Towards a Brighter Future: Laser-based White Lighting

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LEDs and lasers offer huge energy savings

LEDs show the many successes of solid-state lighting; lasers are next!

Advanced Research Projects Agency Energy (ARPA-E) is funding UCSB to integrate lasers into white-light sources

I develop optical models to screen lasers for color and brightness

Solid state lighting projection by DOE, May 2015
Current lighting: LED and phosphor combo

Phosphor converts color of LED emission to cover visible spectrum

LED converts electricity to light

Radiation from phosphor

Radiation from LED

LEDs suffer from efficiency droop; lasers dominate high powers.

Opens up whole new markets of high-power devices!

Adapted from Joachim Piprek’s *Comparative analysis of efficiency limitations* NUSOD 2016 conference paper.
What's the best laser wavelength? 450 nm as example

I parametrize final spectrum by how much laser light the phosphor absorbs.
The eye response function: color picks brightness

Relative brightness

Human eye is more sensitive to green and yellow light than red or blue
Balancing color and brightness

CIE diagram maps wavelengths to color

A mix of two colors falls on the line between the two
Balancing color and brightness

CIE diagram maps wavelengths to color

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Phosphor color point

Laser color point
Shaping the direction of laser research

Model shows 450nm laser better at reaching color and brightness goals

415nm color point

450nm color point
Current successes and future goals

Successfully described laser pumps in terms of their color and brightness capabilities

Developed foundation for screening phosphors and pumps with ability to grow

Want to take on new color rendering metrics and keep pushing at frontier of lighting!