

## PI-LED® Technology

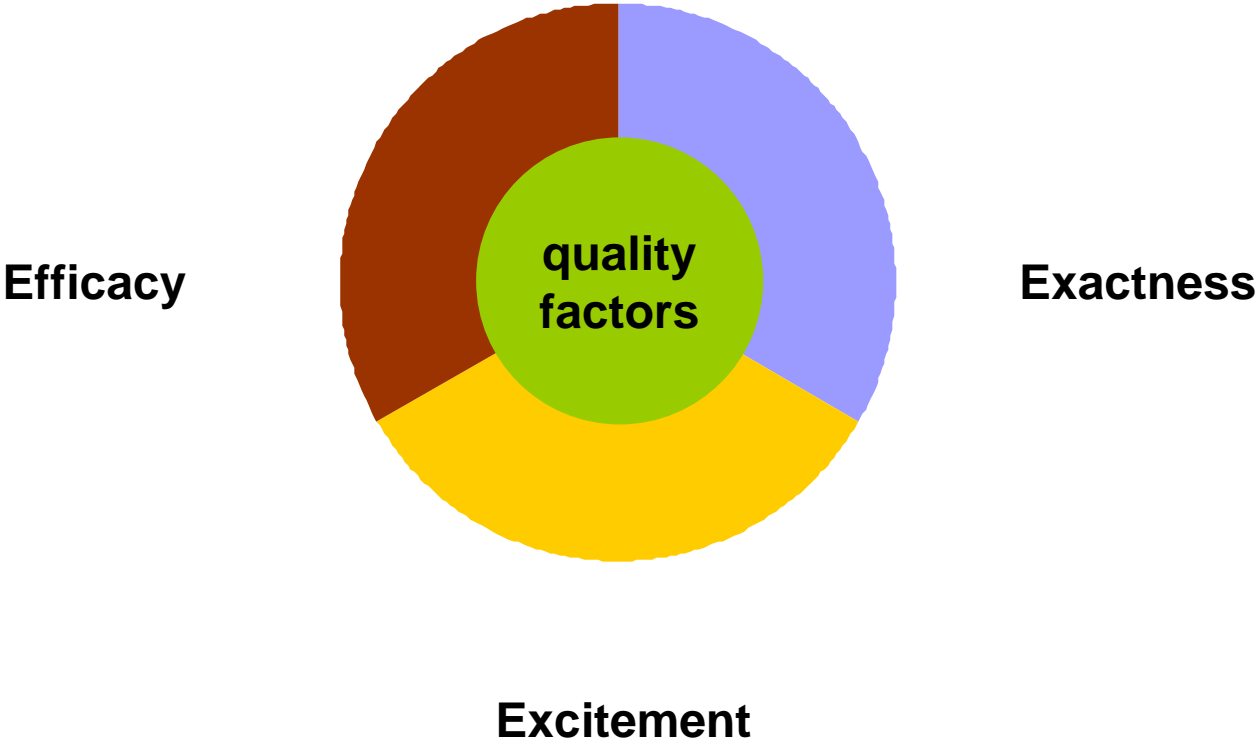


**PI-LED® Technology  
for professional lighting applications**

Martin Hartmann  
Tridonic, Austria

- ▶ **3E – Requirements of a LED light source**
- ▶ **Existing LED-solutions for variable (white) light**
- ▶ **PI-LED® Technology**
- ▶ **Applicability of PI-LED® Technology**

- ▶ **3E – Requirements of a LED light source**
- ▶ Existing LED-solutions for variable (white) light
- ▶ PI-LED® Technology
- ▶ Applicability of PI-LED® Technology



## ► Efficacy

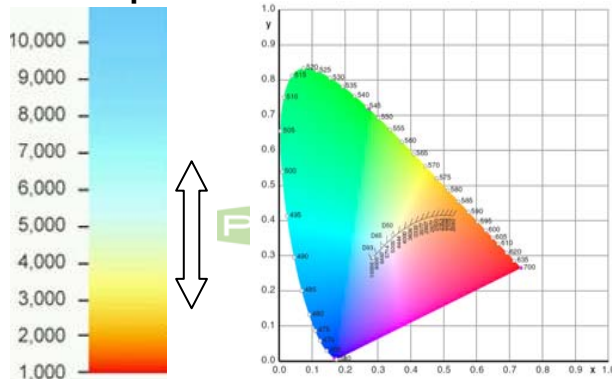
High luminous efficacy  
90 lm/W @2700K



## ► Exactness

Colour Rendering Index > 90  
Colour tolerance -> Mac Adams 3  
luminous flux tolerance < 5%

## Colour Temperature

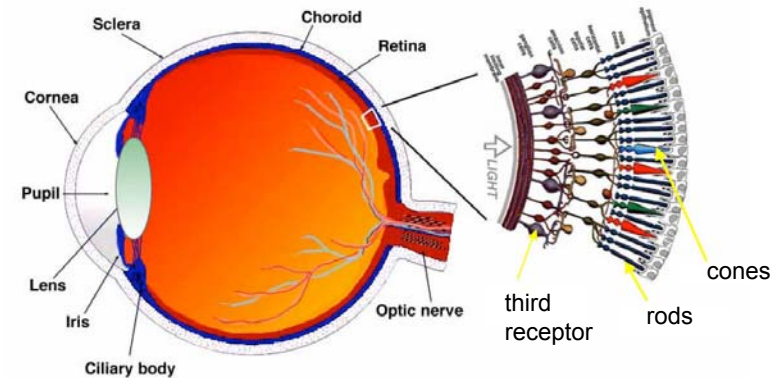


source: [www.graf-it.de](http://www.graf-it.de)

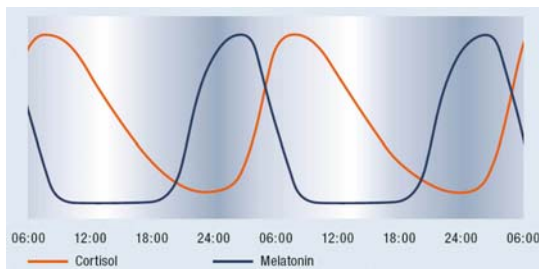
## ► Excitement

Tuneable Colour Temperature -> 2700K up to 6500K  
Variable light colours -> specific CIE x/y coordinates

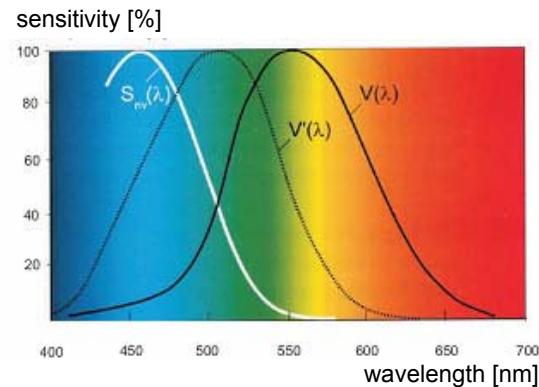
- ▶ Effects of light
  - ▶ Visual
  - ▶ Biological/emotional
- ▶ Dynamic light control
  - ▶ Encourages vigilance
  - ▶ Encourages physical comfort
- ▶ Circadian rhythms
  - ▶ Melatonin (“Sleep-Hormone”)
  - ▶ Cortisol (“Stress-Hormone”)



source: Richter



source: Osram

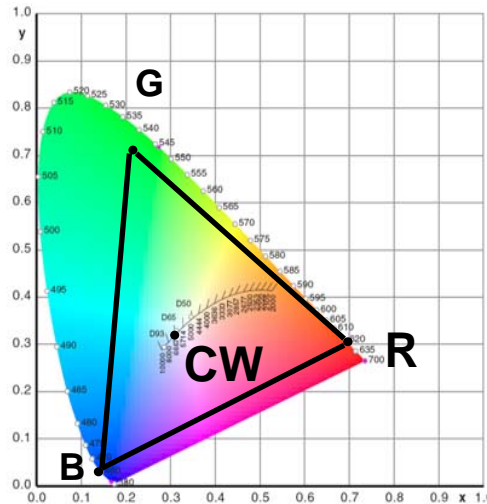
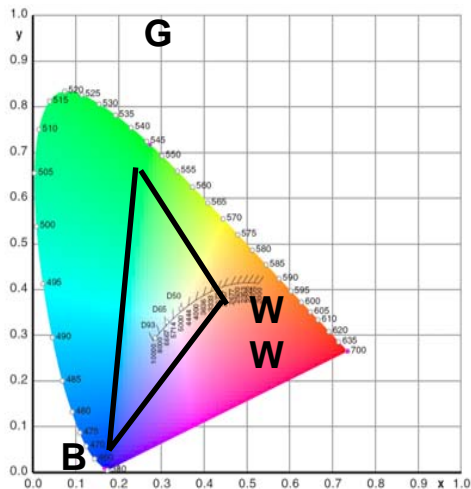
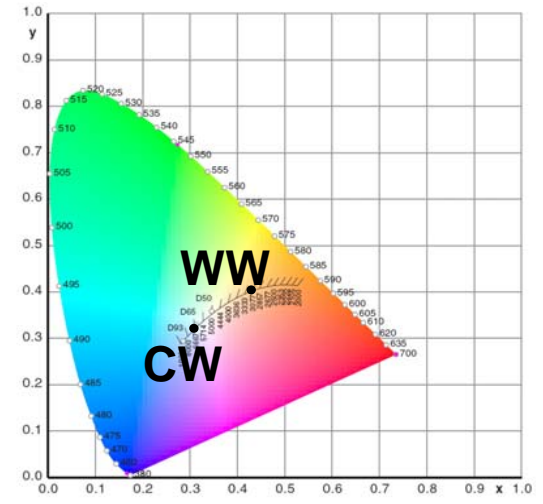
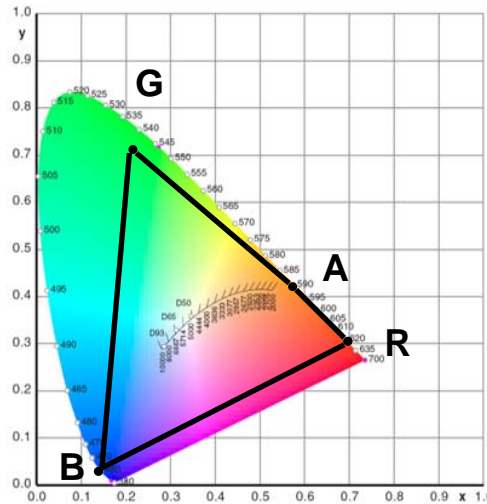
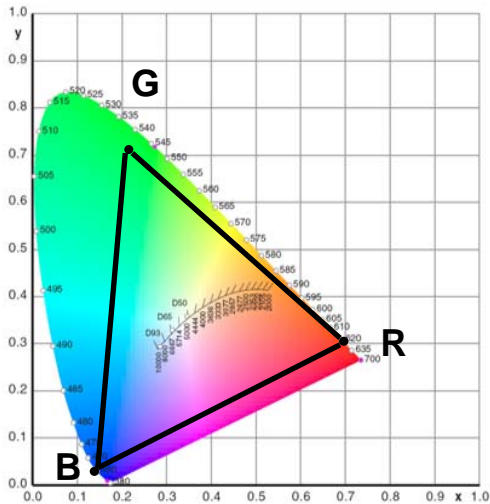


$V(\lambda)$  ... photopic vision (cones)  
 $V'(\lambda)$  ... skotopic vision (rods)  
 $S(\lambda)$  ... depression of Melatonin

source: MA39 Wien

- ▶ 3E – Requirements of a LED light source
- ▶ **Existing LED-solutions for variable (white) light**
- ▶ PI-LED® Technology
- ▶ Applicability of PI-LED® Technology

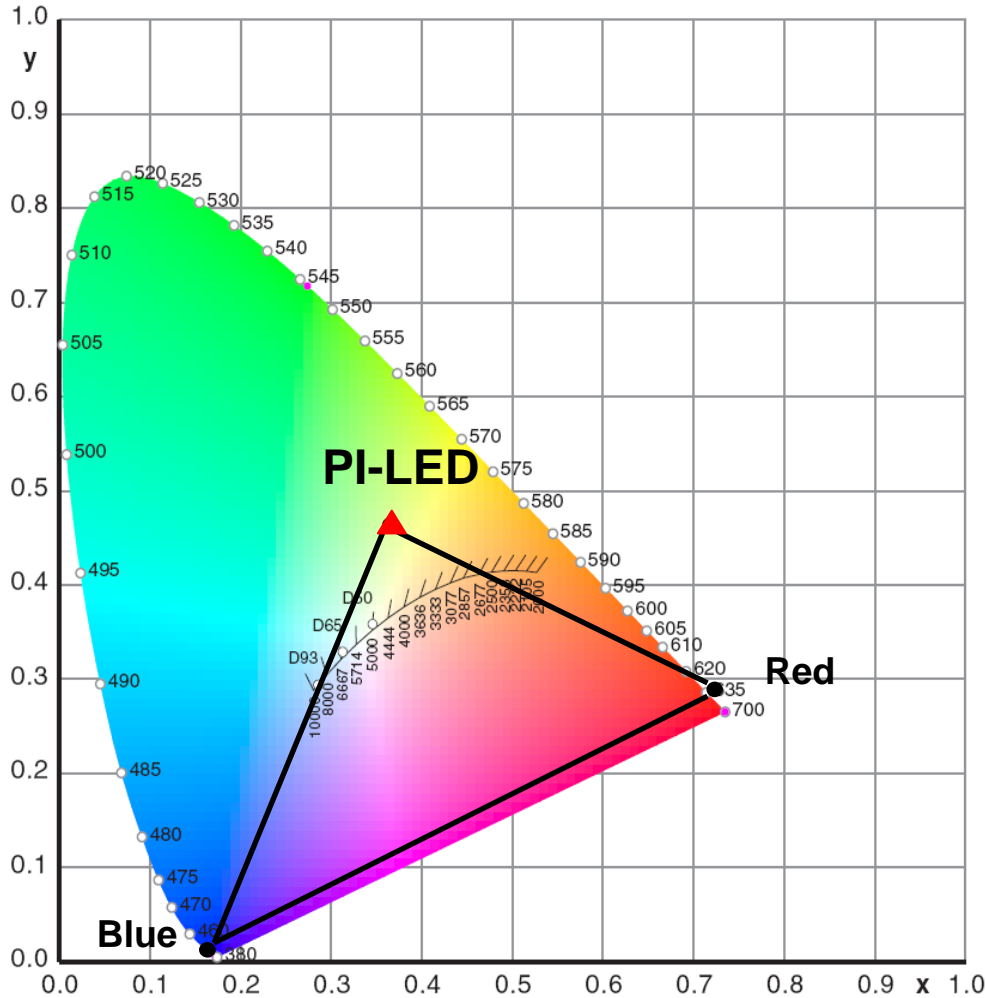
# Existing LED-solutions for variable (white) light



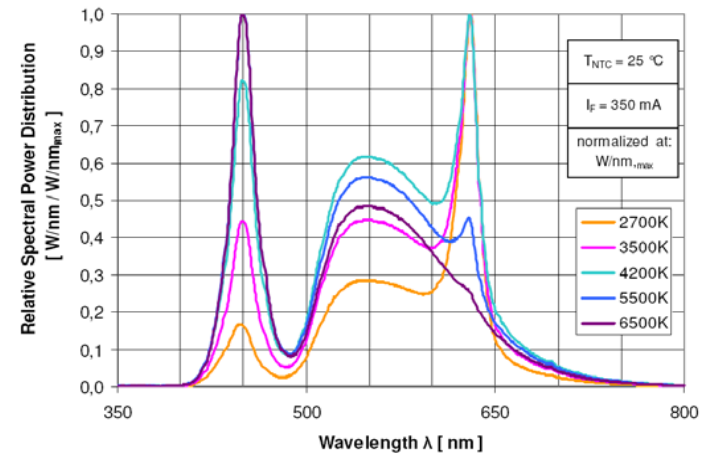
- R red
- G green
- B blue
- A amber
- WW warm white (3200K)
- CW cool white (6500K)



- ▶ 3E – Requirements of a LED light source
- ▶ Existing LED-solutions for variable (white) light
- ▶ **PI-LED® Technology**
- ▶ Applicability of PI-LED® Technology



▲ Maximal efficacy of Phosphor (PI = Phosphor Innovation)



LED combination	CRI			CRI	Efficiency	Complexity
	3000K	4000K	6500K			
Colour converted	70 – 90	70 –80	70-80	N	N	L
RGB	35	45	50	L	H	N
RGBA	85	80	80	H	H	H
6500K+RGB	60	90	91	N	N	H
3000K + GB	95	90	90	H	L	N
<b>PI-LED</b>	<b>92</b>	<b>95</b>	<b>92</b>	<b>H</b>	<b>H</b>	<b>N</b>

L ... Low  
 N ... Neutral  
 H ... High



Light Source	CRI	Efficiency
Incandescent Lamp	100	10-15 lm/W
Low Voltage Halogen Lamp	100	15-25 lm/W
Compact Fluorescent Lamp	>80	50-70 lm/W
Fluorescent Lamp Standard	>80	80-90 lm/W
Fluorescent Lamp De Luxe	>90	60-65 lm/W
<b>PI-LED</b>	<b>&gt;90</b>	<b>90 lm /W</b> ↑



- ▶ **High luminous efficacy**
- ▶ **High Colour Rendering Index**
- ▶ **Low Colour tolerances colour**
- ▶ **Low luminous flux tolerances**
- ▶ **Flexibility in application usage**
  - ▶ Tuneable light colours
  - ▶ Project specific colour settings
  - ▶ Dimmability by DALI or DMX
- ▶ **No damaging UV- or IR-radiation**

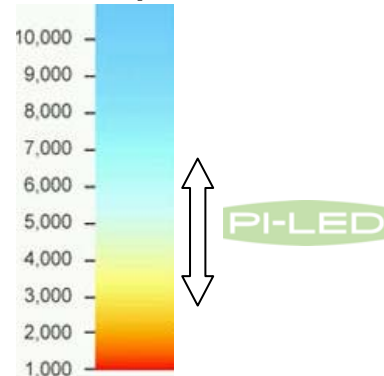
**90 lm/W @2700K**

**CRI > 90**

**Mac Adams 3**

**< 5%**

**Colour Temperature**



source: www.graf-it.de



source: Osram

## PI-LED® Technology for museums

- ▶ „Control of damage to museum objects by optical radiation“ (CIE 157:2004)
- ▶ High Colour Rendering: CRI > 90
- ▶ Continuous control of illumination
- ▶ High efficiency
- ▶ Cost reduction in air conditioning
- ▶ Reduction of maintenance costs



source: www.licht.de

## PI-LED® Technology for shops

- ▶ No damaging UV- or IR-radiation
- ▶ High Colour Rendering: CRI > 90
- ▶ Continuous control of illumination
- ▶ Influence on buying behaviour due to variable colour temperature
- ▶ High efficiency
- ▶ Cost reduction in air conditioning
- ▶ Reduction of maintenance cost



source: www.licht.de

## PI-LED® Technology for offices

- ▶ High Colour Rendering: CRI > 90
- ▶ Continuous control of light colour
- ▶ Continuous control of illumination
- ▶ Increase in vigilance, physical comfort and creativity
- ▶  $a_{cv}$  – circadian factor variable
- ▶ High efficiency
- ▶ Reduction of energy costs
- ▶ Reduction of maintenance costs



## PI-LED® Technology for health-care and wellness

- ▶ High Colour Rendering: CRI > 90, EN 12646
- ▶ Continuous control of light colour
- ▶ Increase in physical comfort
- ▶ Encourages recuperation
- ▶  $a_{cv}$  – circadian factor variable
- ▶ High efficiency
- ▶ Reduction of energy costs
- ▶ Reduction of maintenance costs



## PI-LED® Technology for street lighting

- ▶ **Continuous control of illumination**
- ▶ **S/P-Ratio between 1,4–2,3**
- ▶ **„Mesopic Optimisation of Visual Efficiency“ (MOVE, EU)**
  
- ▶ High lifetime
- ▶ Reduction of maintenance costs



source: [www.licht.de](http://www.licht.de)

## PI-LED® Technology for standard light sources

- ▶ **High Colour Rendering: CRI > 90**
- ▶ **Highest efficiency at warm white light**
- ▶ **High lifetime**





**Thank you for your attention**

Martin Hartmann  
Business Development Manager LED  
Tridonic  
6850 Dornbirn  
Austria