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Het belang van de juiste specificatie LEDs en verdere ontwikkelingen

Patrick van der Meulen – Business Development Manager

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Letter 706 to Gauguin,17 October 1888
….‘the walls pale lilac’

Light is energy is cumulative and not reversibel

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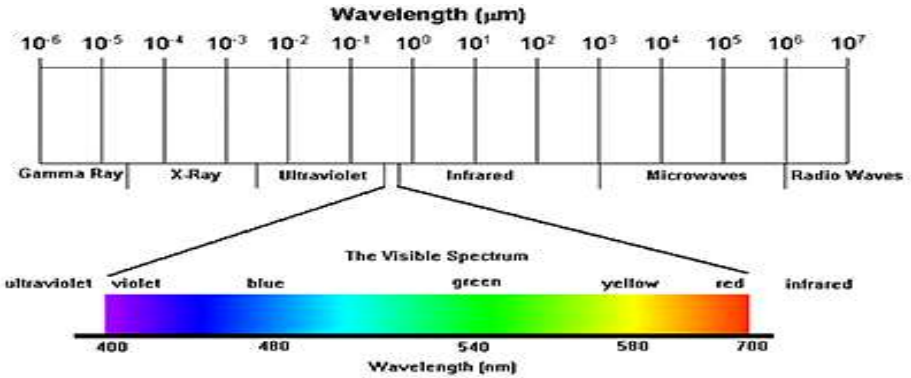

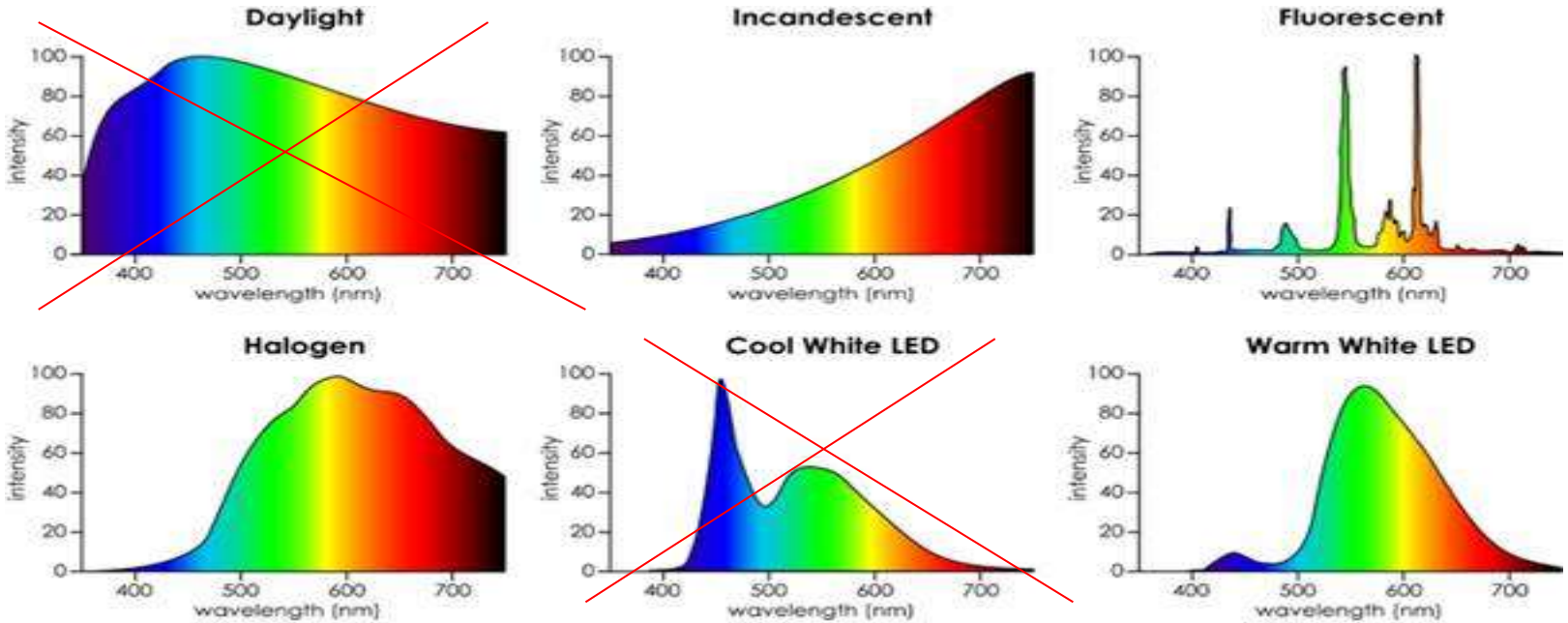

Choose light with the lowest blue-green components (≤ 525 nm)

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Option 1 – ‘as is’

- 4 Mlx.hours acceptable
- 53000 hours @ 75 lx
- 365 days @ 8 hours per day = 3000 hours a year
- 53000 hours / 3000 hpy = 18 jaar

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1. 30 YEARS MAX. 4MLh
2. LIGHT REGISTRATION
3. REDUCE LIGHT WHEN MUSEUM IS CLOSED
4. REDUCE DAYLIGHT
5. REDUCE PARTIES WHEN MUSEUM IS CLOSED
6. RESEARCH COLOUR FADING
7. REDUCE LIGHT TO 50 LUX
8. NEW LIGHT SOLUTIONS
9. REVICE LOANCONDITIONS

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Museums and galleries: lamp selection

- When displaying art, several criteria must be balanced in illumination design:
  - Visual
    - Viewers experience and understanding (individual paintings and gallery as a whole)
    - The artist’s intention
  - Conservation
  - Cost of Ownership

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Why LEDs in museums and galleries?

- Cost of Ownership savings due to:

  - Energy savings – lower Total Circuit Watts c/w halogen
    - As well as direct savings indirect savings are important.

  - Maintenance savings – longer life and greater reliability
    - Curators often change all halogen lamps before major new exhibitions to safe-guard against outages during the run
    - Can involve special lifts for high ceiling heights
    - Can be difficult because the accent luminaires are focused and dimmed for a specific purpose and should not be altered through relamping

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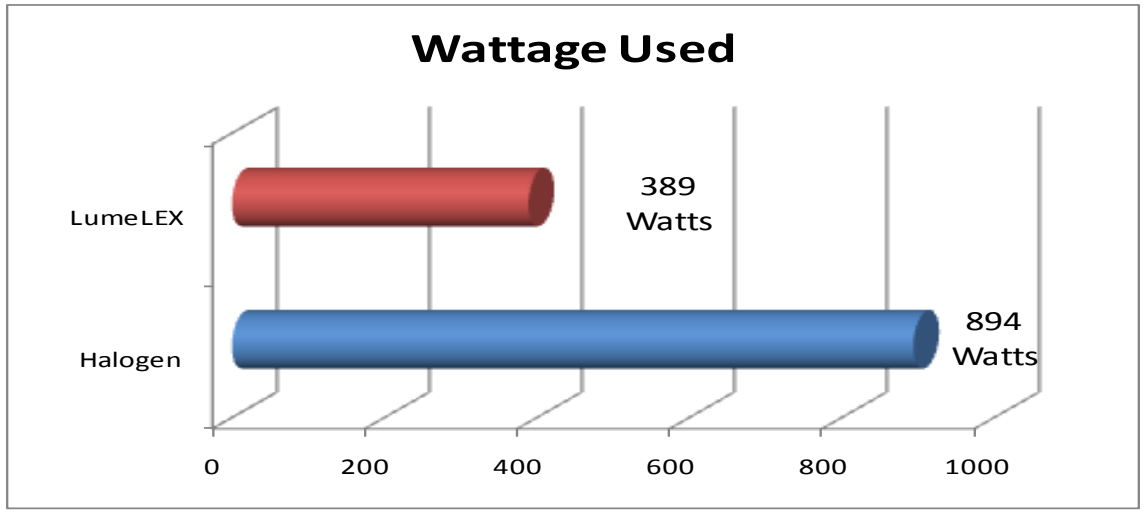
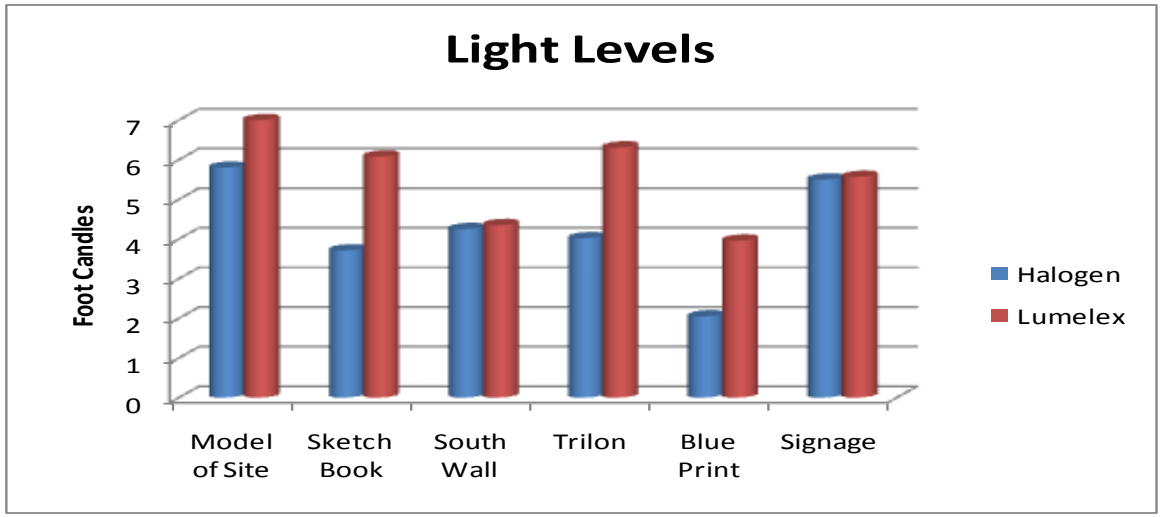
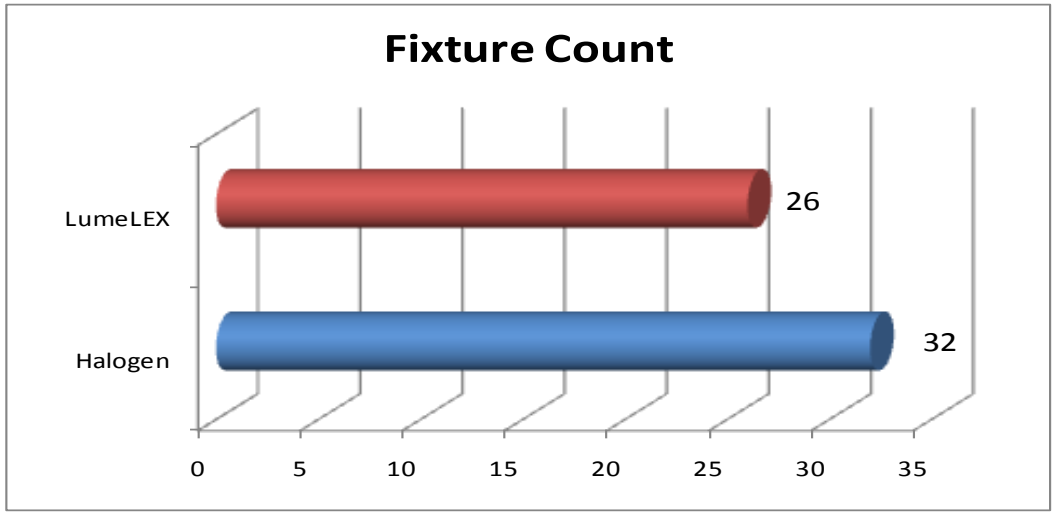

Wattage Used
LumeLEX
389 Watts
Halogen
894 Watts
0
200
400
600
800
1000


Light Levels
Foot Candles
0
1
2
3
4
5
6
7
Model of Site
Sketch Book
South Wall
Trilon
Blue Print
Signage
Halogen
Lumelex


Fixture Count
LumeLEX
26
Halogen
32
0
5
10
15
20
25
30
35

The visual: make certain no compromises

1. Colour point target
2. Maintaining target color point
    1. Part to part
    2. Through life
3. Colour Rendering - full spectrum essential otherwise possibility of impairment to human colour discrimination
4. Conservation considerations – certain wavelengths cause impairment of light sensitive pigments or materials

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The gallery as a whole: CCT options

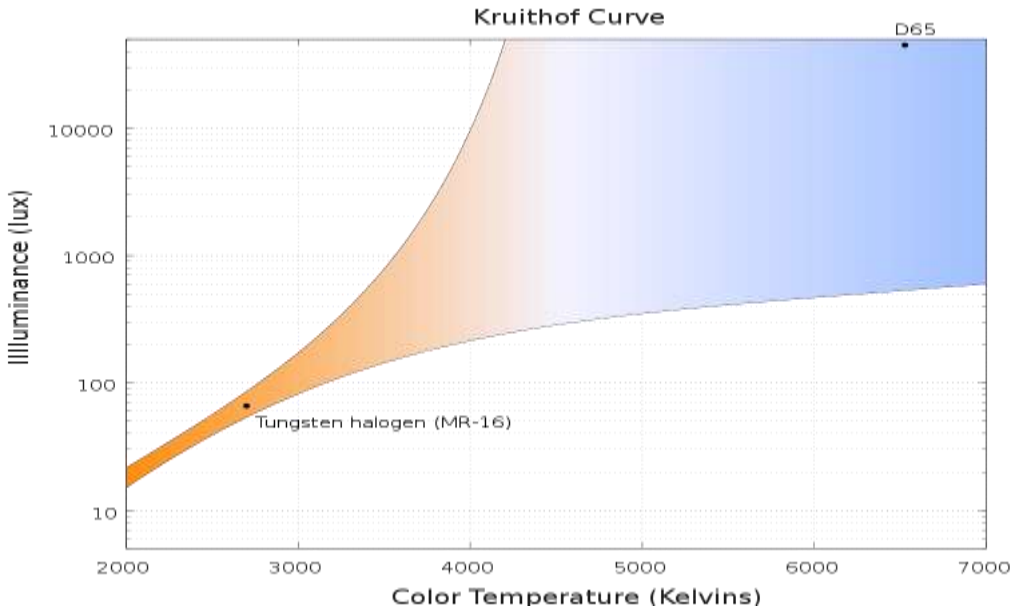
There are a number of theories:

1. Relate to Kruithof's Law and CCT according to light level, eg 2700K option for a comfortable environment at low light levels

2. Relate to expectations set by the experience of daylight and artificial light sources. – so 2700K / 5000K

3. Relate to genre, so old Dutch masters at eg 2500K and impressionist (en plein air) at 5000K

4. 3600K is the most pleasing CCT, irrespective of background illumination level. ('Museum Lighting: Optimizing the lluminant' by Michael Scuello, Israel Abramov, James Gordon & Steven Weintraub, 2004)



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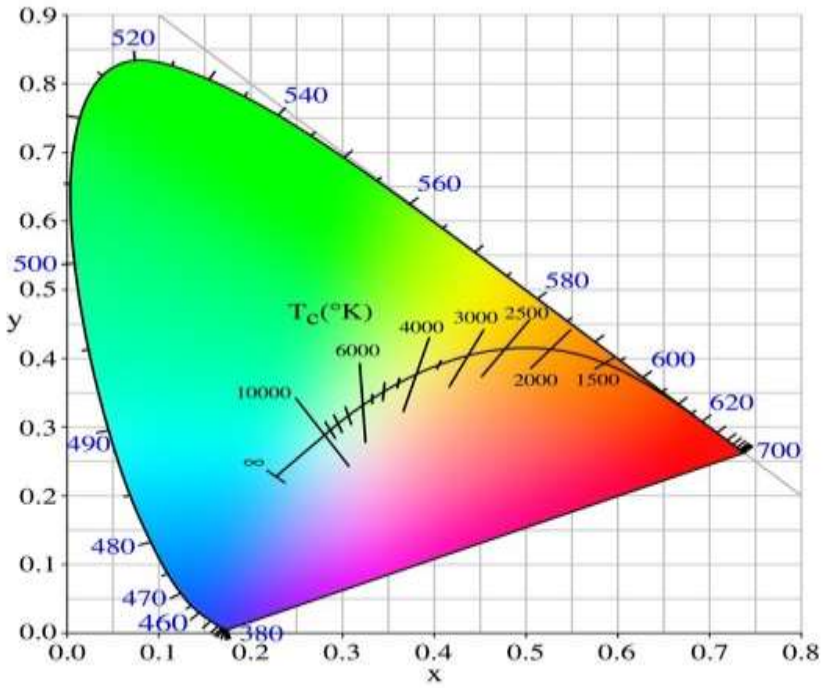
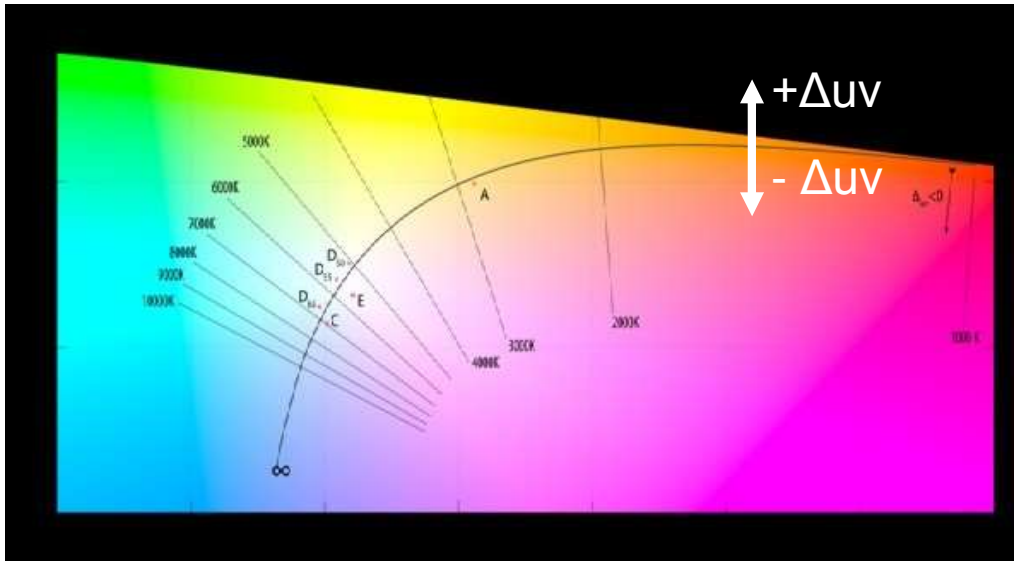
Colour point target

- Moving away from the black body curve even with the same CCT will affect colour appearance
- Δuv is a measure how different the colour will appear
- + Δuv moves towards green and increases flux. This results in a poorer colour quality but higher flux





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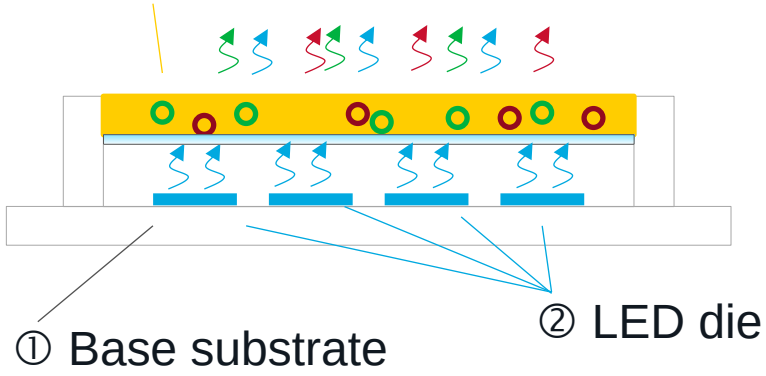
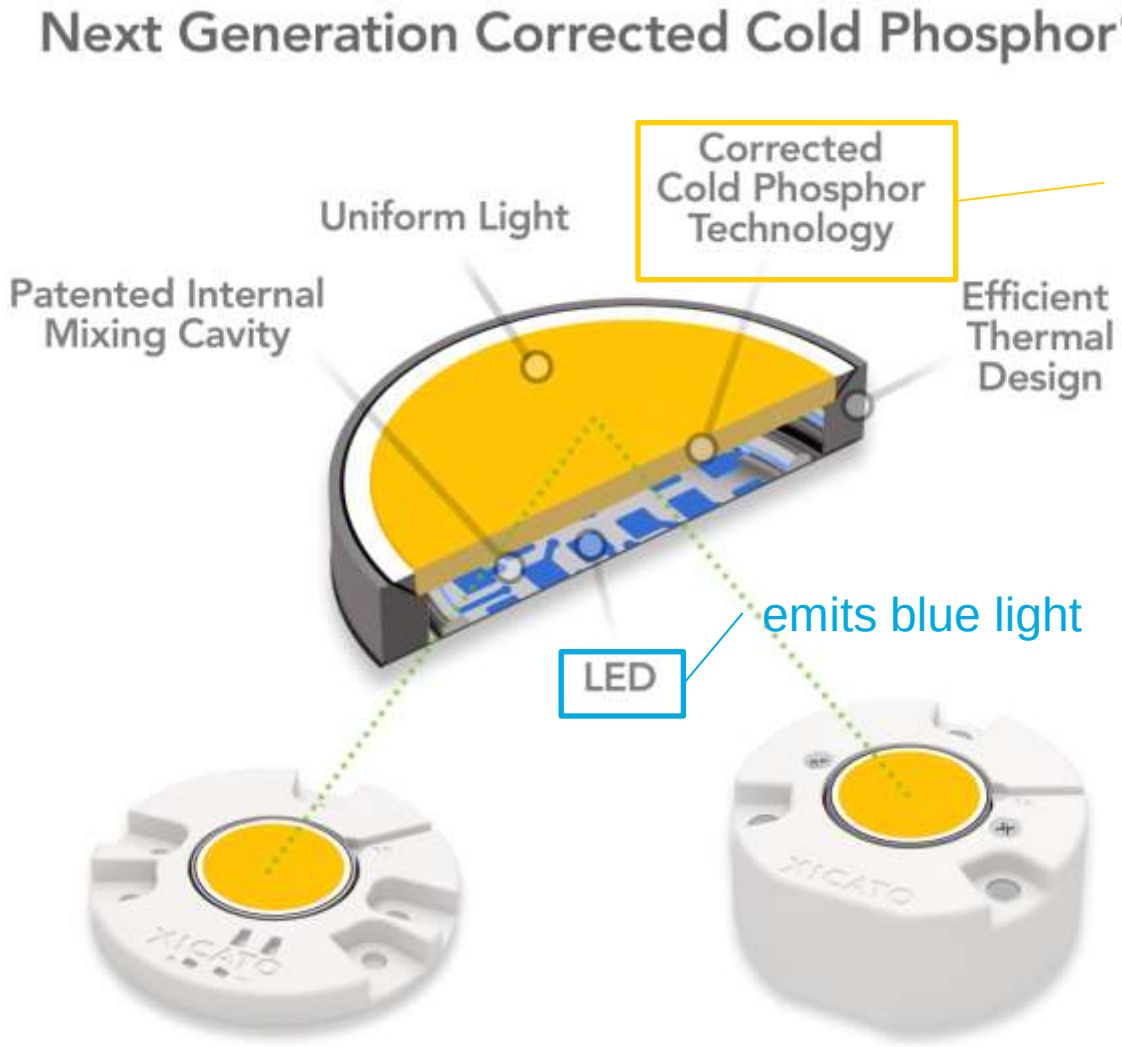
Anatomy of an LED module





Contains green and red particles – that is why it looks **yellow!**

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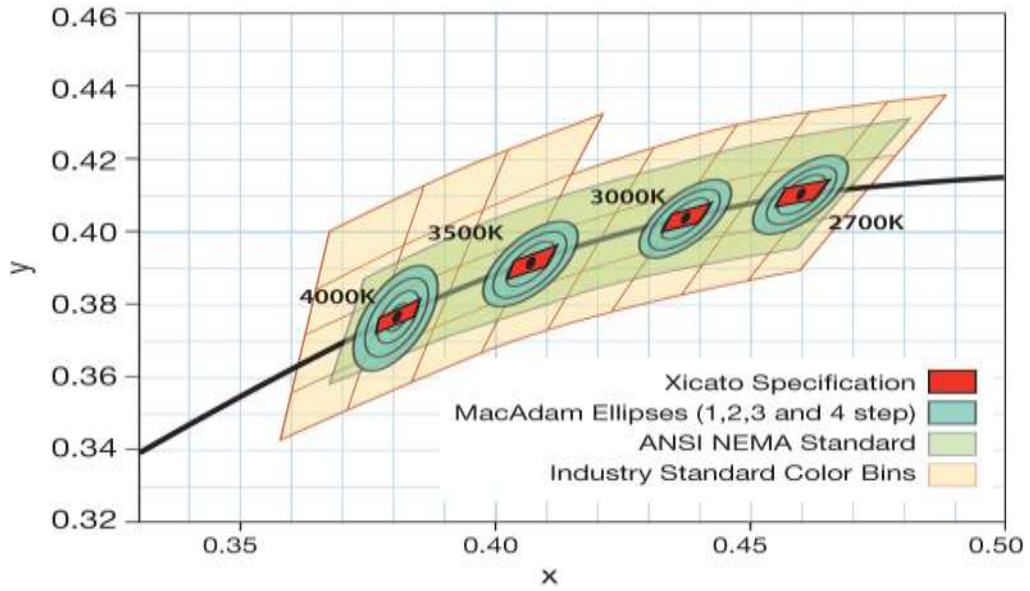
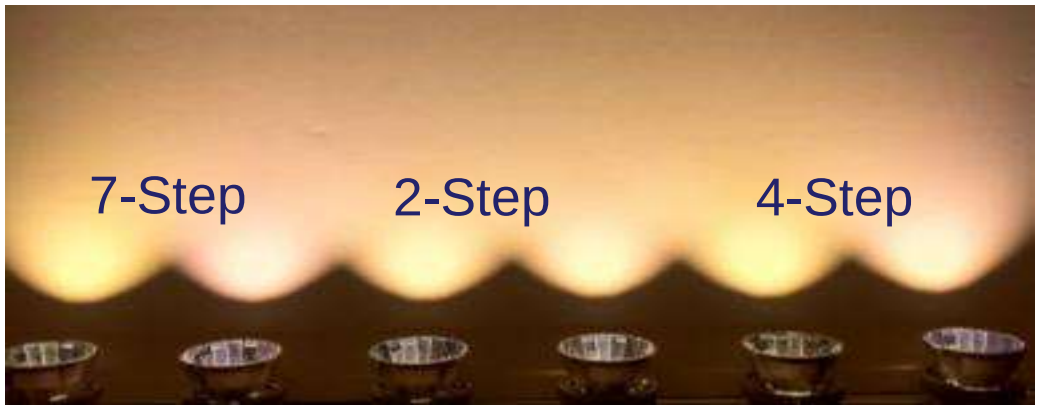
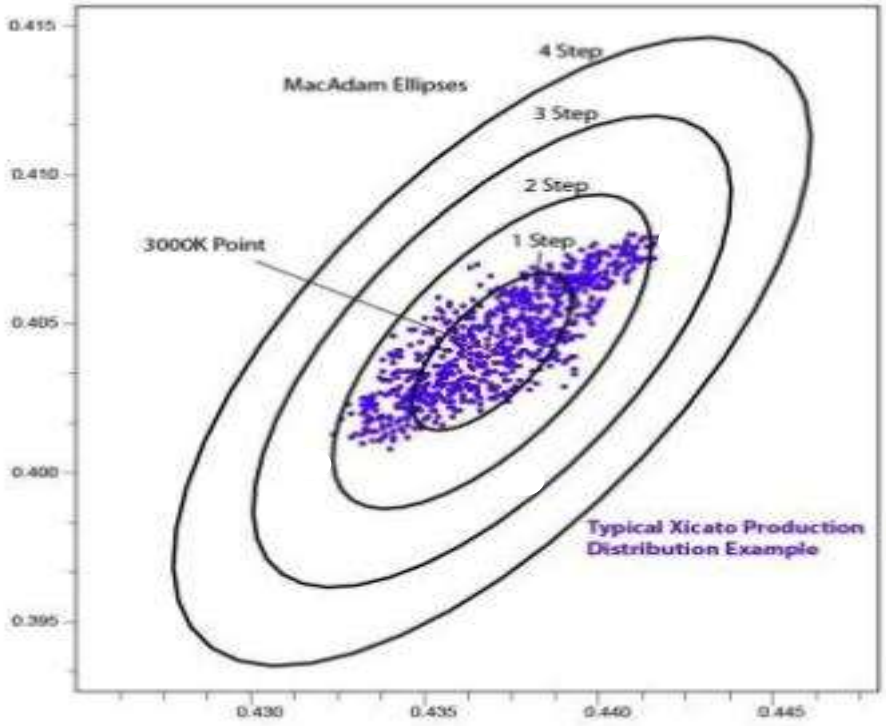
Consistency- Initial







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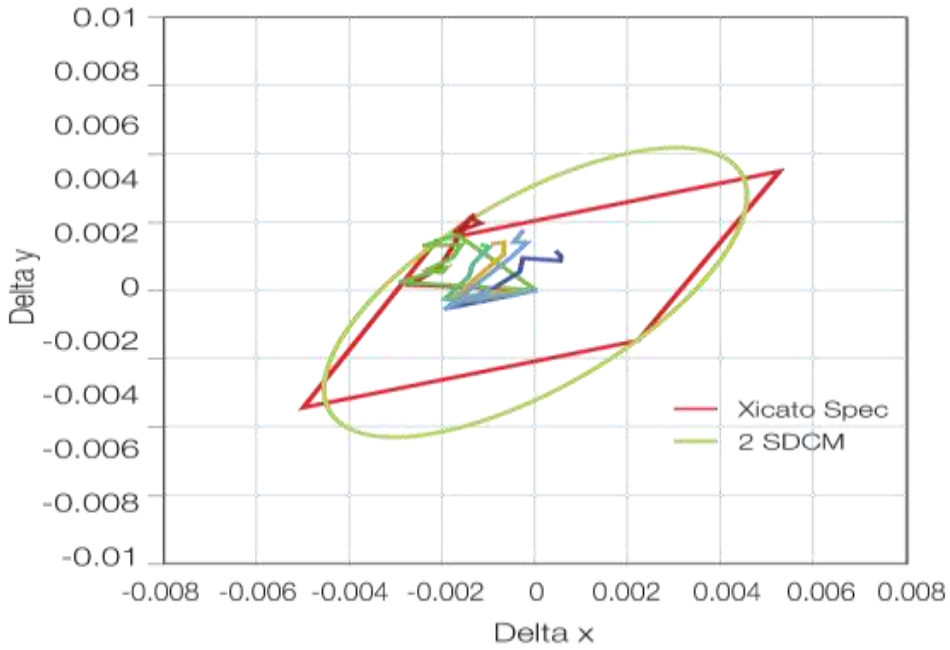
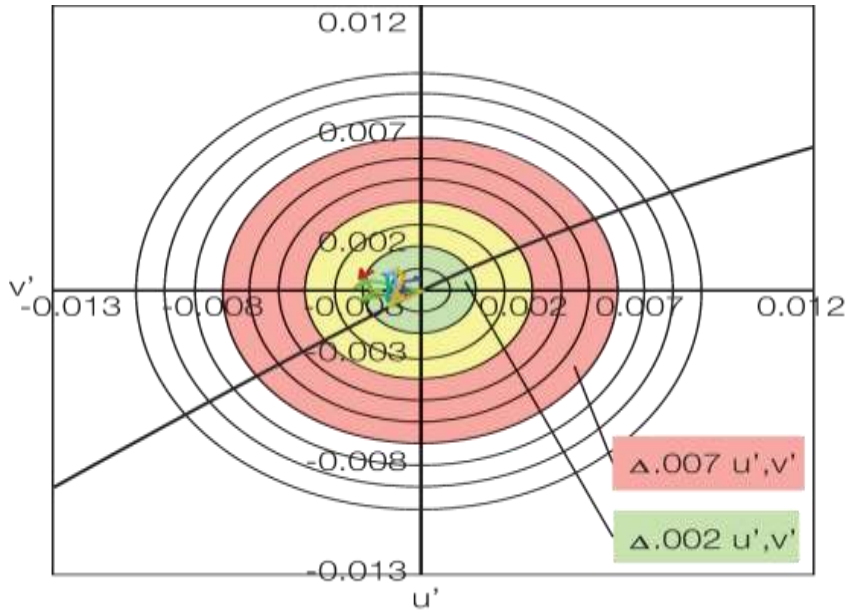
Consistency - sustained

CIE1931 x,y format

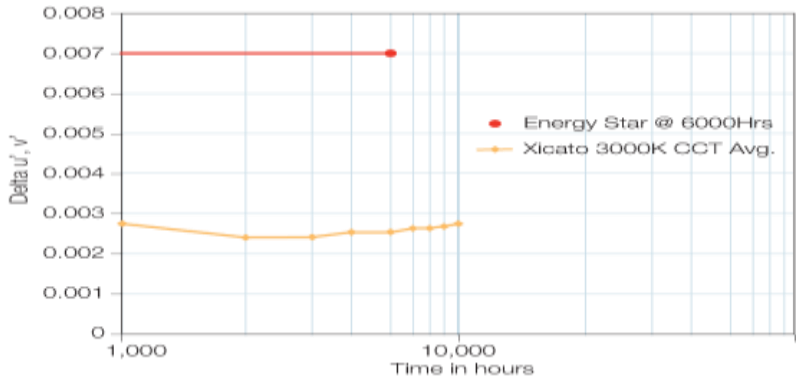


CIE1976 u',v' format



0.001u'v' ≈ 1 McAdam ellipse or 1 SDCM.

Tc=85C, If 1050mA, HTOL, 9,000hr.



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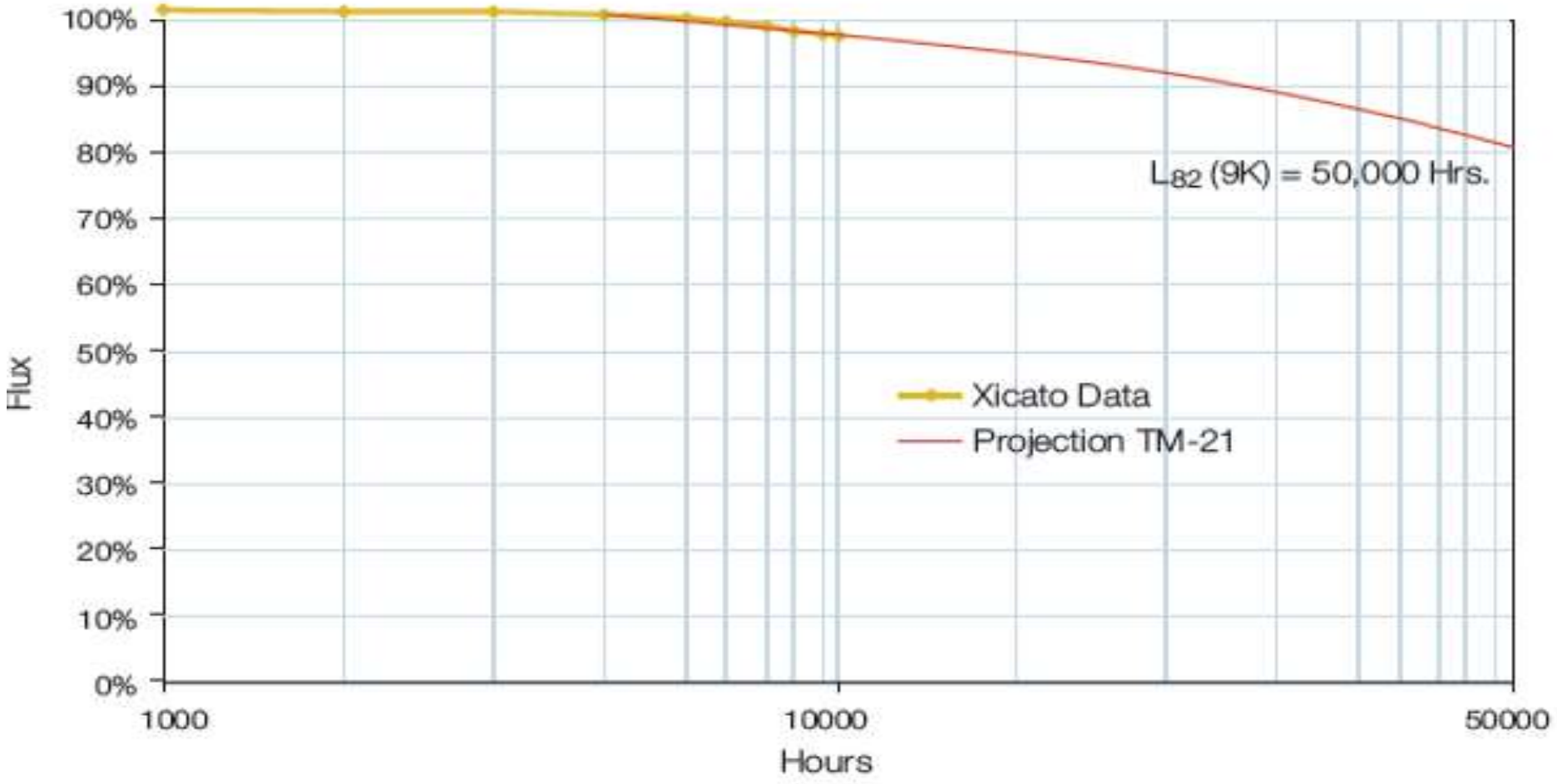
Lumen Maintenance



6 samples, at T_C = 85˚C, I_F = 1050mA, HTOL, 9000 hrs

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5 Year Field Implementation Evaluation

- Replaced Luminaires after 5 years (2011 – 2016)
- Re-measured the modules and compared to new
- Colour shift after 5 years:
  - 20-30K
  - 0.00056 – 0.00063Duv

St John’s Church, London

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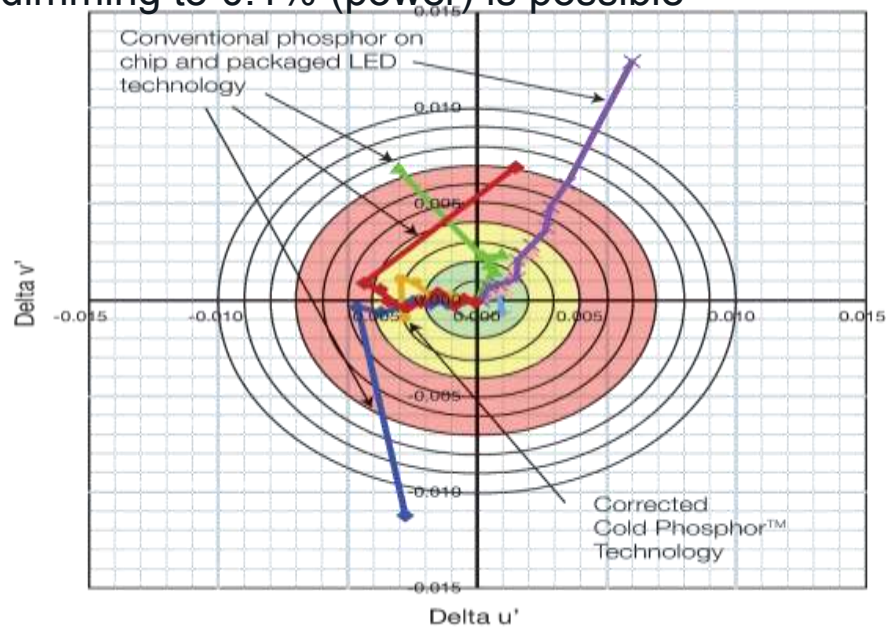
The gallery as a whole: colour shift with dimming

Smooth dimming is possible with all Xicato modules

- Clear advantage over CFL & CMH
- No adverse effect on lifetime
- Compatible with DALI, 0-10V, Triac, ELV, Push and DMX controllers
- Stable color point - virtually no noticeable color change
- Deep dimming to 0.1% (power) is possible



Dimming example in a Sutton Vane Associates scheme, Luminaires by Projection Lighting

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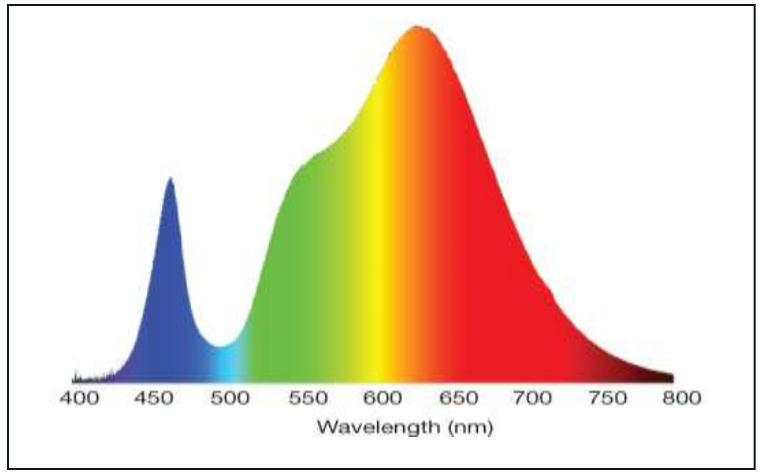
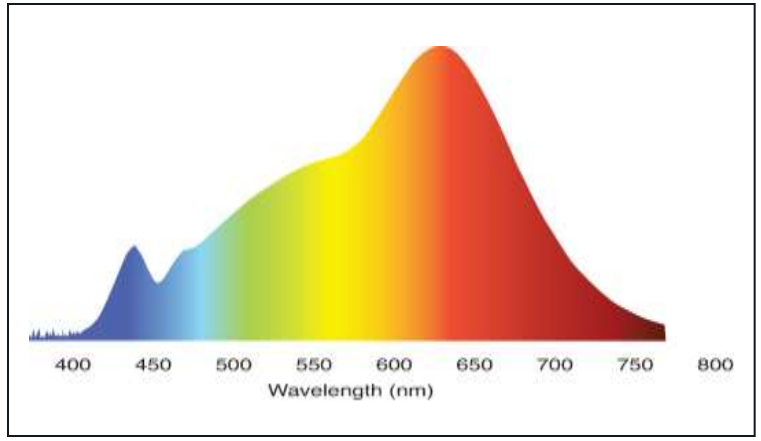
Colour rendering

Standard 80 CRI (min.)



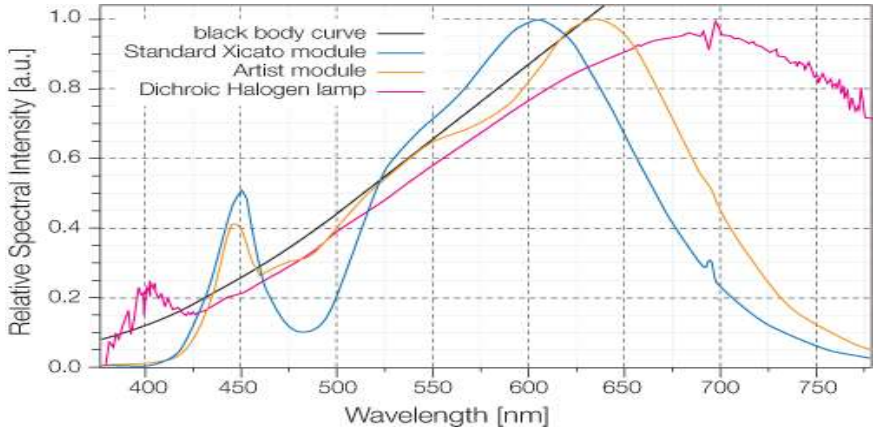
Artist 95 CRI, 90 R9, 95 R15 (min.)



	Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Standard XSM	81	80	85	89	81	78	80	86	66	16	64	79	58	81	93	75
Artist Series XSM	98	98	99	98	98	98	97	98	98	96	99	98	88	98	98	98
Typical IR coated Halogen Dichroic	98	98	99	99	99	98	98	99	97	92	97	98	97	98	99	97
Typical Compact Metal Halide	82	90	94	69	82	81	81	87	71	27	59	62	55	93	78	88
Typical Compact Fluorescent	87	91	93	86	91	89	90	88	70	17	76	91	81	93	92	81

Independent measurements by University College London

- Artist Series LED modules for color discernment on a par with halogen



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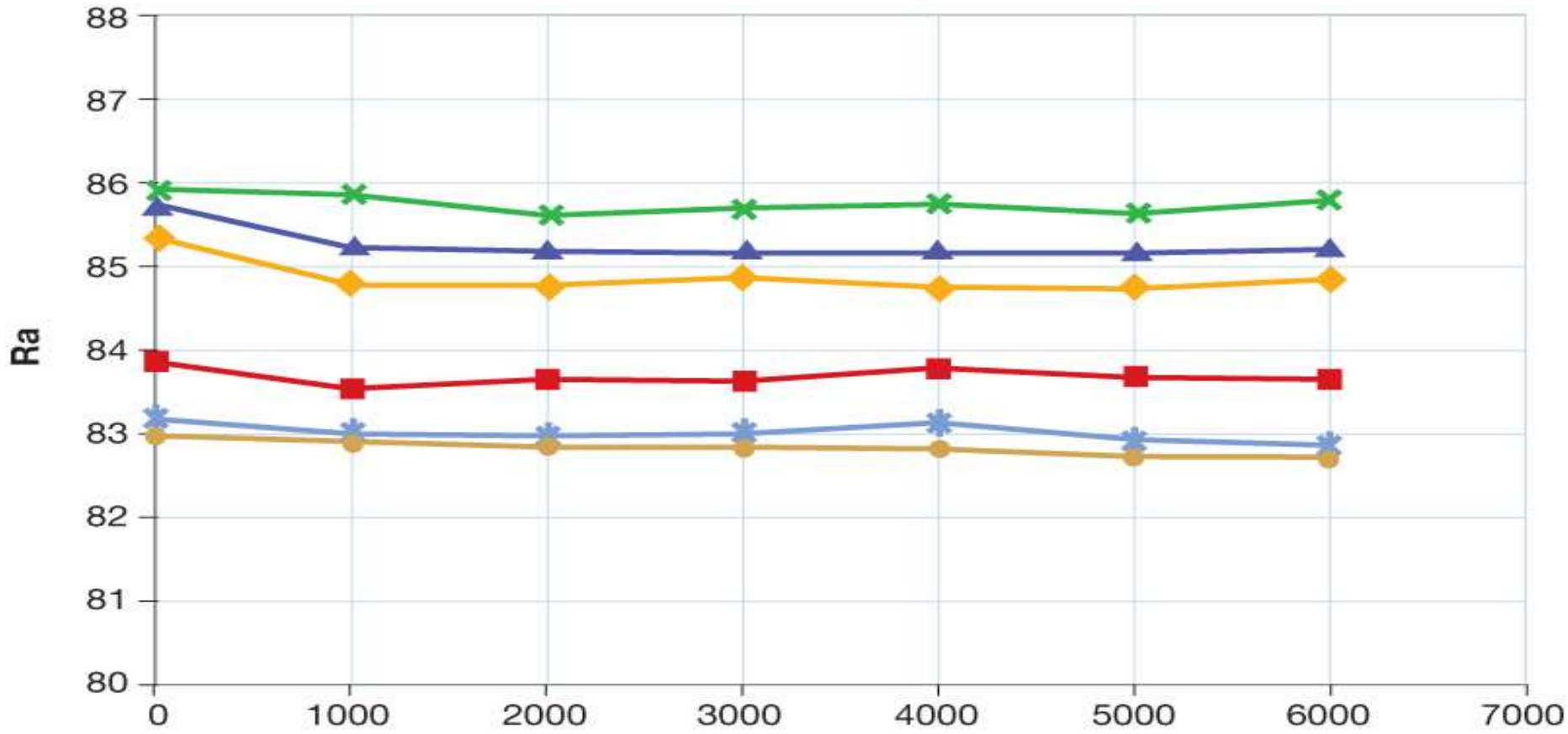
The Xicato Spectral Power Distributions at 3000 Kelvin

Independent measurements by University College London

CRI maintenance

6000hr data, 6 module test set



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Conservation

- The extent of damage from photochemical action depends on:
  - The light dose (Lux – hours / year)
  - The spectral power distribution of the light source. (Short wave radiation is more damaging than longer wavelength radiation)
  - The spectral sensitivity of the illuminated object (paintings: pigments and binder, varnish, paper)

‘Look-up’ tables

Extremely sensitive	Very sensitive	Sensitive	Insensitive
Brasilwood lake	Kermes lake	Madder lake	Most inorganic pigments including Ultramarine Azurite Malachite Verdigris Earth pigments Lead-tin yellow Naples yellow Lead white Carbon blacks
Cochineal lake (on Ca substrate)	Cochineal lake (on Al substrate)	Cochineal lake (on wool or silk)	
Buckthorn lake (on Ca substrate)	Buckthorn lake (on Al substrate)	Weld lake (on wool or silk)	
Litmus	Lac lake	Alizarin crimson	
	Weld lake	Vermilion	
	Quercitron lake	Red lead	
	Gamboge	Chrome yellow	
	Indigo	Prussian blue	
	Sap green		

Category	LOAED	Preservation Targets		
		1000 yrs	100 yrs	10 yrs
High Sensitive ISO 1, 2, 3	ISO 2: 1.0 Mlx hr	50 lux for 20 hrs/yr	50 lux for 25 days/yr 500 lux for 25 hrs/yr	50 lux for 250 days/yr 500 lux for 25 days/yr
Medium Sensitivity ISO 4, 5, 6	ISO 4: 10 Mlx hr	50 lux for 25 days/yr 500 lux for 20 hrs/yr	50 lux for 250 days/yr 500 lux for 25 days/yr	340 lux for 365 days/yr 500 lux for 250 days/yr
Low Sensitive ISO 7, 8, above	ISO 7: 300 Mlx hr	100 lux for 365 days/yr 500 lux for 75 days/yr	1000 lux for 365 days/yr (500 lux/yr for target 200 yrs)	

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CIE 157:2004
CONTROL OF DAMAGE TO MUSEUM OBJECTS BY OPTICAL RADIATION

Lamp Type	Relative Damage Potential	Lamp Type
Tungsten Halogen	1.04	3000º Kelvin
Xicato 80+ CRI	0.88	3000º Kelvin
Xicato 95+ CRI	0.84	3000º Kelvin
Cool White Fluorescent	1.37	4000º Kelvin
Sun + Daylight	1.71	5000º Kelvin

Calculations by Art Preservation Services

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Getty Conservation Institute and blue wool testing

ISO Blue Wool	% improvement over Halogen
Blue Wool 1*	25%
Blue Wool 2**	33%
Blue Wool 3**	40%

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Blue wool test cards

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What can smart lighting offer to galleries?

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Patrick van der Meulen

What can smart lighting offer to galleries?

- What can smart lighting offer galleries?
  - Light quality: sustained accurate colour portrayal
  - Easier (re) commissioning
  - Maintenance savings
  - Energy saving
  - Conservation Management
  - Indoor location services
- Demonstration at our Booth

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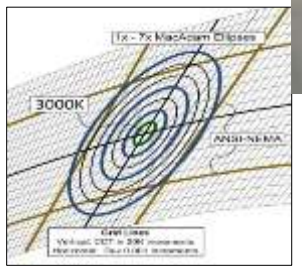
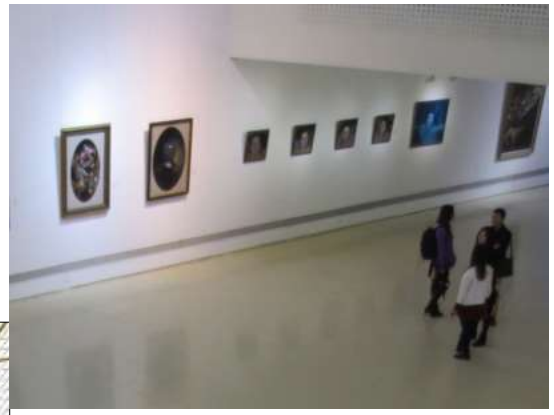
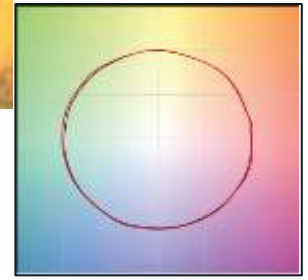
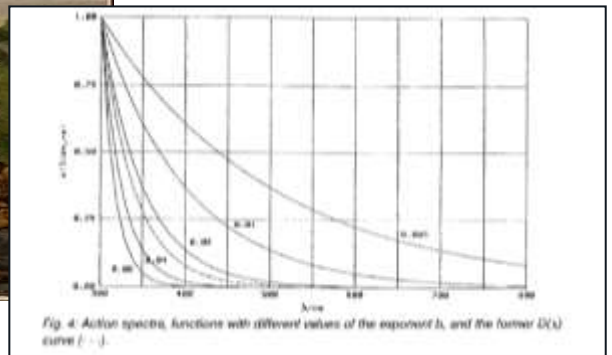
Light quality (SPD)









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Peer to peer communication

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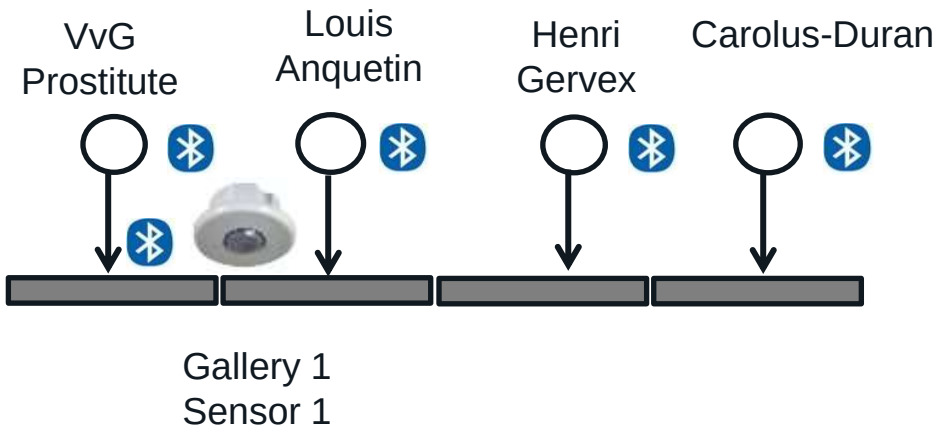
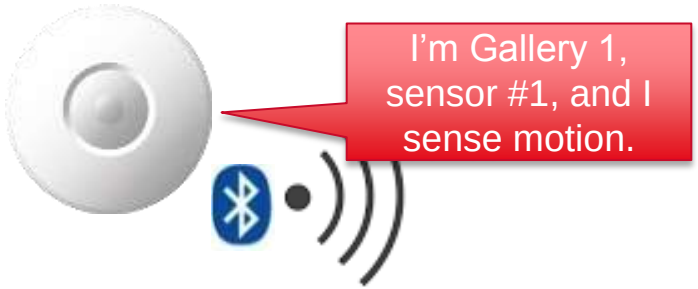
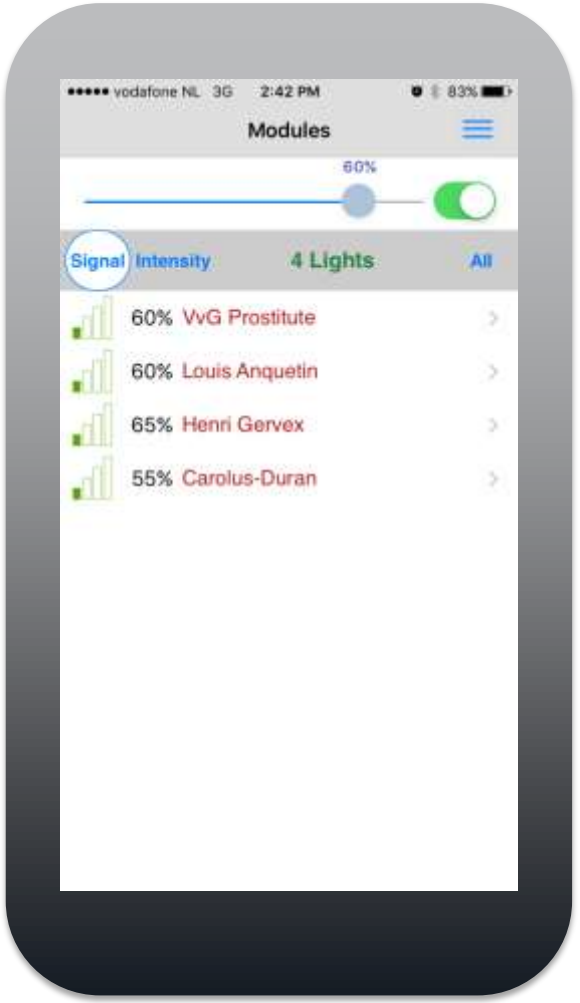
Easier (re) commissioning





Do I listen to Gallery 1, sensor #1?
Yes.
What do I do?
I go to 80% intensity.



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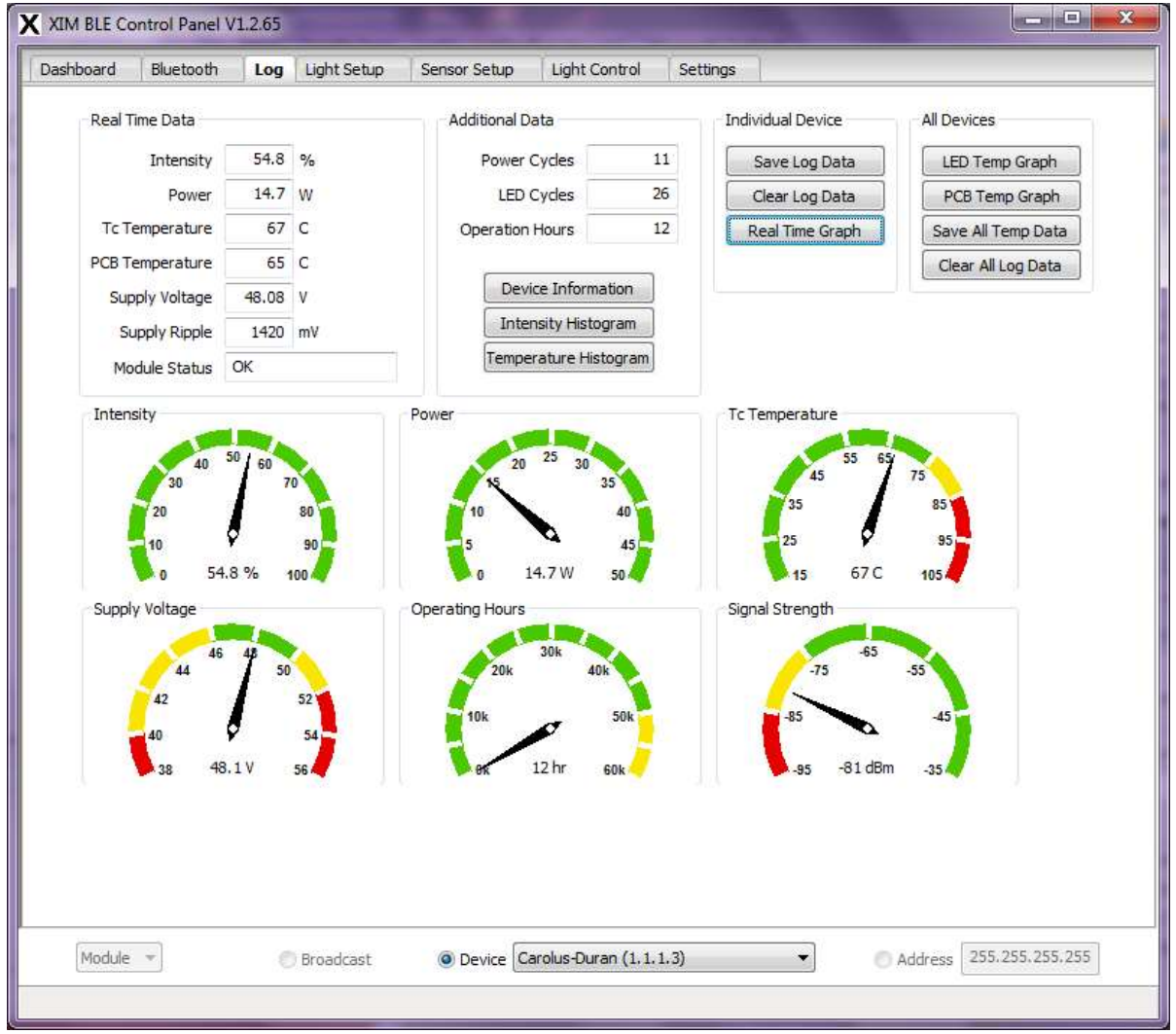
Energy and Maintenance savings

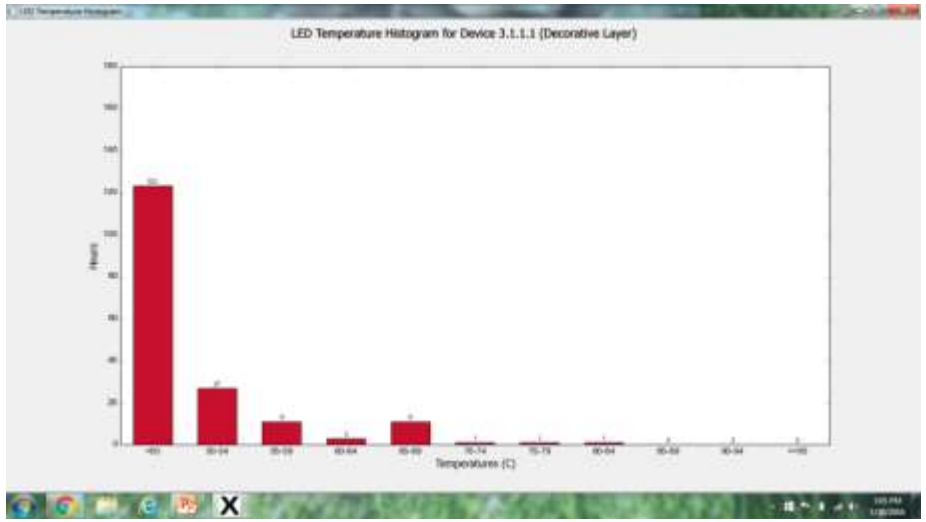


Energy saving:

- Scheduling
- Linking to sensors

Maintenance saving:

- Prolonged life through auto correction
- Instantaneous running status
- Historical data



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Conservation management

Managing light dose to minimise photochemical action

- Light dose (Lux-hours / year)
  - The spectral sensitivity of the illuminated object
  - SPD
  - Preservation Target
- Methodologies
  - Limit times the art is on show. Lighting fixed during opening times
  - Above with lighting varying during opening times by fixed schedule, eg for the Ardabil carpet at the Victoria and Albert museum.
  - Above with smart lighting linked to movement and ambient light sensors

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Bluetooth Smart movement and ambient light sensors

- Position sensors next to paintings and calibrate
- Input exposure limit (lux hours) into app for painting being lit.
- Use BLE to set desired maximum light level on the painting
- App to feedback on resultant display time at that level (hours per season)
- User to tweak output to achieve desired display time.
- User to set illumination level for painting when no presence is detected
- Database to display running lux hours for each painting with advice
- Alarm function

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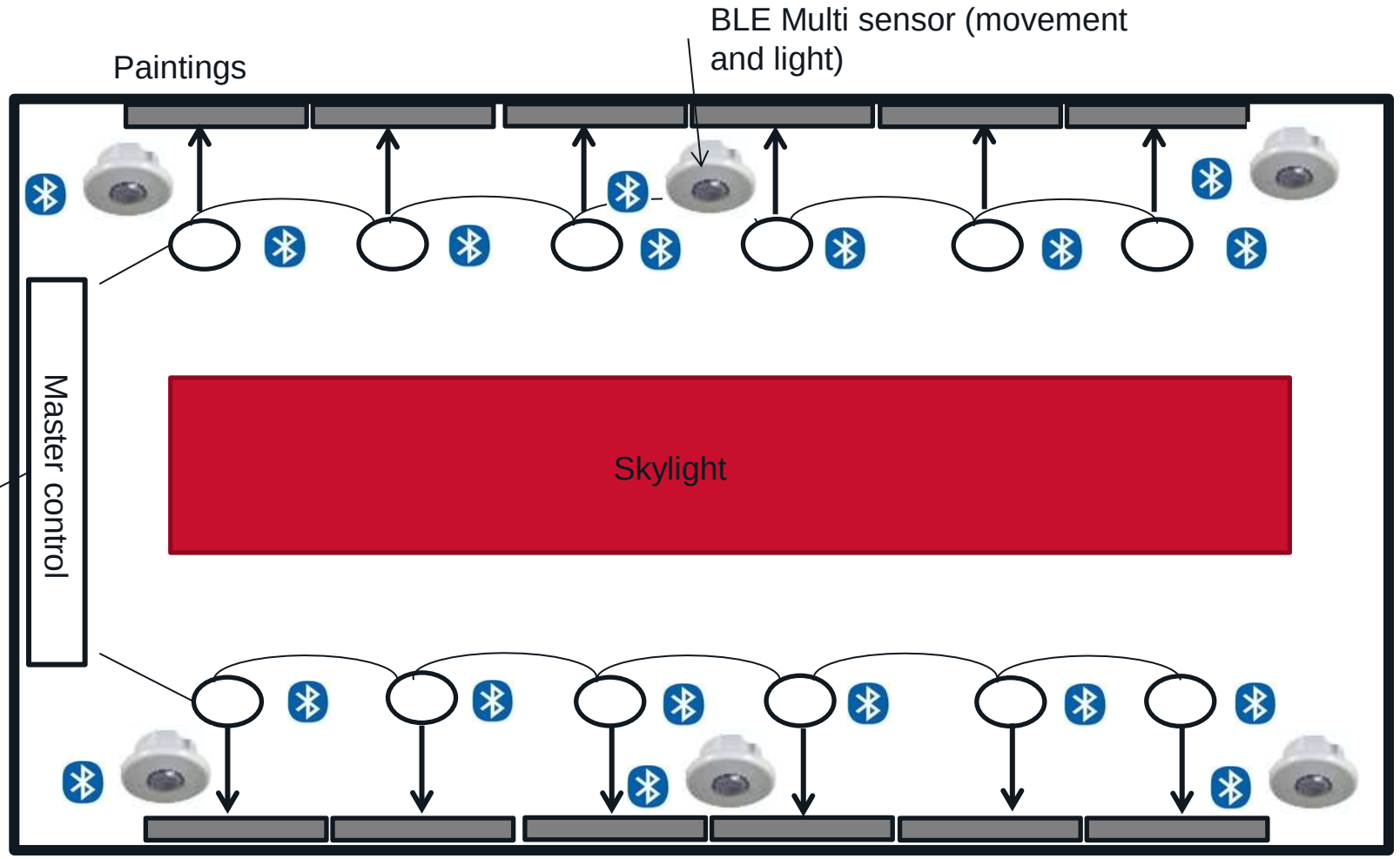
Hypothetical application

BMS

- Overall power management
- Energy data



Localised control for commissioning

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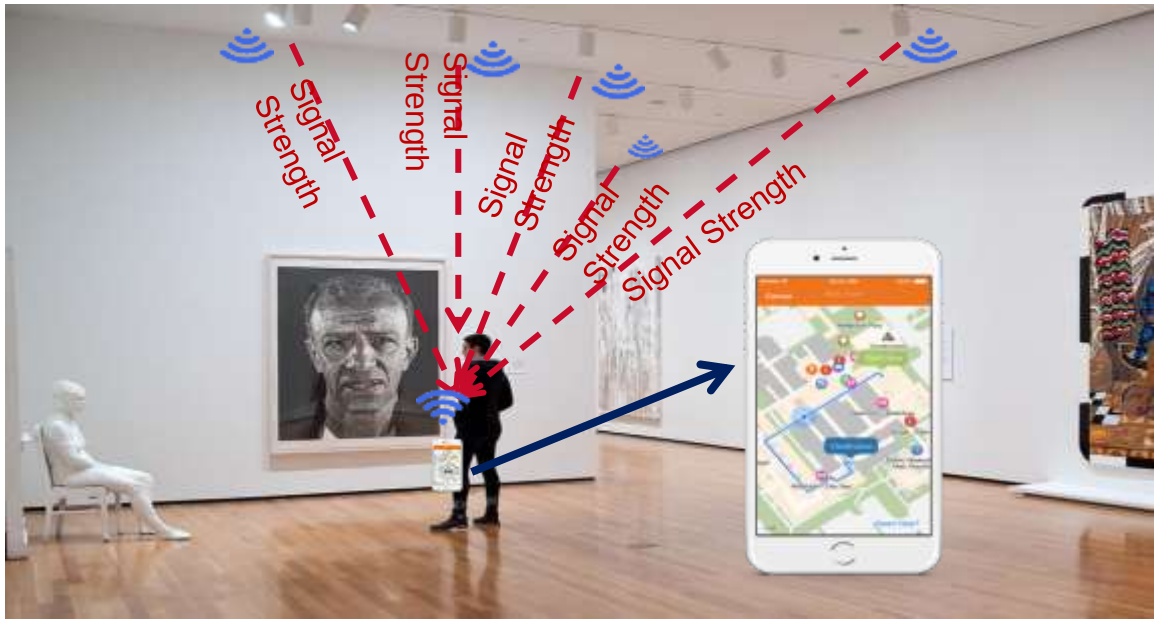
Indoor location Services

Bluetooth Low Energy Enabled Lighting Fixture

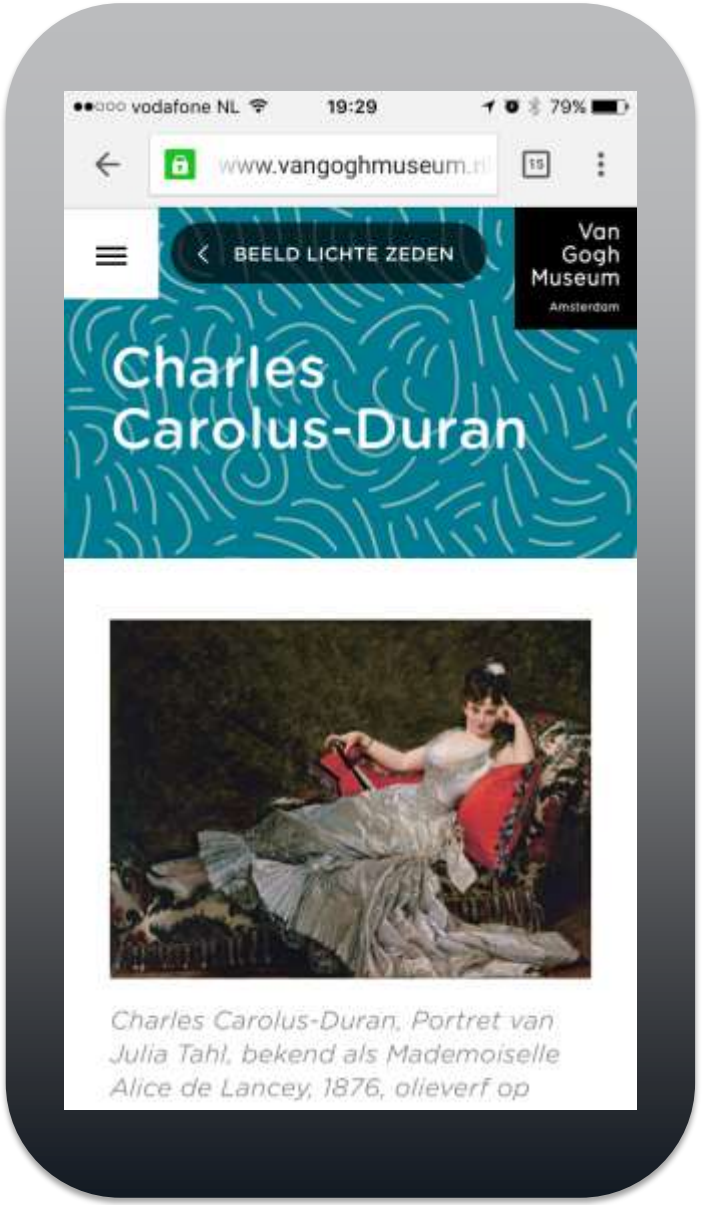
Smart Device

“App ”



Indoor location Services

Indoor positioning



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