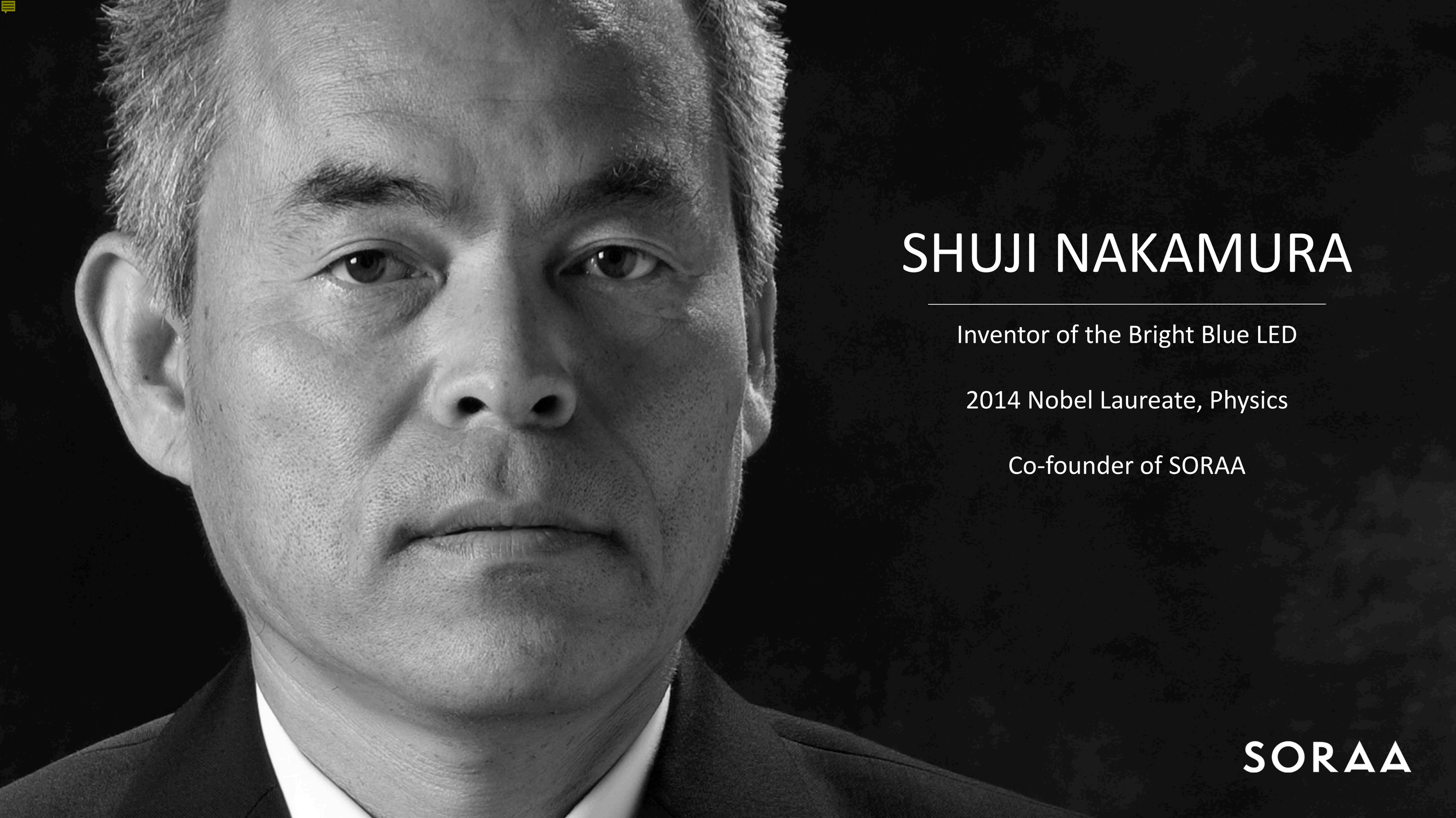
‘Simply Perfect Light’

SORAA®


SHUJI NAKAMURA
Inventor of the Bright Blue LED
2014 Nobel Laureate, Physics
Co-founder of SORAA
SORAA

FULFILLING THE PROMISE OF LED LIGHTING

1962 — First (Red) LED Created

1993 — Bright Blue LED Breakthrough

2006 — GaN on GaN LEDs Invented

2008 — SORAA Founded

2012 — SORAA Launch First GaN on GaN LED Lamp

2014 — SORAA Directional Lamp Portfolio Expands

2015 — Optical Light Engines Released

2016 — First GaN on GaN Ambient Fixtures

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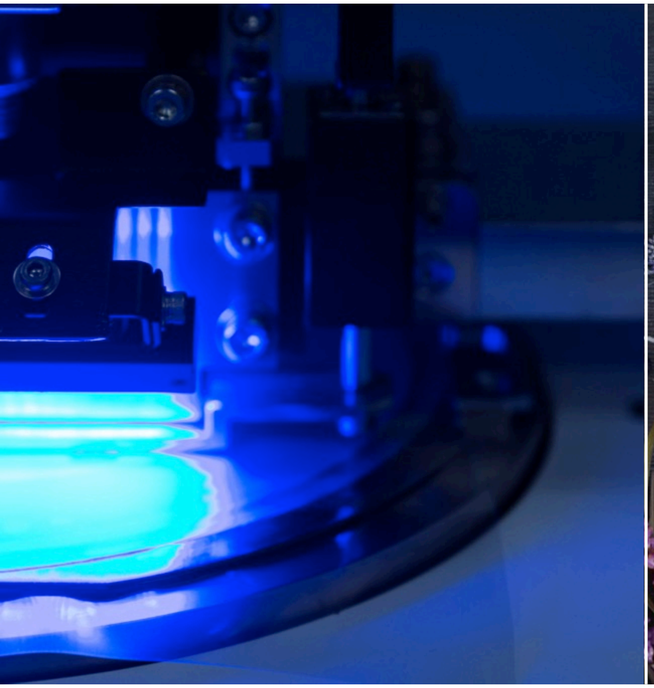
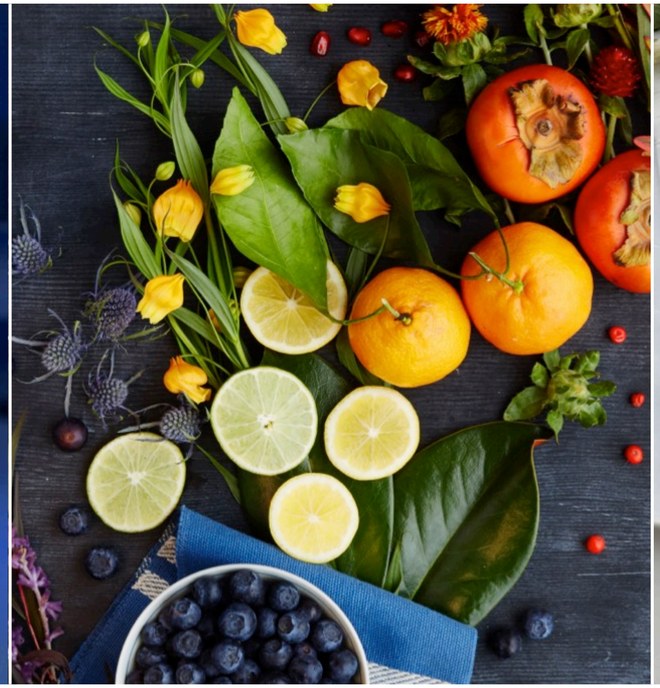
THE RECIPE FOR SIMPLY PERFECT LIGHT



GaN on GaN™



Soraa VIVID Colour™

Soraa Natural White™

Point Source Optics™

SORAA

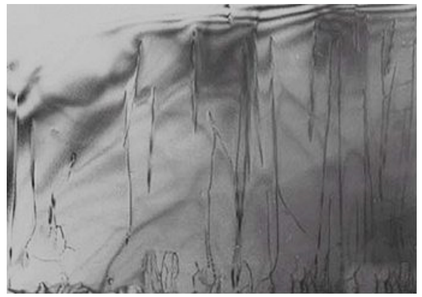
GaN on GaN™

THE FOUNDATION OF PERFECTION

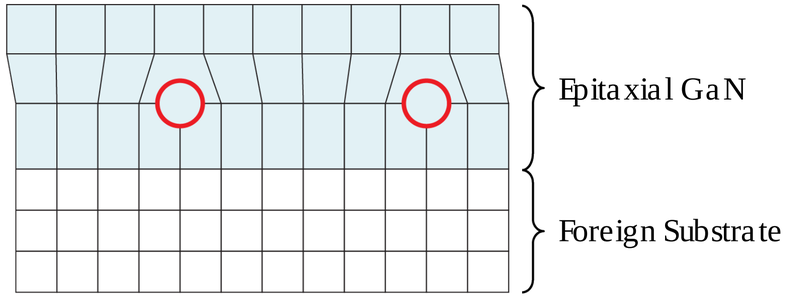
SORAA

PERFECT CRYSTALS

- Conventional crystals generate many defects on foreign substrates

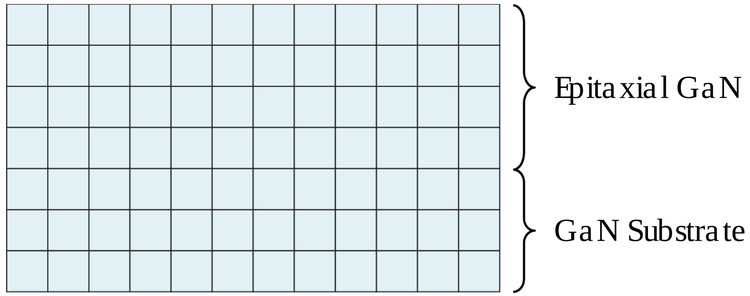


Standard (Sapphire, SiC, Si)

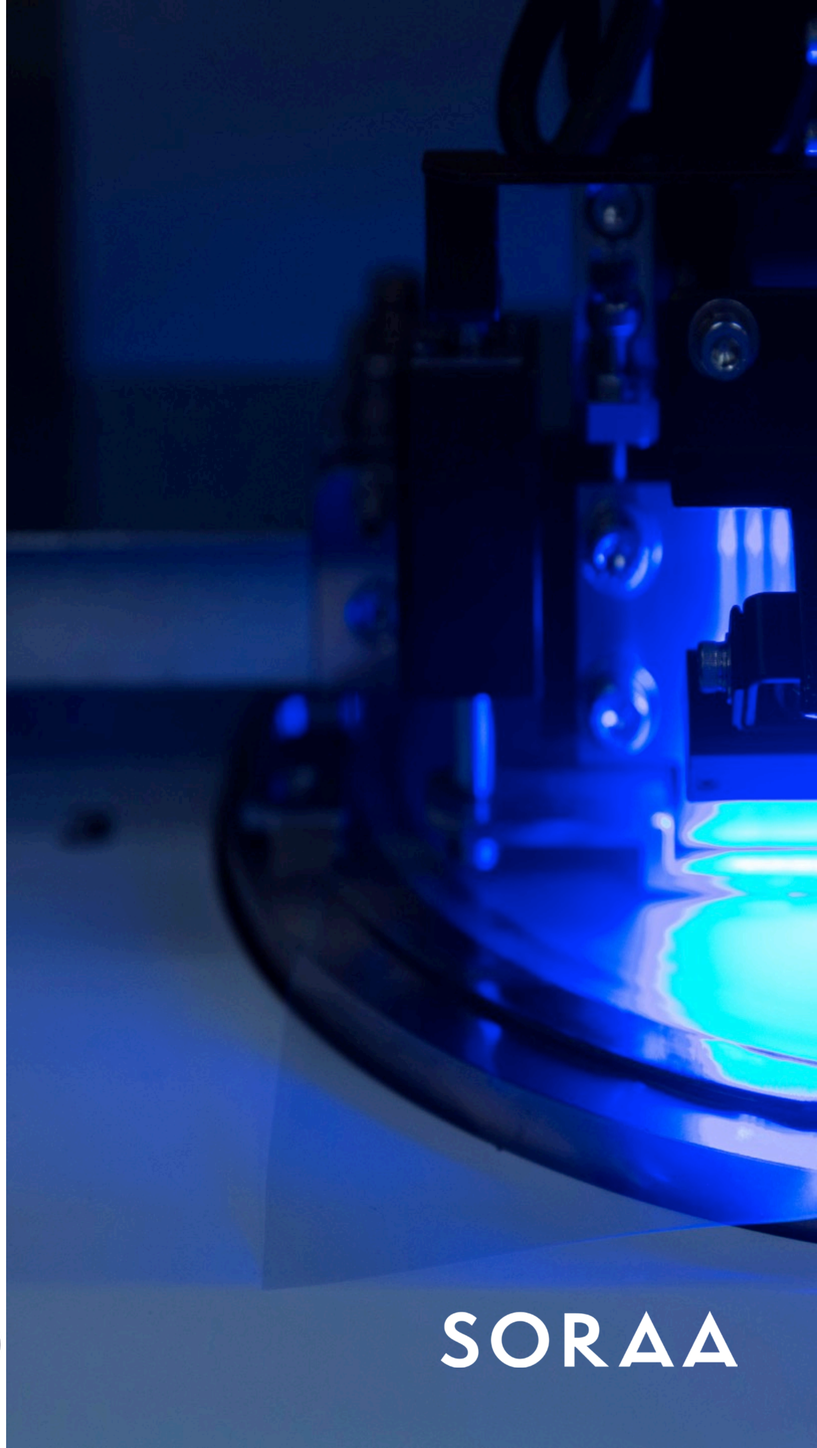


- GaN on GaN™ results in crystal structure with 1000x fewer defects

SORAA GaN on GaN™

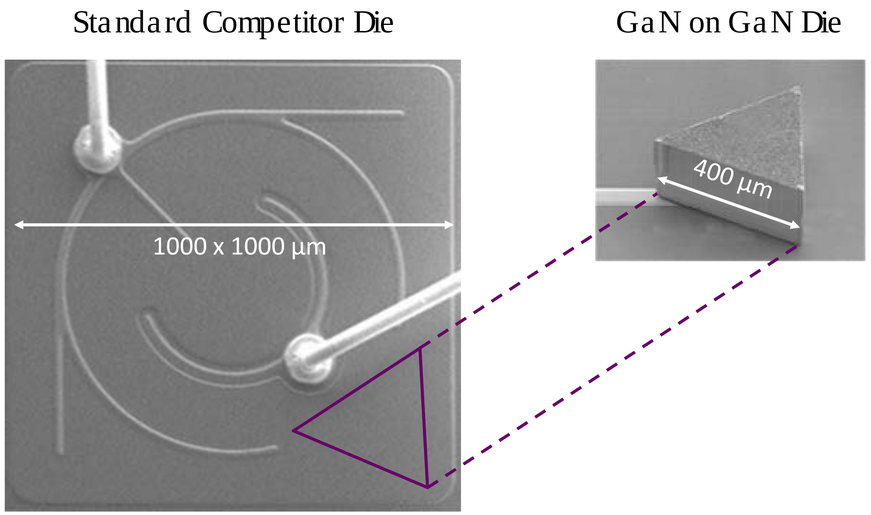


- Recognized by Shuji Nakamura as the next step in LED technology (“LED 2.0”)
- Enables **very efficient, very small violet LEDS**

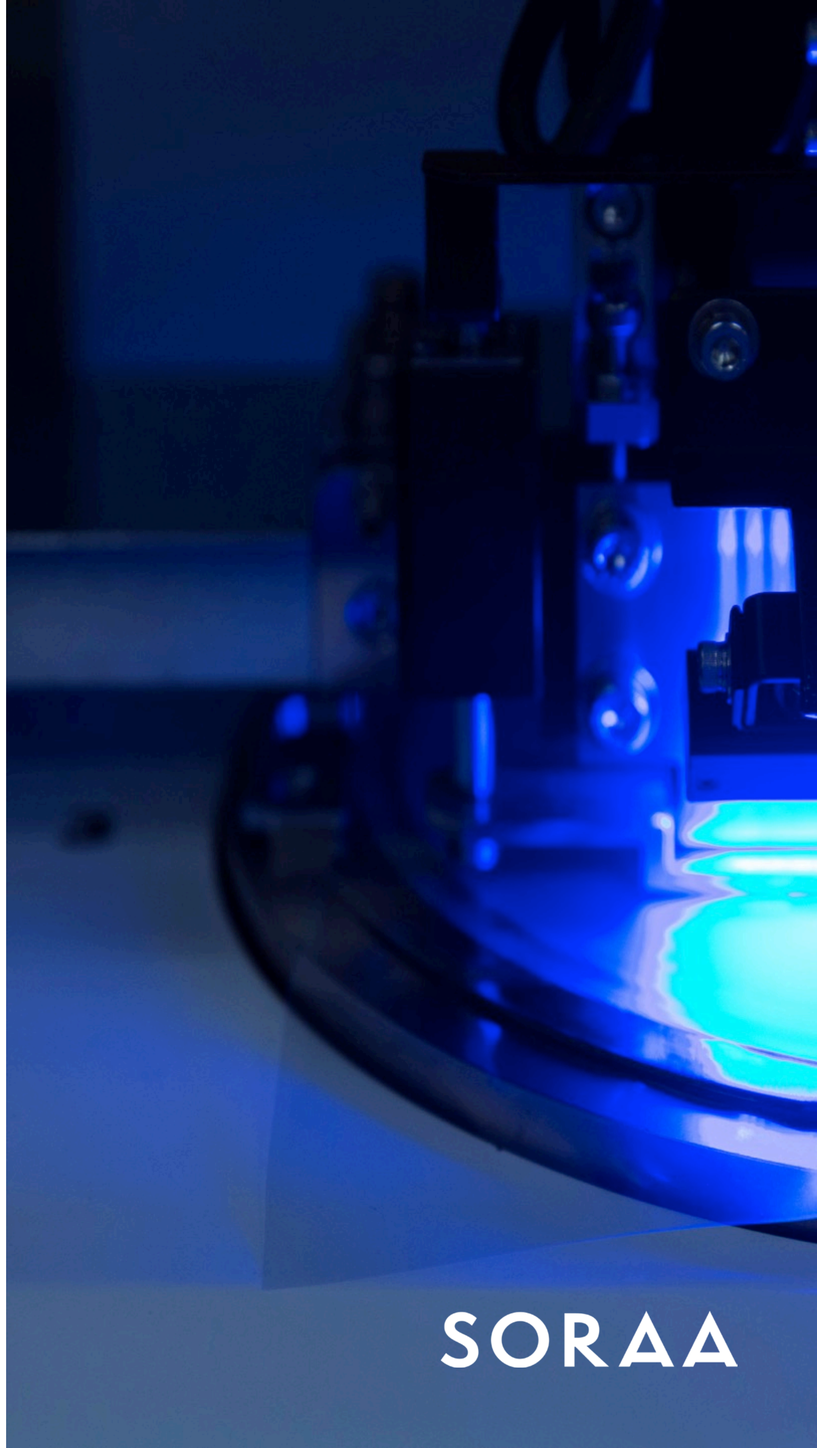


SMALLER DIE SIZE

- GaN on GaN's perfect crystal structure emits 5x more light per unit area than conventional LEDs

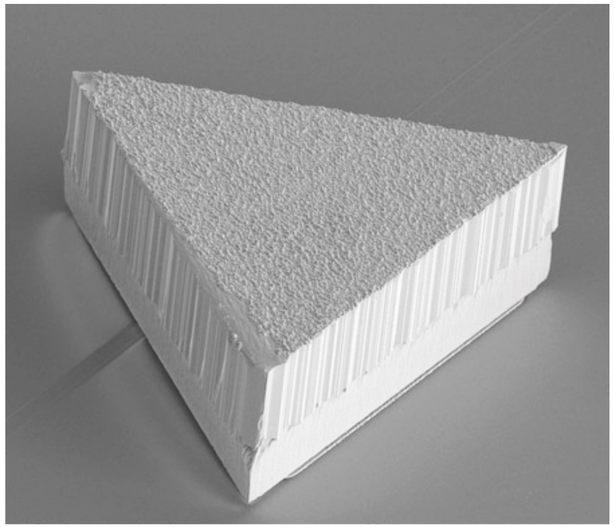


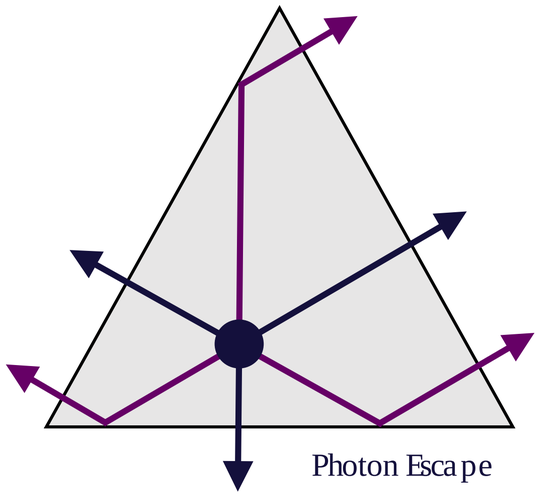
- Efficiency of SORAA's Tri-LED technology means that LEDs can be smaller, reducing costs and enabling a single source solution



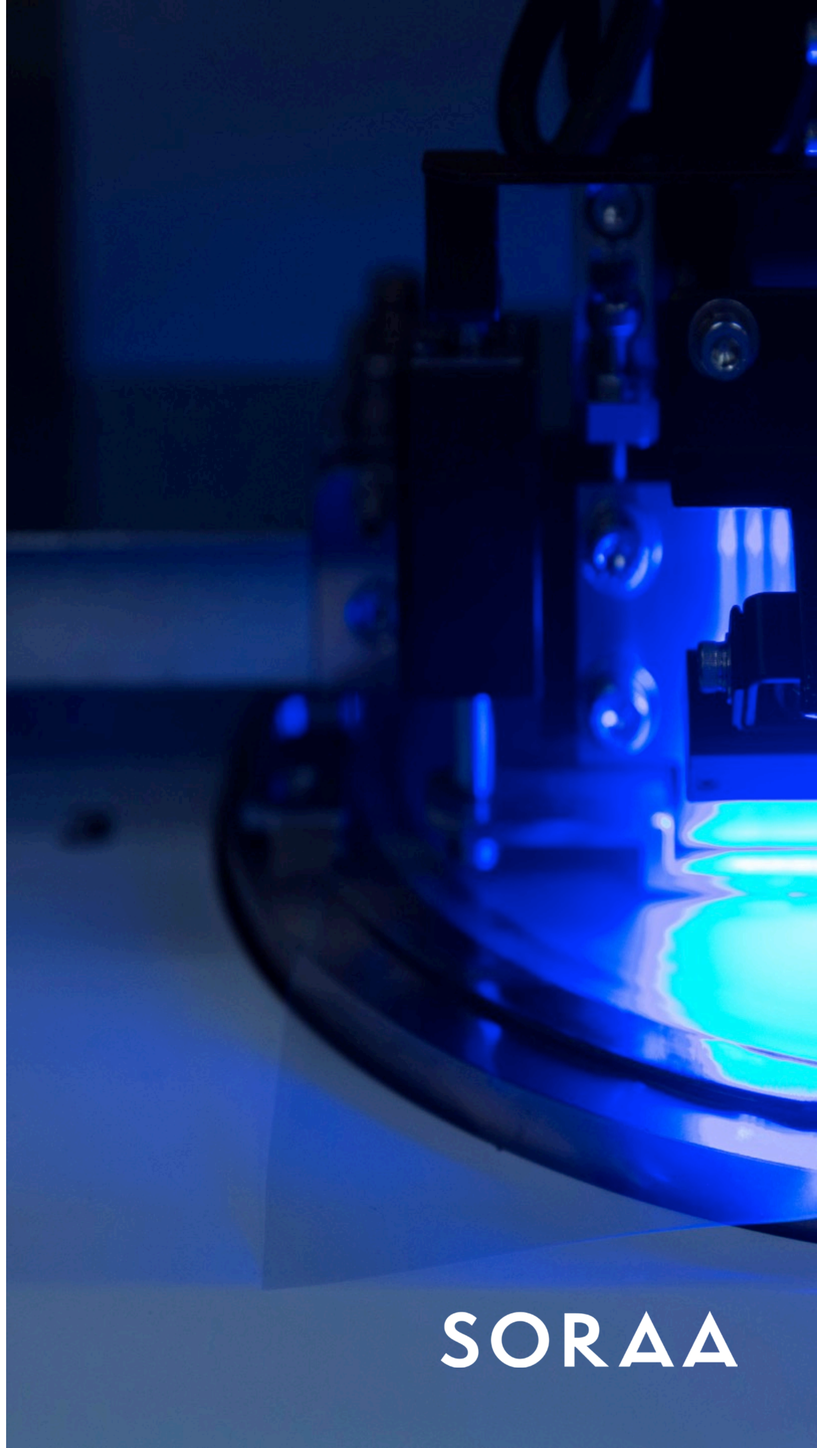
INNOVATIVE CHIP DESIGN

- 1000x few crystal dislocations enables SORAA's innovative triangular LED design, whilst GaN substrate enables volumetric chips



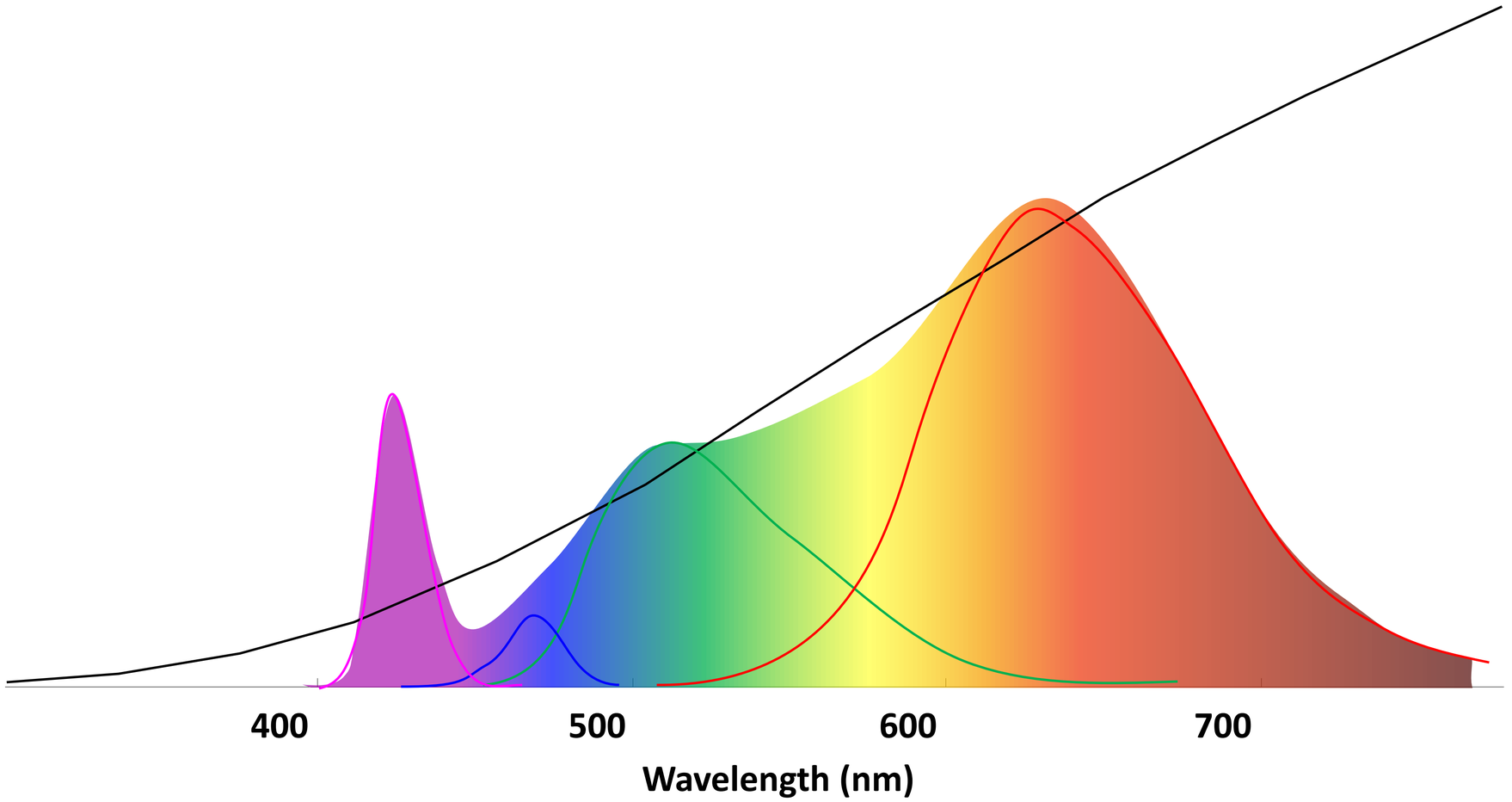


- Tri-lateral ("Tri-LED") configuration allows more light to escape die
- Roughened surface of LED chip further improves light extraction with efficiency beyond the thin-film limit, approaching 90%



SORAA VIVID COLOUR™

LEDs and spectrum

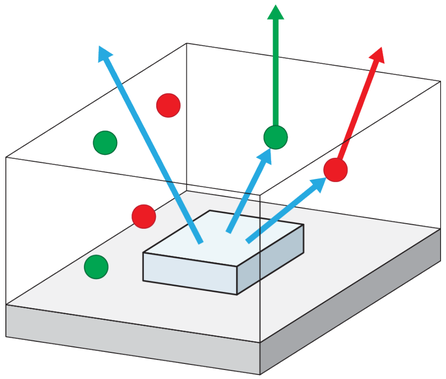


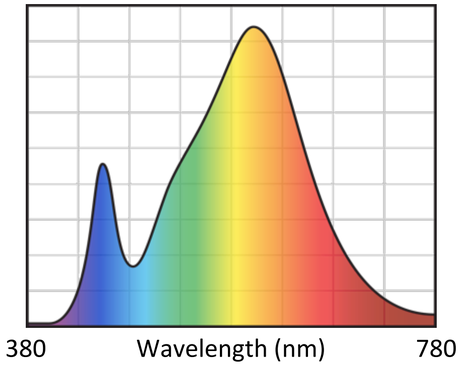
We generate a white spectrum by combining

- a pump LED (violet for us)
- several phosphors

VIOLET-EMISSION 3-PHOSPHOR TECHNOLOGY

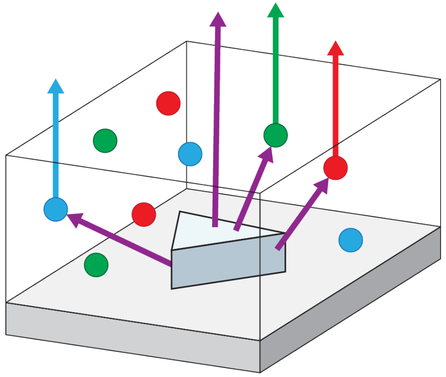
- Standard LEDs emit blue light with red and green phosphors

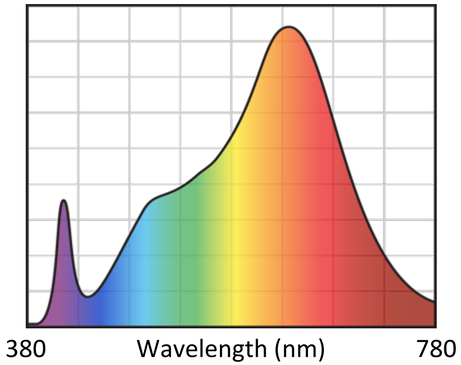




2 phosphor mix produces a “Broken Spectrum”

- SORAA emits violet light with red, green and blue phosphors

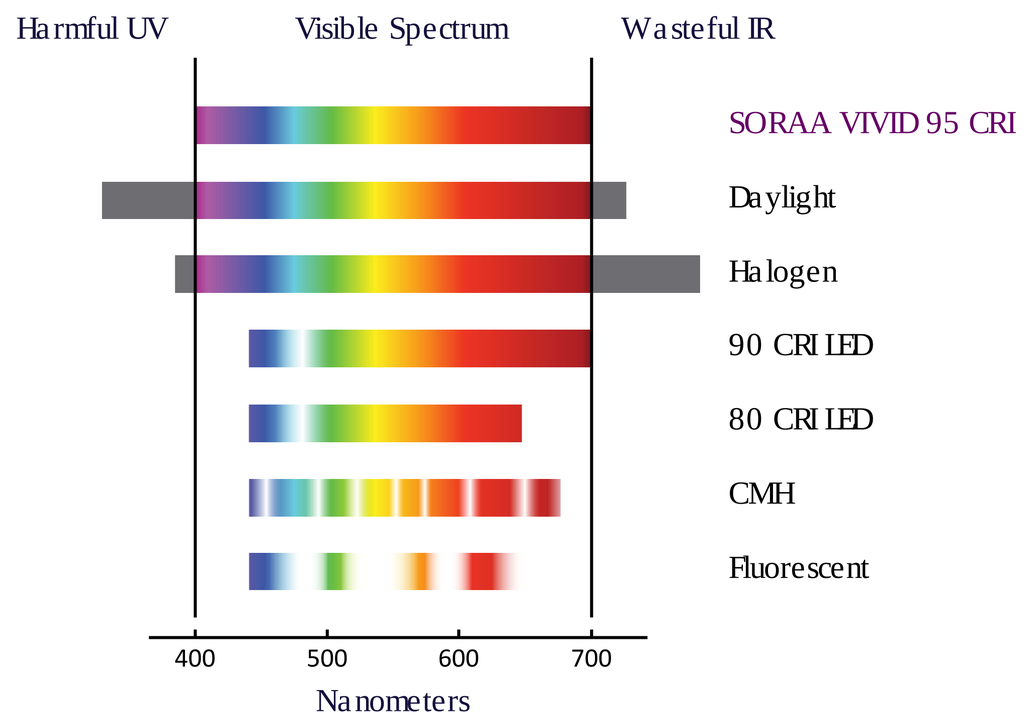




3 phosphor mix produces a “Full Spectrum”

FULL-VISIBLE-SPECTRUM LIGHTING

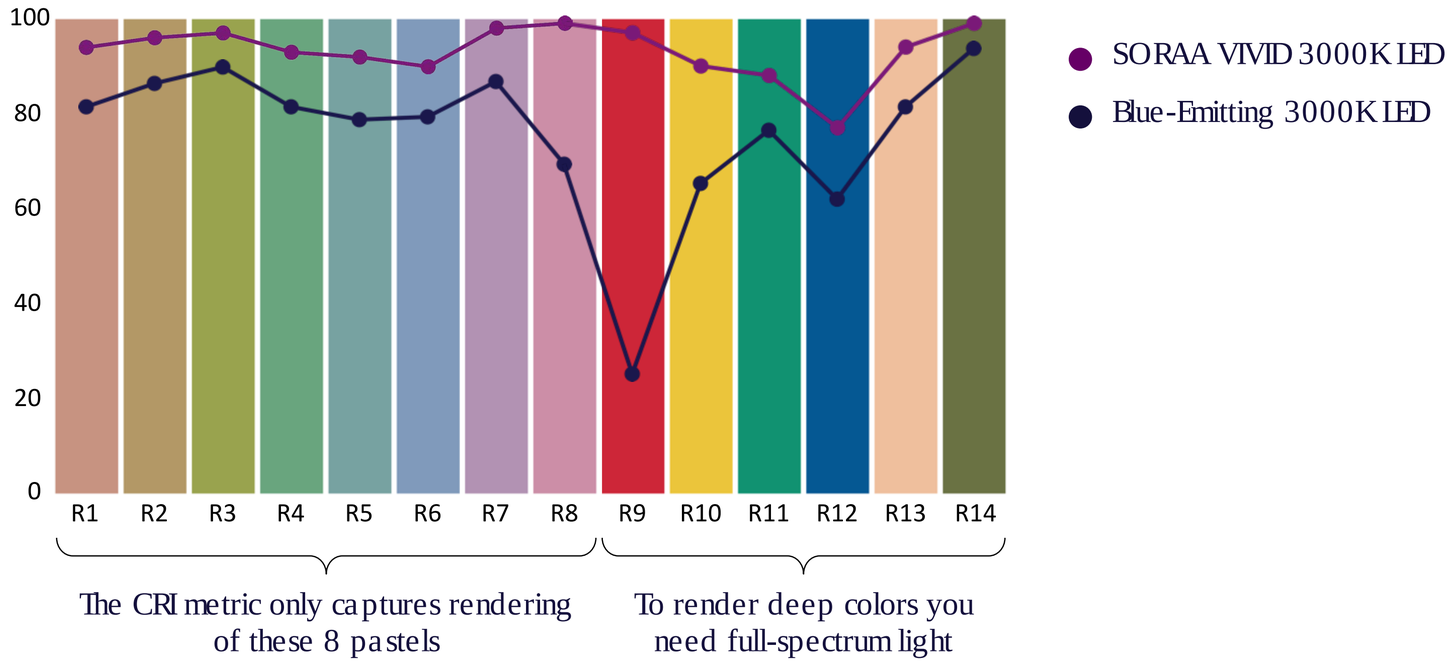
- SORAA's violet-emitting GaN on GaN™ LEDs with a 3-phosphor mix render a complete and continuous spectrum



- Soraa's technology ensures there are no gaps in red or cyan

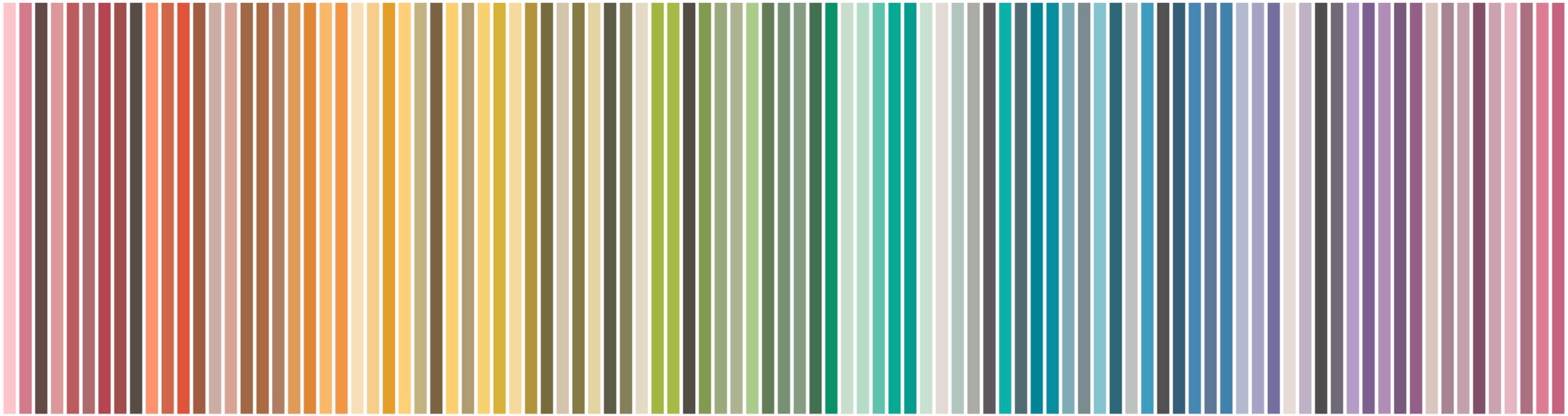
EVERY TONE, SHADE, TINT AND HUE

- SORAA's technology enables excellent colour rendering across all colours



- Every colour looks richer and brighter, including warm tones such as R9

HIGHER ACCURACY, MORE INFORMATION



TM-30 uses 99 colour samples vs CRI's 8

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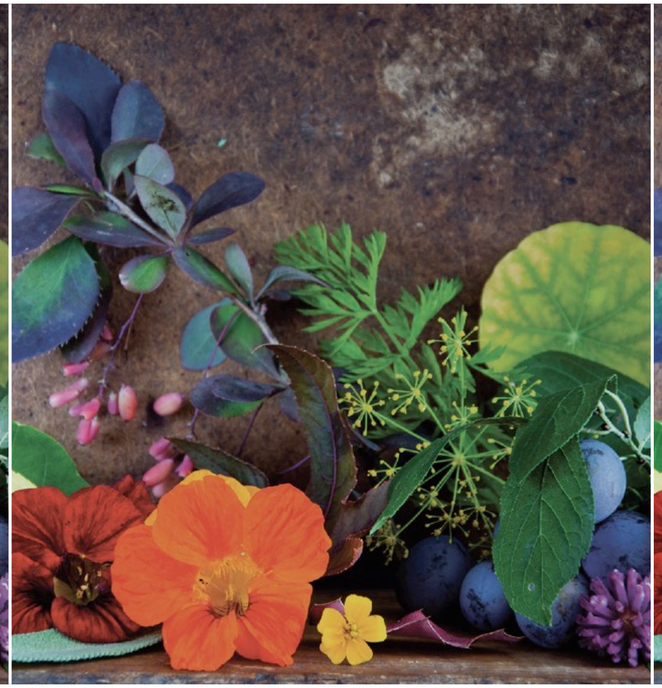
COLOUR METRICS - COLOUR RENDERING INDEX (CRI)

70 CRI



80 CRI

90 CRI

95 CRI

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SEEING RED?

90 CRI | R9 50

90 CRI | R9 95

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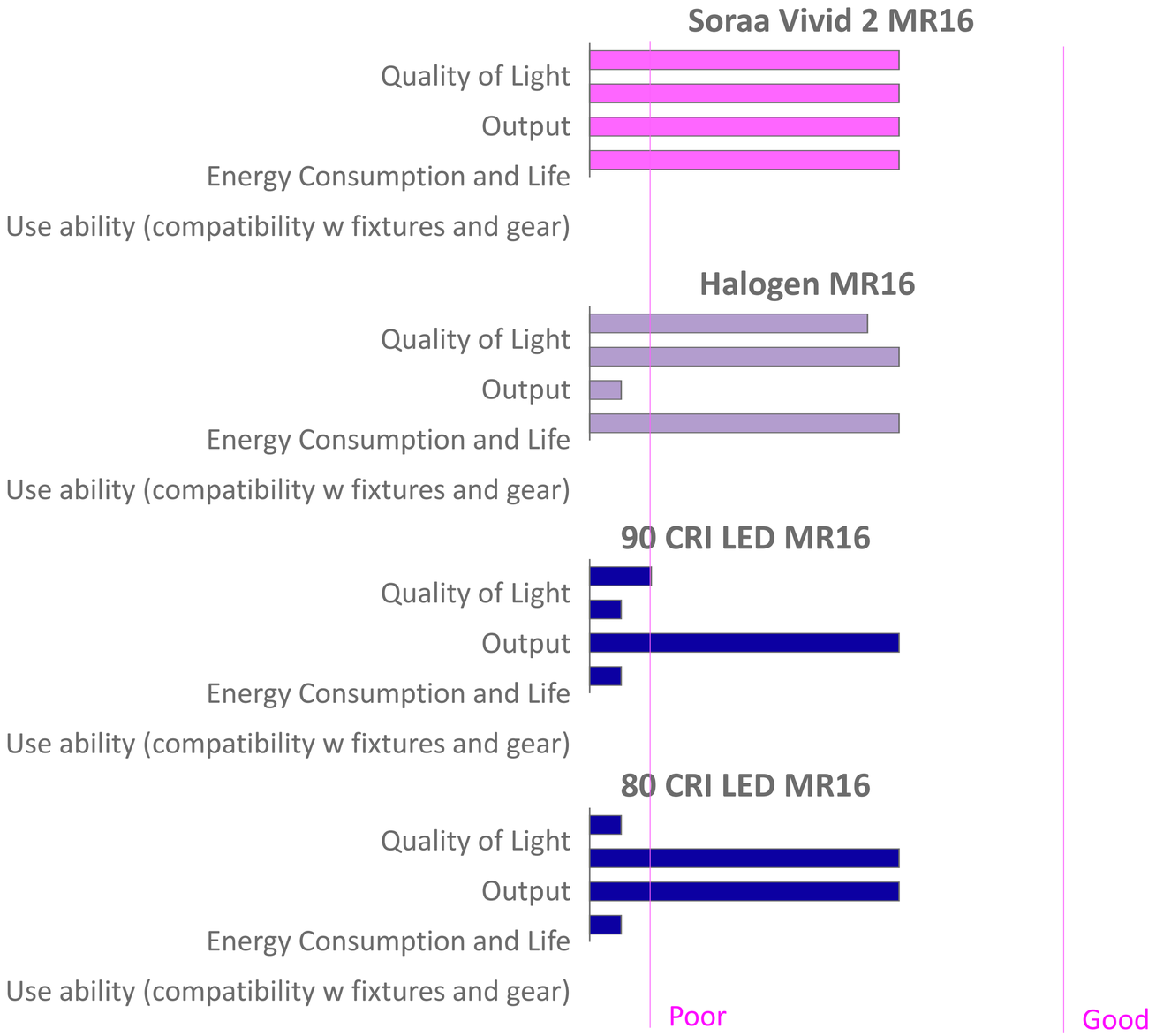
Summary



Soraa Vivid 2 MR16:

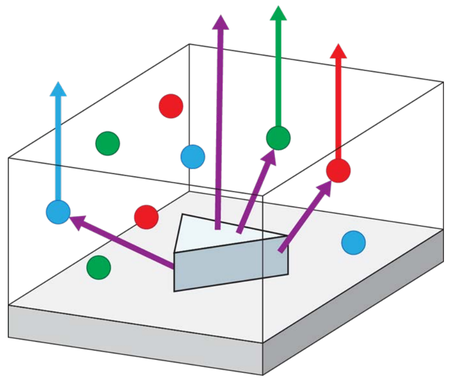
- Outperforms Halogen MR16 on quality of light with no compromise on output and fixture and gear compatibility

Blue Pump LED MR16s:

- Even 90CRI has substantial short comings on Quality of Light
- They pose a trade-off with color rendering and output, but never come up with an offer that matches halogen on both
- LED MR16s are rated for use in open fixtures only and have shortcomings in approbation (UL Class 2 only)

SORAA NATURAL WHITE™

VIOLET NOT BLUE

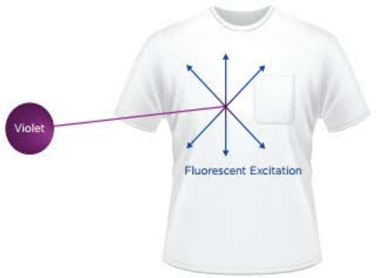


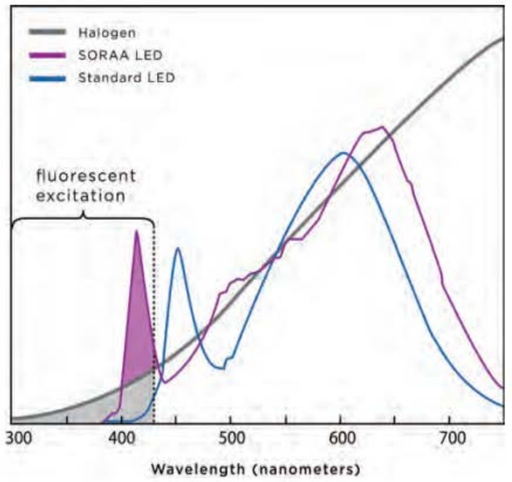
TRUE TO LIFE WHITES

VP_3 NATURAL WHITE™

Many white objects carry fluorescent agents only picked up by violet light. SORAA's LED cover the entire spectrum of colour from violet to red, which reveal whites true to thier indented hue – from warm rich creams to cool bright whites.

This is SORAA VP_3 NATURAL WHITE™—perfectly rendering the infinite range of shades of whites.





Unlike Standard LEDs whose wavelength starts at 430nm, our spectral wavelength begins at 400nm, providing all the fluorescent excitation needed to clearly distinguish between shades of white.

Standard blue-emitting LED

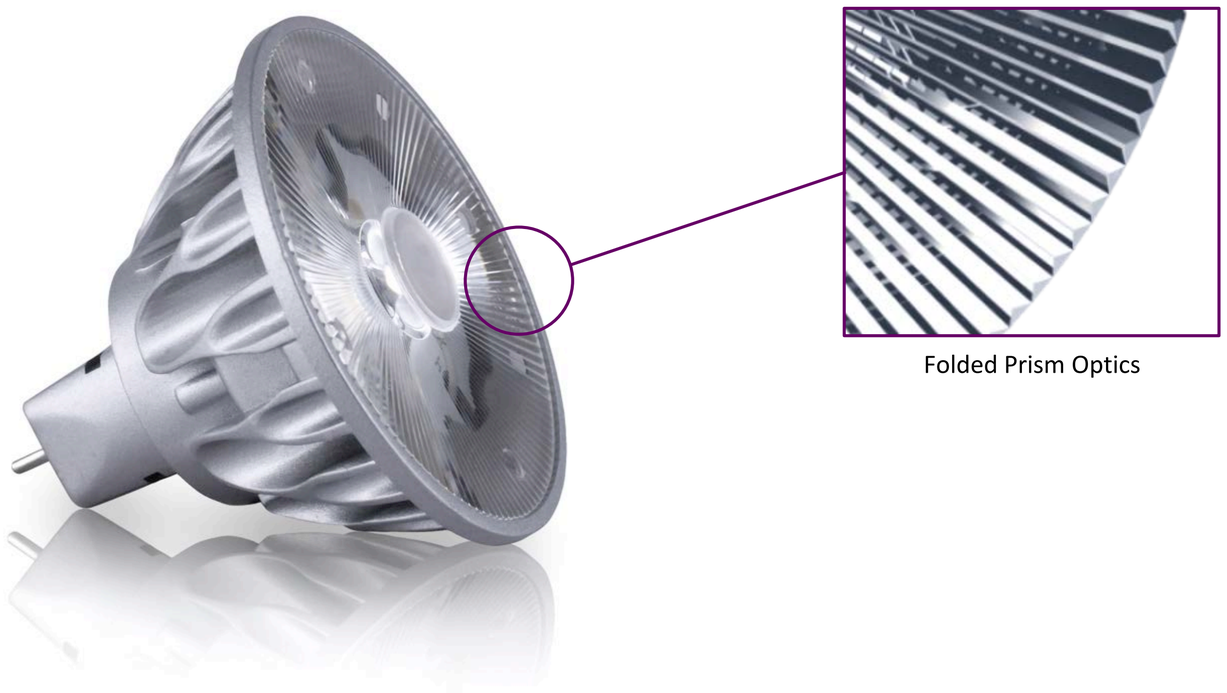
SORAA violet-emitting LED

- SORAA's LEDs reveal the different shades of white around us

SORAA POINT SOURCE OPTICS™

POINT SOURCE OPTICS

- Directional lighting requires well controlled beam angles from narrow to flood; tight form factors; and sharp single shadows

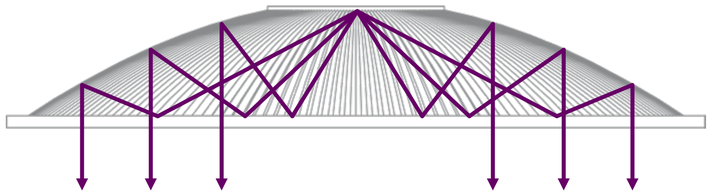


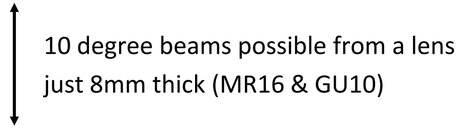
Folded Prism Optics

- SORAA's innovative folded optics enable crisp, focused beams

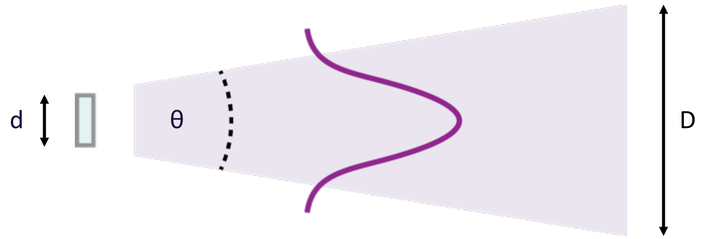
NARROW BEAMS

- SORAA's prismatic optic is a breakthrough in footprint, offering extremely narrow beam distributions from a low-profile design





- Fundamental laws of optics dictate that large sources in small form factors result in wide beam angles



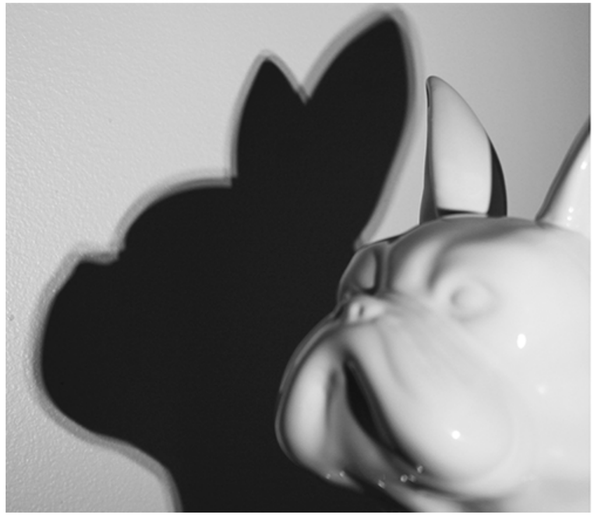
$$d = D \sin(\theta / 2)$$

- The same laws that hinder beam design with large, multiple light sources become an asset with a small single source

CRISP SHADOWS

- SORAA's Point Source Optics provide crisp, single shadows

Multi-Source Competitor LED



Multiple sources create multiple shadows

SORAA Single-Source LED

Single source provides a crisp, single shadow

- Multi-source LEDs project multiple shadows with multiple colours yielding less attractive results

Customise Your Beams

SORAA **SNAP SYSTEM**
LED MR16 ACCESSORIES

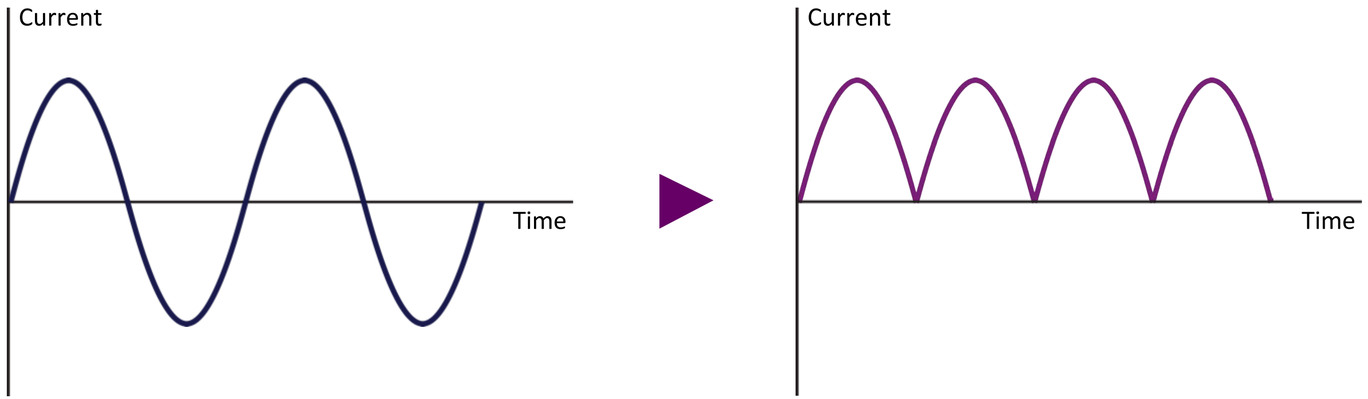
- World's First 10° Single Source LED MR16
- CRI 80 or 95 Full Spectrum Lamp
- Magnetic Self Centering
- Fits All Fixtures
- Multiple Stackable Accessories
- Any Beam Angle
- Ellipse, Color Filters, Louvers
- Dimmable
- Stackable

FREE YOUR IMAGINATION WITH UNLIMITED DESIGN POSSIBILITIES

SORAA FLICKER FREE™ TECHNOLOGY

WHY DOES FLICKER OCCUR?

- Flicker is caused by the ‘ripple’ in AC current which leads to a ‘ripple’ in light output



AC Input to lamp (50-60Hz)

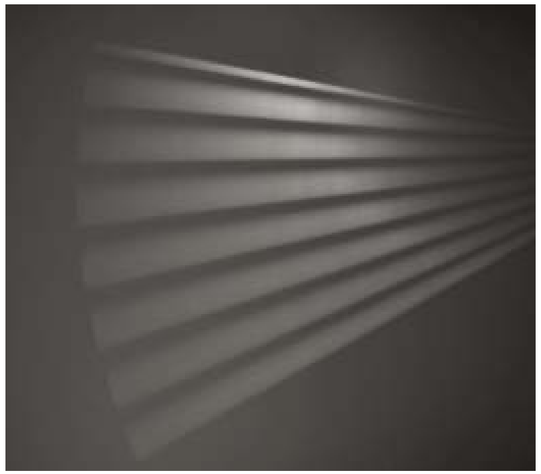
‘Rippled’ DC Input to LED (100-120Hz)

- Unlike in halogen lamps, LEDs powered by AC sources respond almost instantly to changes in current
- Ripple in the light output is undampened, leading to a greater perception of flicker in LEDs

INVISIBLE FLICKER

- Humans are sensitive to ‘invisible flicker’, or ‘stroboscopic effect’, due to variations in light output between 50Hz – 500Hz

Wand Test



Intervals of low light lead to gaps in the fan

Smartphone Test

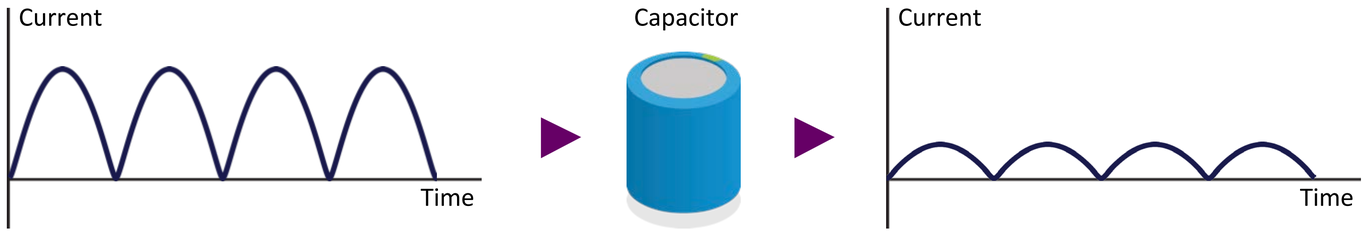
Photographs show bands of light and dark

- Stroboscopic effects have been associated with headaches, eye strain and fatigue

ERADICATING INVISIBLE FLICKER

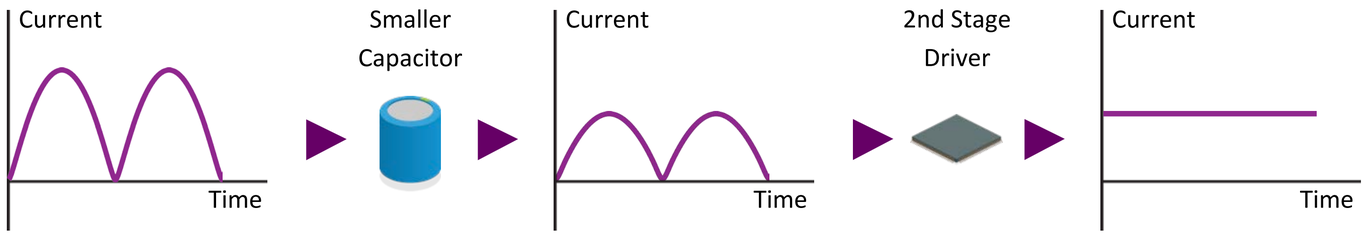
- SORAA developed a two-stage digital driver to eliminate the problem of stroboscopic flicker in our low voltage MR16 lamps

Competitor Single Stage Lamp



Capacitor receives rippled input and delivers reduced ripple to LED

SORAA Two-Stage Flicker Free™ Lamp



Smaller capacitor delivers greater ripple, but 2nd stage eliminates it completely

SORAA FLICKER FREE™

- SORAA's Flicker Free™ low voltage MR16 lamps completely address the adverse physiological effects of invisible flicker

Wand Test

Smooth, unvarying light output leads to no gaps (flicker free)

Smartphone Test

Results in clear photographs with no banding

- Two-stage driver acts as a 'constant flow valve', smoothing the current and delivering flat DC power to the LED

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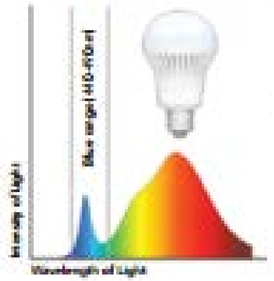
SORAA BLUEFREE LED™ TECHNOLOGY: WHITE LIGHT WITHOUT BLUE

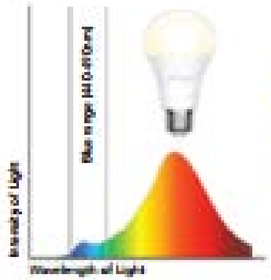
STANDARD LED

large blue peak



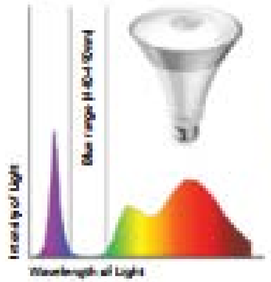
Faded colors and whites

SLEEP LED – reduced blue, unnatural yellow



Unnatural yellow tint

SORAA BLUEFREE LED – soft white light with no blue



Beautiful colors and whites

SORAA






"When it comes to quality of light…




…SORAA outshines the competition."