



# Human Centric Lighting

Light is much more than the opposite of dark

innovation  you



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# Human centric lighting

**Human centric lighting brings together:**

- an in-depth understanding of user needs
- lighting applications
- scientific insights

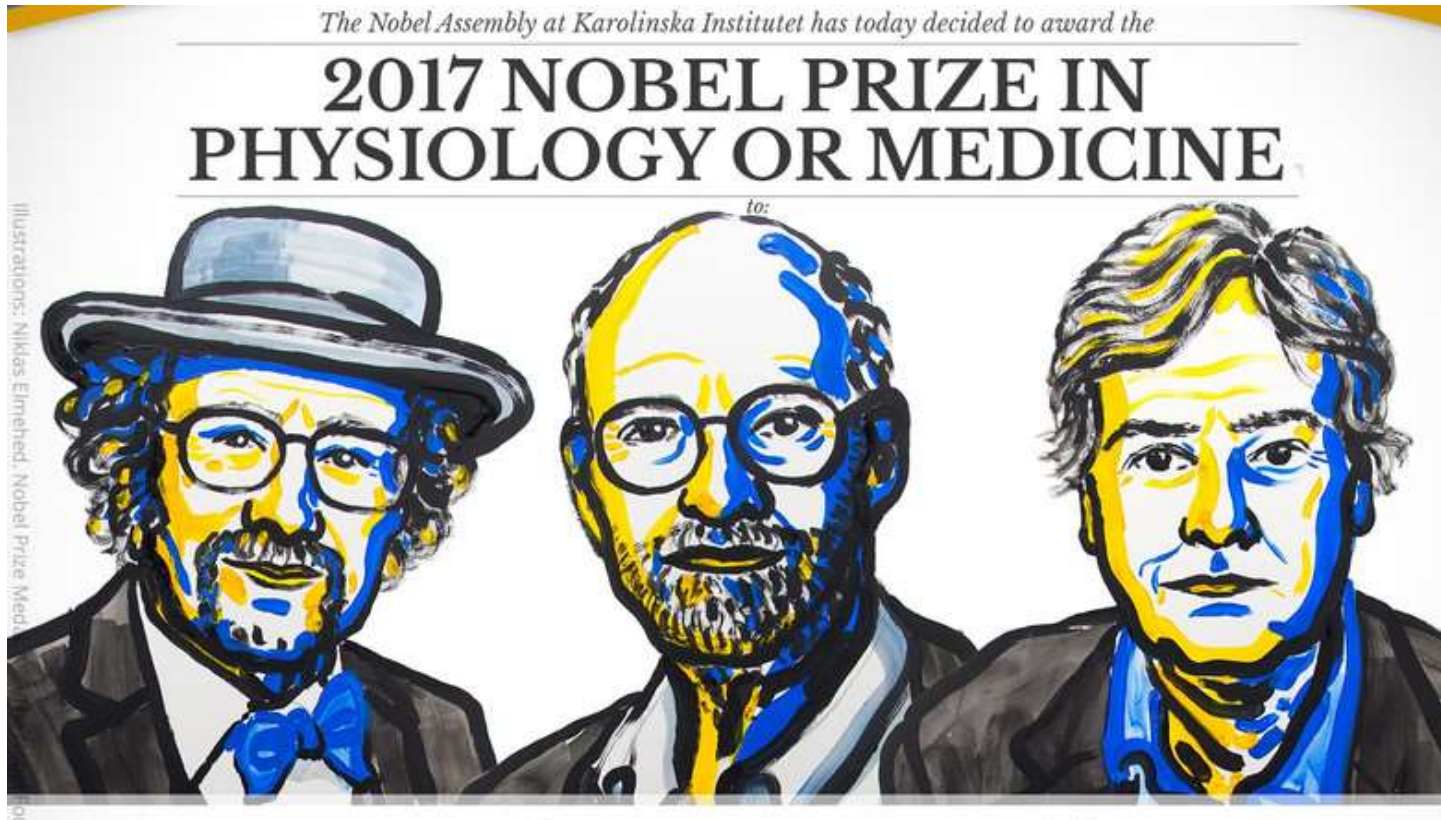
**to create evidence-based lighting solutions:**

- for optimal vision
- sense of well-being and performance.

Daylight is always an important source of inspiration, as it delivers the winning combination:

- **The right light**
- **With the right spectral content**
- **At the right time**

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Last year's Nobel Prize winner in medicine:  
Jeffrey C. Hall, Michael Rosbash i Michael W. Young

The Nobel Committee appreciated their work related to the functioning of the biological clock. The laureates increased "*awareness of the importance of proper sleep hygiene*" - said Juleen Zierath from the Nobel Academy quoted by Reuters.

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# Non-visual pathway

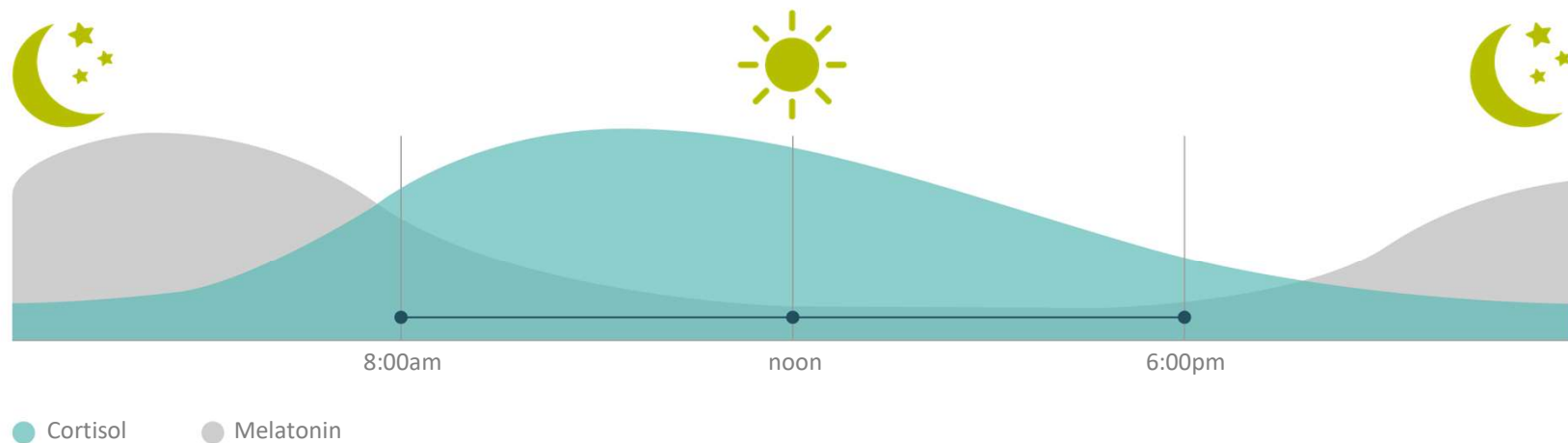
## Light regulates our biological clock

### Affecting for instance:

- State-of-mind
- Sleep Concentration
- Alertness
- Development/growth

### And more indirectly also affecting:

- Immune system
- Recovery
- Wound healing
- Memory
- Behavior



# Non-visual pathway

## Light regulates our biological clock

- ✓ **Increasing light intensity** (and blue content) **increases alertness** (all time of day)
- ✓ **Decreasing light intensity** (and blue content) **support relaxation** (all time of day)
- ✓ **Light at night must be handled with care:** *not to disrupt sleep and health*
  - ✓ The visual acuity depends on the intensity of light:  
about **40%** increase when going from **50 lx to 500 lx**
  - ✓ Eye becomes tired less quickly at **6 000K** than **2 700K**



# Three scientific-based benefits of light on life

There are two known pathways through which light can affect our well-being:

- **Visual** – The visual cortex, via the photoreceptors (rods and cones) in the retina of the eye
- **Non-visual** – The central biological clock (SCN), via a third photoreceptor: melanopsin



**See better**  
(visual)



**Feel better**  
(emotional)



**Function better**  
(biological)



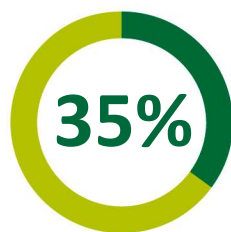
# Supported by evidence

## Research from the University of Twente

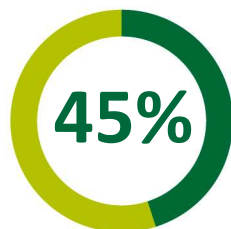
**Increase**  
in reading concentration by



**Increase**  
in reading speed by



**Decrease**  
in frequency of errors by



**Decrease**  
in hyperactive behavior by



SchoolVision was put to the test in an independent study by the government of Hamburg, Germany and the Universitätsklinikum Hamburg-Eppendorf.

A total of **166** pupils and **18** teachers took part in the year-long scientific experiment, which recorded significant improvements in student performance.

Compared to children under normal lighting, the children studying under SchoolVision showed improvements in concentration, attention span, and behavior. In addition, they read faster and made fewer mistakes.

# LED – paramteres

Visible

- **Technical specifications**
- **Price**
- **Design**





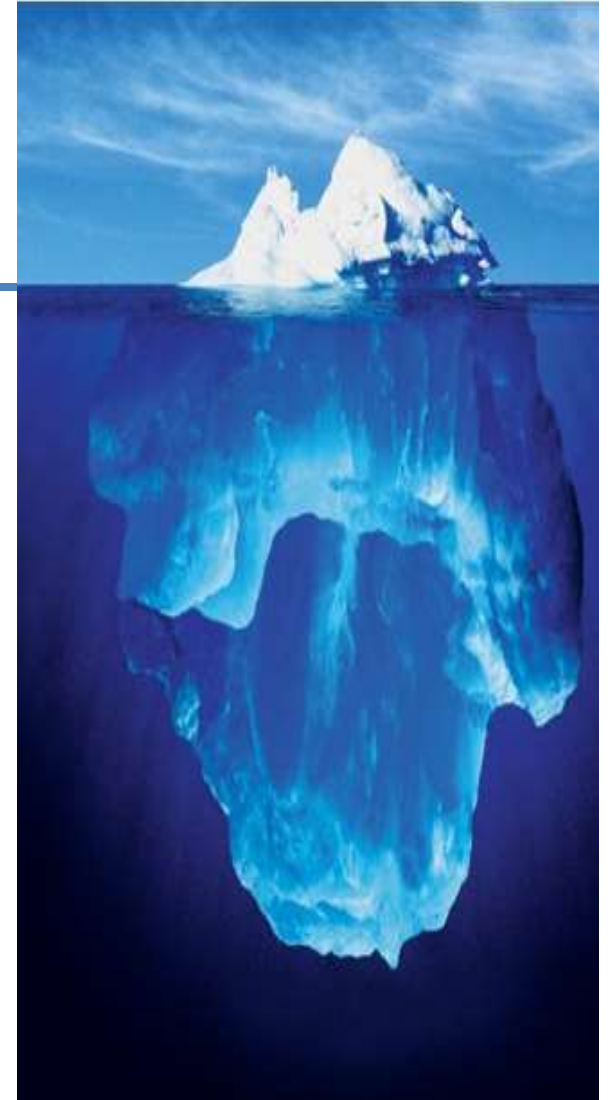
# LED – paramteres

## Visible

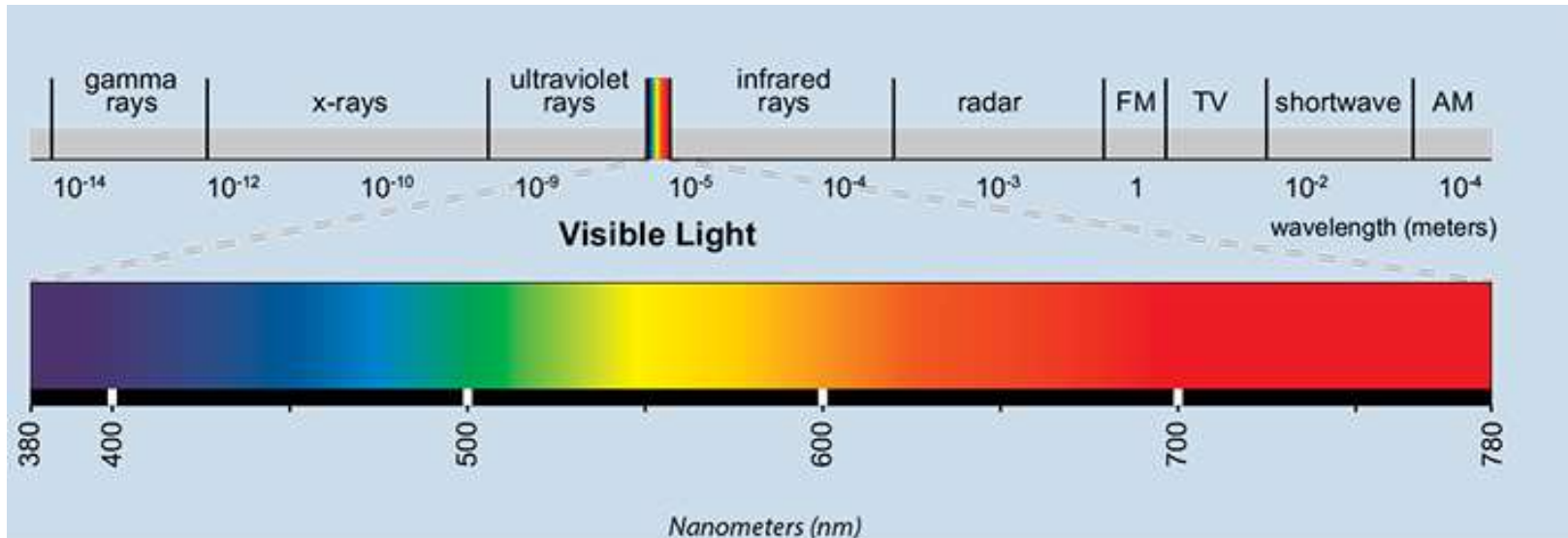
- **Technical specifications**
- **Price**
- **Design**

## Invisible

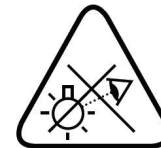
- Photobiological saftey (EN62471)
- EMC – Electromagnetic Compatibility
  - Equipment for general lighting purposes (EN 61547)
  - Harmonic emission level (EN 55015)
  - Limits of vottage fluctuations and flickering of light (EN-61 000-3-2)
- Evaluation of lighting equipment in terms of people's exposure to electromagnetic fields (EN 62493)
- Maintenance of luminous flux and color temperature during use



# Photo-biological safety



Hazard	Wavelength range (nm)
Actinic UV	200-400
Near UV	315-400
Blue light	300-700
Retinal thermal	380-1400
IR eye	780-3000

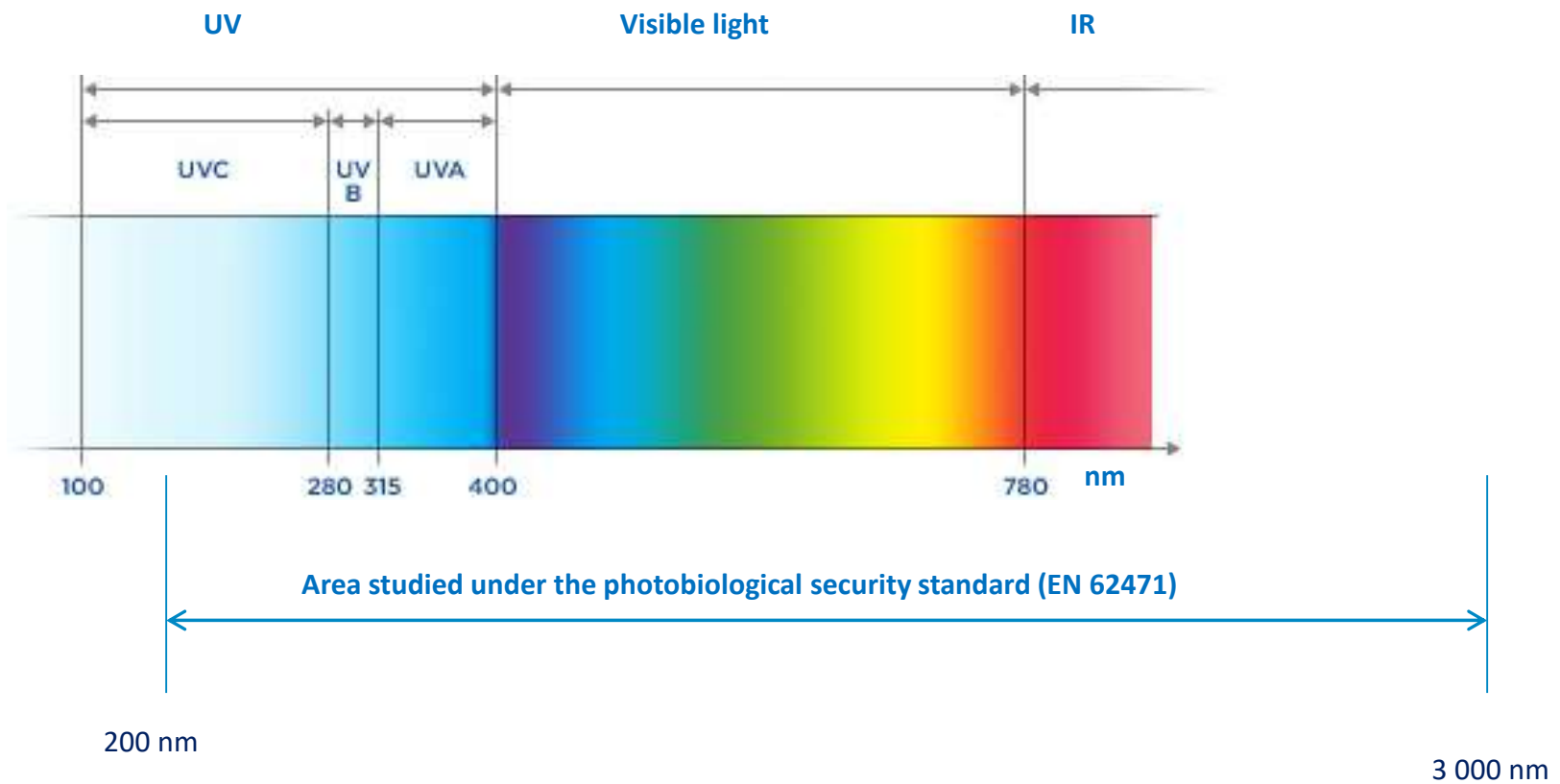


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# Photo-biological safety

- The use of LED light sources has elevated concerns about potentially **harmful photobiological effects** that can result from incidental exposure to LED light.
- Products safety standards include specific testing requirements to evaluate and classify the **photobiological risk associated with LEDs**.
- Today's Photobiological Safety requirements are published in the **IEC standard 62471**
- The Photobiological Safety standard IEC 62471 gives guidance on evaluating the photobiological safety of **lamps and lamp systems including luminaires**.
- The standard specifies **the exposure limit**, reference measurement technique and classification scheme.

# Photo-biological safety



# Photo-biological safety

## Emission limits and risk groups

- Risk Groups: When a product's effective irradiance and radiance values are compared against limits, risk group can be determined:
  - **RG 0 / Exempt:** LED light source does not pose any photobiological hazard
  - **RG 1 / Low:** LED light source does not pose a hazard due to normal behavioral limitations on exposure
  - **RG 2 / Moderate:** LED light source does not pose a hazard due to the aversion response of discomfort
  - **RG 3 / High:** LED light source may pose a hazard even for momentary or brief exposure

# TLA – Temporal Light Artefacts

Flickering



From **1 Hz** to **80 Hz**

Stroboscopic Effect



From **80 Hz** to **2000 Hz**











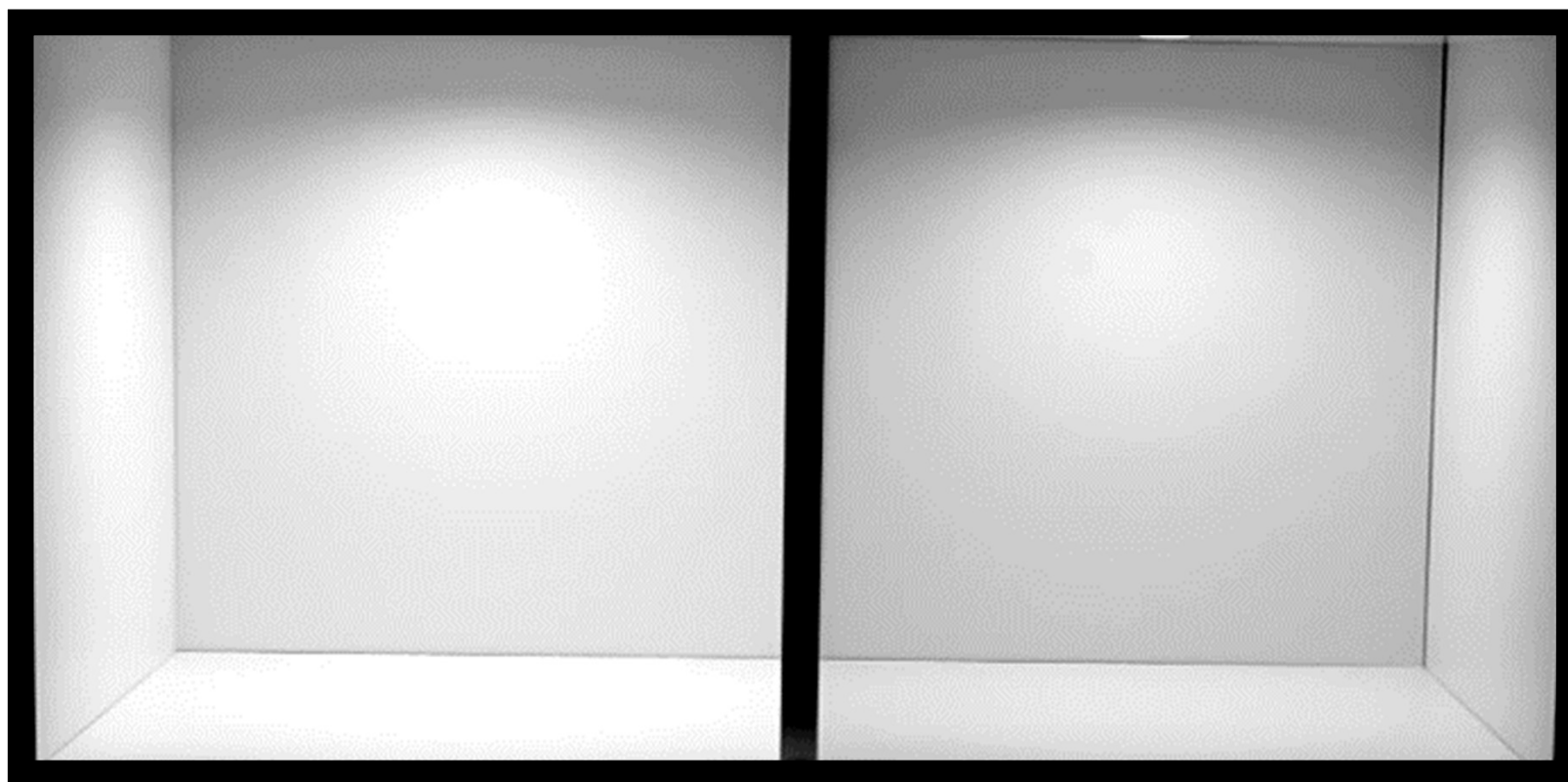




# Poorly designed LEDs have flicker & strobo

Can trigger discomfort, eye strain, performance reduction & headaches

**Video for demo**



# Why 'TLA' matters

## Effect on humans:

- Headaches
- Neurological problems: photosensitive epilepsy
- Autistic sensitivity
- Performance reduction

## Safety

- Distraction
- Possible hazard from stroboscopic effect: apparent stopping or slowing of motion of machinery

## interference of optical apparatus

- camera's
- bar code readers,



# Light yourself better... Why does it matter



Have you ever noticed that your eyes get tired easily, or experienced a decline in productivity due to low concentration?

Have you ever thought that maybe it's to do with your lighting?

Today, you can find a large range of LEDs in the market; from poor quality/low cost Chinese products to more sophisticated products sold by private labels.

Even if the difference seems indiscernible to your eyes, compromising on light quality can have serious consequences.

The quality of your light may matter more than you previously thought!