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Observer Metamerism

Toronto's Graphic Arts Day

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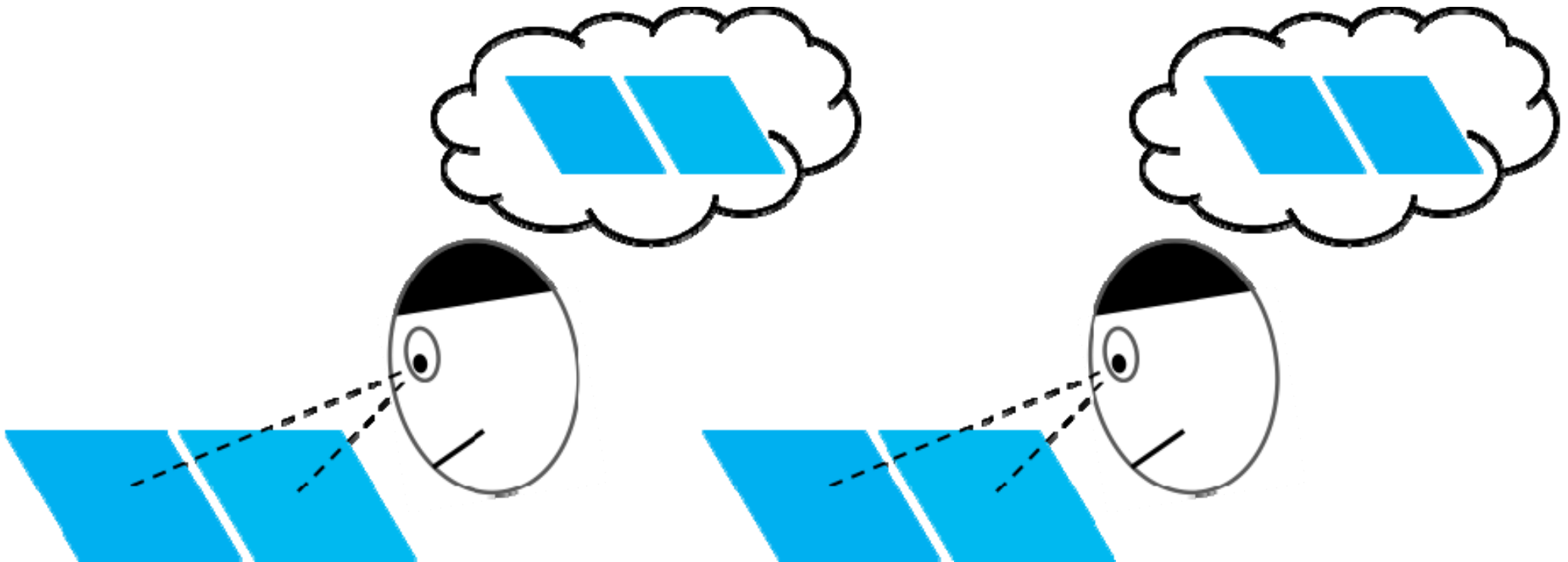
Overview

- **What is Observer Metamerism?**
- **How about in Digital World?**
- **Some More Research...**
- **How to Tackle the Problem?**
- **Result**
- **Conclusion**



What is Observer Metamerism?

- The phenomenon by which two materials that match under one circumstance appear different to different observers.





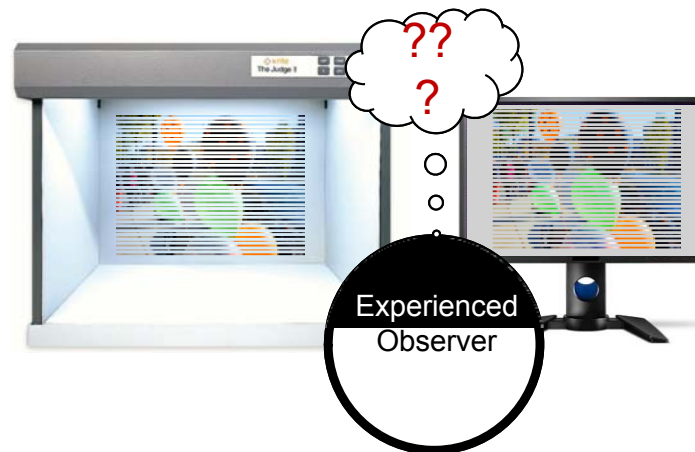
Example - Painting





How about in Digital World?

- **When BenQ 1st LED backlight color management monitor was announced in 2013.**
 - **Very exciting news!**
 - **Experienced users found out LED backlight monitor did not performed well in soft proofing scenario.**





Symptoms

- Variations in blue, green and pale yellow tones, for example.
- Difference in **perceived saturation**.

Overall
saturation is
different



Viewing Booth
(Simulated)



LED Backlight Monitor
(Simulated)

Slight hue
shift in blue

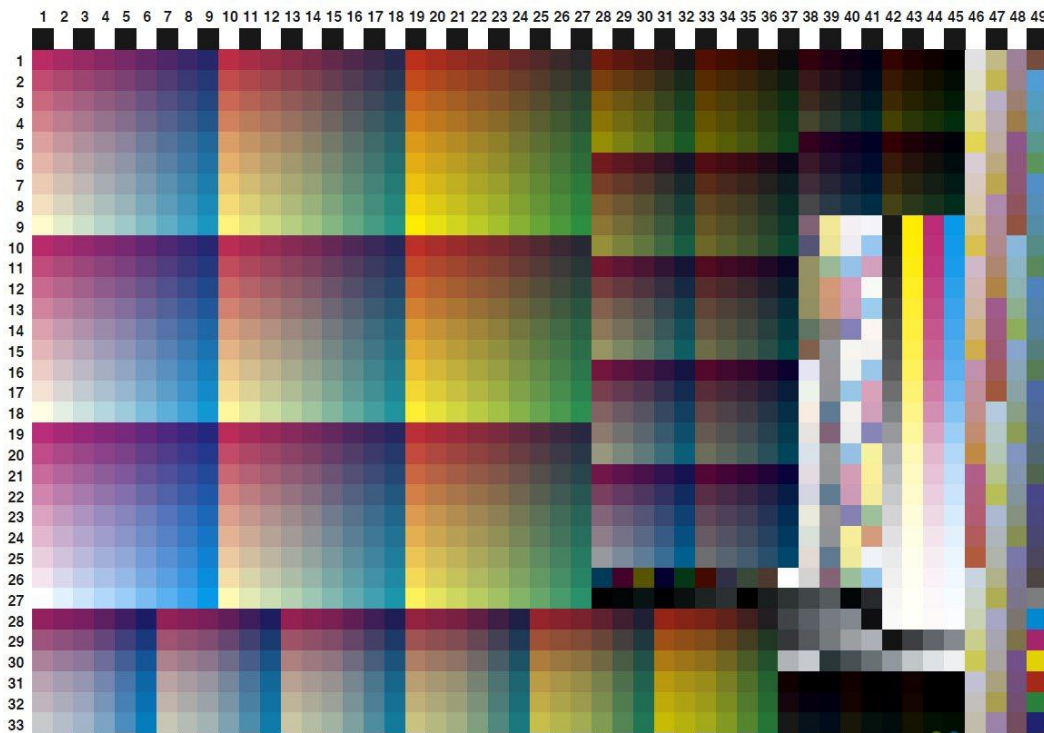
Slight hue
shift in green

Slight hue shift
in pale yellow



What was Wrong?

- ΔE_{00}^* is more or less the same...



Tested with IT8.7/4 1617 Patches:

- LED Monitor:
 - Avg. ΔE_{00}^* = 1.25
 - Max. ΔE_{00}^* = 4.35
- CCFL Monitor:
 - Avg. ΔE_{00}^* = 1.20
 - Max. ΔE_{00}^* = 4.25

Not much difference from the values alone.

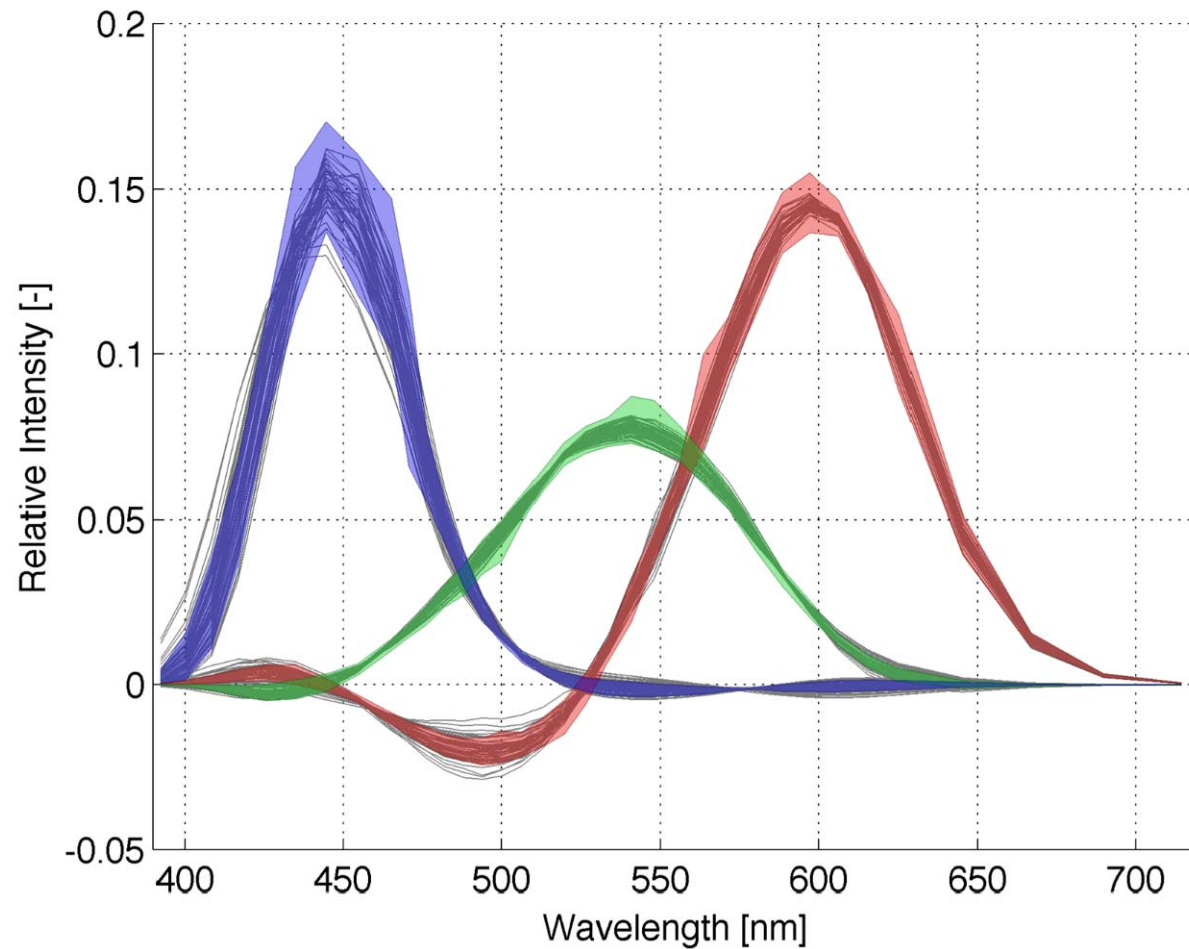


Some More Research...

- **CIE Report*** suggested:
“A potential practical solution is to implement an observer-dependent color imaging workflow at the device level. ... Conceptually this is similar to the device-dependent color imaging, a well-established color management concept. “
- **But no spectral color management workflow was established at that time.**
- **Only Standard Observer could be applied.**



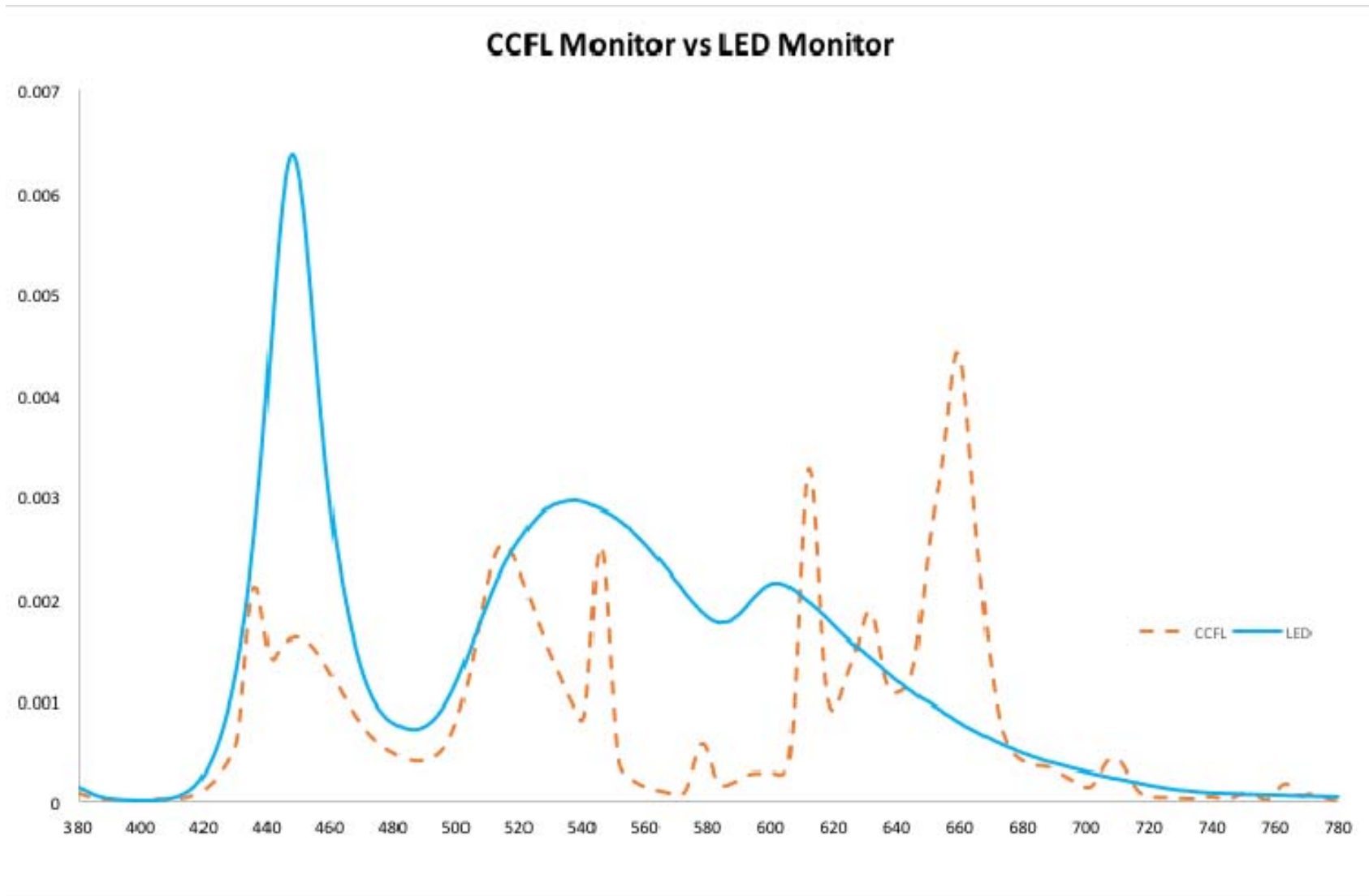
Observer Variations



*Y. Asano, MSCL, RIT, USA <http://www.cis.rit.edu/~yxa8513/Research.html>

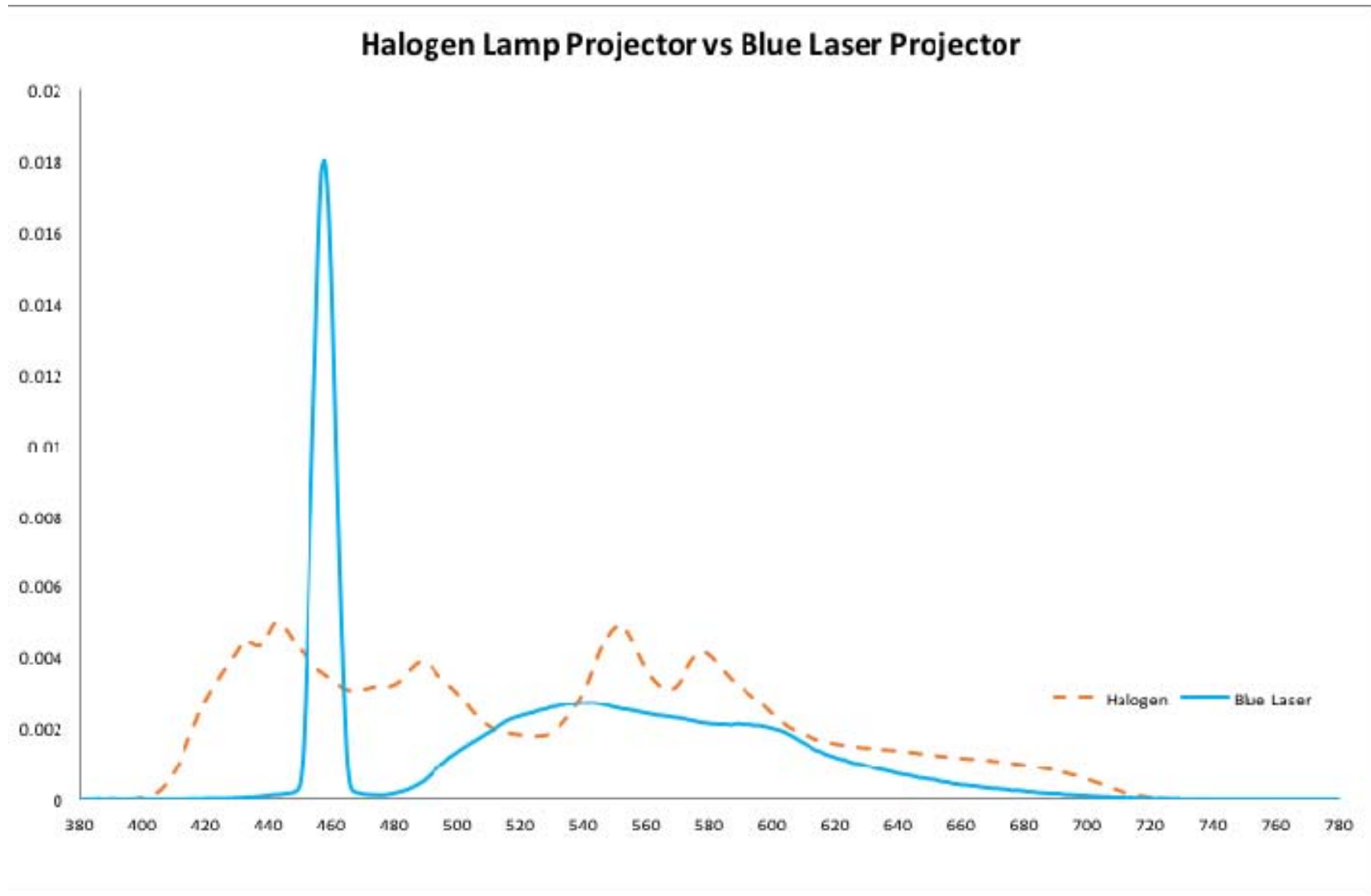


Narrow-band vs Broad-band Light Source





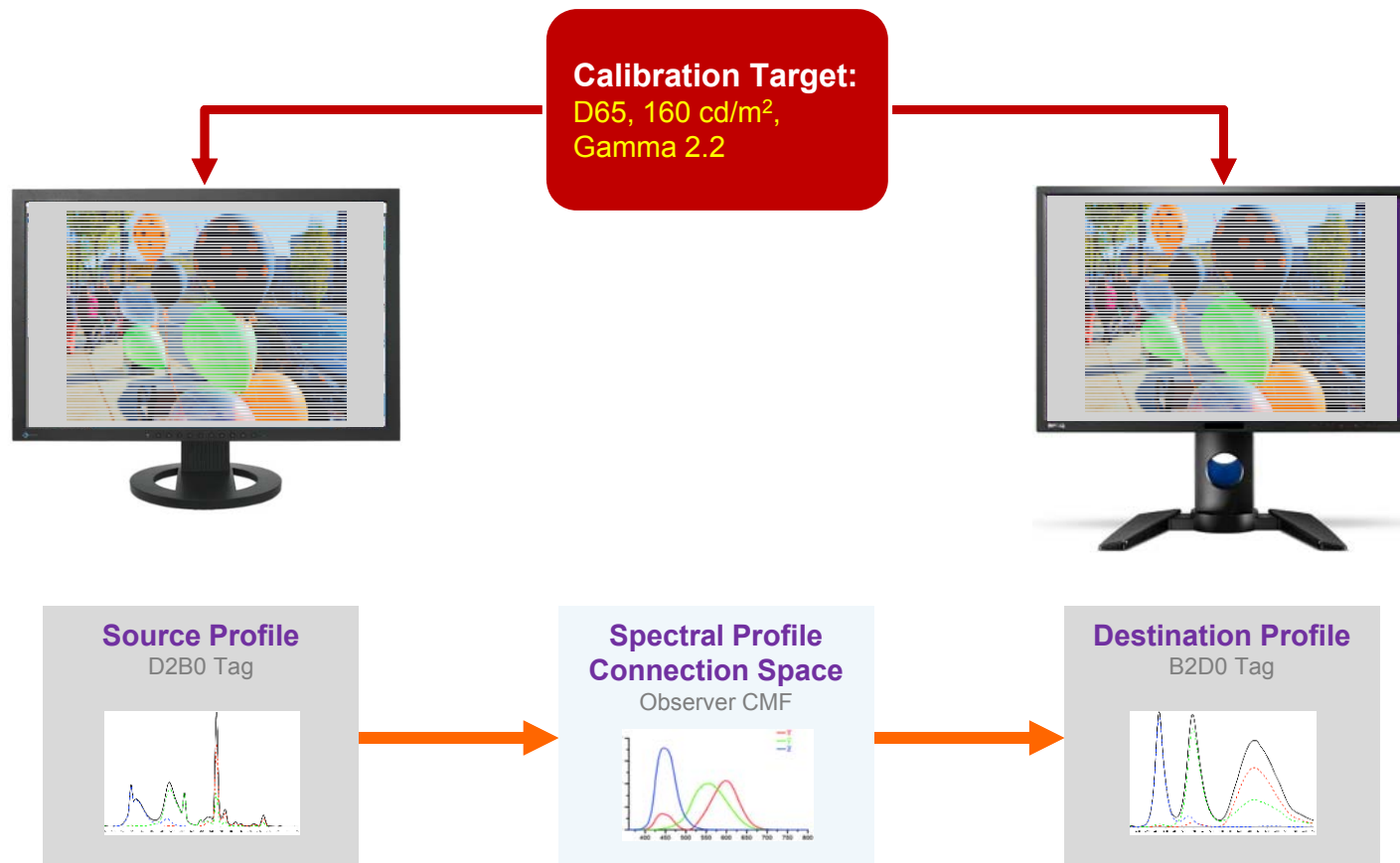
Narrow-band vs Broad-band Light Source





How to Tackle the Problem?

- Apply **iccMAX** Workflow!





Test Images



Test Image 1



Test Image 2



Test Image 3



Test Image 4



Test Image 5



Test Image 6



Test Image 7



Test Image 8



Result



Test Image 1



Test Image 2



Test Image 3



Test Image 4

BEFORE	No. of Acceptable	7	9	3	4
	No. of Unacceptable	5	3	9	8
	Rate of Acceptable	58.3%	75.0%	25.0%	33.3%
AFTER	No. of Acceptable	9	10	8	6
	No. of Unacceptable	3	2	4	6
	Rate of Acceptable	75.0%	83.3%	66.7%	50.0%
Improvement		+16.7%	+8.3%	+41.7%	+16.7%



Result



Test Image 5



Test Image 6



Test Image 7



Test Image 8

BEFORE	No. of Acceptable	4	8	6	5
	No. of Unacceptable	8	4	6	7
	Rate of Acceptable	33.3%	66.7%	50.0%	41.7%
AFTER	No. of Acceptable	3	10	9	6
	No. of Unacceptable	9	2	3	6
	Rate of Acceptable	25.0%	83.3%	75.0%	50.0%
Improvement		-8.3%	+16.6%	+25.0%	+8.3%



What Do Images Look Like for One Observer?



Before



Before



Before



Before

Test Image 1



Original

Test Image 2



Original

Test Image 3



Original

Test Image 4



Original



After



After



After



After



What Do Images Look Like for One Observer?



Before



Before



Before



Before

Test Image 5



Original

Test Image 6



Original

Test Image 7



Original

Test Image 8



Original



After



After



After



After



Conclusion

- **Observer Metamerism was improved after utilizing iccMAX workflow.**
 - Blue and green tones
 - Saturated colors
- **Some area still needs further investigation:**
 - Pale and low brightness colors
 - Skin tone
 - Red tones
- **Overall, with proper adjustment, iccMAX is the key to solve observer metamerism on narrow band emission devices.**



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**Thank You for Your
Attention!**