

# QUALITY AND CONSISTENCY OF LED FIXTURES FOR CAMERA

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# WHAT WE WILL DISCUSS

Additive vs.  
subtractive  
color mixing

LED  
spectrums  
and arrays

LED binning

LED fixture  
calibration

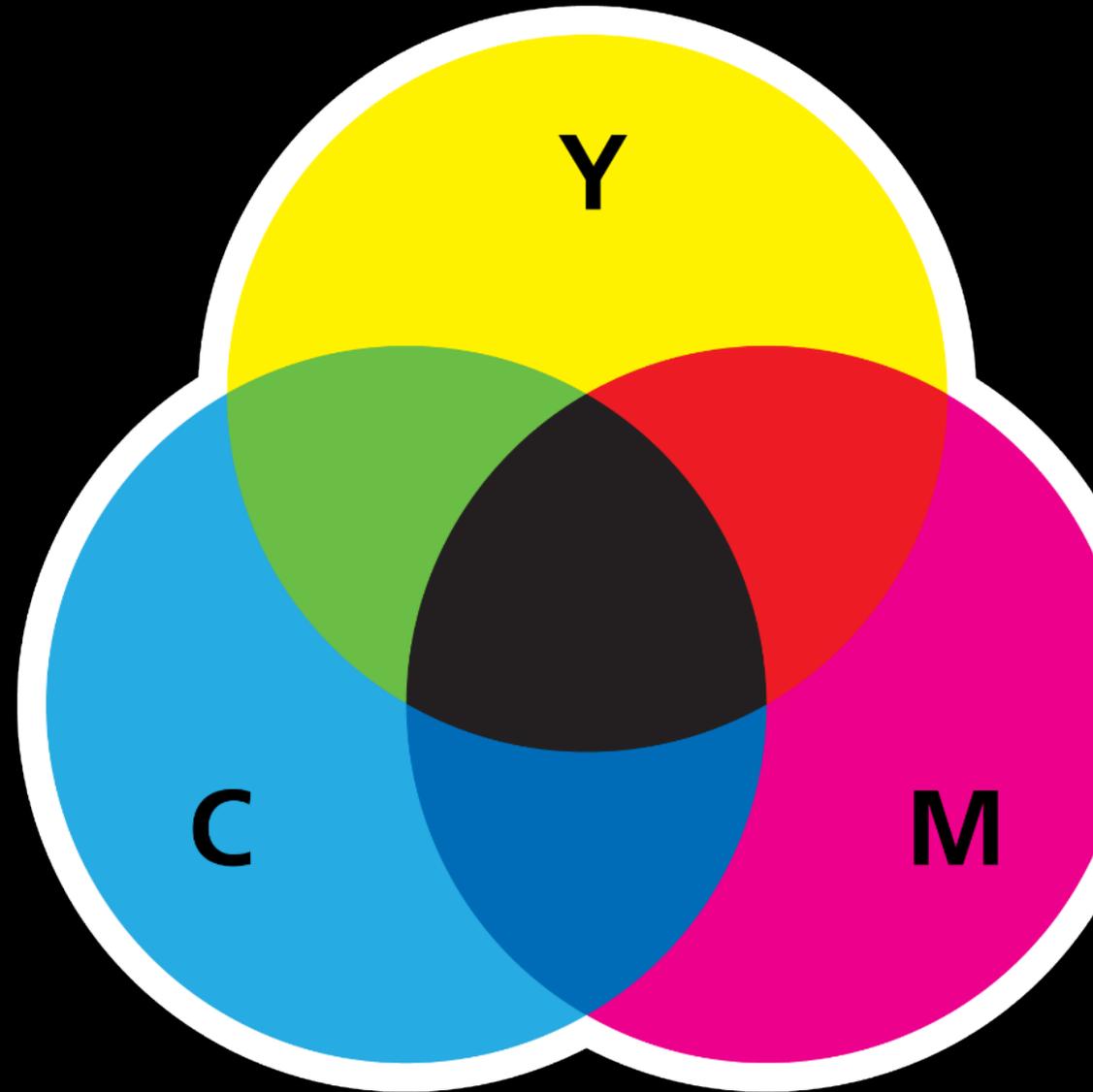
# SUBTRACTIVE COLOR MIXING

## Pros

- Usually starts from a full spectrum
- Low cost
- Very bright in white or pastels

## Cons

- Limited colors based on available filters
- Inefficient
- Saturated colors can be dim



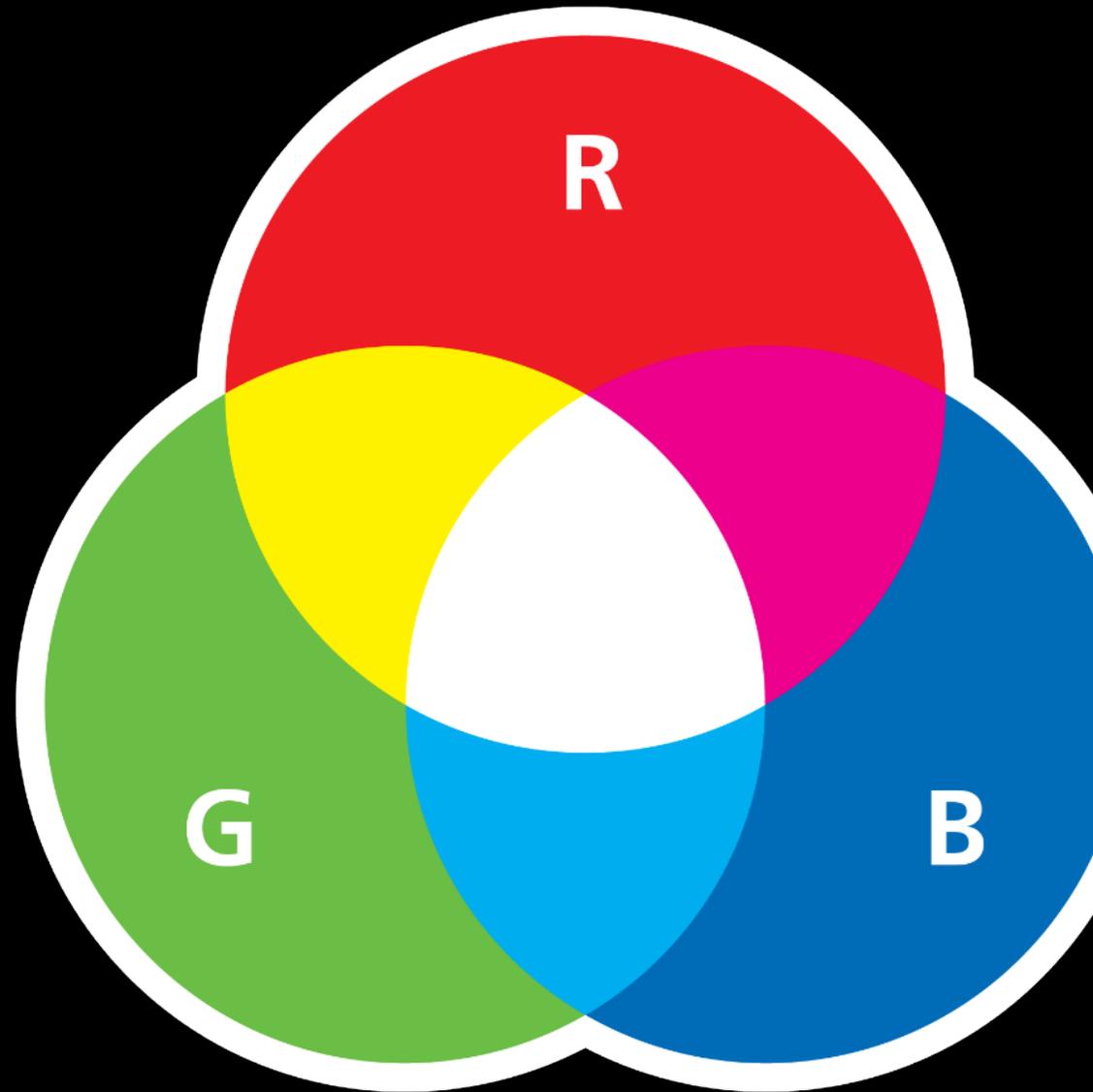
# ADDITIVE COLOR MIXING

## Pros

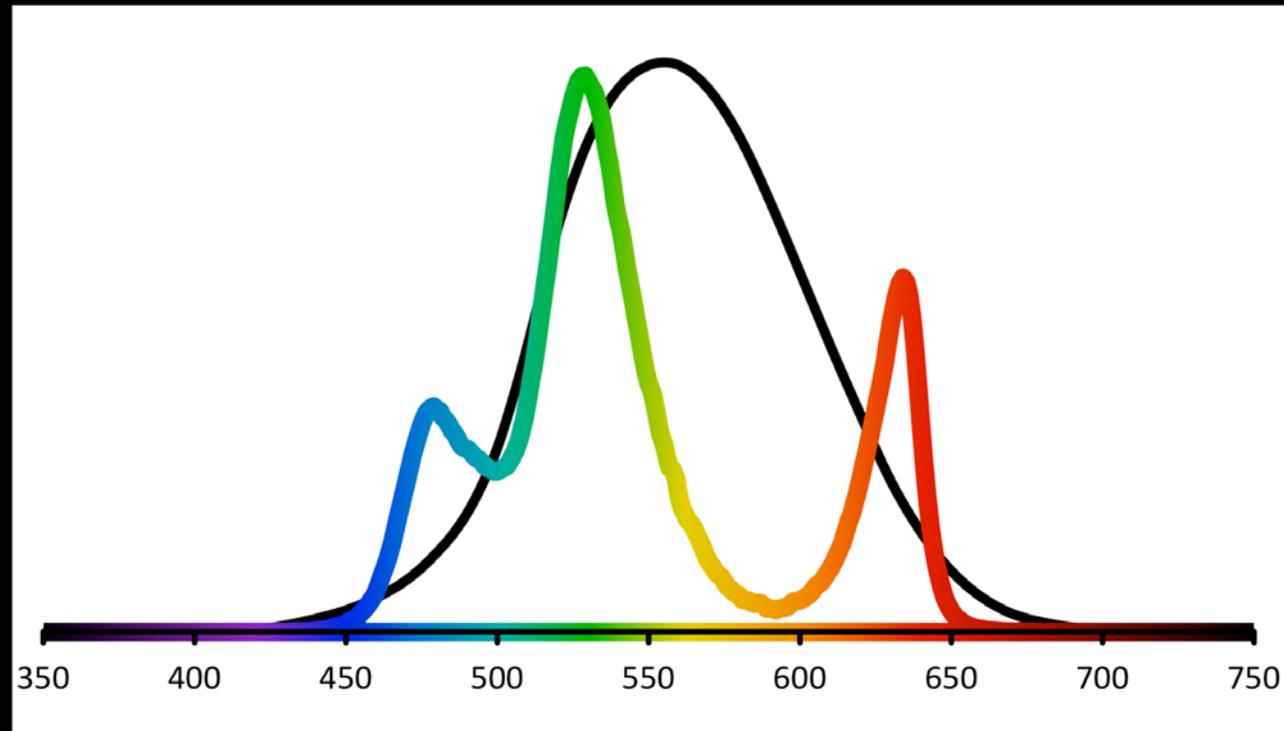
- "Unlimited," highly tunable colors
- Efficient
- Low maintenance

## Cons

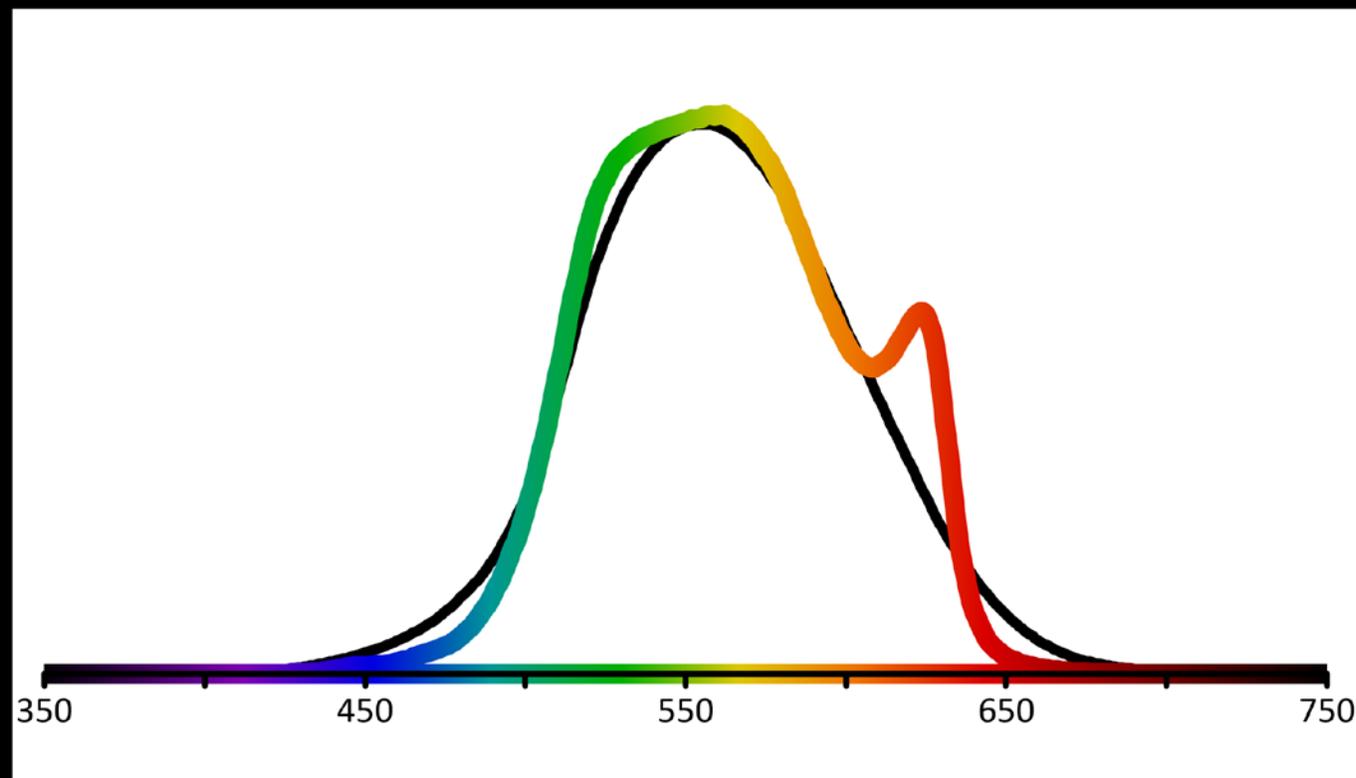
- Narrow band emitters means parts of spectrum may not be present
- Consistency takes technology
- Usually more costly



# SPECTRUM: RGB ARRAY



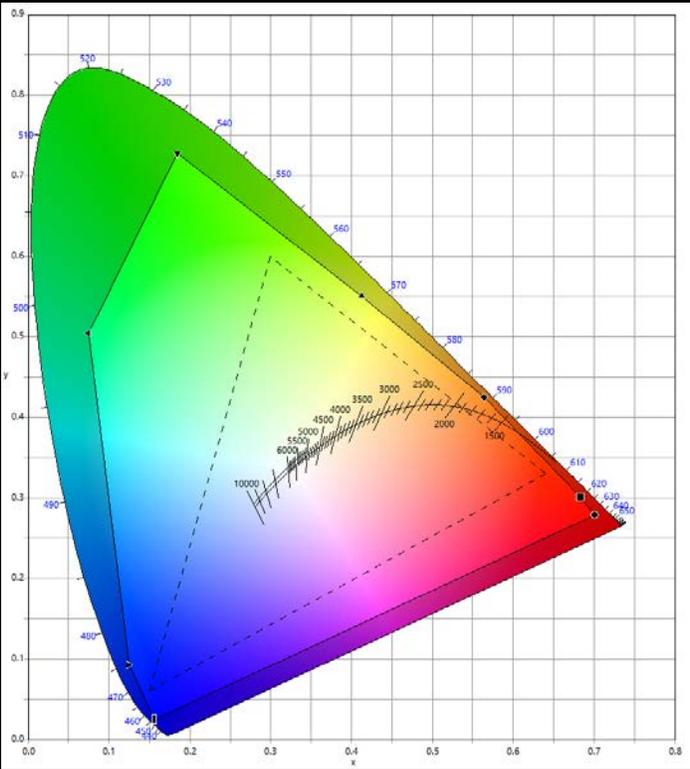
# SPECTRUM: X7 ARRAY



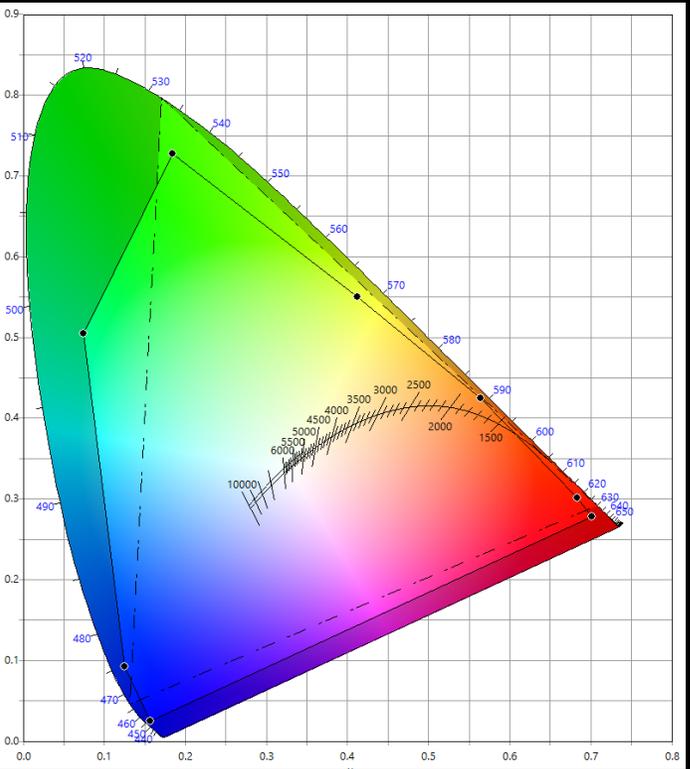


# BEYOND SPECTRUM...GAMUT

Rec. 709 (100%)

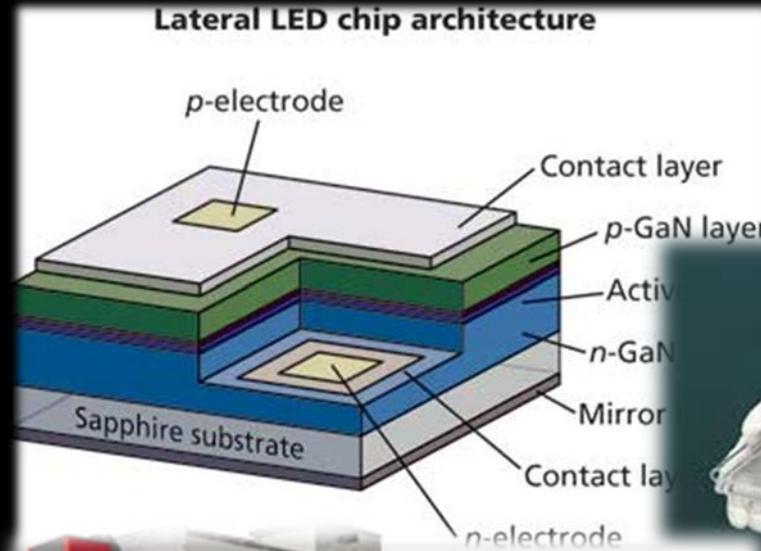


Rec. 2020 (94%)



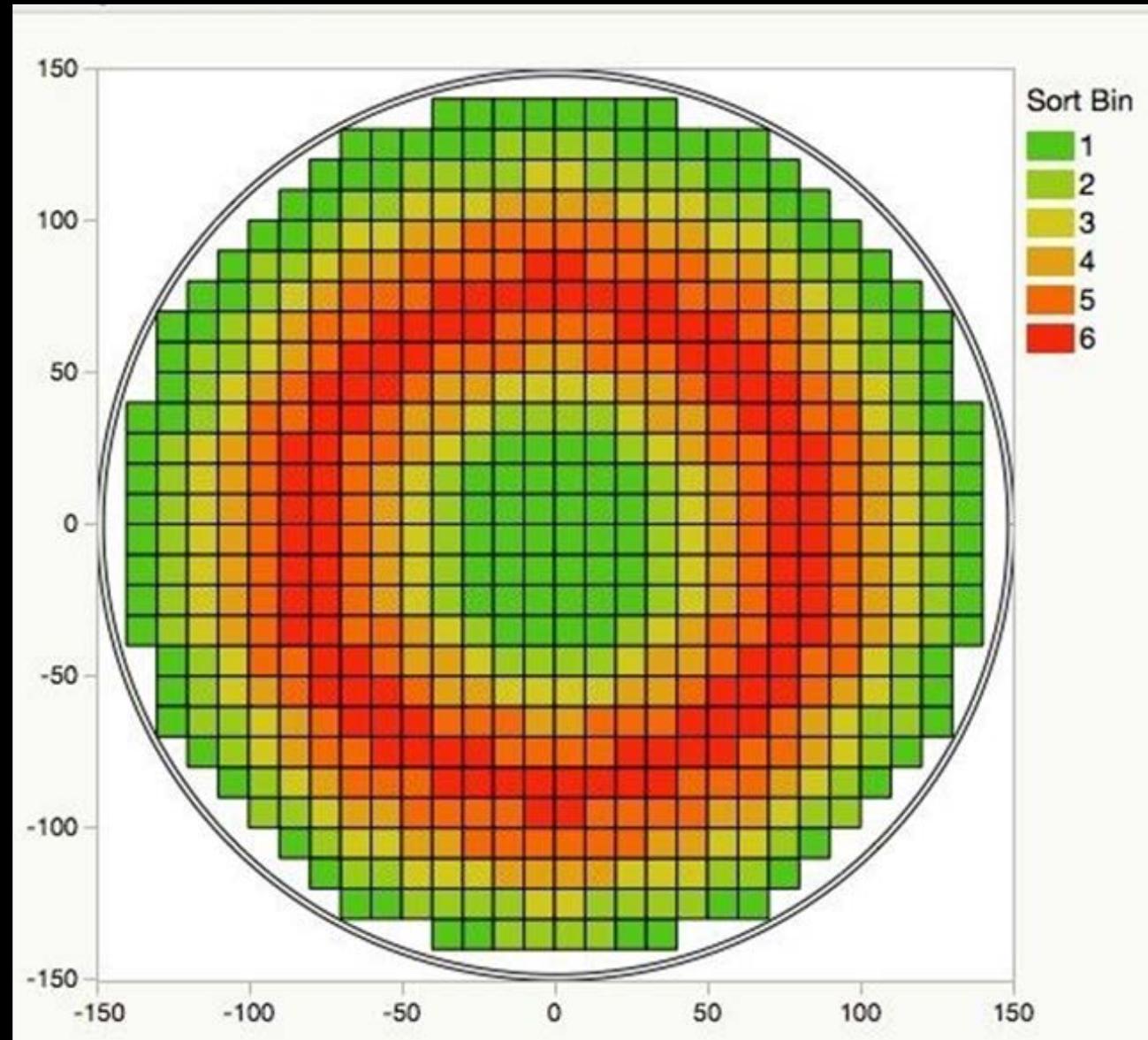
# HOW ARE LEDs MADE?

Layers...  
are deposited onto wafers...  
and 'baked' in an oven.



# HOW ARE LEDS MADE?

Because this is an organic process (crystals), results vary across every wafer



# BINNING

... is the process of sorting the resulting LEDs into similar Flux and wavelength bins for sale



# BINNING

- Manufacturers select bins based on the characteristics that are important to them.

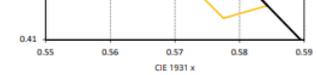
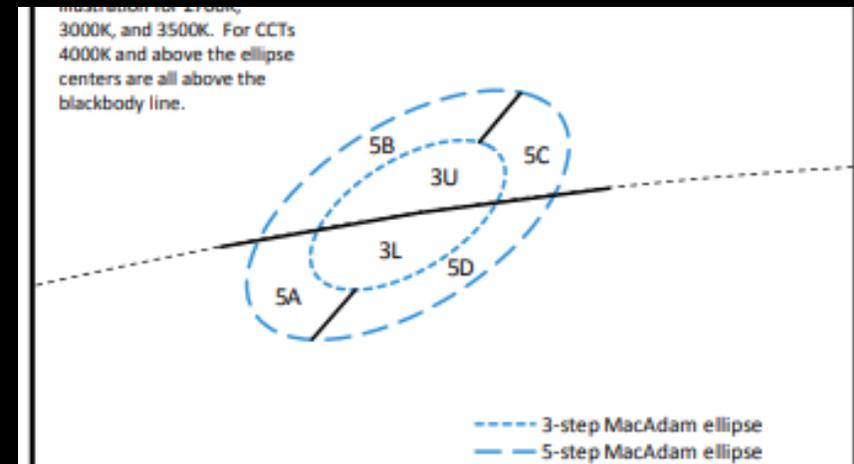
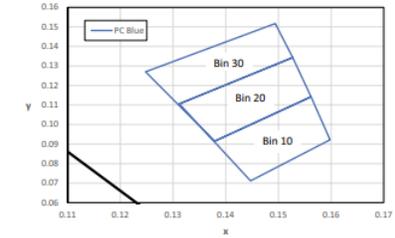
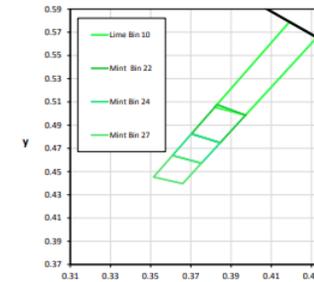


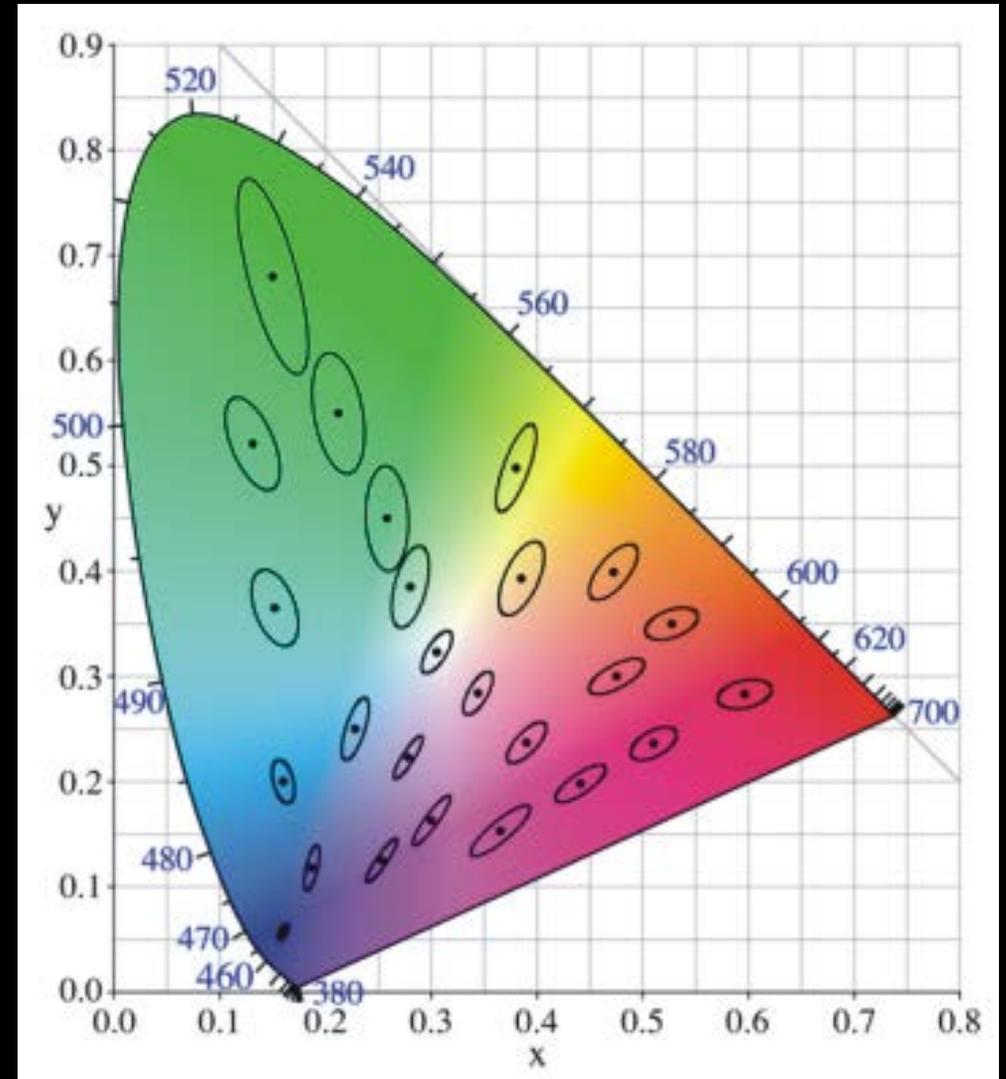
Figure 7. Color bin structure for LUXEON C PC Amber for Table 7.



COLOR	DOMINANT OR PEAK WAVELENGTH <sup>(1)</sup> (nm)		LUMINOUS FLUX (lm) OR RADIOMETRIC POWER <sup>(2)</sup> (mW)		
	MINIMUM	MAXIMUM	MINIMUM	TYPICAL	
Far Red	720	750	190	340	L1C1-
Deep Red	655	675	280	380	L1C1-
Red	624	634	35	49	L1C1-
Red-Orange	614	624	45	60	L1C1-
Amber	585	600	20	30	L1C1-
PC Amber	-	-	80	110	L1C1-
Mint	-	-	140	152	L1C1-
Lime	-	-	125	149	L1C1-
Green	520	540	90	141	L1C1-
Cyan	490	510	65	100	L1C1-
Blue	465	485	25	43	L1C1-
PC Blue	-	-	40	52	L1C1-
Royal Blue	440	460	480	552	L1C1-
Violet	420	430	480	595	L1C1-

# WHAT IS A MACADAM ELLIPSE?

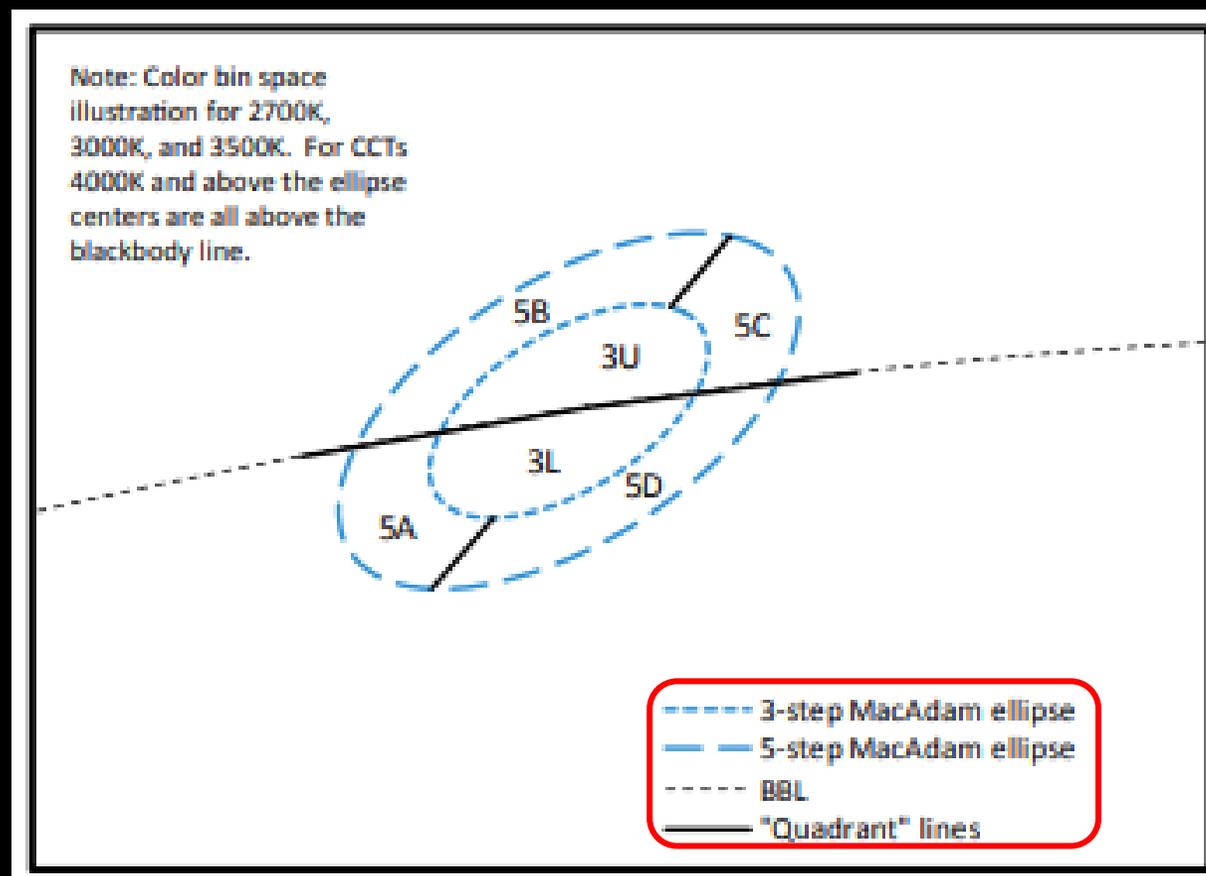
- *MacAdam Ellipse*
  - A region in a color diagram where color difference is indistinguishable to the average human



\*10-step ellipse

# BINNING

- Lets take a closer look at those bins...



# WHERE DOES THAT LEAVE YOU?

Binning can get you closer but still leaves a lot of potential variability

Bin sizes can vary depending on a number of factors including quantities needed and cost

# SO... WHAT'S NEXT?

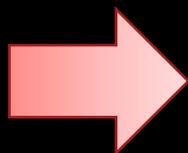
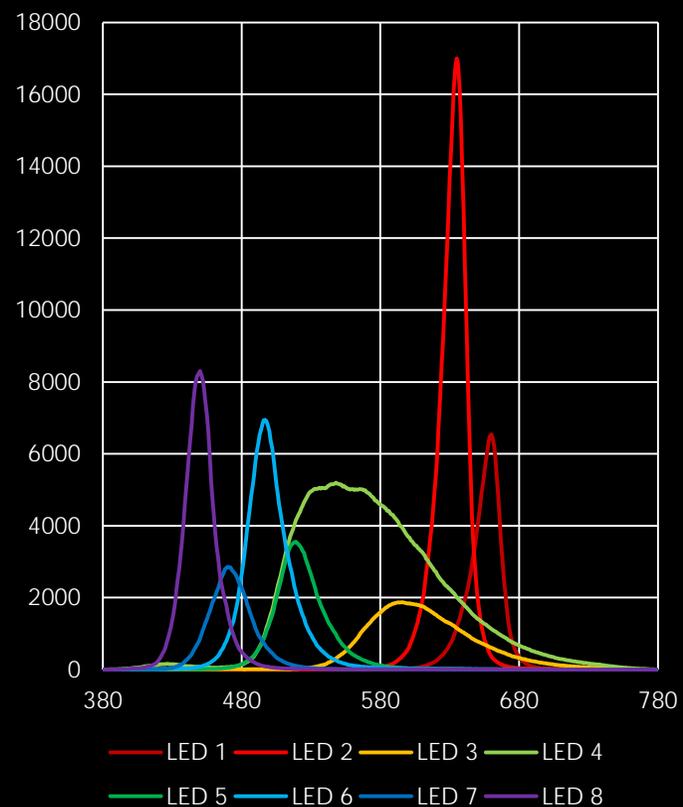
- Nothing
- Randomizing
- Calibration

NO  
CALIBRATION



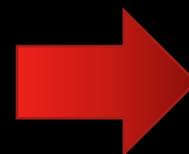
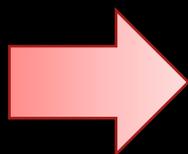
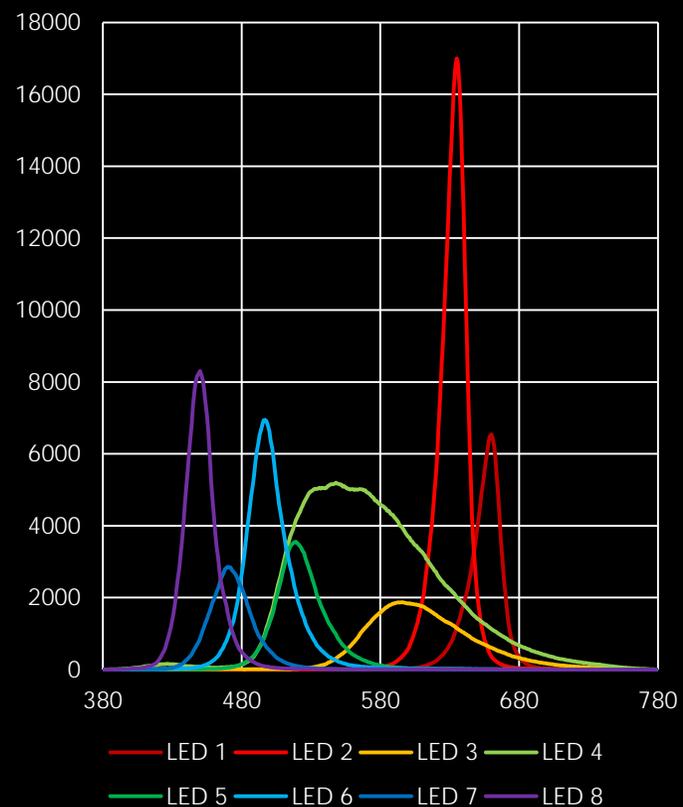
# WHAT IS CALIBRATION?

S4LED Series 3 Lustr



# WHAT IS CALIBRATION?

S4LED Series 3 Lustr



WITH CALIBRATION

QUESTIONS?

