



INTERNATIONAL  
YEAR OF LIGHT  
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**COSMIC  
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Globe at Night - Sky  
Brightness Monitoring  
Network

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# Project background – The Hong Kong Night Sky Brightness Monitoring Network (NSN)

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# Hong Kong Night Sky Brightness Monitoring Network (NSN)

- **A city-wide survey of the light pollution conditions in the city of Hong Kong**
  - **Long-term study of the night sky brightness (NSB) in an urban metropolis**
    - Established in May 2010
    - What is the overall light pollution condition in Hong Kong?
    - How does the night sky brightness vary with location?
    - How does the night sky brightness change with time (monthly, nightly)?
    - How much does artificial lighting affect the night sky?
    - What is relation between cloud coverage and the night sky brightness (cloud-NSB study)?
    - What is relation between moonlight and the night sky brightness (moon-NSB study)?
  - **Platform for disseminating light pollution information and public outreach**
  - **Information for the government in drafting of outdoor lighting usage regulations**

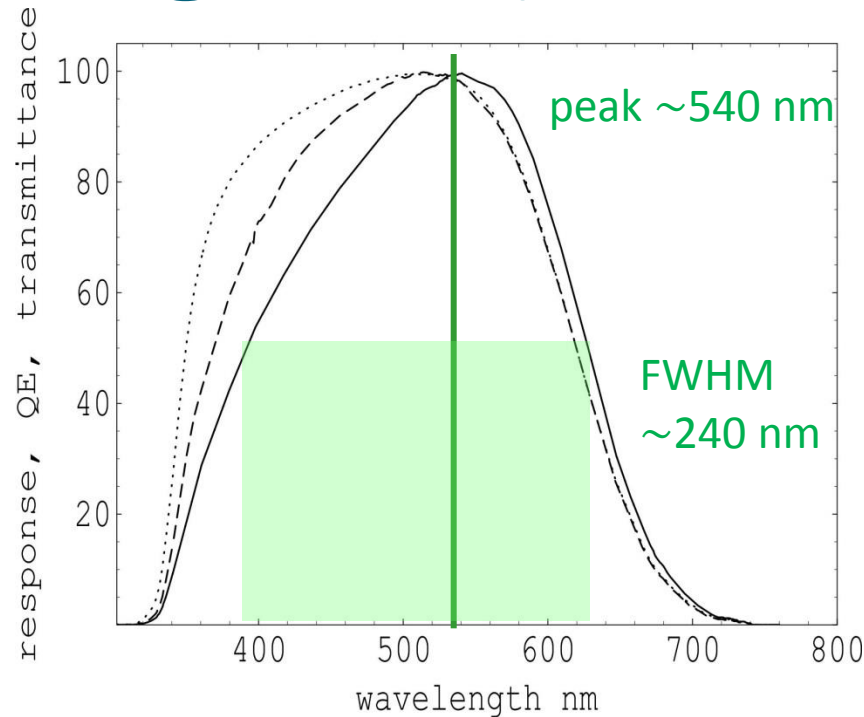
# Measuring NSB by SQM-LE



Figure source: Unihedron

- Sky Quality Meter – Lens Ethernet (SQM-LE)
- Ethernet connectivity
- Light sensor: TAOS TSL237 High-Sensitivity Light-to-Frequency Converter
- Near-IR blocking filter: Hoya CM-500
- Size 3.6 x 2.6 x 1.1 in.
- Operates from 5-6V DC adapter
- Gives NSB in the unit of mag arcsec<sup>-2</sup>
- Claimed accuracy of  $\pm 0.1$  mag arcsec<sup>-2</sup>
- Calibrated by the manufacturer before shipment
  - had not been calibrated to accurately measure a night sky darker than 23 mag arcsec<sup>-2</sup>
- The same device used in the current Globe At Night network project

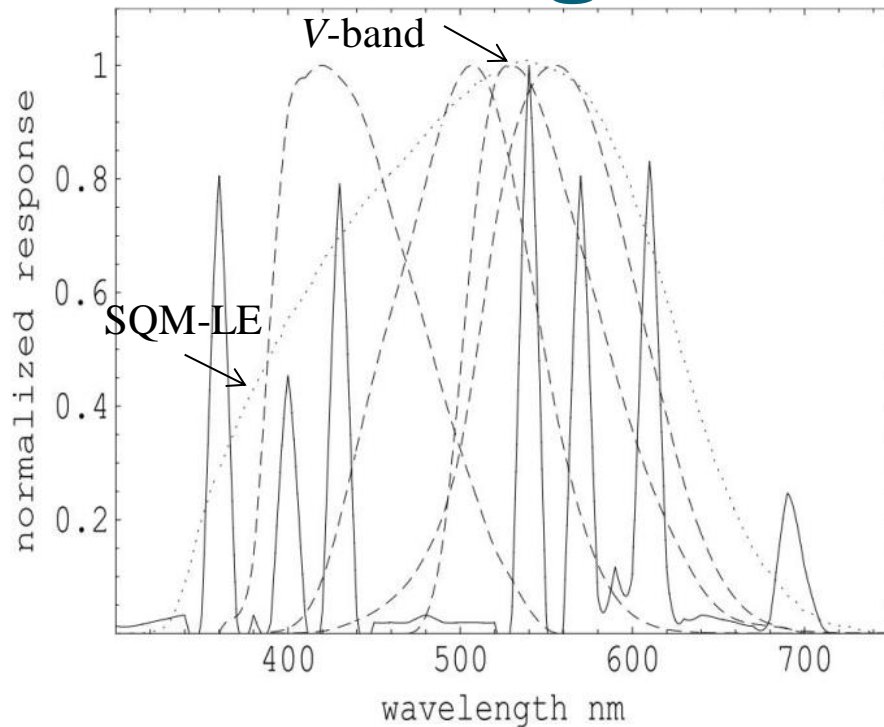
# Measuring NSB by SQM-LE



**Spectral response** function of SQM-LE (solid), quantum efficiency (dashed), and filter transmittance (dotted)

(Cinzano 2005)

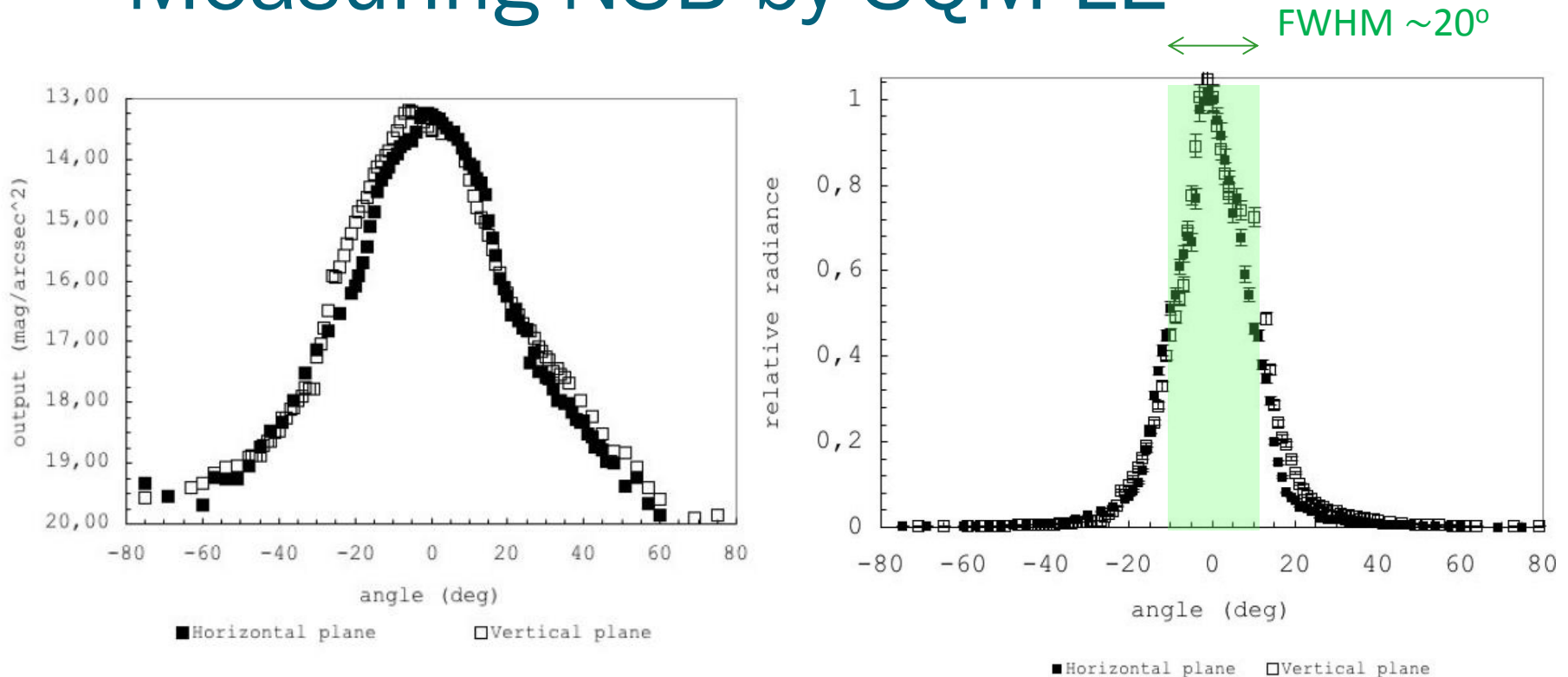
# Measuring NSB by SQM-LE



Comparison of **SQM-LE normalized spectral response** (dotted curve) with the spectral curves of Johnson B-band, scotopic, **Johnson V-band**, and photopic (dashed curves from left to right) and the emission spectrum of a mercury vapor lamp (solid curve) (Cinzano 2005)

- Compare photometric Johnson V-band vs SQM-LE response:
  - FWHM:
    - SQM-LE: 240 nm
    - V-band: 84 nm (Bessell 2005)
  - Peak:
    - SQM-LE: 540 nm
    - V-band: 545 nm (Bessell 2005)
- The offsets between V-band and SQM-band:
  - Depends on sky spectrum and cloud condition
  - 0 - 0.25 mag arcsec<sup>-2</sup> (Cinzano 2005)
  - Up to 0.6 mag arcsec<sup>-2</sup> when cloudy (Puschnig et. al. 2014)

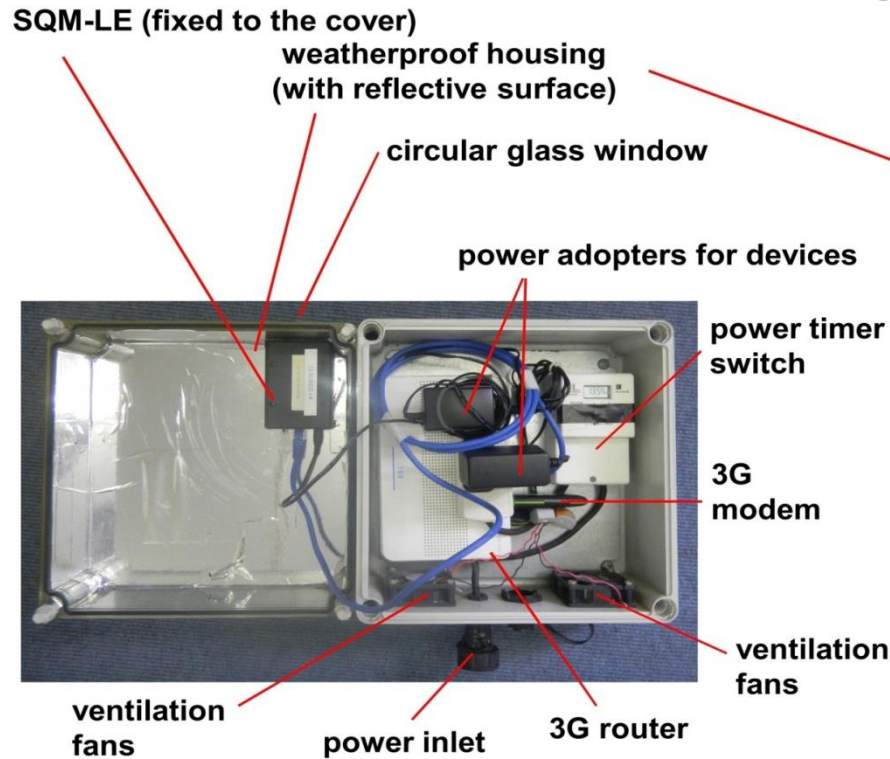
# Measuring NSB by SQM-LE



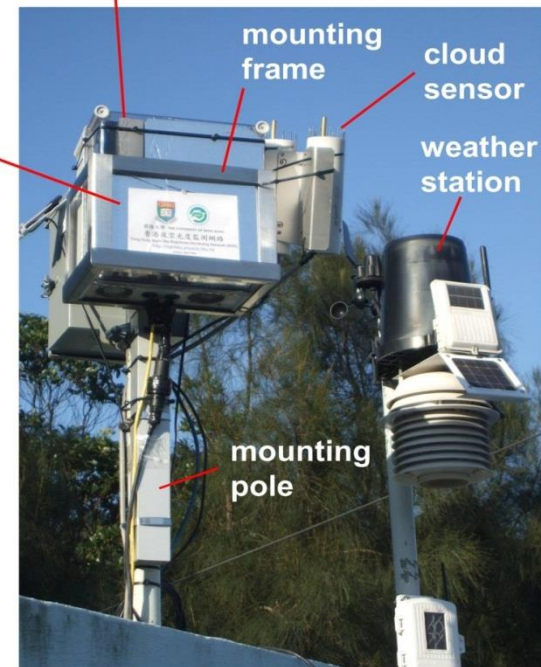
**Angular response** of SQM-LE in log (left) and linear (right) scales.

(Cinzano 2007)

# Measuring NSB by SQM-LE



SQM-LE points to zenith (within the housing)



The housing used in NSN was different from that for the current  
Globe At Night network project

# The use of 3G mobile network for data collection in NSN

- 3G SIM card (with fixed IP address) + modem + router
- **Advantages:**
  - Request real-time data actively from server
  - Save cost on:
    - routing cables from indoor to outdoor
    - putting a computer on site
  - Increase flexibility on station selections
- **Disadvantages:**
  - Need a larger housing to house equipment
  - Higher setup cost (for fix IP address & housing)
  - Need network coverage
  - Unstable network in extreme weathers



# NSN stations

10 urban stations  
 6 rural stations  
 2 not-classified stations

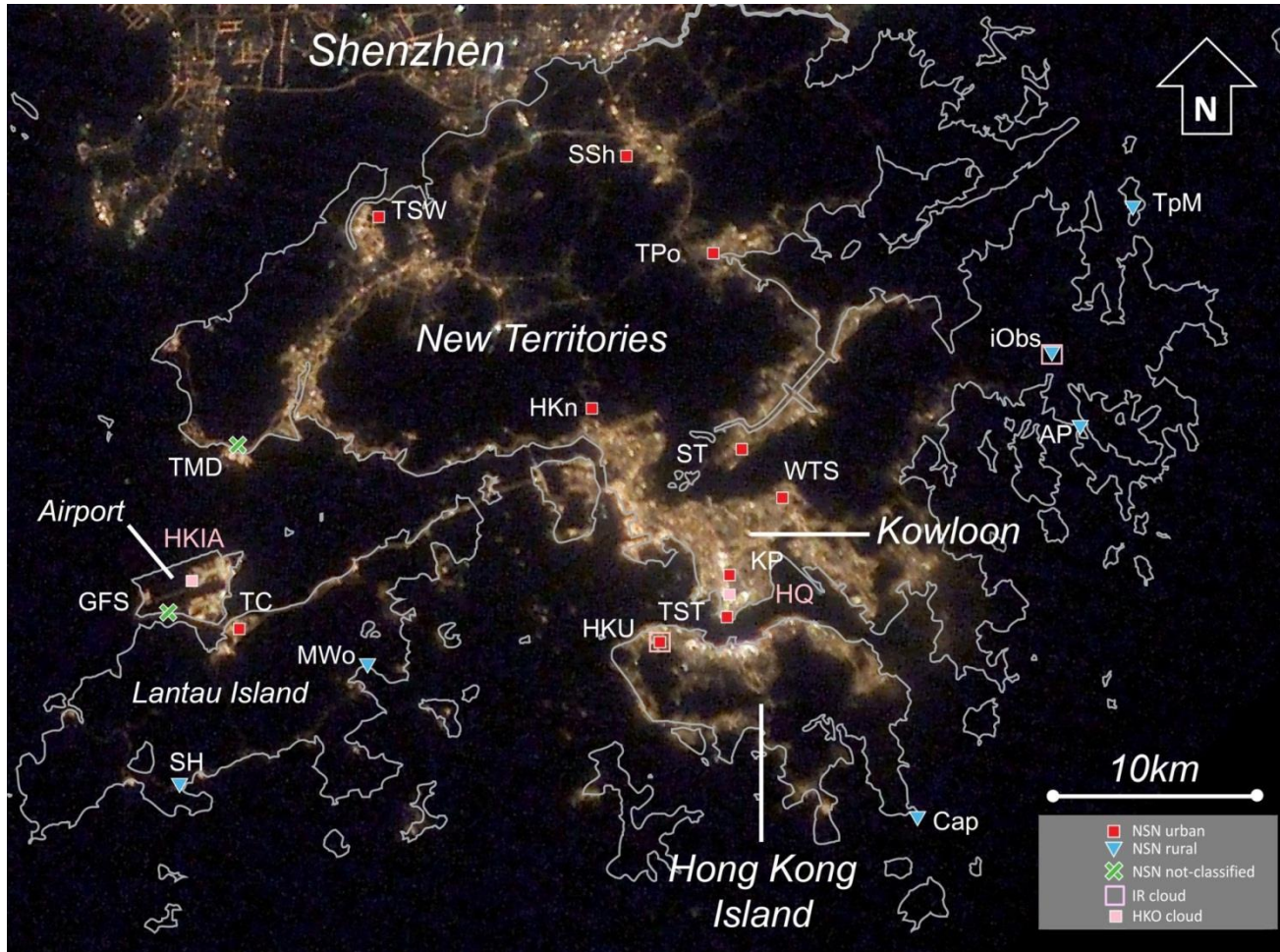


Image courtesy of Image Science and Analysis Laboratory, NASA-Johnson Space Center, The Gateway to Astronaut Photography of Earth

# For additional details...

- Project website: <http://nightsky.physics.hku.hk/>
- Publications:
  - **Contributions of artificial lighting sources on light pollution in Hong Kong measured through a night sky brightness monitoring network**  
Authors: Chun Shing Jason Pun, Chu Wing So, Wai Yan Leung, Chung Fai Wong  
Journal of Quantitative Spectroscopy and Radiative Transfer  
May 2014, Volume 139, Pages 90-108, DOI: 10.1016/j.jqsrt.2013.12.014  
<http://www.sciencedirect.com/science/article/pii/S0022407313004950>
  - **Night-sky brightness monitoring in Hong Kong - A city-wide light pollution assessment**  
Authors: Pun, Chun-shing, Jason and So, Chu-wing  
Environmental Monitoring and Assessment  
April 2012, Volume 184, Issue 4, pp 2537-2557, DOI: 10.1007/s10661-011-2136-1  
<http://www.springerlink.com/content/08814311727512q4/>