

U.S. Department of Energy

SOLID-STATE LIGHTING WORKSHOP

Cosponsored by the Illuminating Engineering Society

Breaking Through to Next-Level Lighting Performance

Programmable Spectrum, Color Mixed Architectures

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Agenda

- Introduction
- Motivation
- Status
- Challenges
- Summary

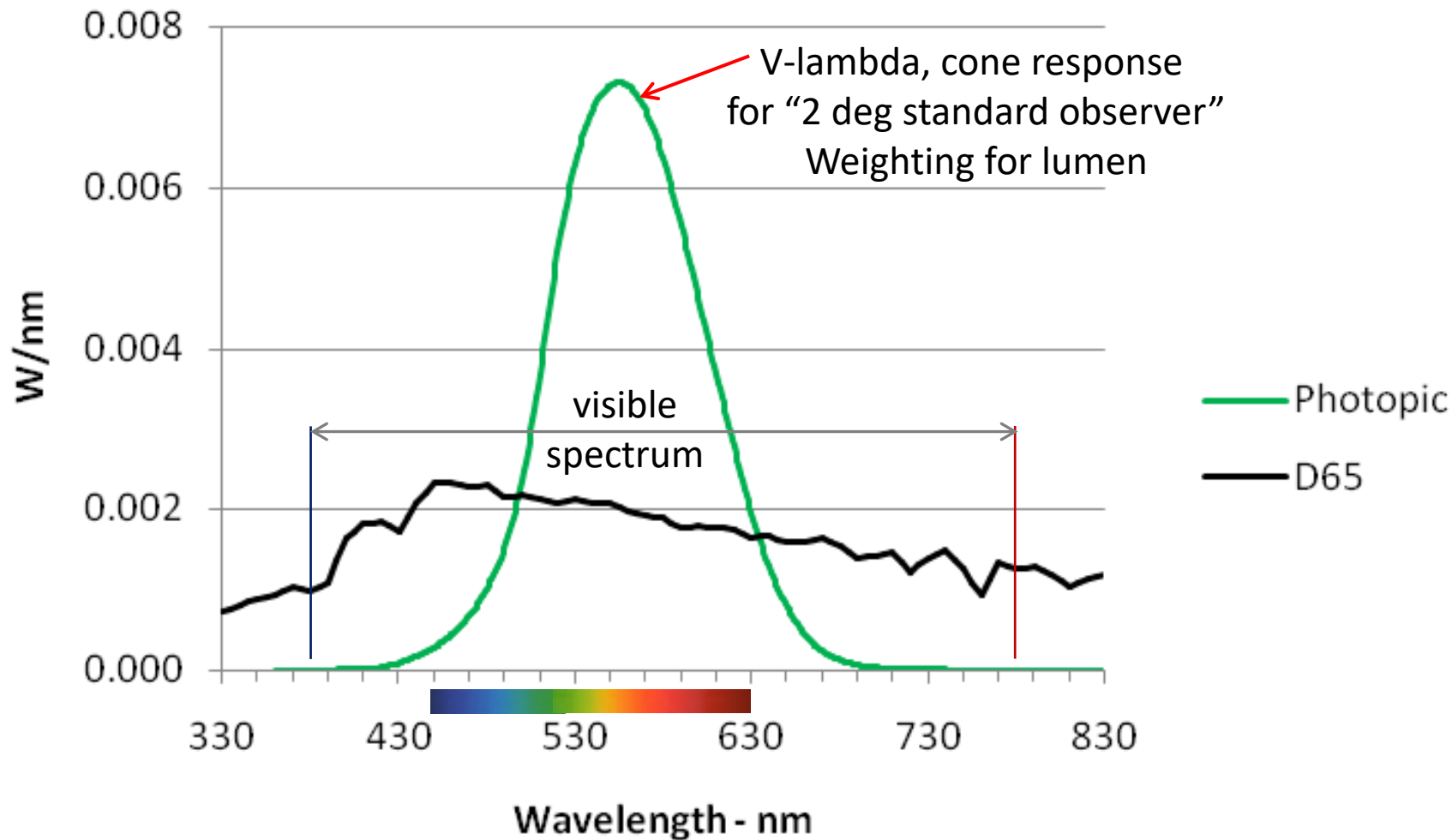


The Recording and Playback of Light

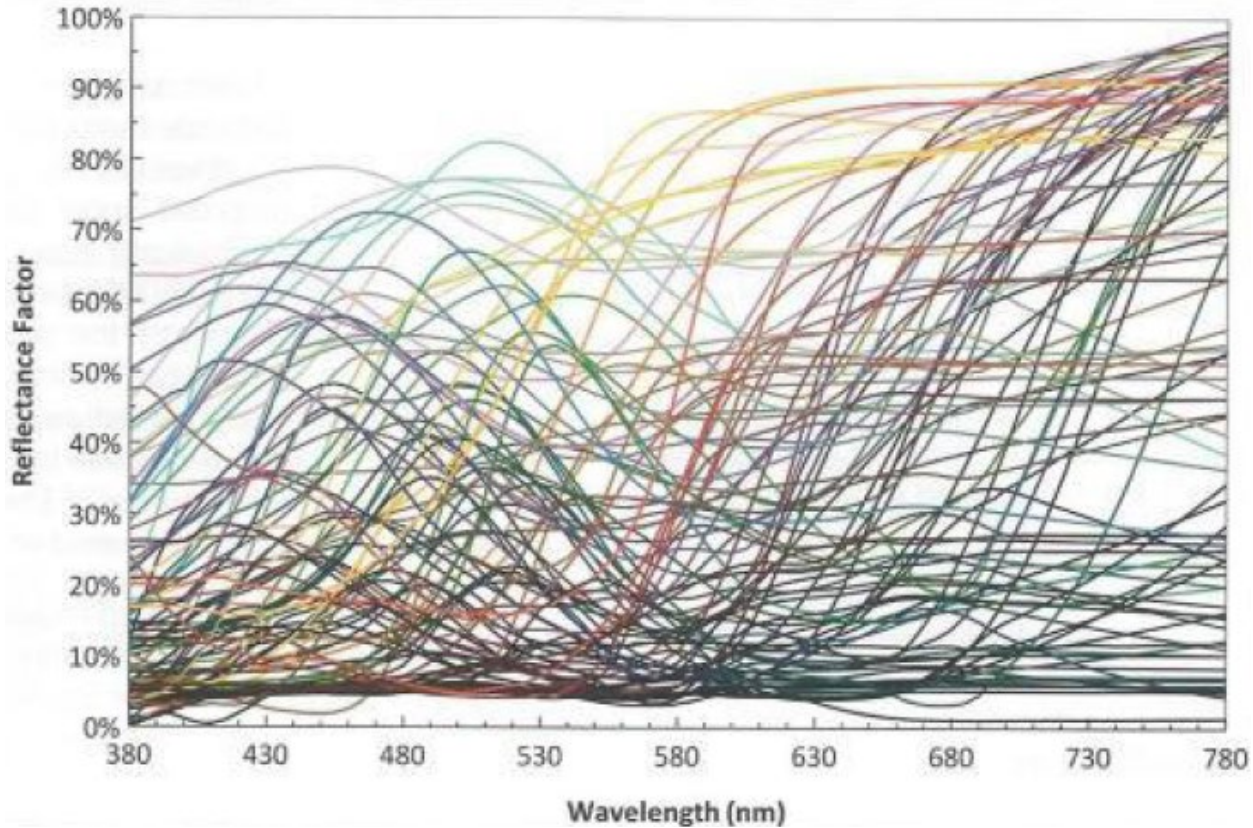
- Founded 2007 – Silicon Valley, CA
- Purpose – Replicate any spectral power distribution
 - Products and services to create and playback light
- Privately owned
- Current products:
 - Octa (8 channel light player)
 - Dittosizer (24 channel light player)
 - Content (spectrometer recordings)

Programmable Spectrum Motivation

- Higher efficacy
- Health and wellness including better wake/sleep
- Replicate actual daylight
- Enhance product appearance
- Find better/best SPD for specific applications
- Hold chromaticity constant with various SPD
- Dynamic, enjoyable, pleasant, thrilling, experiences

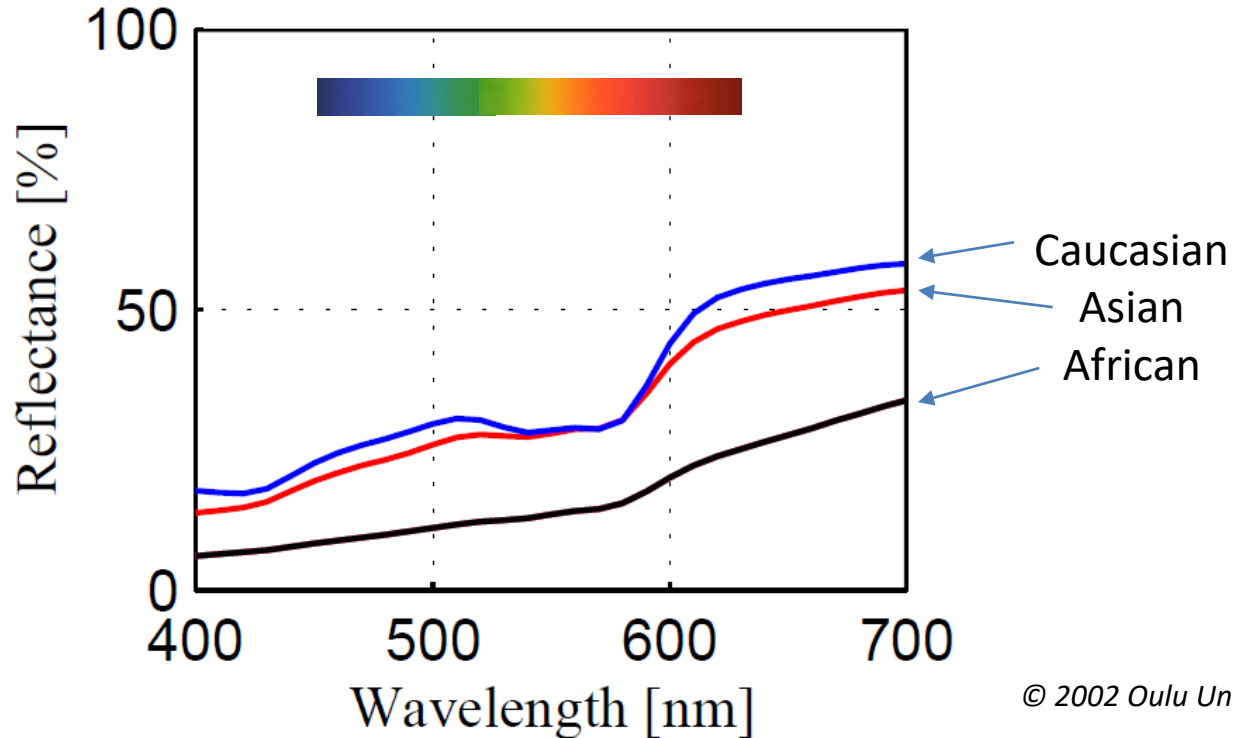


TM-30 colors - 99

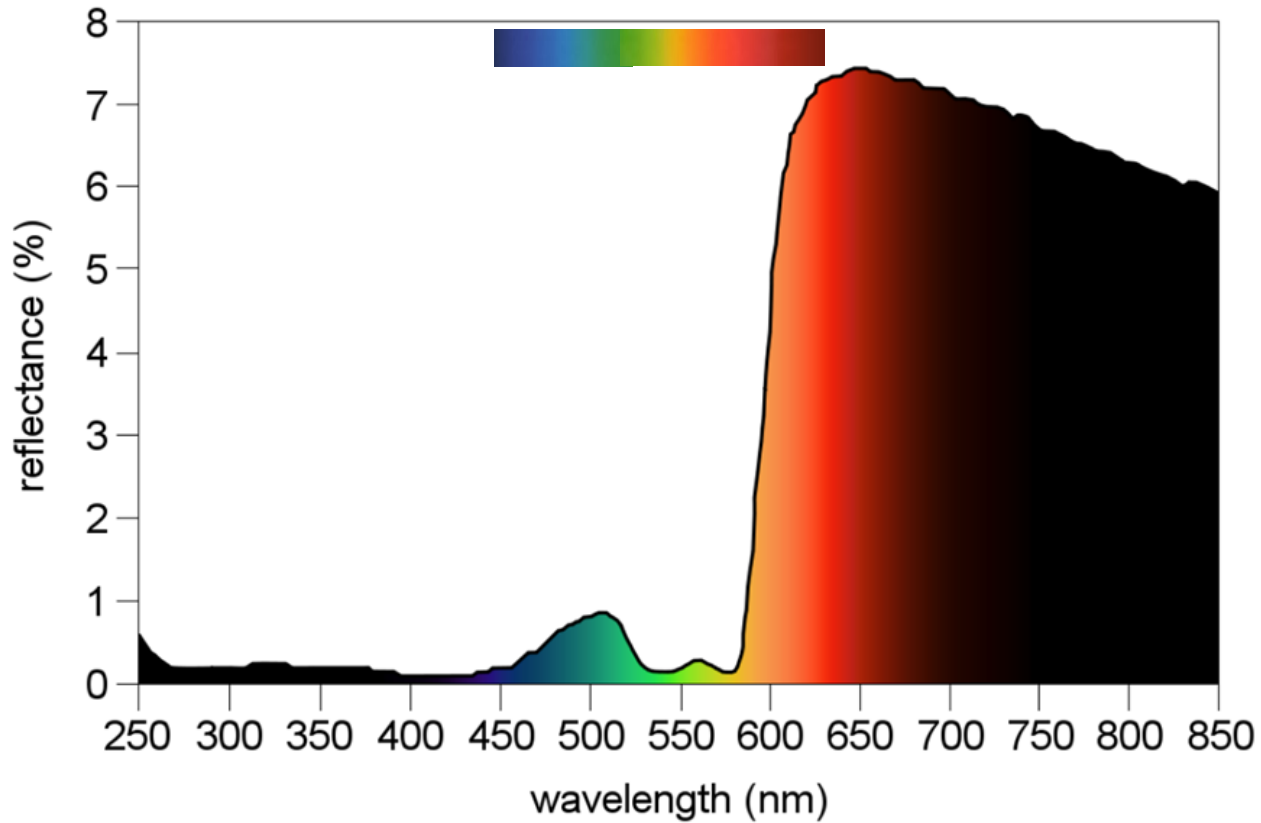


Deep Red is Key to Proper Skin Rendition

About half the response is >600nm

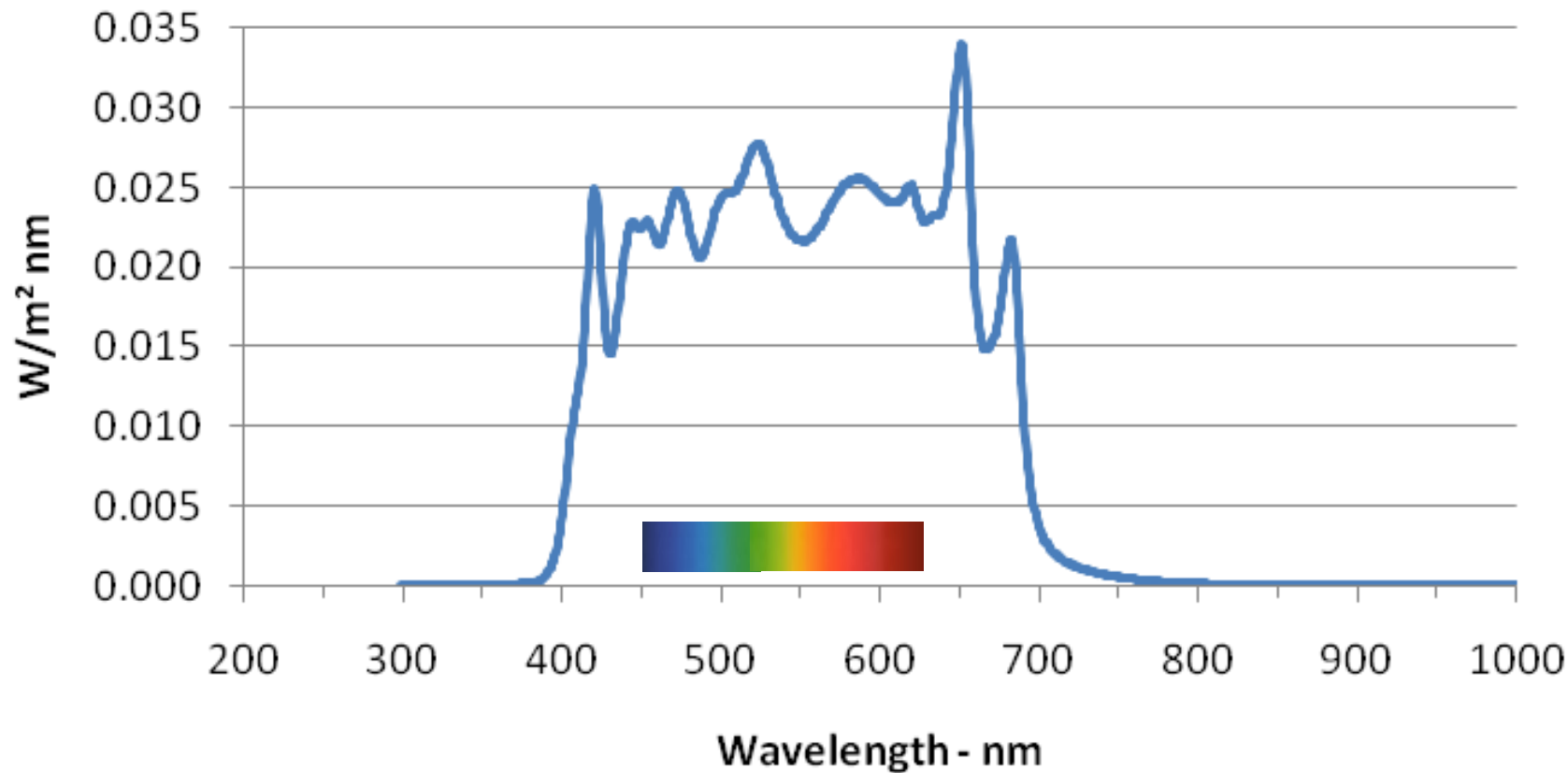


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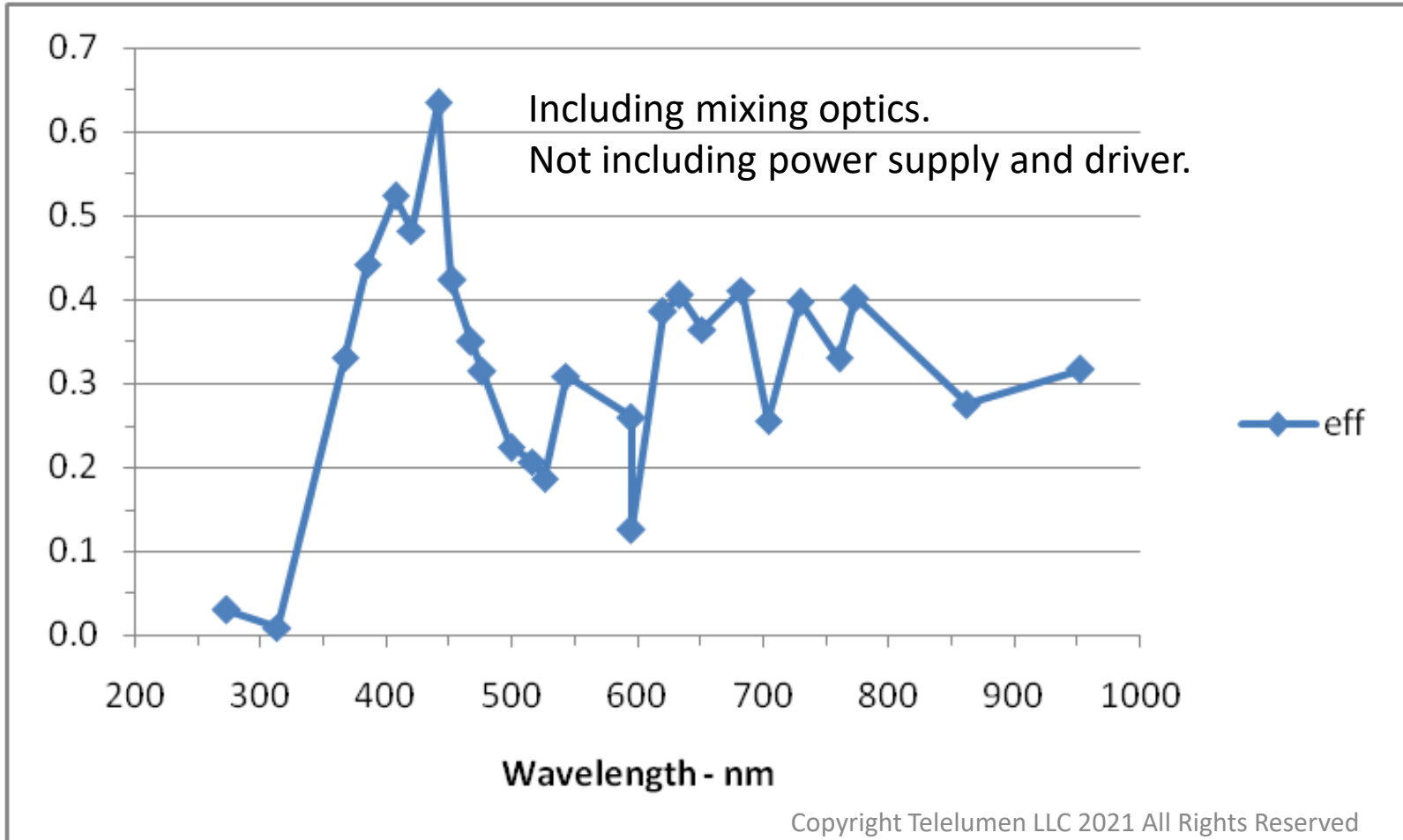


Diffuse reflectance of human blood with a hematocrit of 33%, oxygen saturation of 100%, and mean cell volume of 83 femtoliters. Public Domain Image, data source: M. Meinke, image source: Christopher S. Baird.

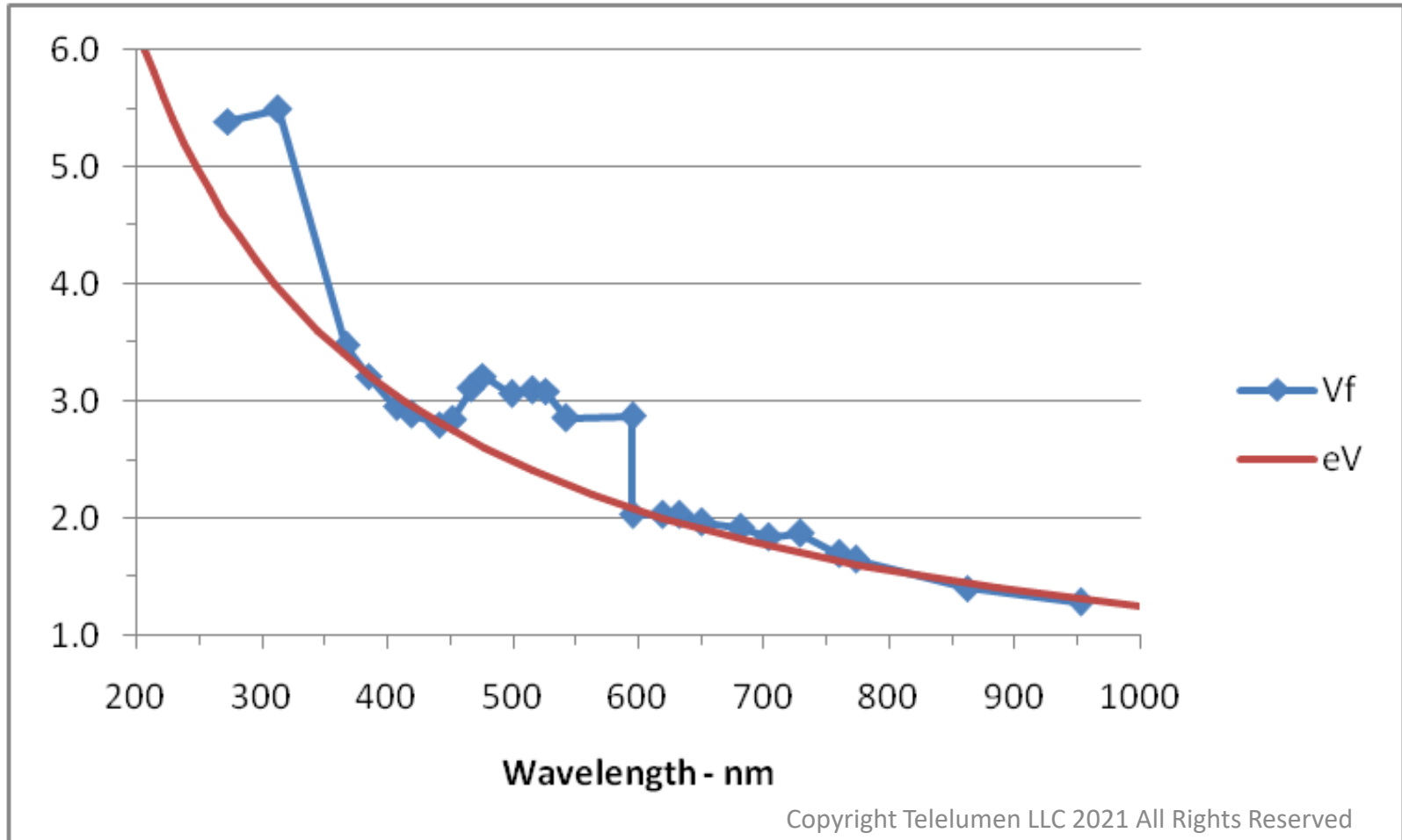
5000K, 98 Rf, 101 Rg, 6300 lm, 79.5 W



Efficiency vs. Wavelength



Photon Energy and Vf vs. Wavelength



SPD is the definitive description of light
and its properties,
CCT and chromaticity are not enough.

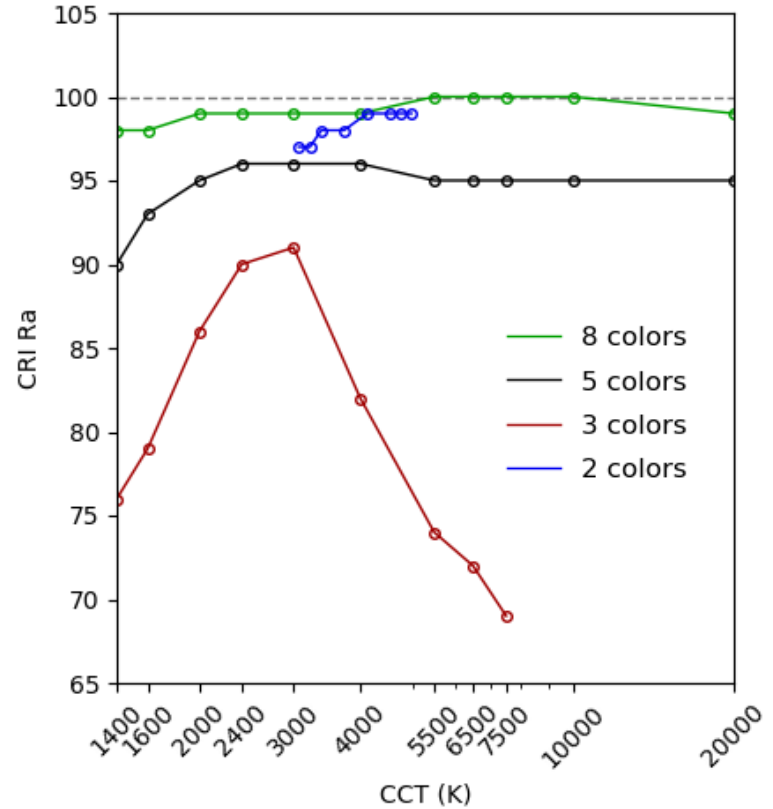
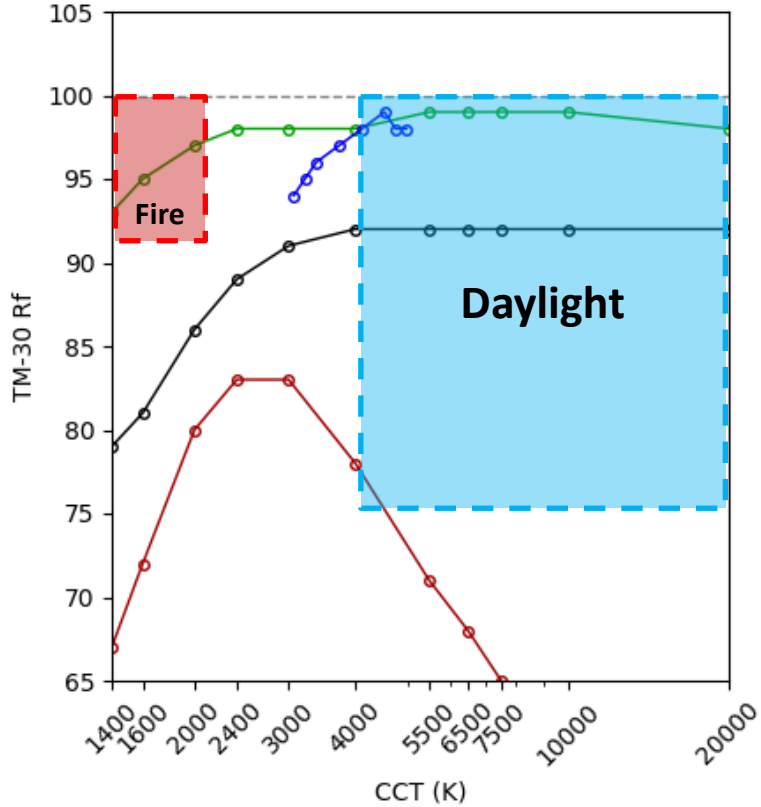
In general - SPD

- A more continuous spectrum and wider range of wavelengths produce higher color quality light sources.
- A less continuous spectrum and truncated range of wavelengths are more efficacious.

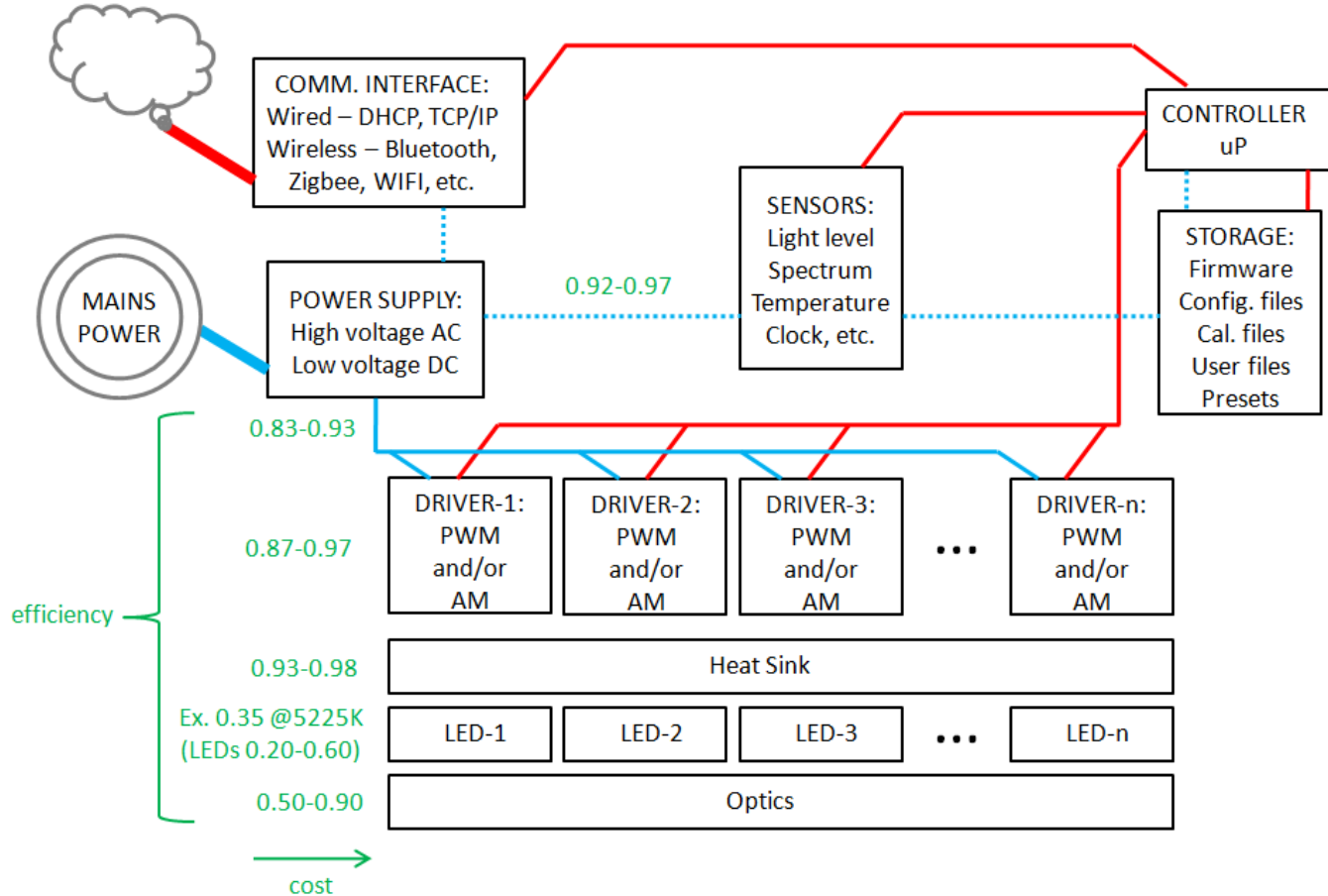
Tunable spectrum challenges

- More efficient emitters
- Efficacy (lm/ele-W) vs. Efficiency (opt-W/ele-W)
- Supremacy of photometrics over radiometrics (SPD)
- Multi-channel, high dynamic range drivers (16-bit)
- Efficient, compact color mixing
- One-to-one channel color sensors

Rf vs. Ra vs. Channels



Spectrally Tunable Architecture



Summary

- For some years to come, fixed spectrum phosphor converted sources will be the most efficacious.
- Programmable spectrum sources facilitate a wider range of solutions beyond traditional photometrics.
- Focus on efficiency, peak wavelength, and SPD
 - NOT efficacy, dominant wavelength, and CCT



The Recording and Playback of Light

Thank You

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