LED Lighting and Astronomy/Ecology

- Shielding and Beam shaping
- Overlighting vs. Tuning of Levels
- Spectral Content

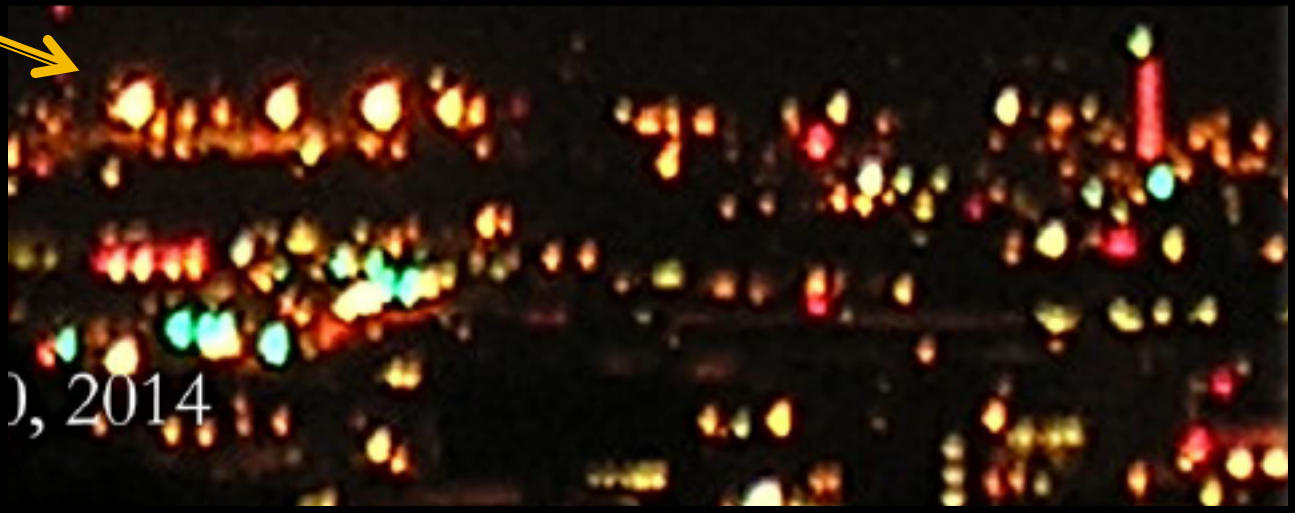
Shielding is critical

- Light must be directed downward
- Eliminate floodlights, wallpacks and other sources of glare and light pollution
- There is an efficient, cost effective and **properly shielded** LED replacement for almost every legacy lighting system

The Difference is Visible

No Excuses For Floodlighting!!!

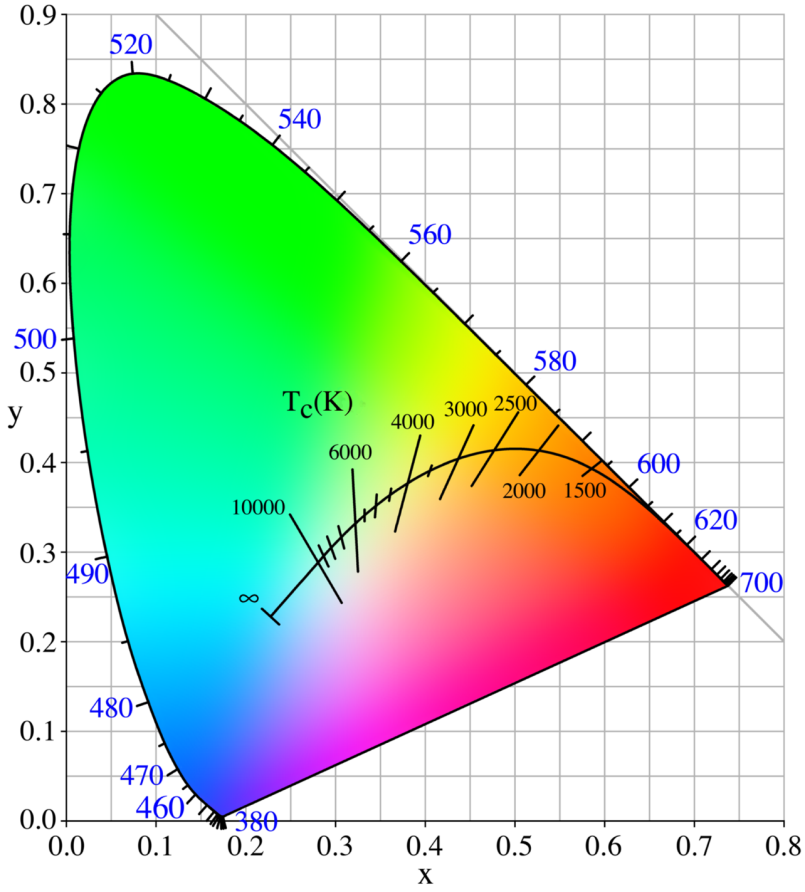
Can You Find TUS now?



VIEW FROM 15MILES AWAY
Before-Above; After - Below

Spectral Content Limits for Skyglow Controls are Inconsistent

- Chile : Max. 15% sub-500nm
- Cochise County AZ, Near LBT: 3000K CCT Max.
- Pima County AZ: 3500K CCT Max
- Canary Islands: Max. 15% sub-550nm



CCT is based upon Planckian Blackbody Radiator

S/P Ratio is a Better Metric

IEEE Photonics Journal — Approach to Solid-State Lighting Performance

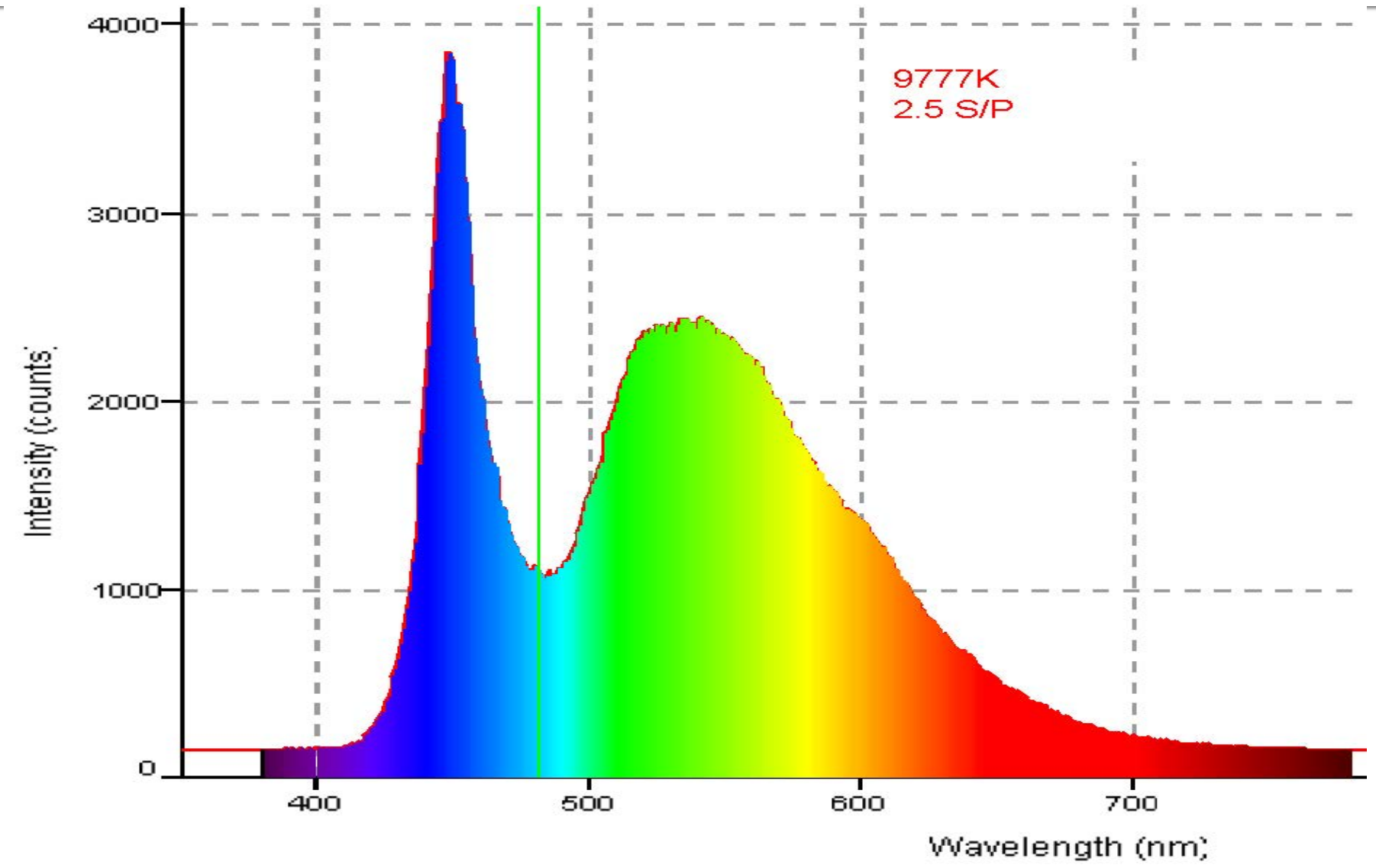
TABLE 1

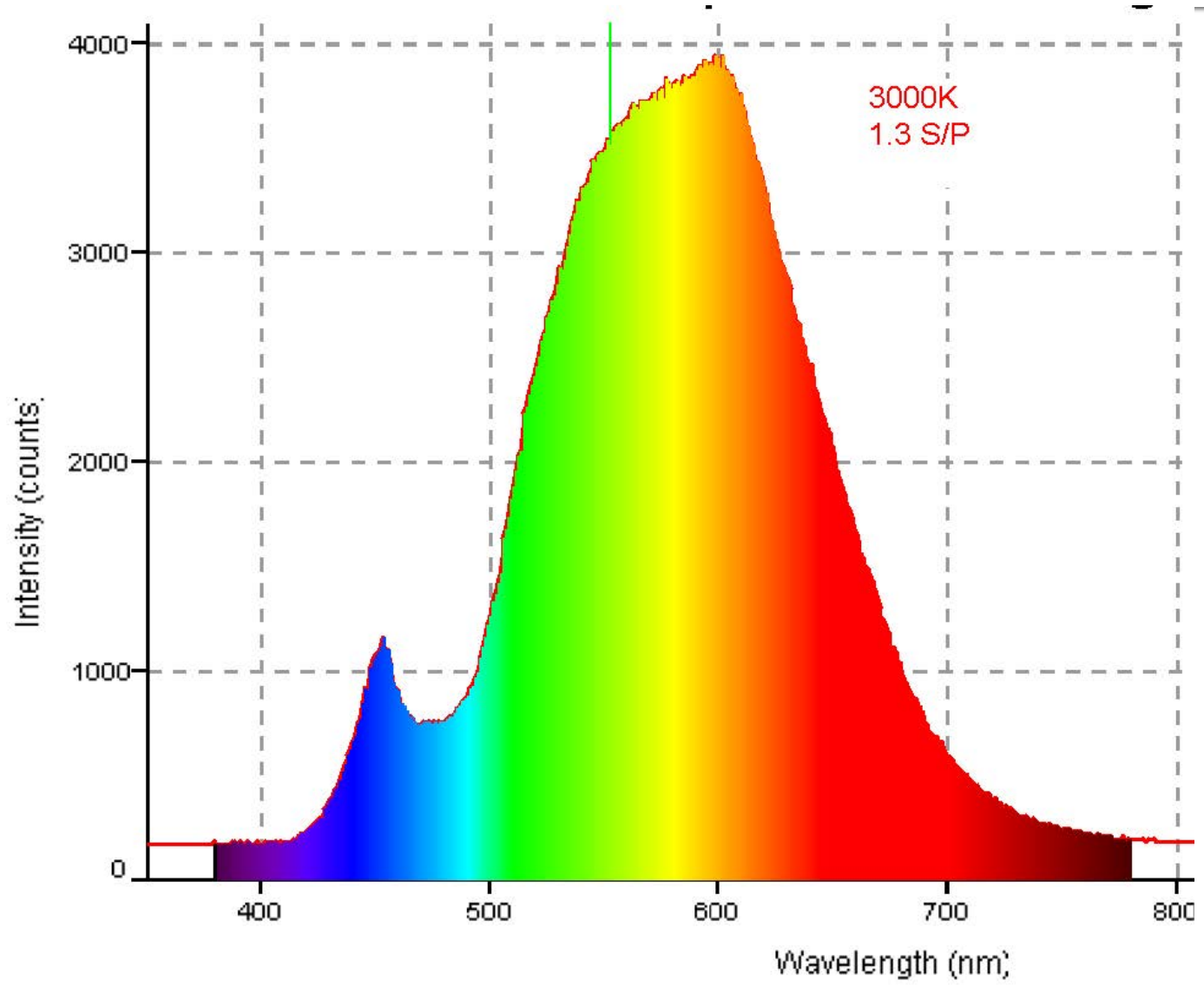
Photometric and colorimetric properties of the light sources

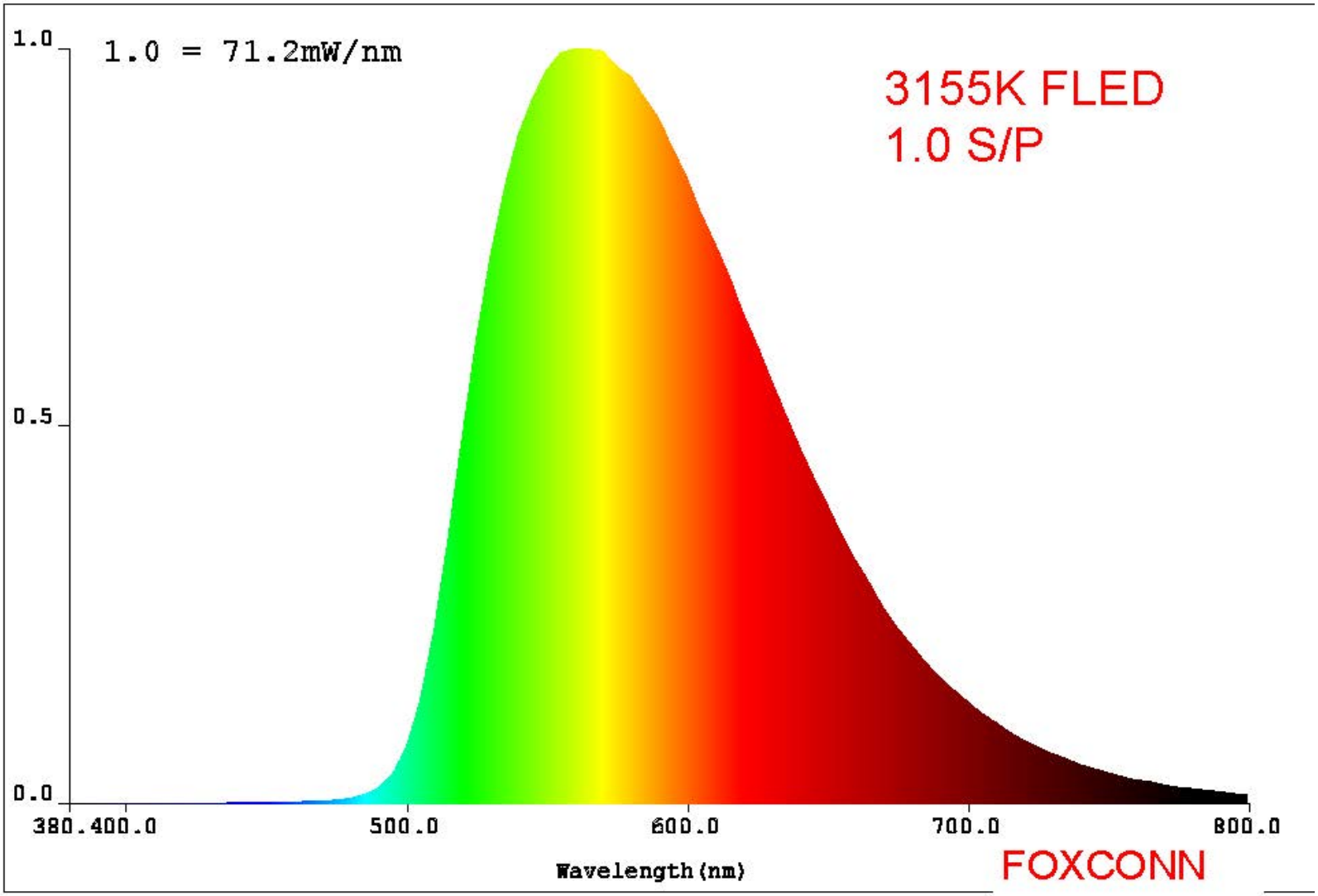
Light source	CCT (K)	Chromaticity coordinates		S/P	(M)LER (lm/W)		
		x	y		0.1 $\mathrm{cd/m^2}$	2 $\mathrm{cd/m^2}$	photopic
LPS lamp	1814	0.5669	0.4324	0.23	380	493	517
HPS lamp	1886	0.5390	0.4104	0.54	325	376	387
Firelight LED cluster	**1859**	**0.5424**	**0.4101**	**0.49**	**295**	**347**	**358**
Candlelight pc LED	2001	0.5215	0.4067	0.85	249	260	263
Warm white pc LED	2725	0.4582	0.4114	1.19	331	314	311
Cool white pc LED	3991	0.3839	0.3893	1.39	388	350	342
Daylight white pc LED	6084	0.3207	0.3287	1.92	414	332	314
CIE standard illuminant A	2854	0.4475	0.4074	1.41	178	160	156

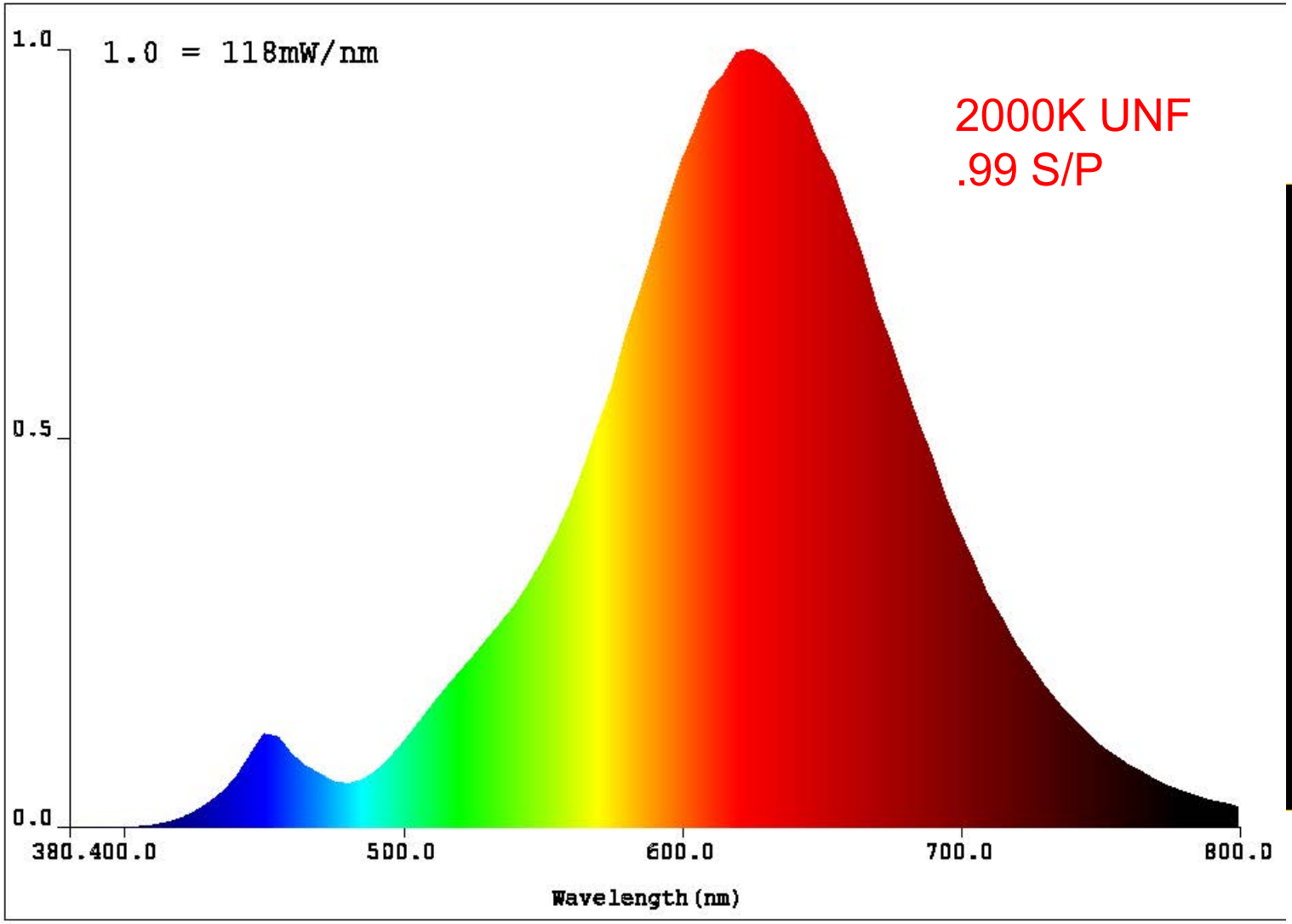
S/P Ratio is a Better Metric

- Readily Measurable as Part of CIE/IES Testing Format
- Accurate metric for blue and green content
- Cited in several LP related research papers
- Can be field verified for conformance with handheld meter

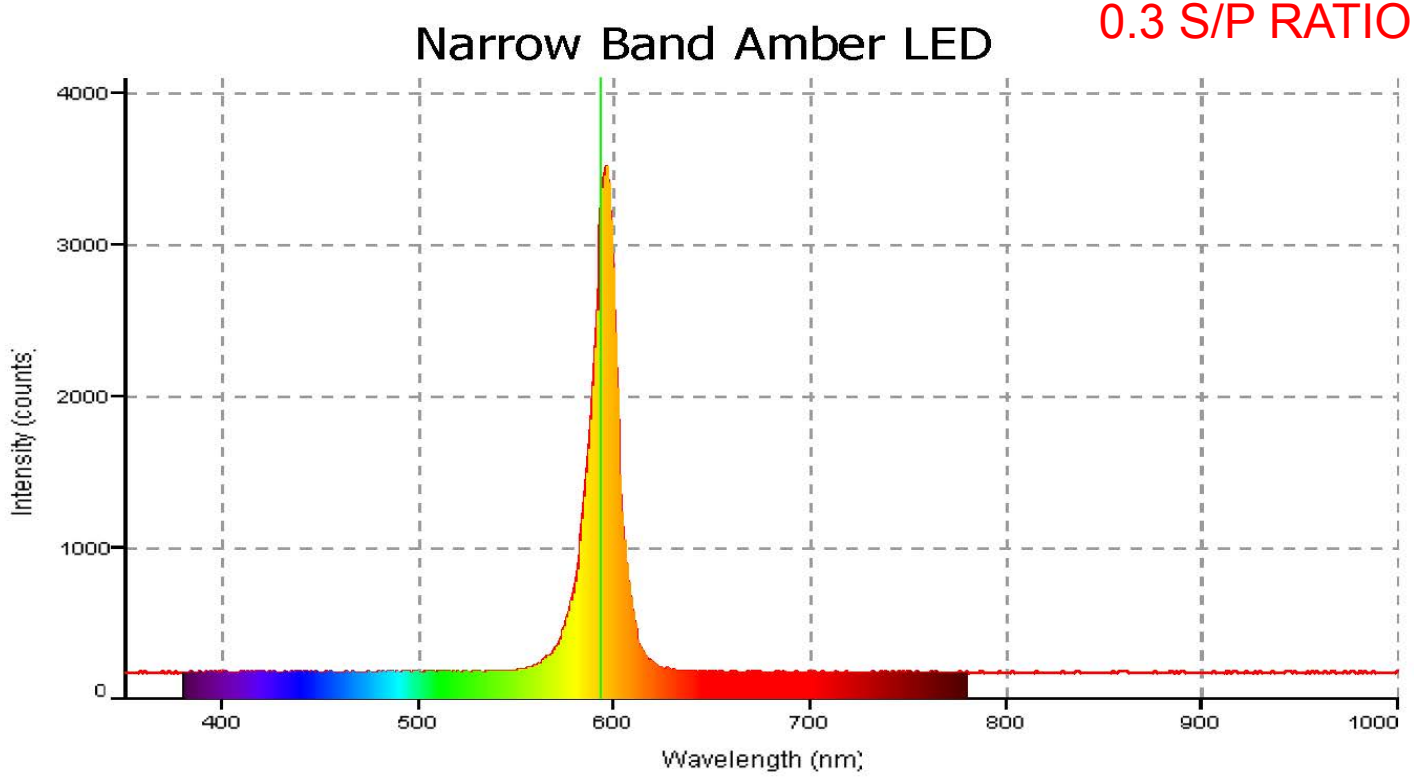

9777K
2.5 S/P
4000
3000
2000
1000
0
Intensity (counts)
400
500
600
700
Wavelength (nm)


3000K
1.3 S/P
4000
3000
2000
1000
0
Intensity (counts)
400
500
600
700
800
Wavelength (nm)


1.0
1.0 = 71.2mW/nm
3155K FLED
1.0 S/P
0.5
0.0
380.400.0
500.0
600.0
700.0
800.0
Wavelength(nm)
FOXCONN


1.0
1.0 = 118mW/nm
0.5
0.0
380.400.0
500.0
600.0
700.0
800.0
Wavelength(nm)
2000K UNF
.99 S/P

0.3 S/P RATIO



Narrow Band Amber LED

Another source : Hybrid 80/20 NBA/2700K