

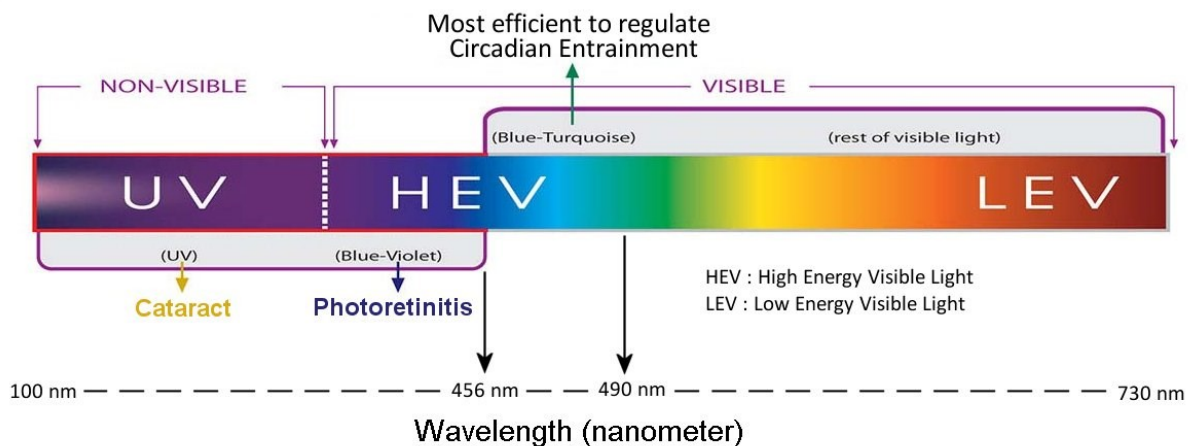
**LiteBlue** LED produces white light by using Gallium Nitride based die of 465 - 470 nanometers wavelength and then excited through a phosphor coating of special formula. The generated blue light is most sensitive in suppressing Melatonin secretion and thus highly efficient to regulate the Circadian Rhythm, when compared with other color light. Blue light can be classified into two categories,



Blue-violet light (415 - 455 nanometers)

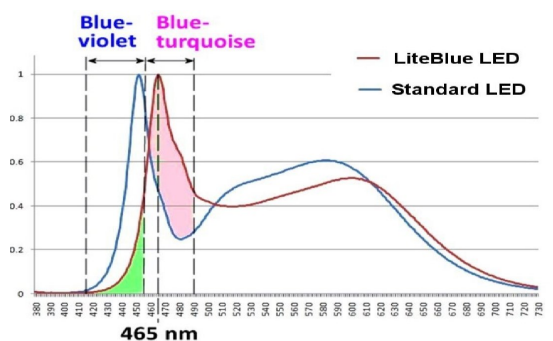
Blue-turquoise light (456 - 490 nanometers)

**LiteBlue** LED emits about 90% of blue-turquoise light within the blue light content, while standard LED of blue pump of 450 nanometers emits about 50% of blue-turquoise light. At the same time, **LiteBlue** LED emits several times less blue-violet light than standard LED.



**LiteBlue** LED offers the following three benefits, as compared with standard LED,

- More efficient to regulate the circadian entrainment during daytime. It also helps cognitive function, elevates moods and synchronizes body-clock.
- Bridging the cyan gap at around 480 nanometer makes the light to be perceived more aesthetically pleasant .



- Less sensitive to Retinal Blue-Light Hazard stated in IEC/EN 62471 (Photobiological safety of lamps and lamp systems) , which is related to the Photoreinitis (i.e. damage to the retina caused by high energy incident light). Also, numerous studies show that blue-turquoise light may be less damaging than blue-violet light, which can bring on Age-related Macular Degeneration and digital eye strain.

### Typical Electro-Optical Characteristics

Part number	Nominal CCT (K)	Min. CRI (%)	Max. Drive Current (mA)	Nominal Forward Voltage (V)	Nominal Flux (lm)	Typical Power (W)	Typical Efficacy at I <sub>f</sub> =60mA (lm/W)
LB2835-50-465	5000	80	60	3.0	26	0.18	150
LB2835-40-465	4000	80	60	3.0	26	0.18	150
LB2835-30-465	3000	80	60	3.0	23	0.18	150

### Spectrum Characteristics

**LiteBlue** LED has higher efficiency to regulate the circadian entrainment, and at the same time, less sensitive to Retinal Blue-Light Hazard and Age-related Macular Degeneration. It is because **LiteBlue** LED emits a highly desired mixture ratio of blue-violet light and blue-turquoise light by 0.1 : 0.9 respectively, while standard LED emits a less desired mixture ratio of blue-violet light and blue-turquoise light by 0.5 : 0.5 respectively.

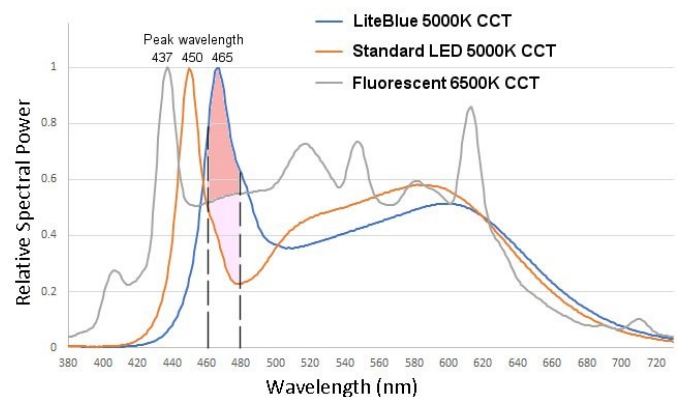
Part number	Color Temperature	Blue Light Content <sup>1</sup>	Blue-Violet <sup>2</sup>	Blue-Turquoise <sup>3</sup>	Ratio <sup>4</sup>
LB2835-50-465	5000K CCT	27%	14%	86%	0.1 : 0.9
LB2835-40-465	4000K CCT	21%	13%	87%	0.1 : 0.9
LB2835-30-465	3000K CCT	13%	8%	92%	0.1 : 0.9

- Note: 1. Blue Light Content is the percentage of blue light out of total spectral power of visible light spectrum  
 2. Percentage of Blue-violet Light within the Blue Light Content  
 3. Percentage of Blue-turquoise Light within the Blue Light Content  
 4. Mixture ratio of blue-violet light and blue-turquoise light within the Blue Light Content

### High Potency Blue Wavelengths

Many studies show that the light between 460 - 480 nanometers is most effective in regulating the circadian entrainment by suppressing the Pineal Gland to secrete Melatonin. These wavelengths are referred as High Potency Blue Wavelengths.

**LiteBlue** LED emits more power within the High Potency Blue Wavelengths than cool-white standard LED of 5000K CCT and daylight fluorescent of 6500K CCT by 1-1/2 and 1/2 times respectively. Higher power in this wavelength range can increase cognitive performance and alertness during daytime.



### Circadian Entrainment

Blue-enriched sunlight plays the most significant part in regulating the Circadian Rhythm of human body. Eye exposure to sunlight during the day is healthful, because it helps cognitive function, elevates moods and synchronizes body-clock. Nowadays, people are spending more and more time indoors during daytime, and thus the eye’s exposure time to sunlight is reduced. Lack of sunlight exposure can lead to disruption of natural sleep-wake cycles, which may be linked to depression, diabetes, cardiovascular disease and obesity.

By emitting abundant amount of energy in the High Potency Blue Wavelengths, **LiteBlue** LED has higher Melanopic Ratio and Circadian Stimulus than standard LED.

Part number	Color Temperature	Equivalent Melanopic Lux (EML)			Circadian Stimulus (CS)		
		Melanopic Ratio (MR)			Circadian Light (CLa) at Ev = 400 Lux		
	CCT	LiteBlue LED	Standard LED	Increase	LiteBlue LED	Standard LED	Increase
LB2835-50-465	5000K	1.027	0.816	+26%	472	409	+15%
LB2835-40-465	4000K	0.837	0.675	+24%	305	270	+13%
LB2835-30-465	3000K	0.647	0.514	+26%	475	386	+23%

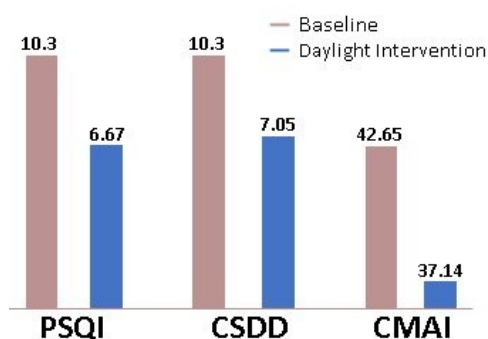
Note: Ev = Vertical illuminance measured at the eyes

### Tailored Lighting Intervention for Seniors

The all-day lighting schedule of Tailored Lighting Intervention for seniors home is recommended as follows:

- 1) Daytime— High Circadian Stimulus (CS) of 0.4, or 400/600 Lux of **LiteBlue** LED 5000K/4000K respectively;
- 2) Evening/Nighttime — Low Circadian Stimulus (CS) of < 0.1, or < 60 Lux of **LiteBlue** LED 3000K;
- 3) Bedtime — Dark or dim light.

Note: CS metrics is covered by UL RP 24480, Design Guideline for Promoting Circadian Entrainment with Light for Day-Active People



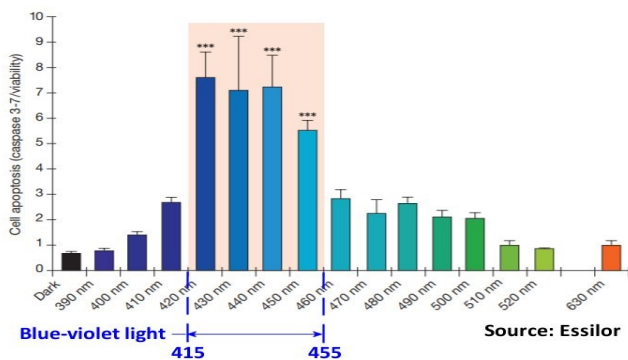
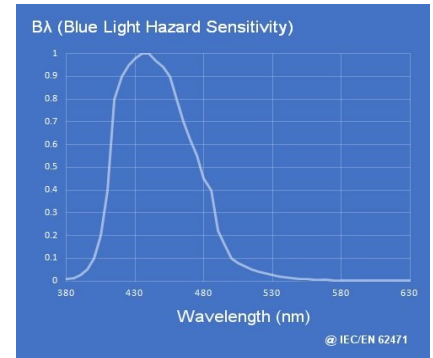
A study of Tailored Lighting Intervention was carried out on patients with Alzheimer's Disease in long-term care facilities. This study shows that the *Daytime Lighting schedule* of CS=0.4 improves all three scores of Pittsburgh Sleep Quality Index (PSQI), Cornell Scale for Depression in Dementia (CSDD), and Cohen-Mansfield Agitation Inventory (CMAI). By emitting more blue-turquoise light, **LiteBlue** LED helps provide CS of 0.4 with less eye irritation and more visual comfort.

Note: Figueiro M.G. et al. Effects of a Tailored Lighting Intervention on Sleep Quality, Rest–Activity, Mood, and Behavior in Older Adults With Alzheimer Disease and Related Dementias: A Randomized Clinical Trial

### Ocular Health

Blue light can cause Photoreinitis on eyes due to excessive exposure, and it may also increase the risk of Age-related Macular Degeneration.

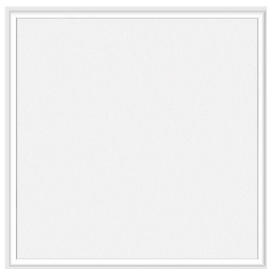
Photoreinitis is a photochemical retinal hazard causing damage to the retina by high energy incident light. The peak wavelength of Retinal Blue-Light Hazard is at 435 - 440 nanometers, and its details are illustrated in IEC/EN 62471 (Photobiological safety of lamps and lamp systems). Excessive exposure of blue-violet light to eyes may have higher risk of Retinal Blue-Light hazard, especially children and seniors are more susceptible to this kind of hazard.



*Note: Arnault et al. 2013 Phototoxic action spectrum on a retinal pigment epithelium model of age-related macular degeneration exposed to sunlight normalized conditions*

Age-related Macular Degeneration may be accelerated by the blue-violet light. A study shows that blue-violet light may increase the Retinal Pigment Epithelium (RPE) cell death rate by about two times more than blue-turquoise light.

**LiteBlue** LED emits only about 10% of blue-violet light within the blue light content, thus significantly lowering the risk of Retinal Blue-Light Hazard and Age-related Macular Degeneration. At the same time, the emitted blue-turquoise light occupying the remaining 90% of the blue content is highly efficient to regulate the circadian entrainment.



Panel



Linear



Flexible Strip



Desk Lamp

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