The Nanosys Quantum Dot Solution for LED Backlighting

Society for Information Display

Bay-Area Chapter

February 16, 2011

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Commercial Strength
Built on Scientific Bedrock

- *Founded in 2001*
- *Based in Palo Alto, CA*
- *Dominant platform of fundamental and applied nanotechnology IP*
  - *Exclusive University Relationships*
  - *Currently 750+ patents & apps*
- *9 Years of industrial development with leading global partners*
- *First year of high-volume shipments*

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Process Innovation

Industrial Revolution

Improving Return on Process Innovation

Industrial Revolution

Materials Revolution

LED Backlit LCD Displays

- Fast becoming the standard in displays from mobile to TV
- Enabling thinner, more energy efficient displays
- Still cannot match the color quality of Cathode Ray Tube or OLED technology
- Alternative wide-gamut technologies are too inefficient and expensive

Nanosys Spectrum Engineering Technology

Introducing QuantumRail™

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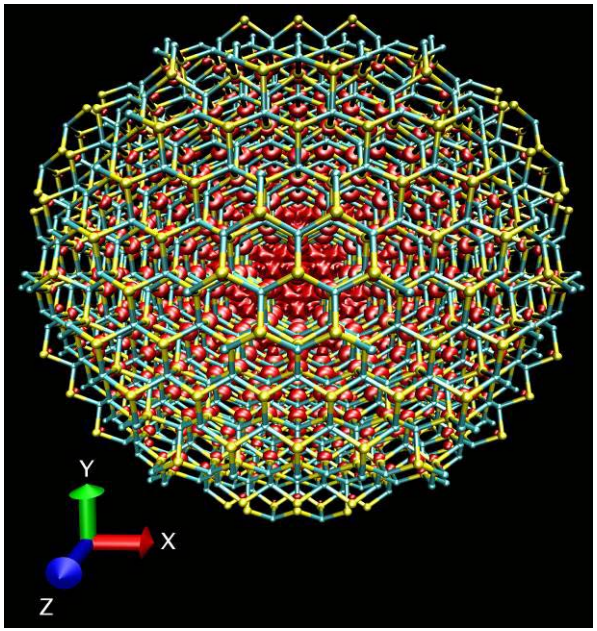
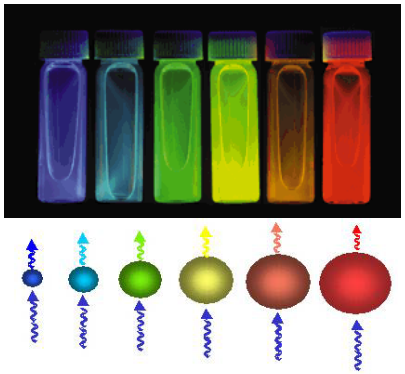
Quantum Dots



What is a Quantum Dot?

- An inorganic highly efficient phosphor crystal grown through standard wet chemical manufacturing processes.
- Governed by their size, QDs have the unique capability to precisely generate a specific wavelength of light.
- They produce pure saturated colors or can be blended to a precisely defined white point



At Nanosys, we call this:

Spectrum Engineering

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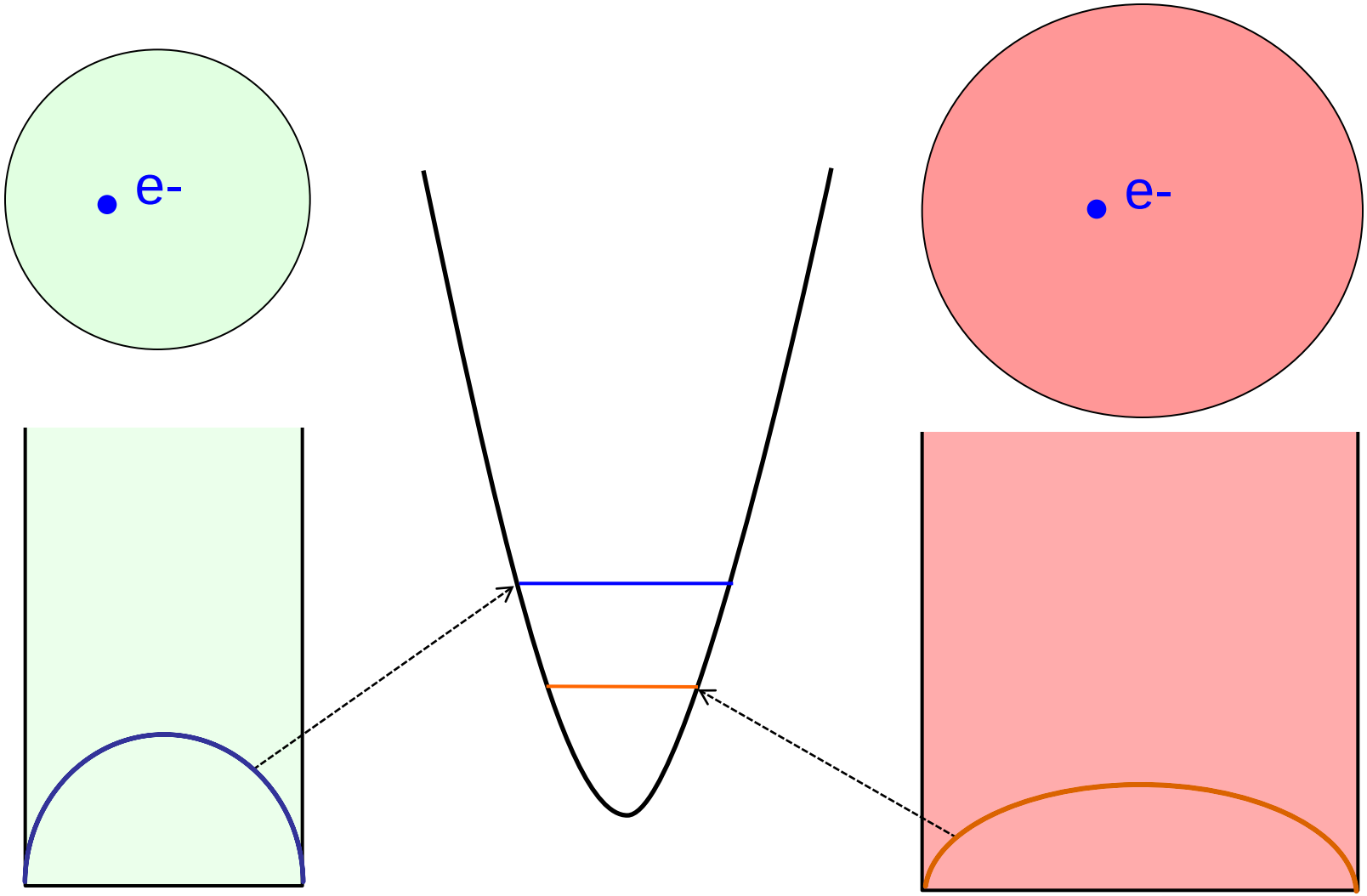
Quantum Confinement

Small Quantum Dot

Big Quantum Dot



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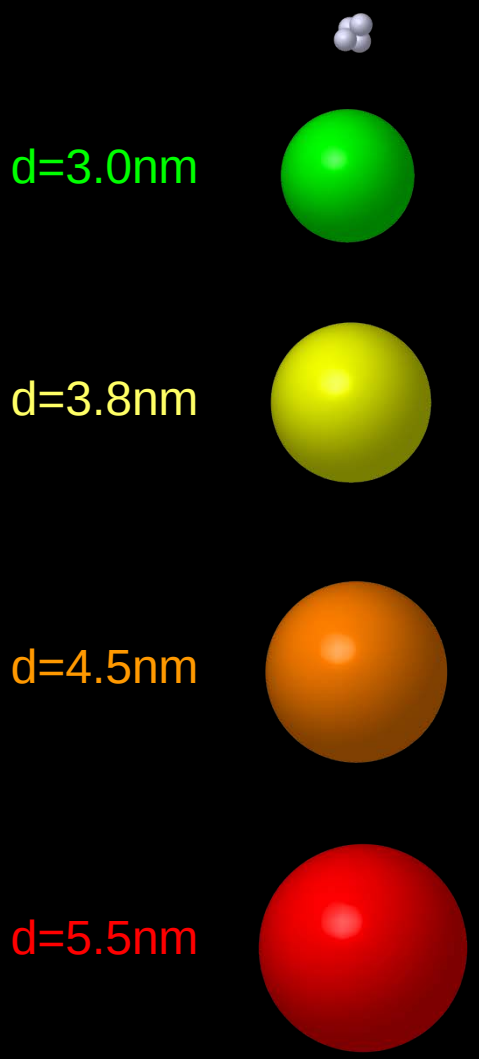
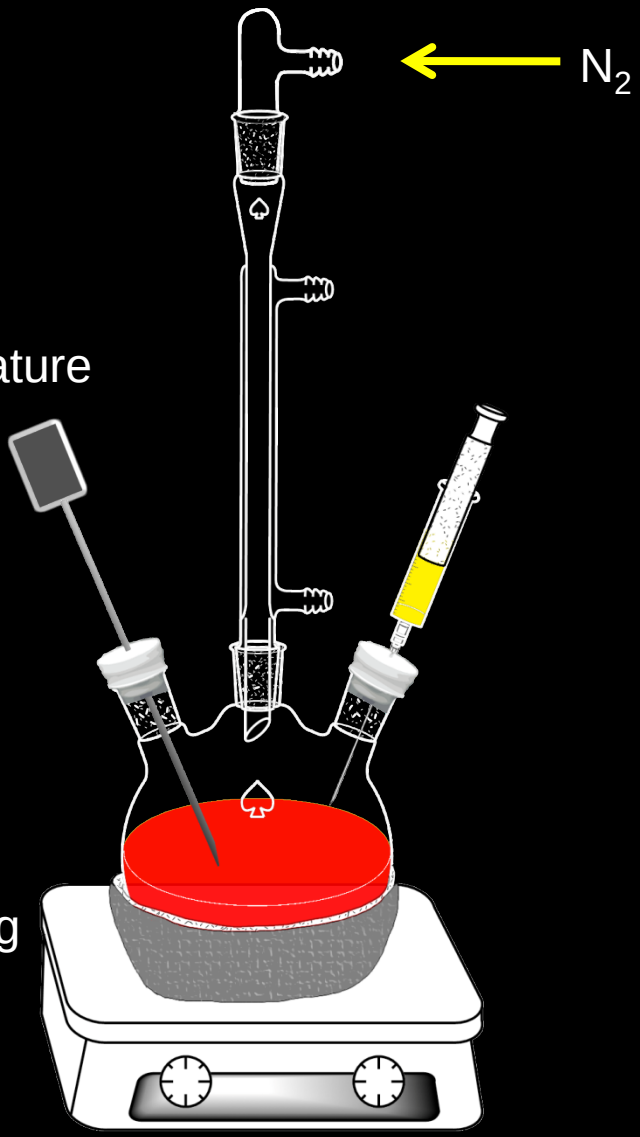
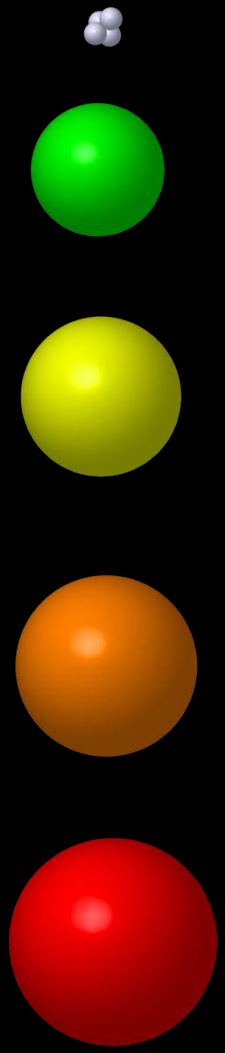
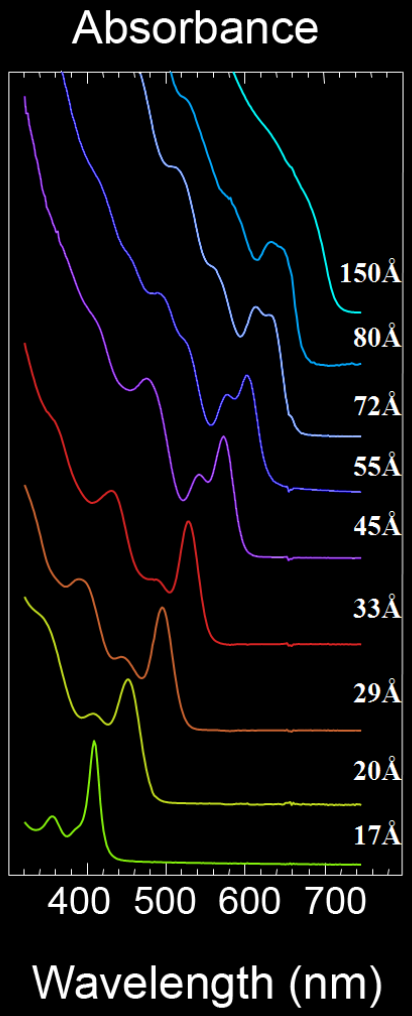
Quantum Dot Synthesis

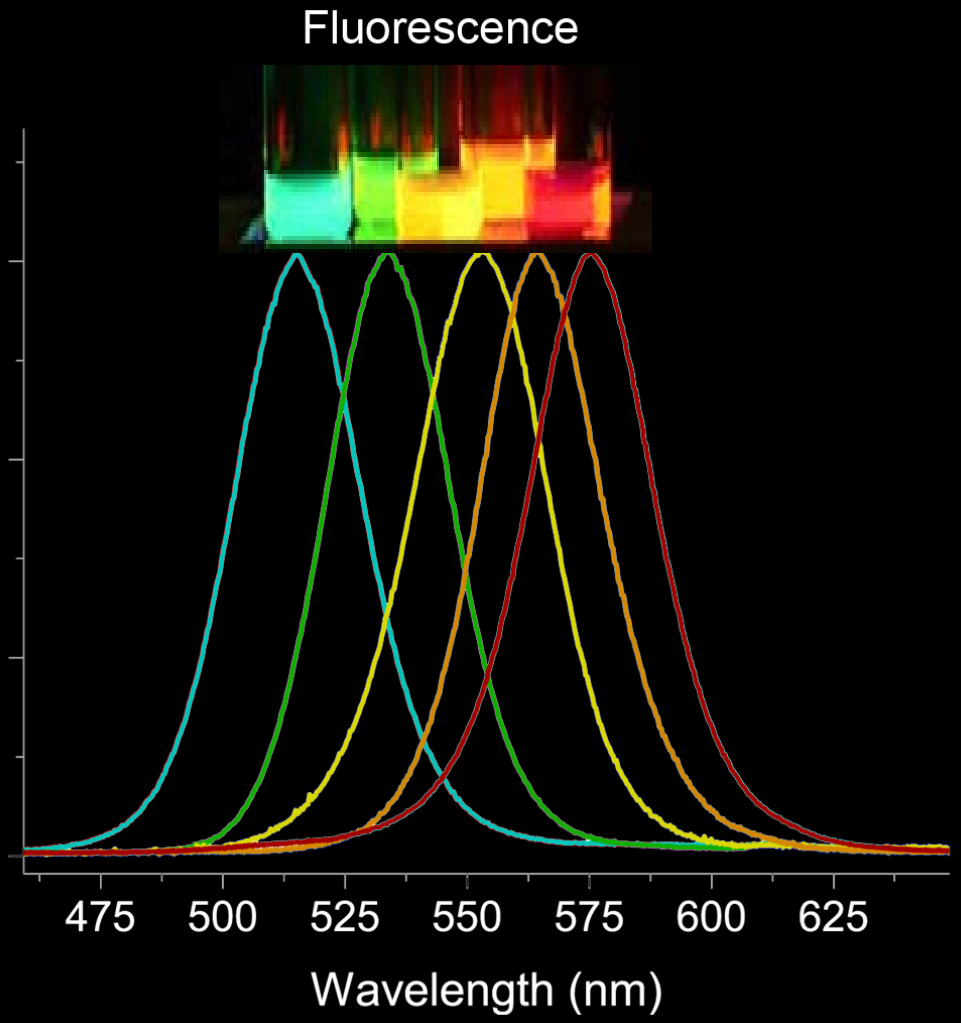




Spectrum Engineering via Quantum Dot Size Control

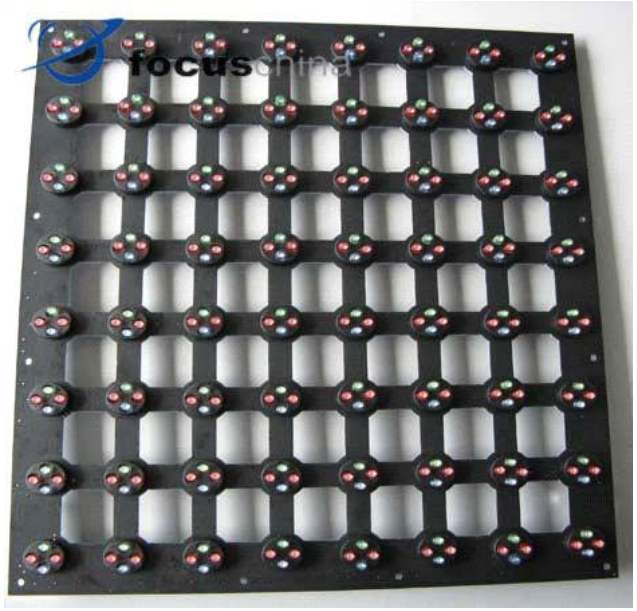




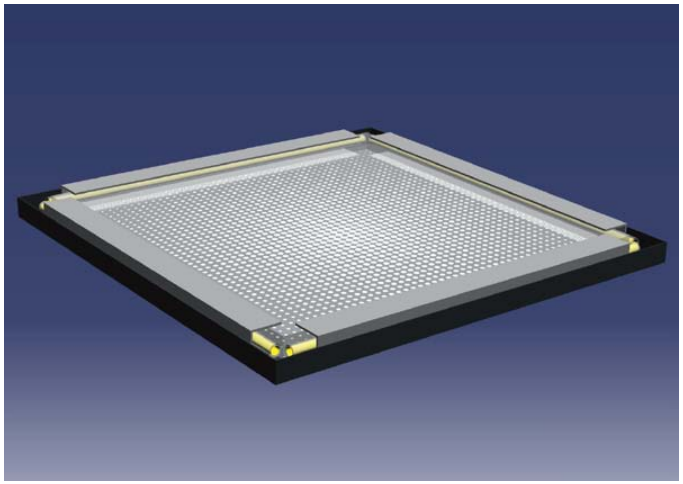


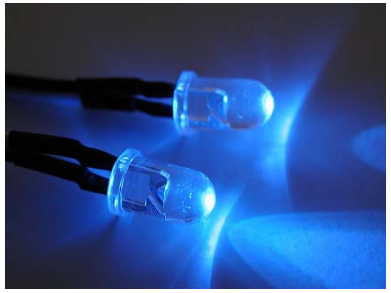
Back Lights for Flat Panel Displays

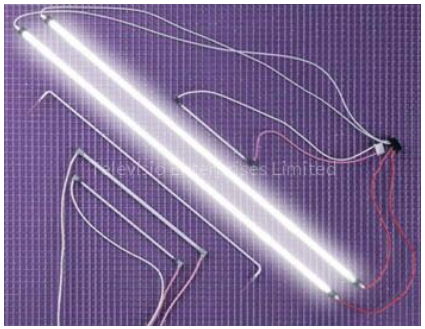
LEDs



CCFL







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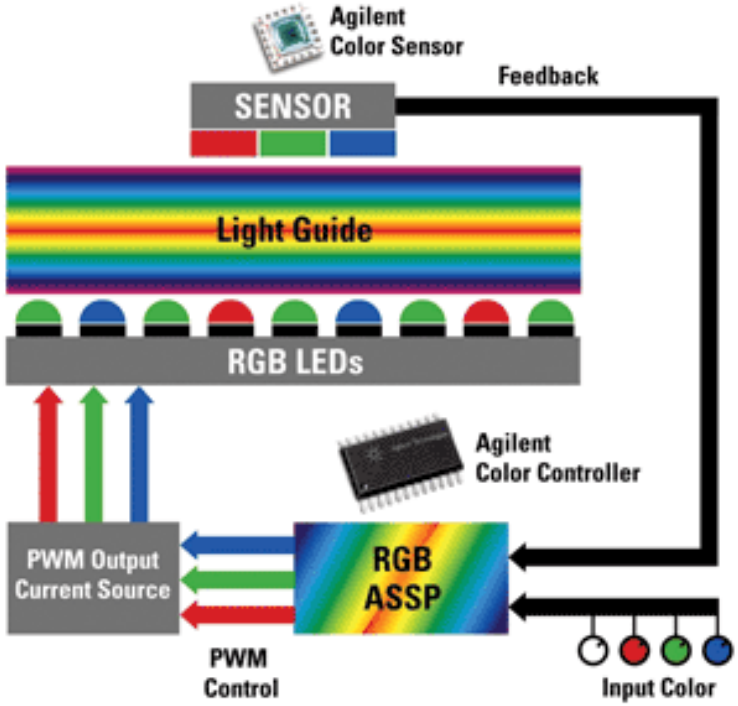
Backlights with RGB LEDs



- RGGB used due to lower efficiency of green LEDs
- Real-time feedback needed to keep the correct white-point due to color drifts mostly in green and red LEDs

Displays with RGB LEDs

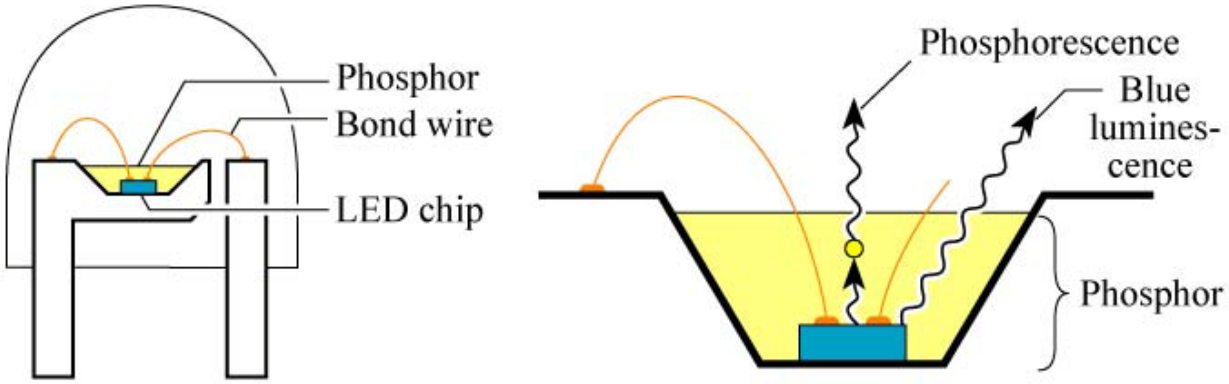
Dell UltraSharp U2410 24-inch

RGB LED

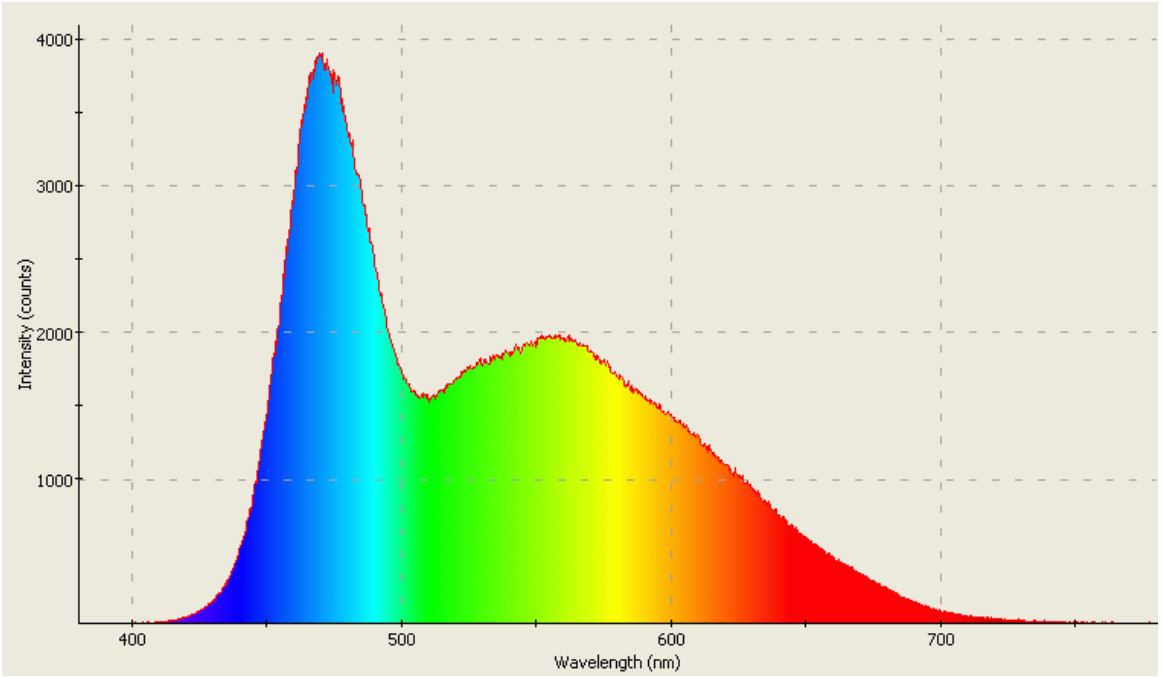
96% Adobe RGB Gamut,

$599

White LEDs
Blue LED Chip + YAG Phosphor



Side-emitting



Top-emitting

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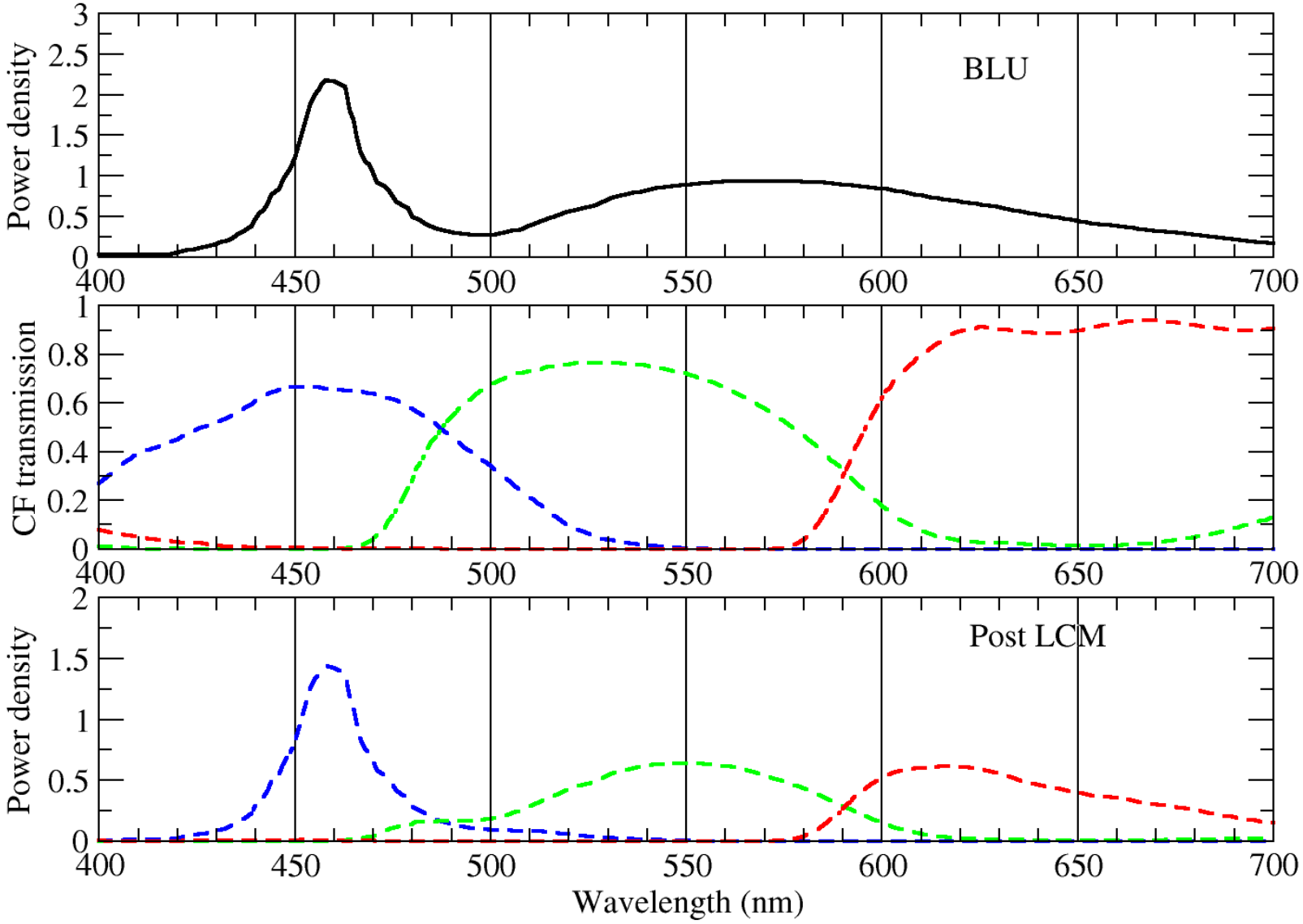
Effect of Color Filters



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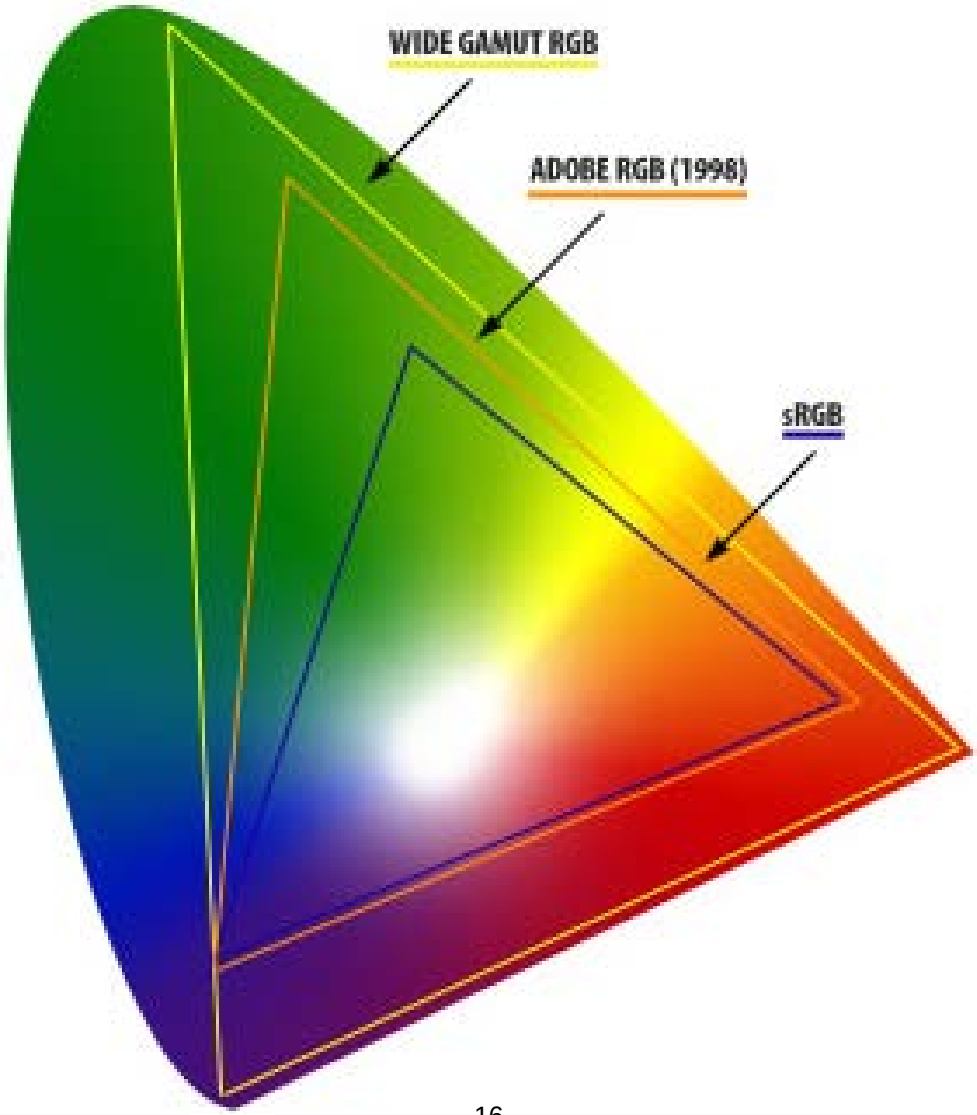
Color Gamut from White LED Backlights



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Displays with RGB vs. White LEDs

Dell UltraSharp U2410 24-inch

RGB LED

96% AdobeRGB Gamut,

$599

Dell P2411H 24-inch

White LED

72% AdobeRGB Gamut,

$358

Source: dell.com

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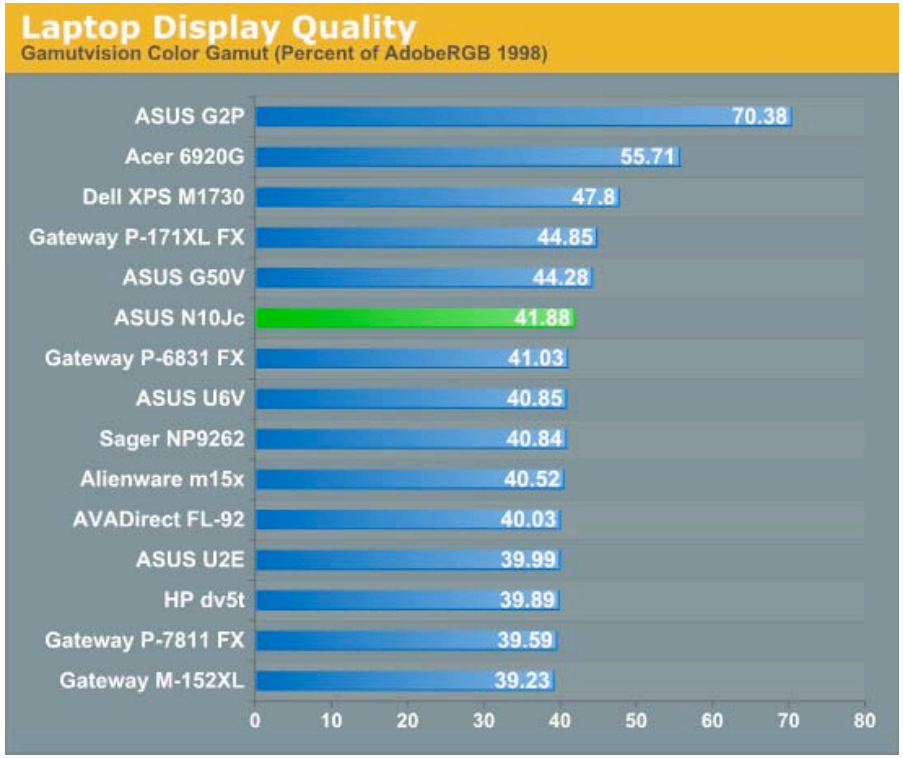
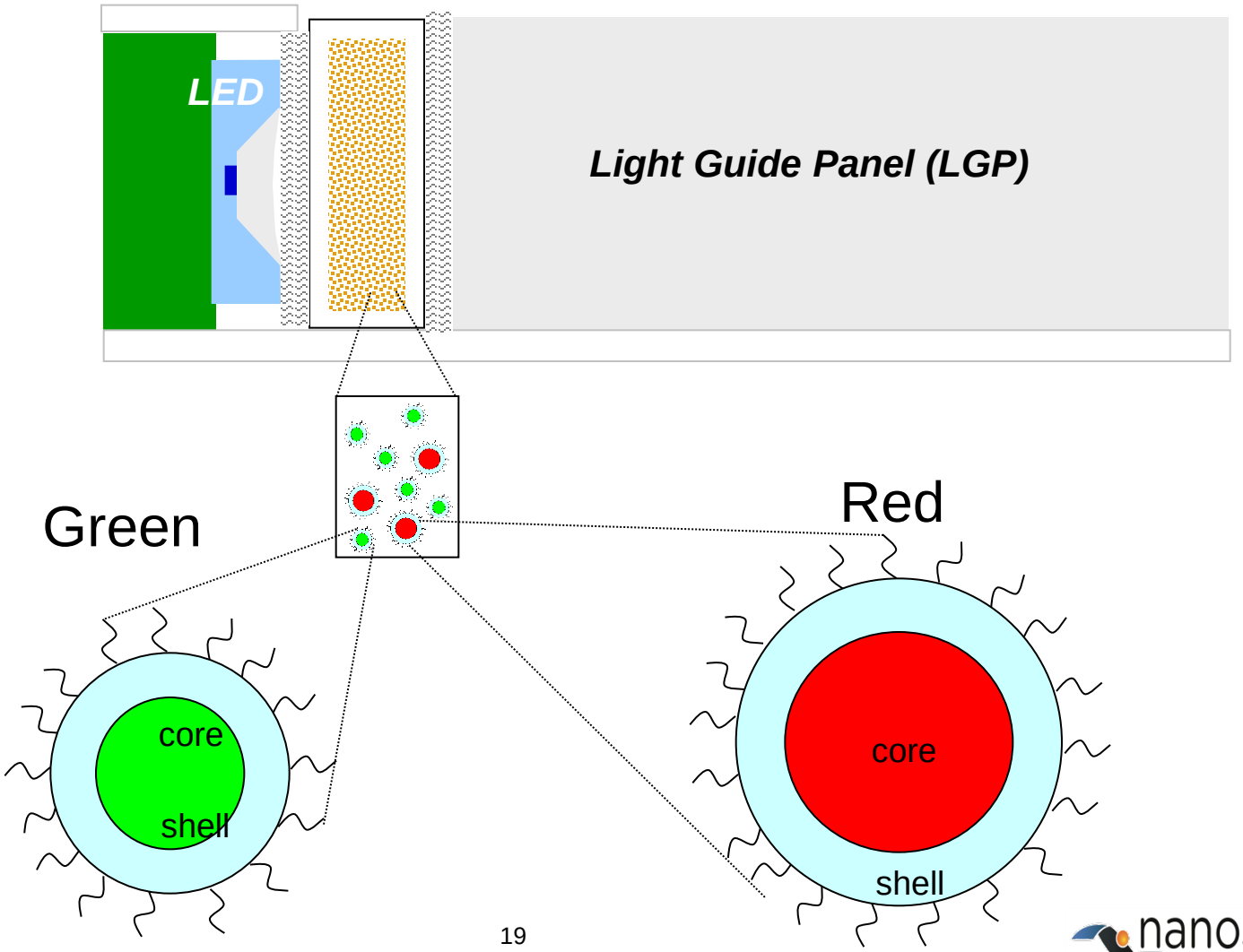
Color Gamuts for Desktop & Laptop Monitors

Desktop Monitors

Laptop Monitors



Green & Red Quantum Dots in QuantumRails



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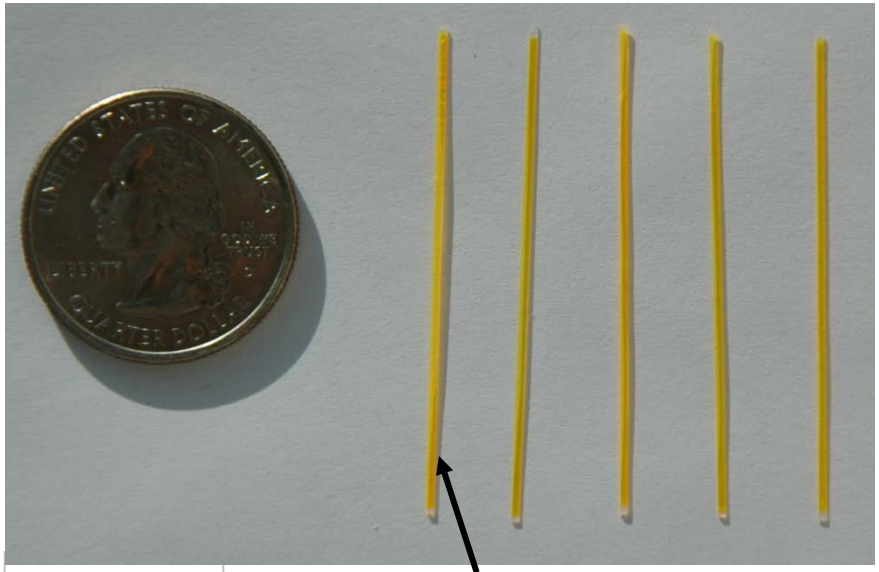
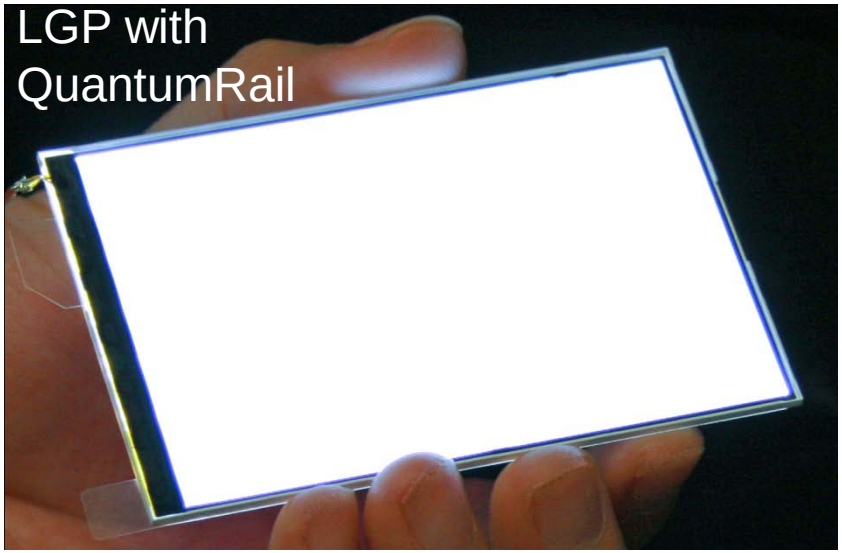
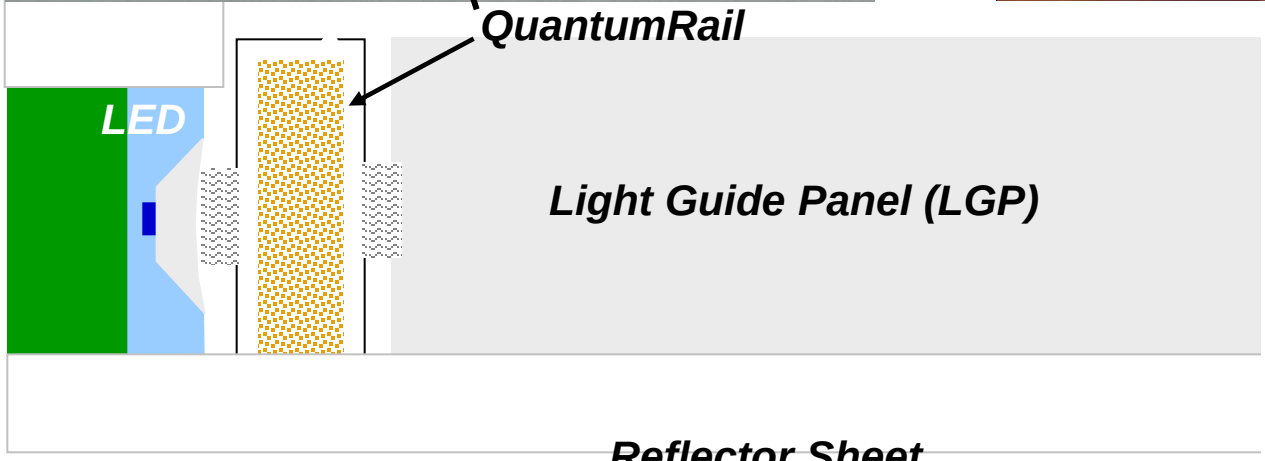
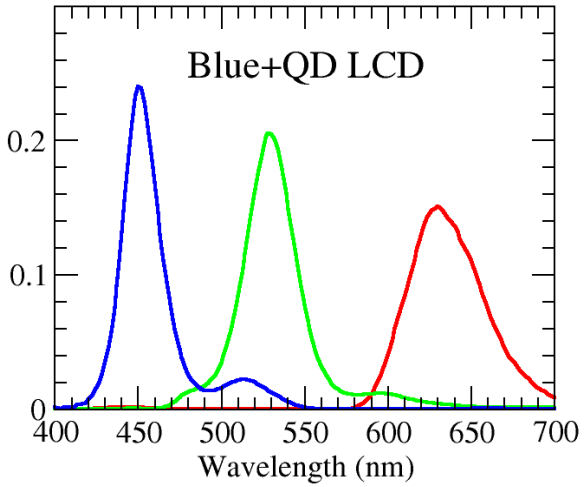
QuantumRail™







Cross-Section



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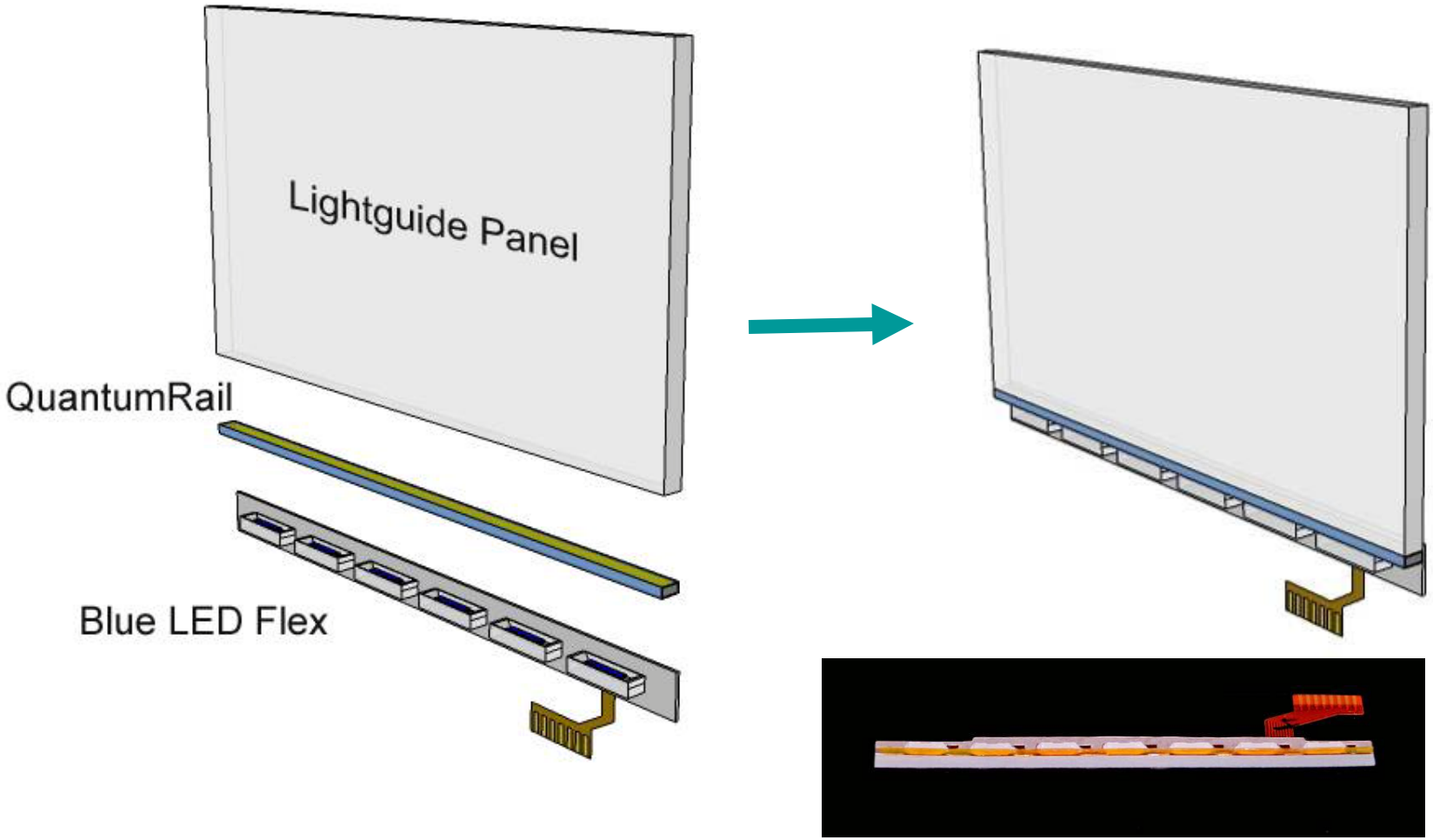
Simple Integration



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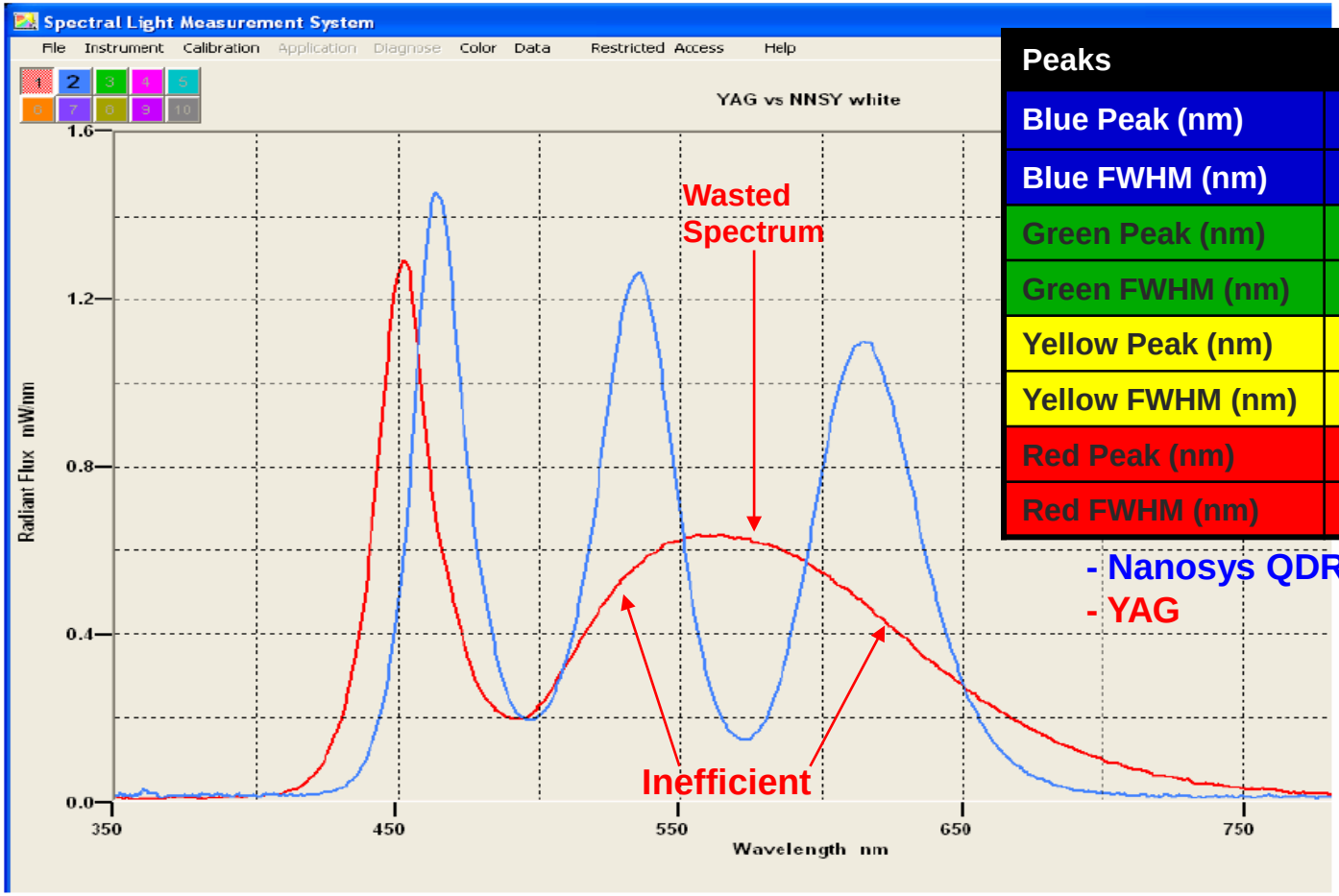
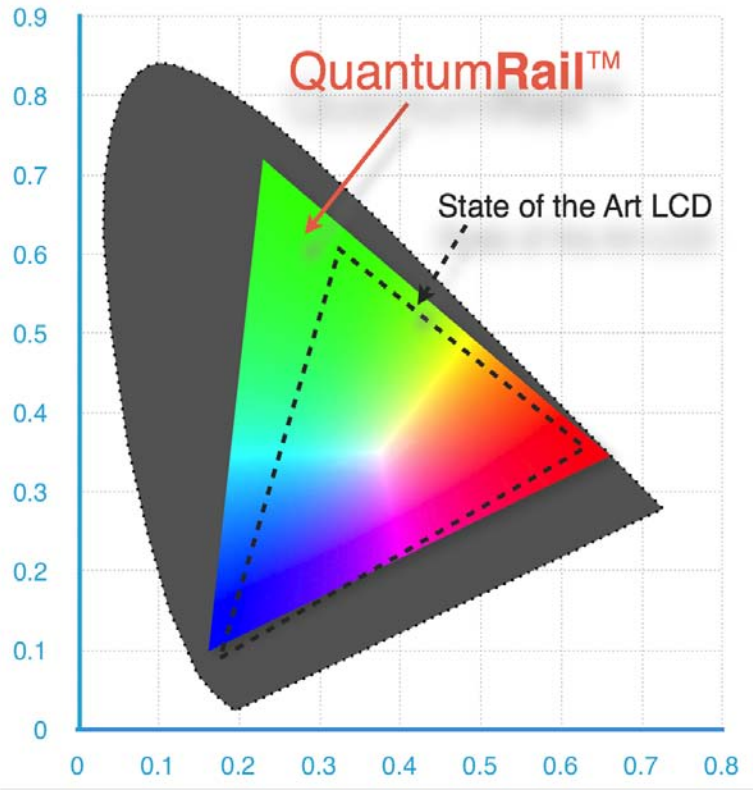
Full Spectrum Engineering vs. YAG

- Precisely controlled emission wavelength (peak wavelength within ±3nm)
- Primary colors (Green and Red) tunable for aligning spectra with display color filter spectra



Peaks	YAG	NNSY
Blue Peak (nm)	451.8	463.5
Blue FWHM (nm)	21.6	21.6
Green Peak (nm)	NA	535.3
Green FWHM (nm)	NA	32.8
Yellow Peak (nm)	559	NA
Yellow FWHM (nm)	105	NA
Red Peak (nm)	NA	614.5
Red FWHM (nm)	NA	44.5

Dramatic Color Gamut Improvement



Color Gamut* with YAG	**43.10%**	**57%**	**70%**
Color Gamut* with QD	**64%**	**88%**	**103%**
Improvement	**48%**	**54%**	**47%**
Results Provided by	**Customer A**	**Customer B**	**Customer C**

*Note: based on NTSC 1953 standard and CIE 1931

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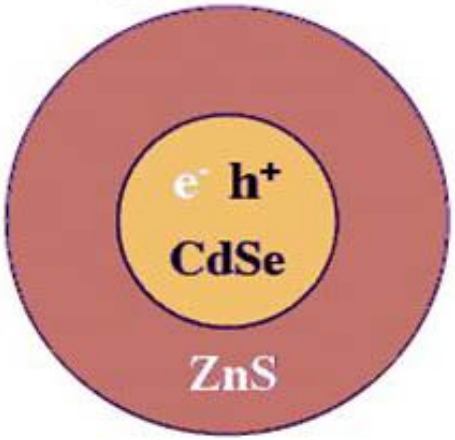
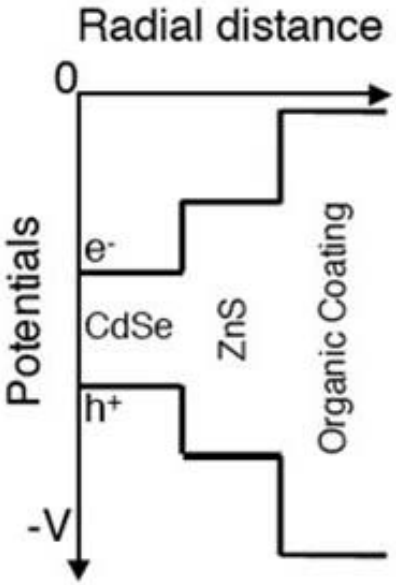
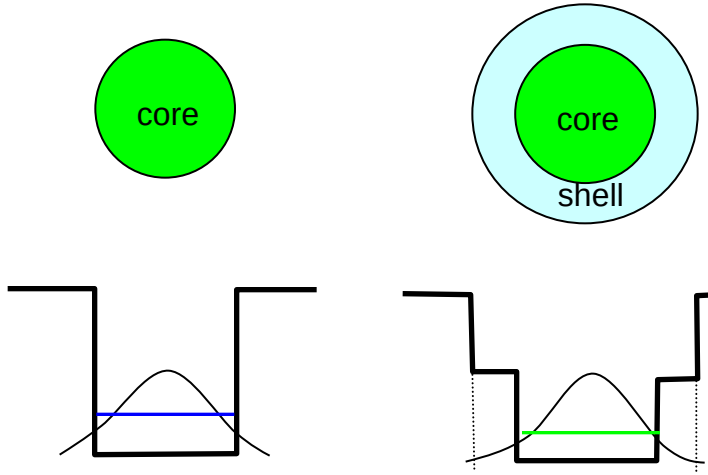
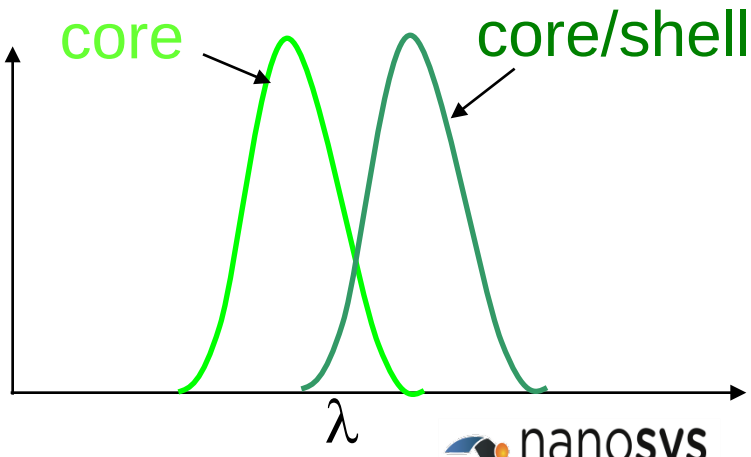
Thank You!

Core/Shell Quantum Dots
High Quantum Efficiency > 85% & Better Stability









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