisers, and reports are coming in from the different sites that hosted cosmic light training events. The Galileo Teacher Training Program and the Cosmic Light EDU partners plan to have this kit as a live legacy of IYL2015, by continuing the enrichment of the repository and fostering the promotion of further training and collaboration efforts.

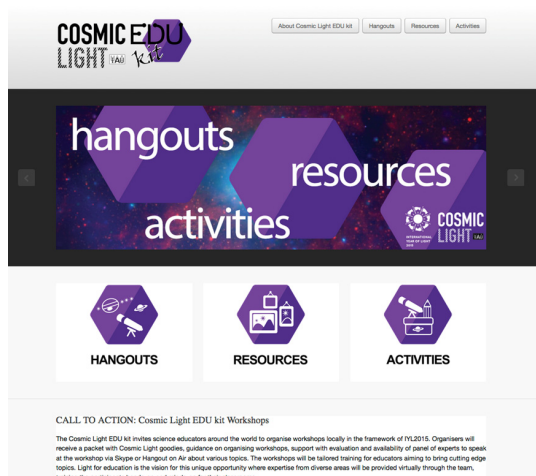


Fig.4 The interface of the Cosmic Light EDU kit website

### 4.4 The Dark Sky Meter app

The Dark Sky Meter IYL2015 Edition is a free app on smart phone to measure the night sky brightness with the press of a button (Fig.5). 3442 downloads for this app in 2015. 7290 (raw, uncleaned) measurements were contributed into the citizen science project “Globe at Night” database.

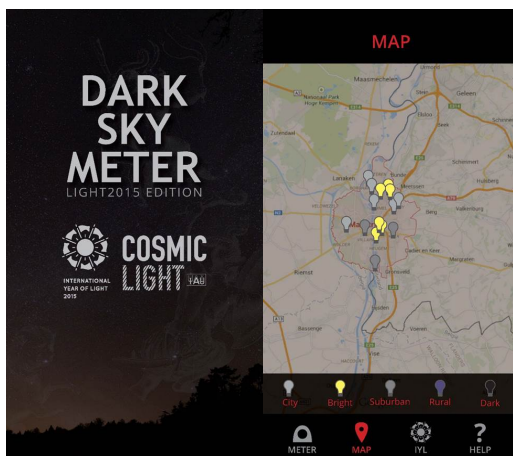


Fig.5 The interface of the Dark Sky Meter app

### 4.5 The Quality Lighting Teaching Kit

The Quality Lighting Teaching Kit was produced by the Education and Public Outreach (EPO) group at the U.S. National Optical Astronomy Observatory (NOAO) received support from the International Astronomical Union (IAU) and the Optical Society (OSA) (Fig.6). The kit included six activities on light pollution and glare (aging eyes), light trespass, wildlife, safety, energy and sky glow.

The goal is to increase student and public awareness of light pollution issues and quality lighting solutions. Reaching the end of 2015, the 100 Cosmic Light Quality Lighting Teaching Kits are being



Fig.6 The content of the Quality Lighting Teaching Kit

shipped around the world, to SPIE student chapters, OSA, CIE, IDA and the regional nodes for the IAU Office of Astronomy for Development.

## 5. The OAO Project – Globe at Night Sky Brightness Monitoring Network

The OAO was actively participated in one of the projects “Globe at Night – Sky brightness Monitoring Network” partnered with The University of Hong Kong. The network was established to collect night sky brightness around the world and provided an interface to see the real-time data online (Fig.7) [2].

The first GaN-MN User Workshop was organized on Jan 7-9, 2015 at the National Astronomical Observatory Japan, 25 participants from 7 countries/regions attended the meeting.

### 5.1 Standardized and data collection scheme

Sky Quality Meter (SQM-LE) was adopted for its modest cost (USD250 for SQM-LE and housing) and robustness.

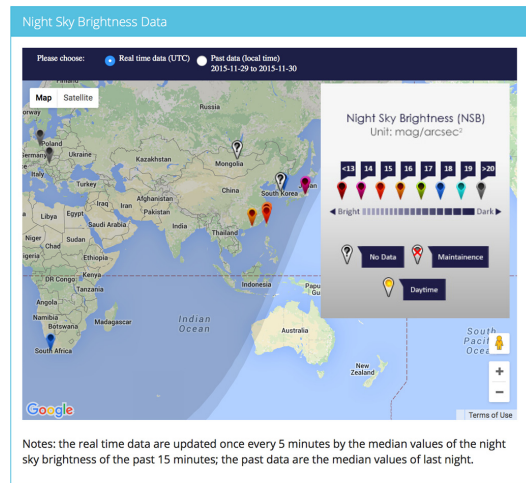


Fig.7 The website of the Globe at Night Monitoring Network, showing the real time sky brightness data

We also used the weather-proof housing provided by manufacturer for ease of standardized data reduction (Fig.8). A short (30 sec) sampling interval adopted to record short-term variations of night sky brightness.

### 5.2 Early Result

By studying and comparing the data among different stations, we can pick up a lot of interesting effects reflected by the light curves, such as the effects of sunlight, halo, haze, difference between urban and rural cities, and the human factors such as holidays.

We can also see the clear difference of the effects of the Moon between a city and a rural area (Fig.9).



Fig.8 The setup of the SQM-LE at NAOJ Mitaka campus

### 6. Challenges and Lessons

There are quite a number of challenges for organizing the cosmic light programs. First of all, astronomy is only part of “light” community, the entire IYL2015 communities are multi-disciplinary, ranging from optics, photonics etc., it was challenging to work with the board physics community, in terms of planning, coordination and resources allocation.

There are too many messages about the IYL2015. Therefore the most important message “protecting the dark sky” from the IAU was in defocus among the other aspects of the general science of light.

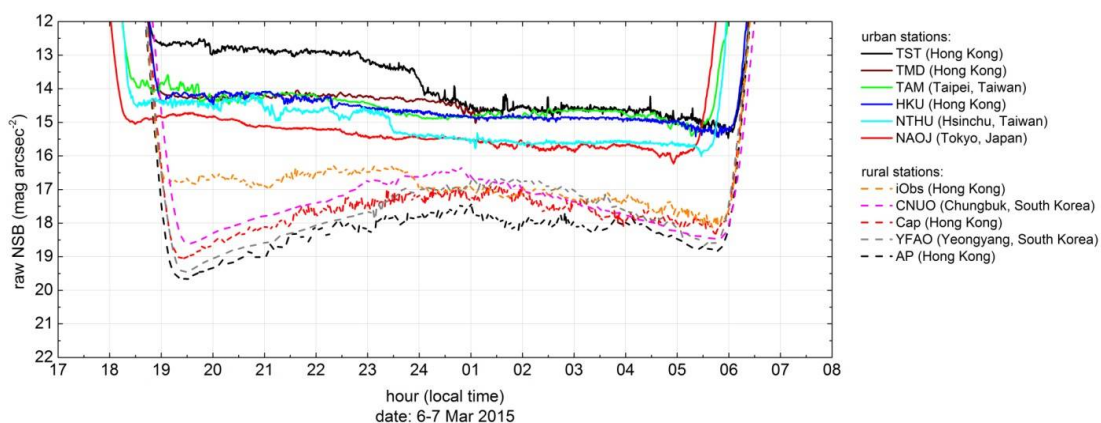


Fig.9 The same date data with the presence of the Moon

## 7. Educating the future

Although the year 2015 is over, the work is not coming to the end, All the work developed has just set the stage for next steps forward.

We can see the trends of interest in light pollution from the Google Trends in Fig.10. It shows a slight increase of the interest from the year 2015. So it is important to continue the education of light pollution to the people.

### 7.1 Beyond Cosmic Light

The IAU Executive Committee would like to continue the efforts to protect the dark sky, We are already discussing the possibilities of forming a working group among the IAU structure. This would be helpful to develop further collaboration with professional bodies on lighting such as the International Illumination Association (CIE) and the International Dark Sky Association (IDA).

### 7.2 Saving the dark skies

The continue education on how to protect the dark skies is important. First of all, we recommend the use of full cut-off fixtures. Second, we should be fully aware of the threat of blue LEDs. The blue peak of blue-rich white light sources is not just a problem for astronomers. A large portion of light emitted by bluish-white LED source falls outside of the human photopic vision range, but falls within the circadian sensitivity curve, where it does not aid photopic vision but may disrupt normal day/night cycles (Fig.11). Artificial light sources have been shown to affect all living organisms through disruption of their natural cycles that rely upon rhythms of daylight and night darkness. Therefore yellow color lighting is recommended.

These messages should be utmost important and need further education to the public.

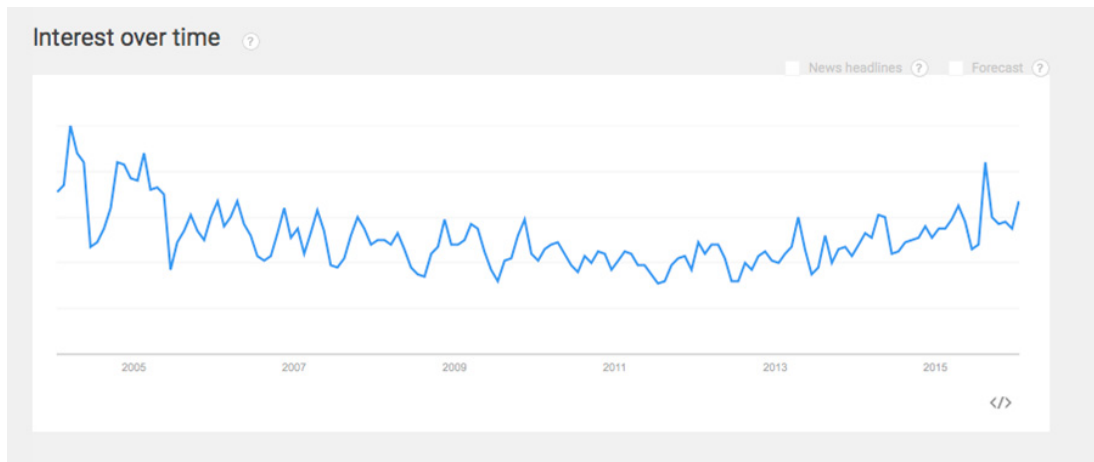


Fig.10 Google Trends for the word “light pollution” among different years

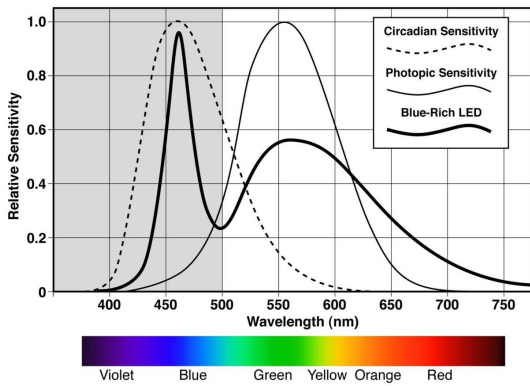
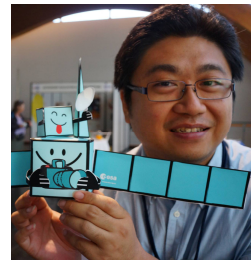


Fig.11 The visible spectrum, the human photopic sensitivity, the human circadian sensitivity and the typical output of a blue-rich white-light LED light source. Bluish-white LEDs emit a large percentage of their energy in the blue frequencies centered within the human circadian sensitivity.

References

- [1] Resolutions of the 28<sup>th</sup> IAU general assembly  
[http://www.iau.org/static/resolutions/IAU2009\\_English.pdf](http://www.iau.org/static/resolutions/IAU2009_English.pdf)
- [2] Globe at Night: Sky brightness Monitoring Network  
<http://globeatnight-network.org>



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