COSI Computational Colour and Spectral Imaging

"Advanced Colour and Spectral Imaging"

Chapter 1: Why spectral science & technology?

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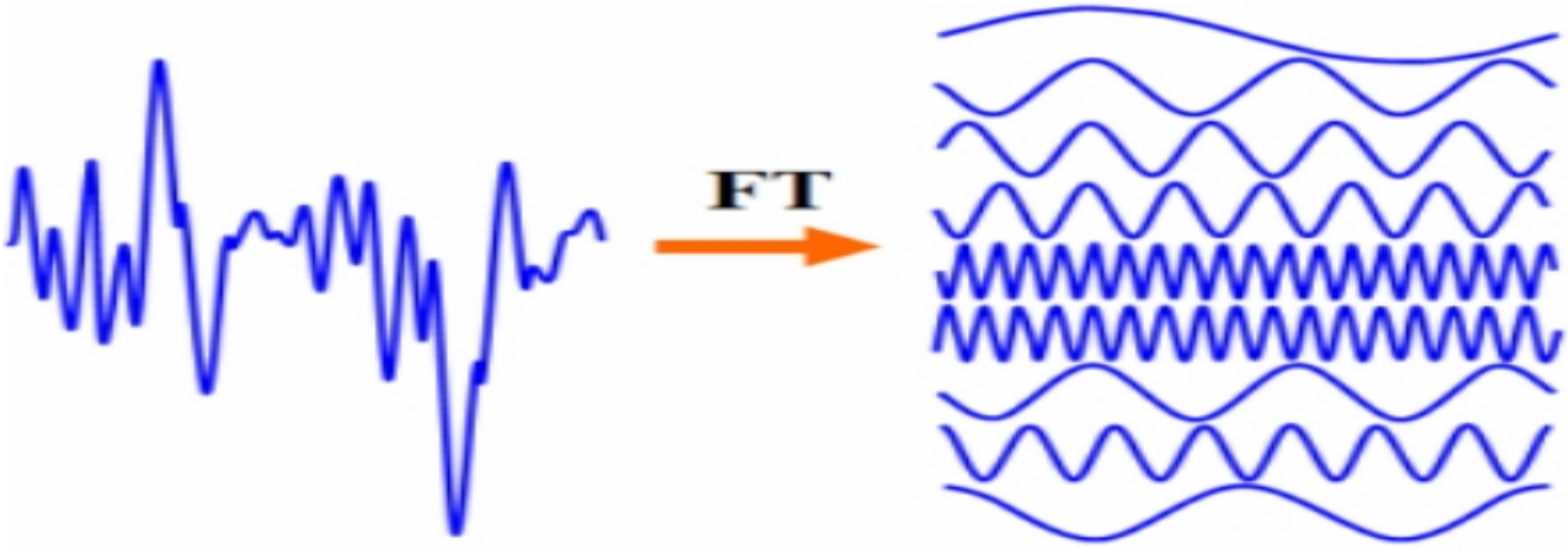
Do we see spectra?

Do we hear spectra?



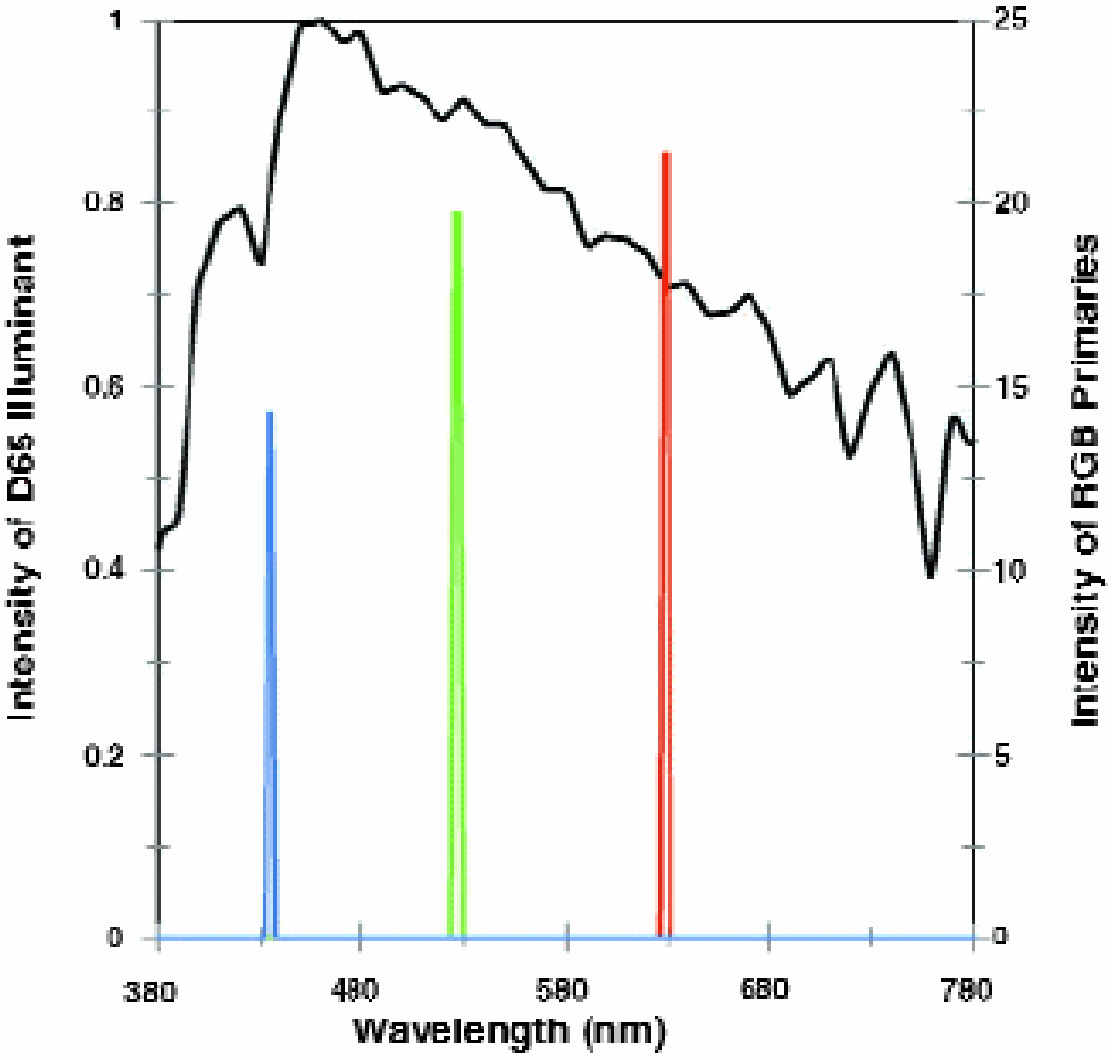
Do we hear spectra?

Our ears-brain system “similar” to a Fourier transformation. A mathematical function of time is turned into series of different frequencies.

Joseph Fourier (podcast): www.bbc.co.uk/programmes/b00ss0l9

Curiosity paper: Human Time-Frequency Acuity Beats the Fourier Uncertainty Principle (arxiv.org/pdf/1208.4611.pdf)

Do we see spectra?



Do we see spectra?
Do we discriminate monochromatic lights?

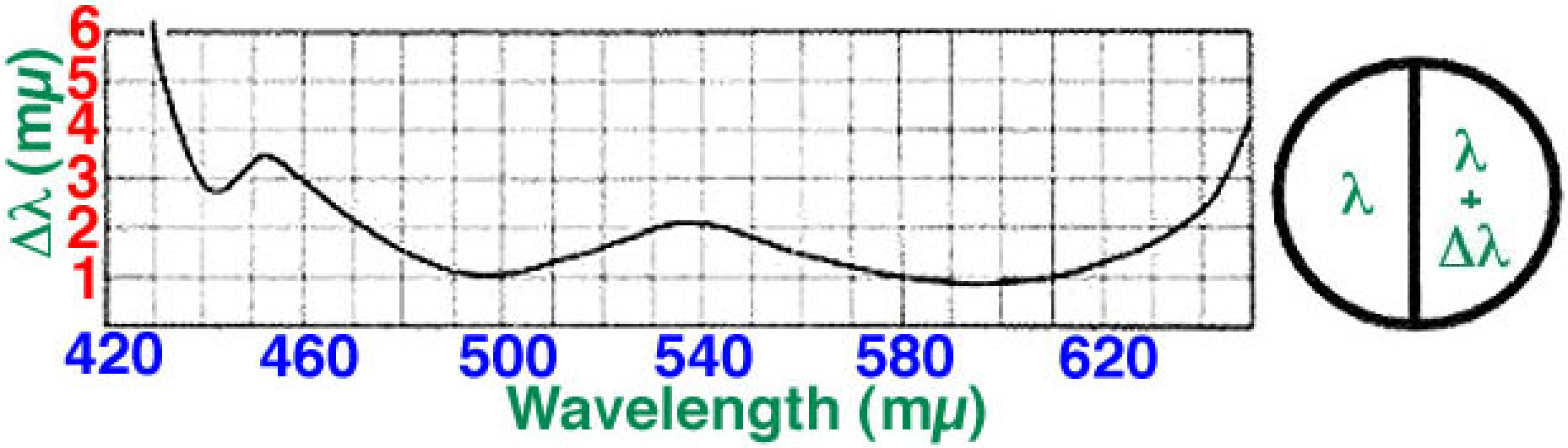
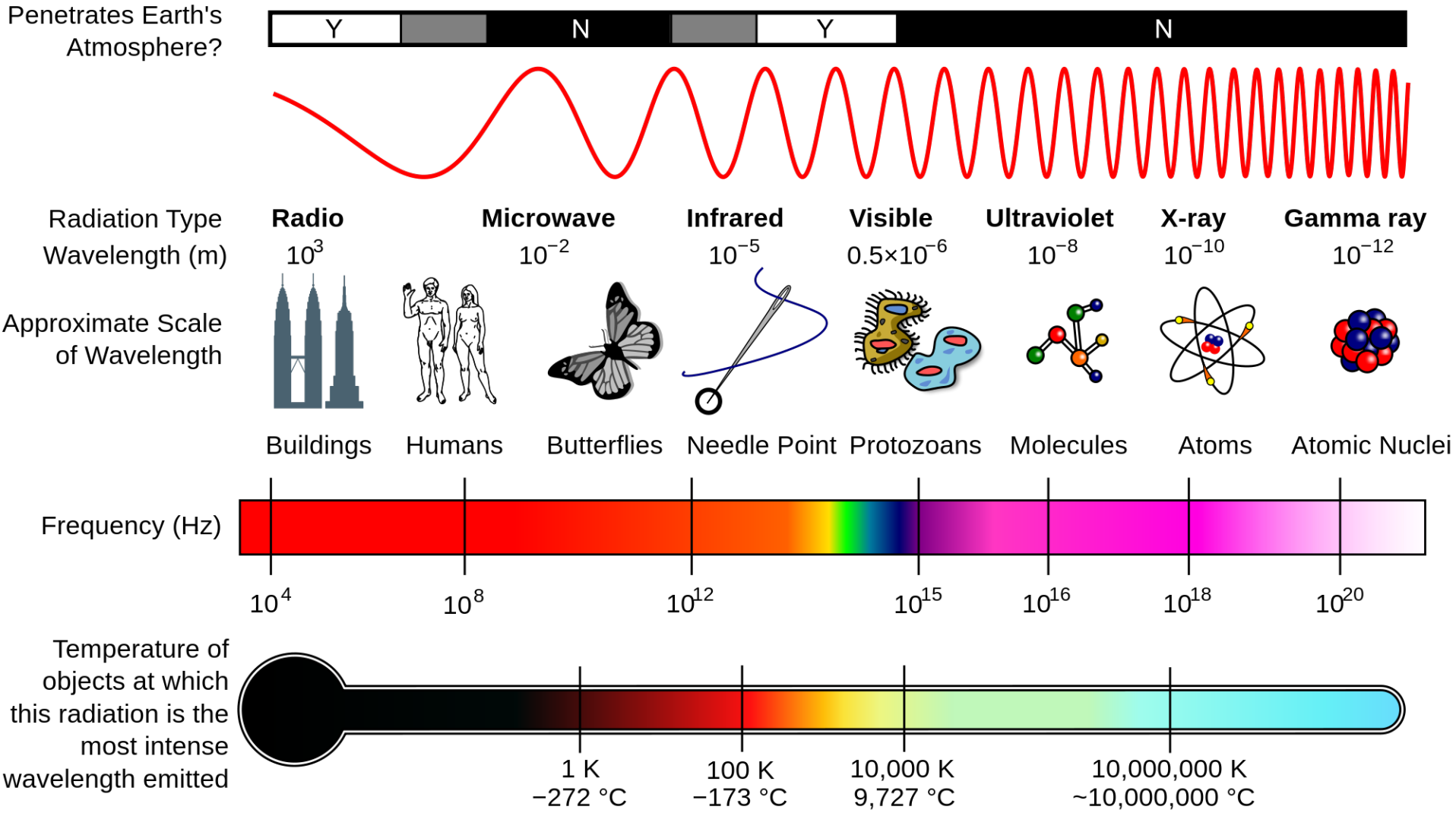


Figure 13. Mean wavelength discrimination curve. (From Davson, H., The Eye, vol 2. London, Academic Press, 1962).

Limitations of our HVS?

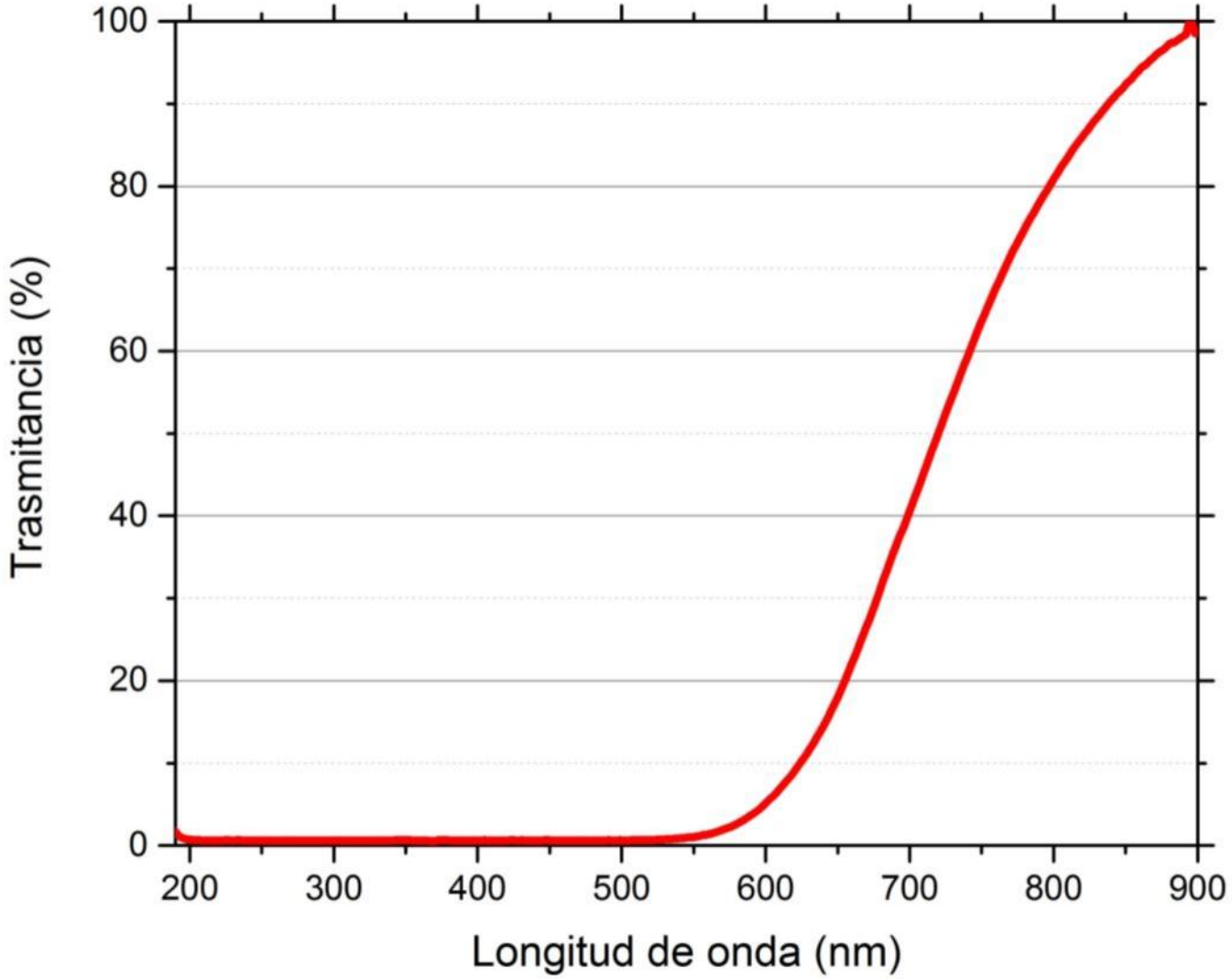


Do we see infrared?

However: https://source.wustl.edu/2014/12/the-human-eye-can-see-invisible-infrared-light/

Do we see infrared?

Do we see infrared?



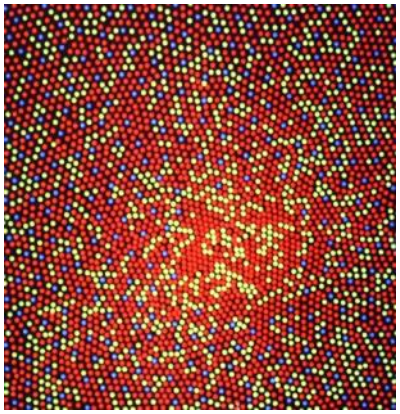
Do we see ultraviolet?

What about the visible spectrum?

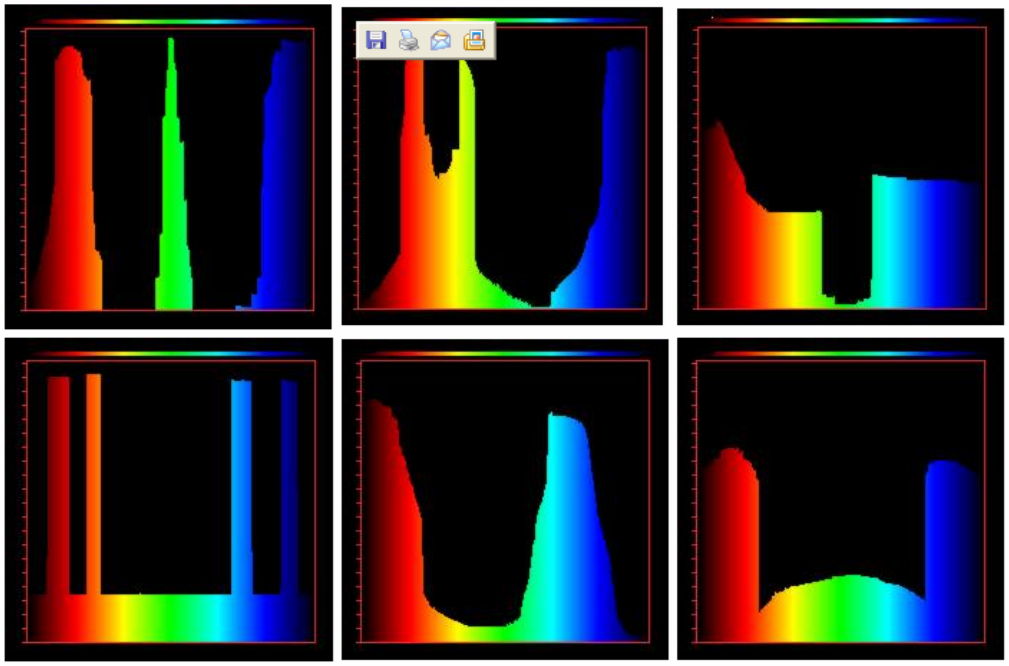
Univariance principle?

Trichromatic color vision?

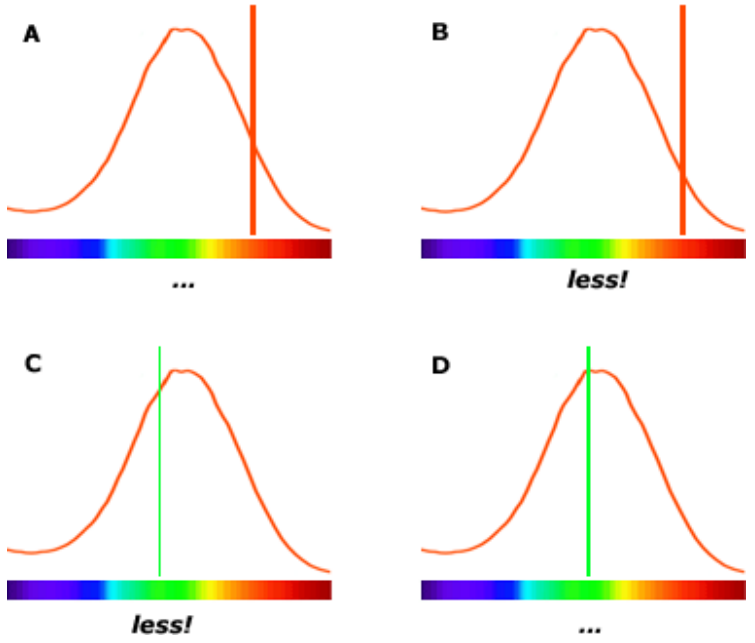
Metamerism?



The six spectra below look the same purple to normal color-vision people =>



Spectra obtained using a simulation by Hughes, Bell and Doppelt (Brown University)



What about the visible spectrum?

Tetrachromatic vision?

FROM THE JULY-AUGUST 2012 ISSUE

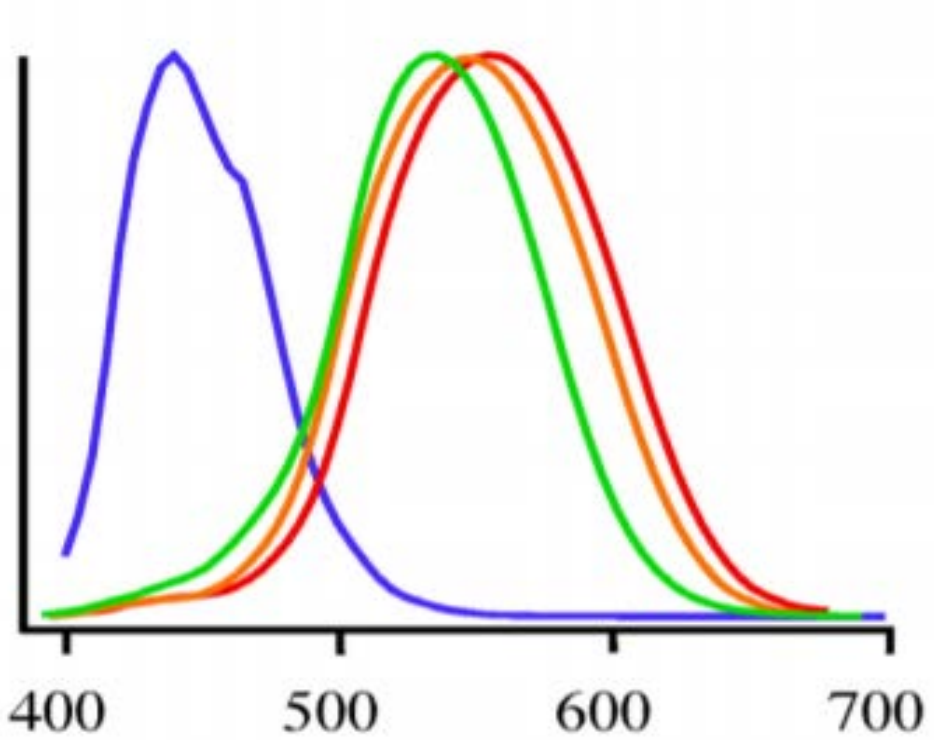
The Humans With Super Human Vision

An unknown number of women may perceive millions of colors invisible to the rest of us. One British scientist is trying to track them down and understand their extraordinary power of sight.

By Veronique Greenwood | Monday, June 18, 2012

RELATED TAGS: SENSES

1.9K



http://www.tenthousandthings.info/

What about the visible spectrum?

Other animals?

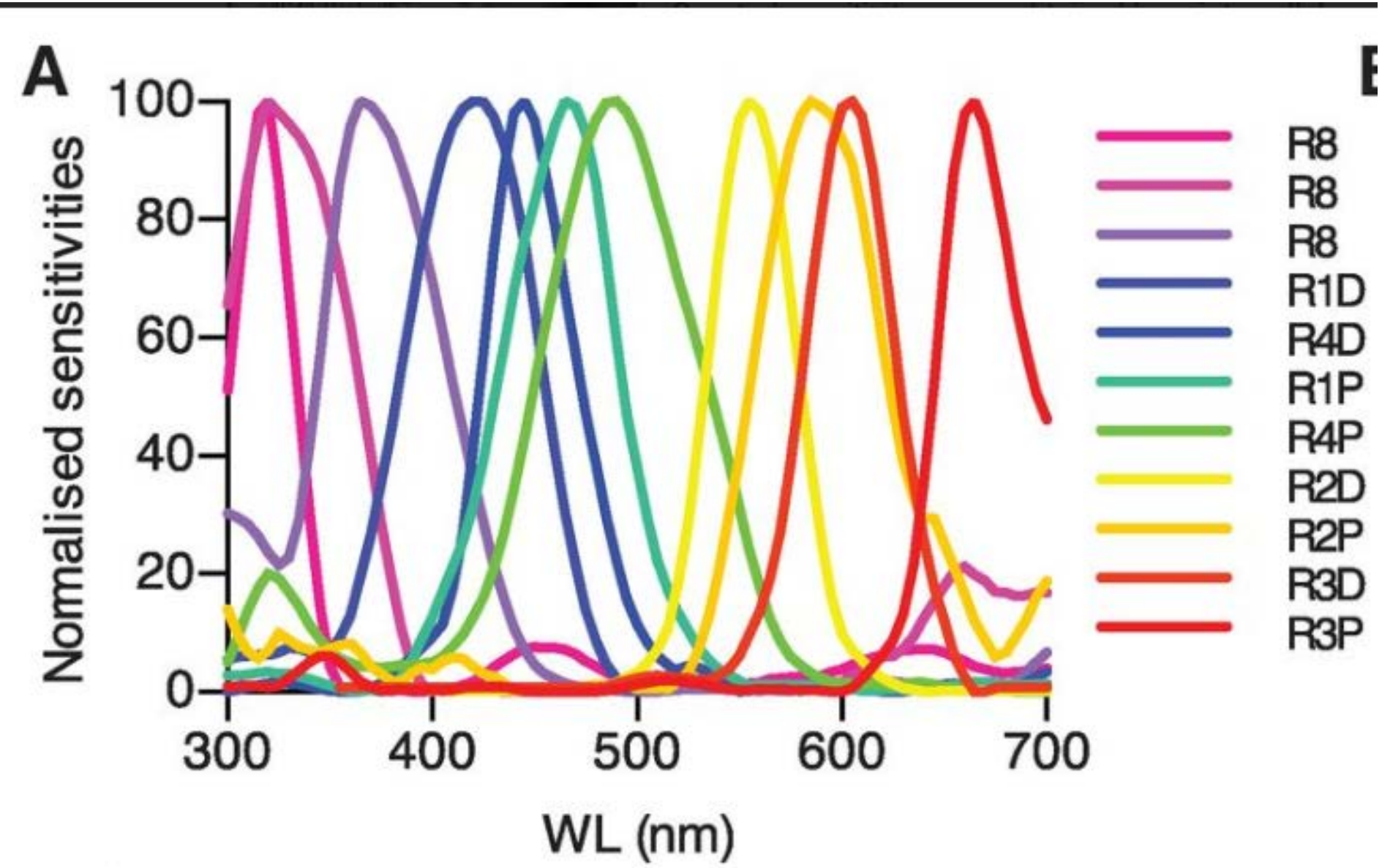
Mantis shrimp
12 photoreceptors

Butterfly
"Graphium sarpedon"
15 photoreceptors

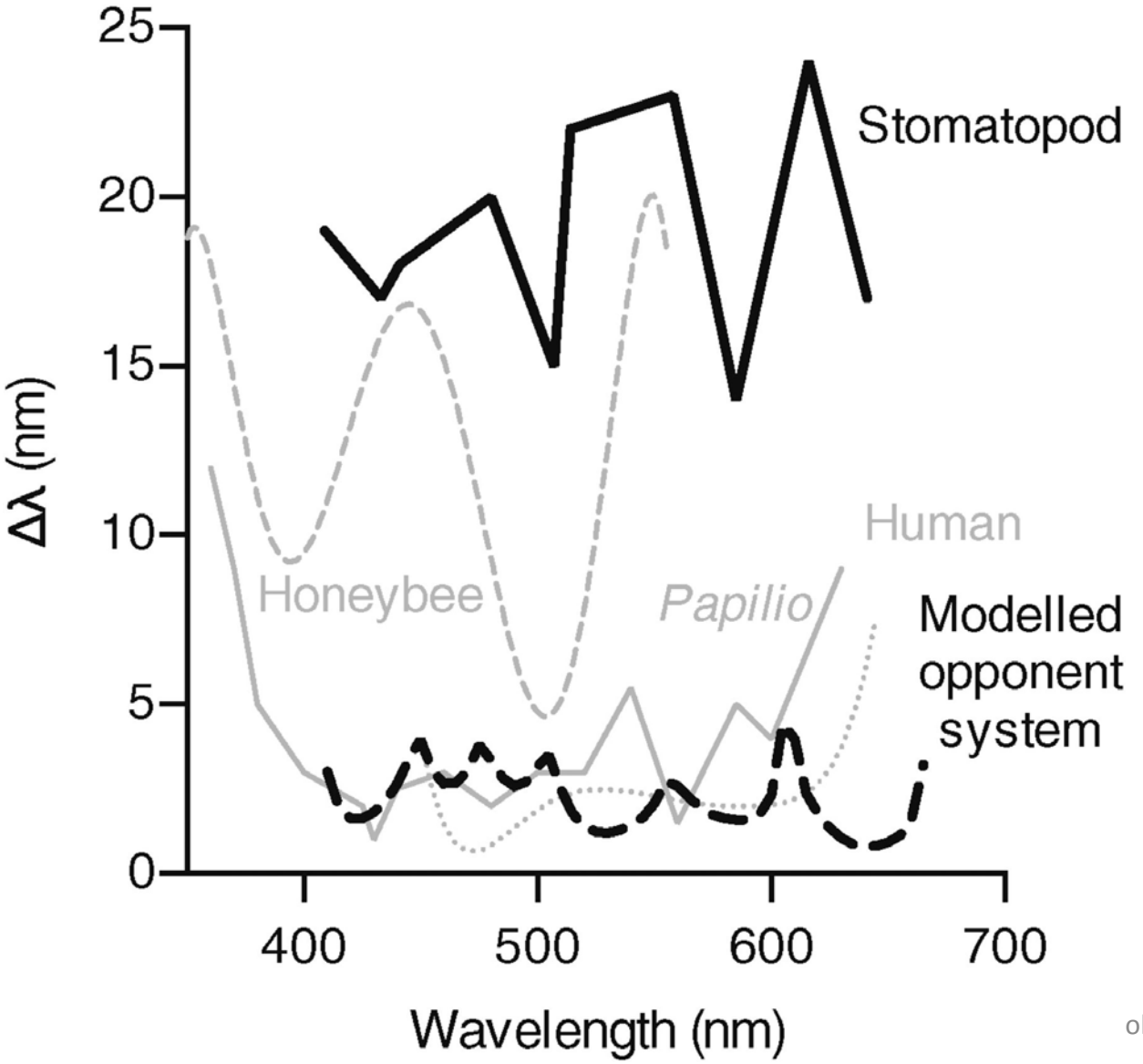
To know more:

http://www.nature.com/news/mantis-shrimp-s-super-colour-vision-debunked-1.14578#/b1
http://science.sciencemag.org/content/343/6169/411.full
http://journal.frontiersin.org/article/10.3389/fevo.2016.00018/full

Mantis shrimp (12 photoreceptors)

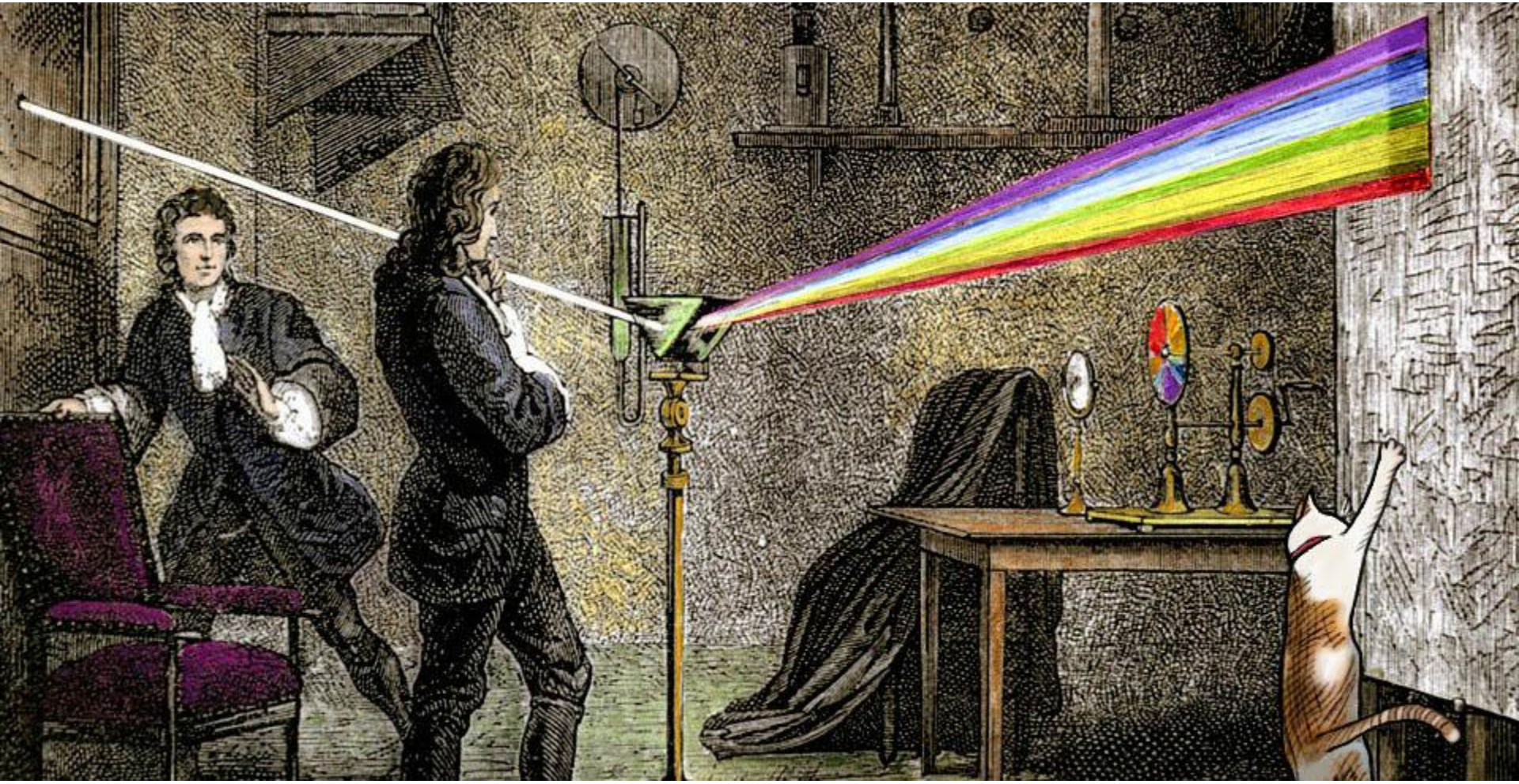


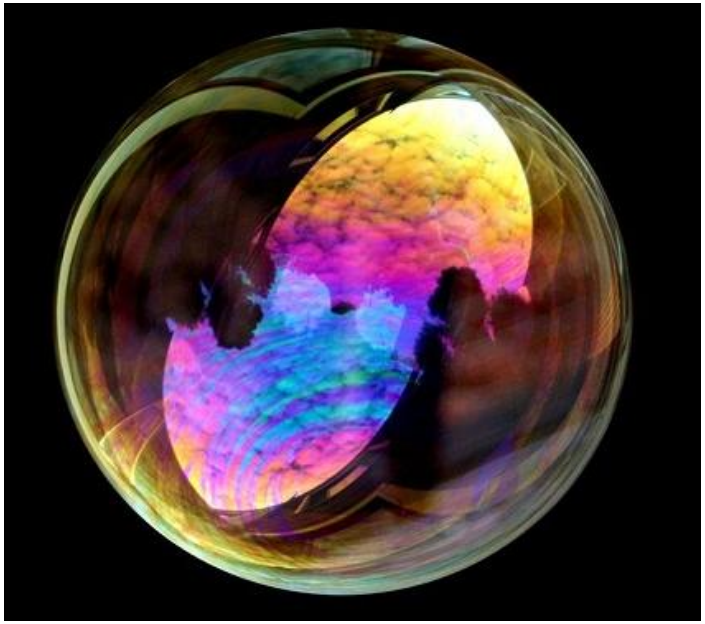
Do we discriminate monochromatic lights?



Spectral discrimination curves (Δλ/λ) from "A Different Form of Color Vision in Mantis Shrimp", 2014.

What about the visible spectrum?





What the spectrum can reveal?

Spectral signature?

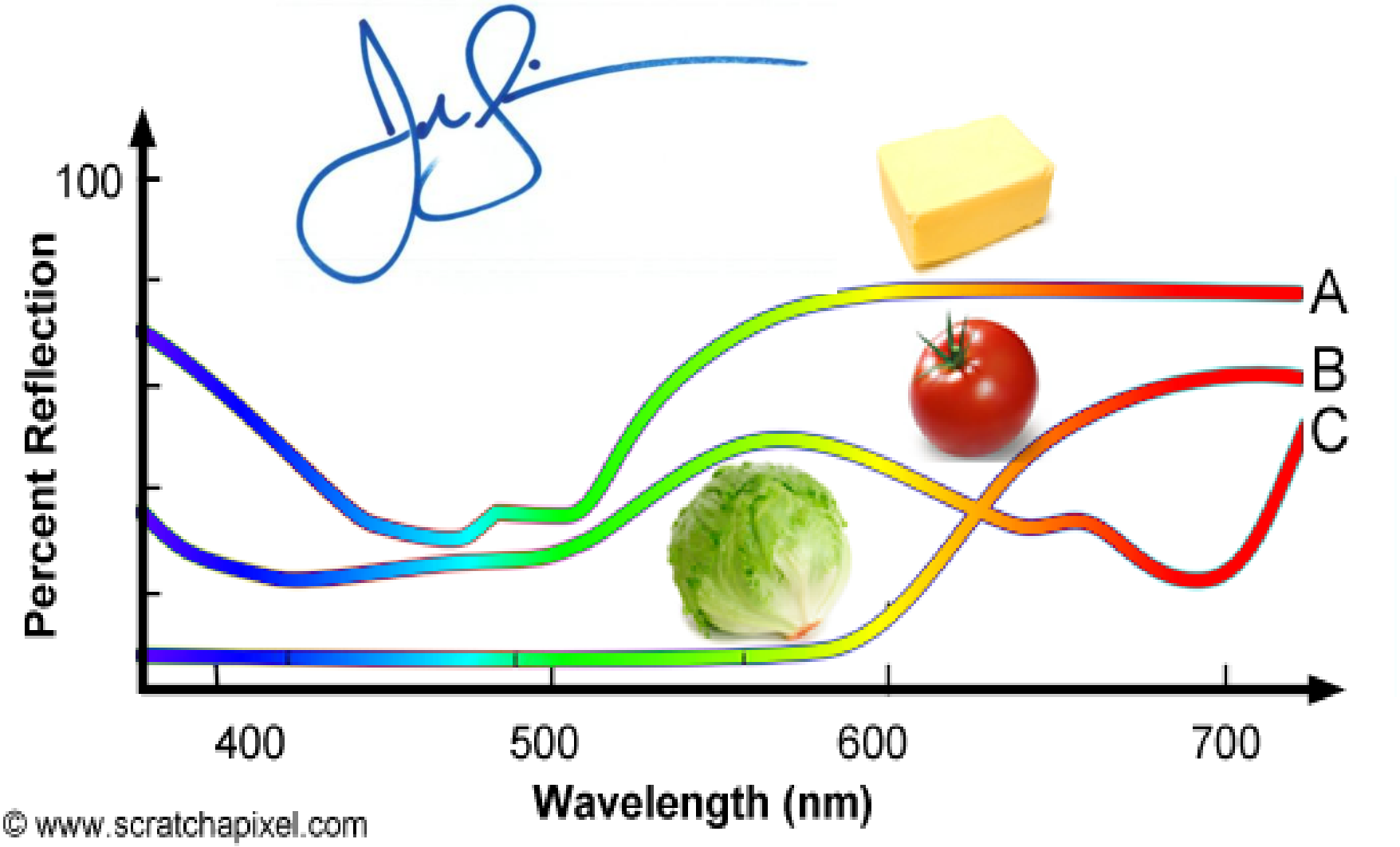
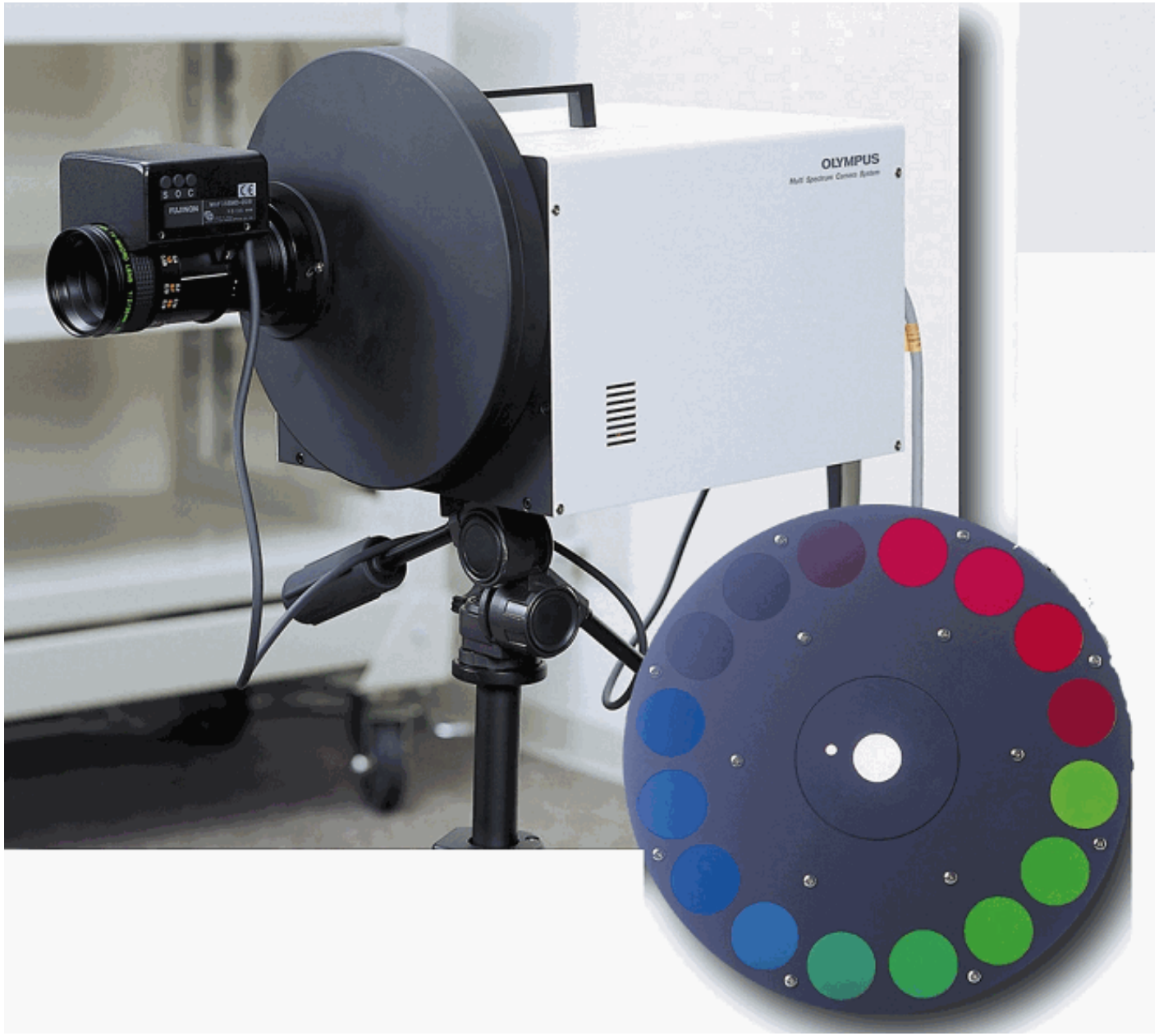
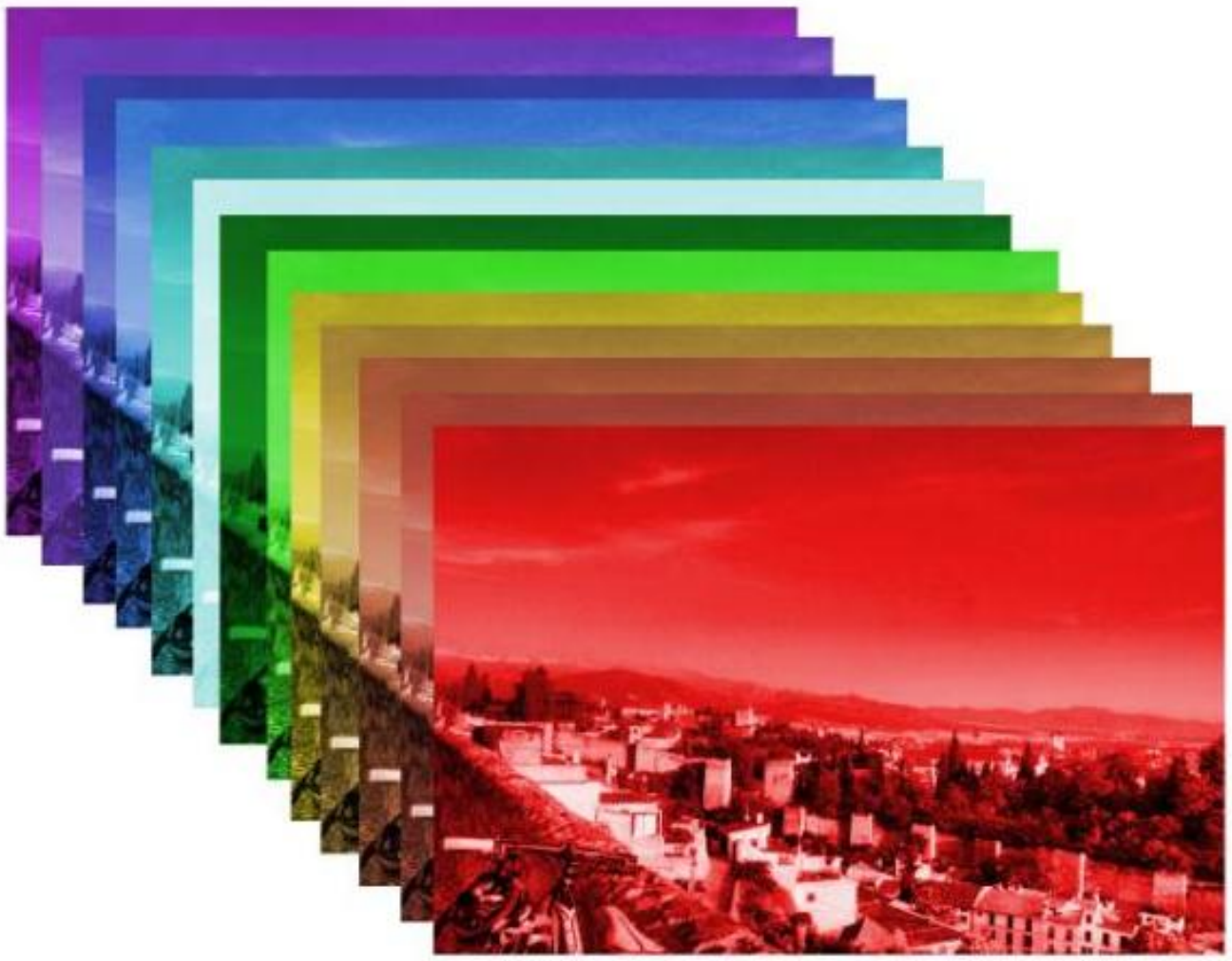


Imagen original

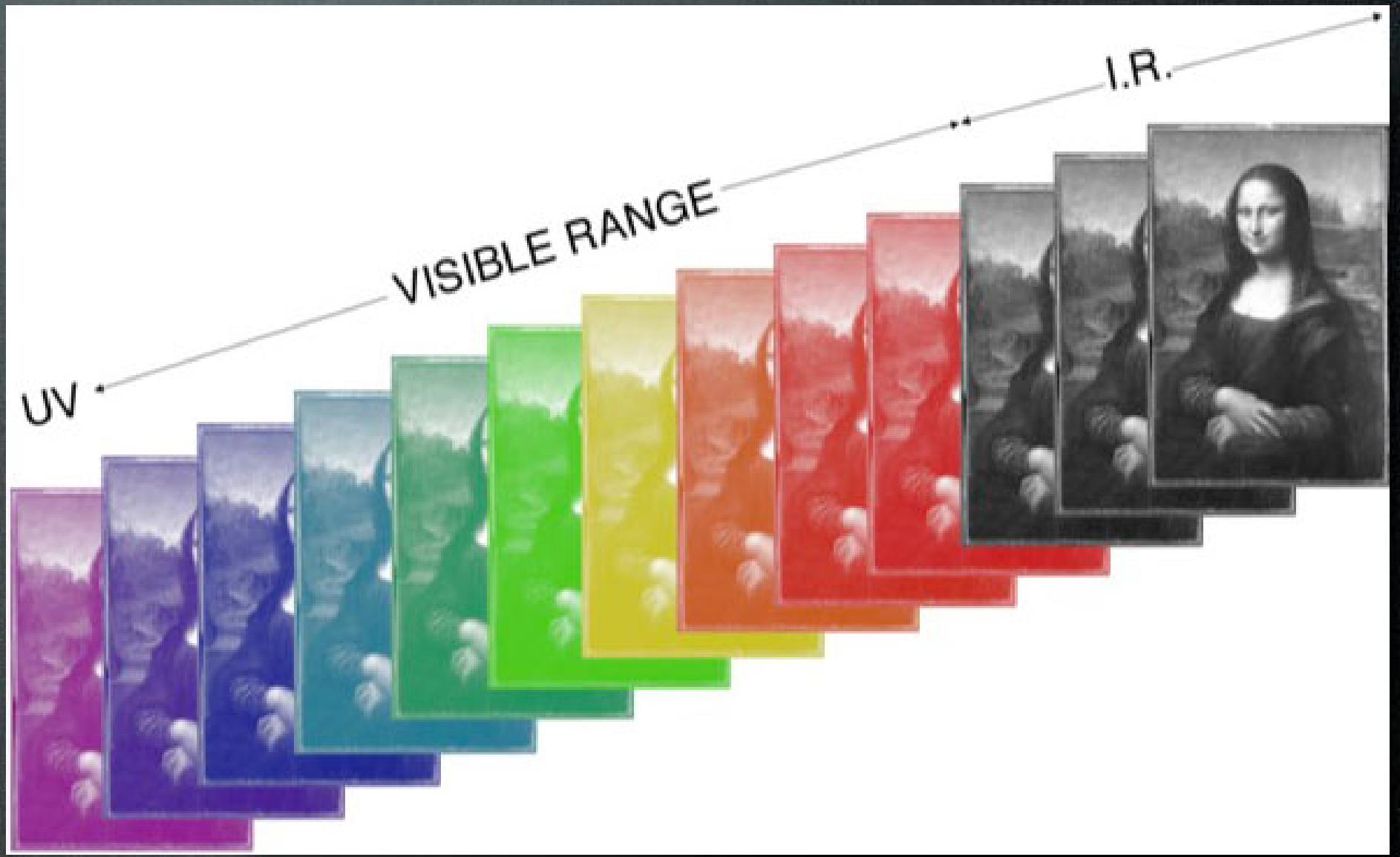
3 canales de color
(RGB convencional)


OLYMPUS



36 canales de color
(nuevo sistema)

Applications: art restoration



Applications: art restoration


325–385 nm


400 nm


335–610 nm


Color

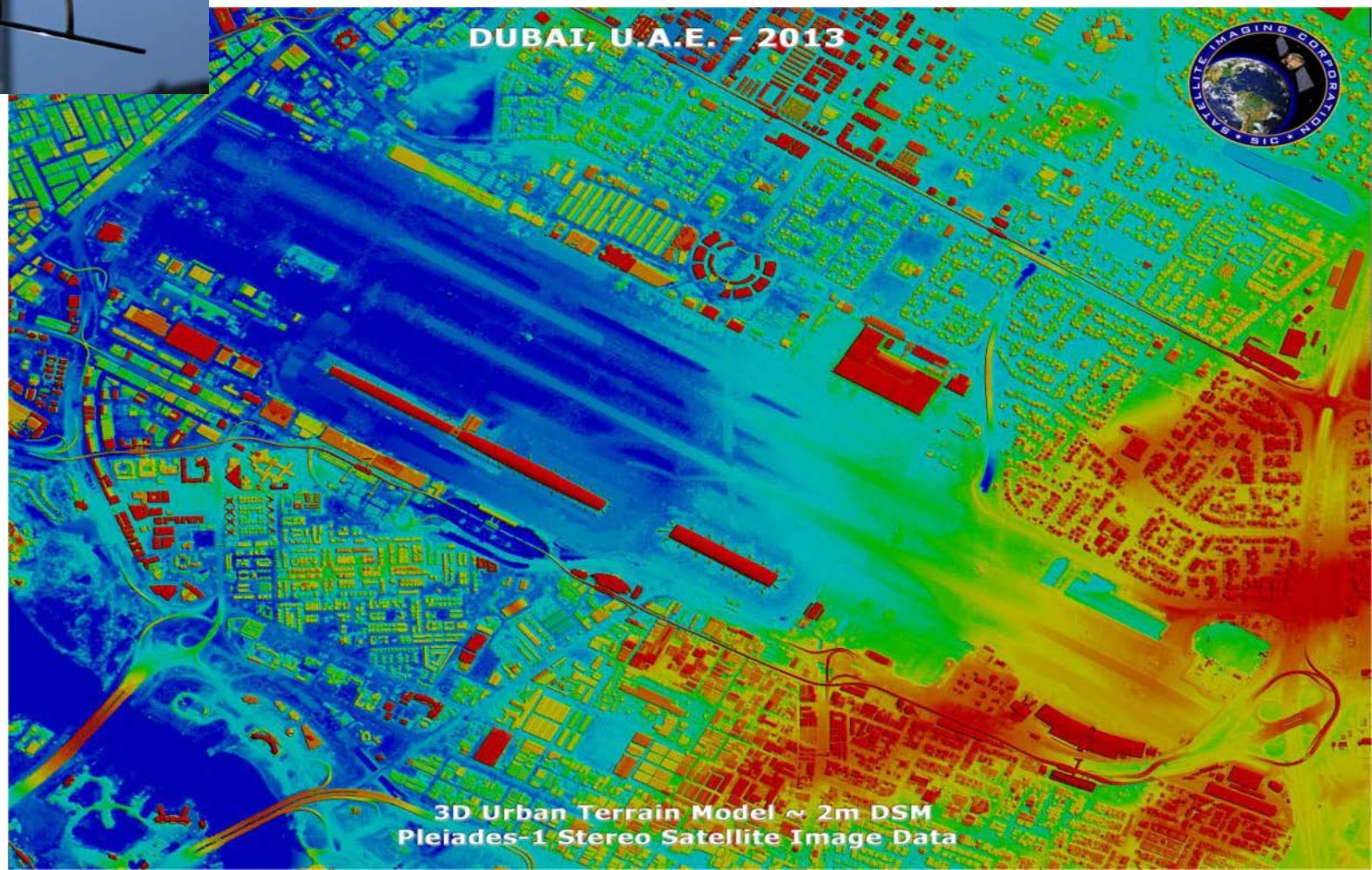

385 nm


420 nm


500 nm

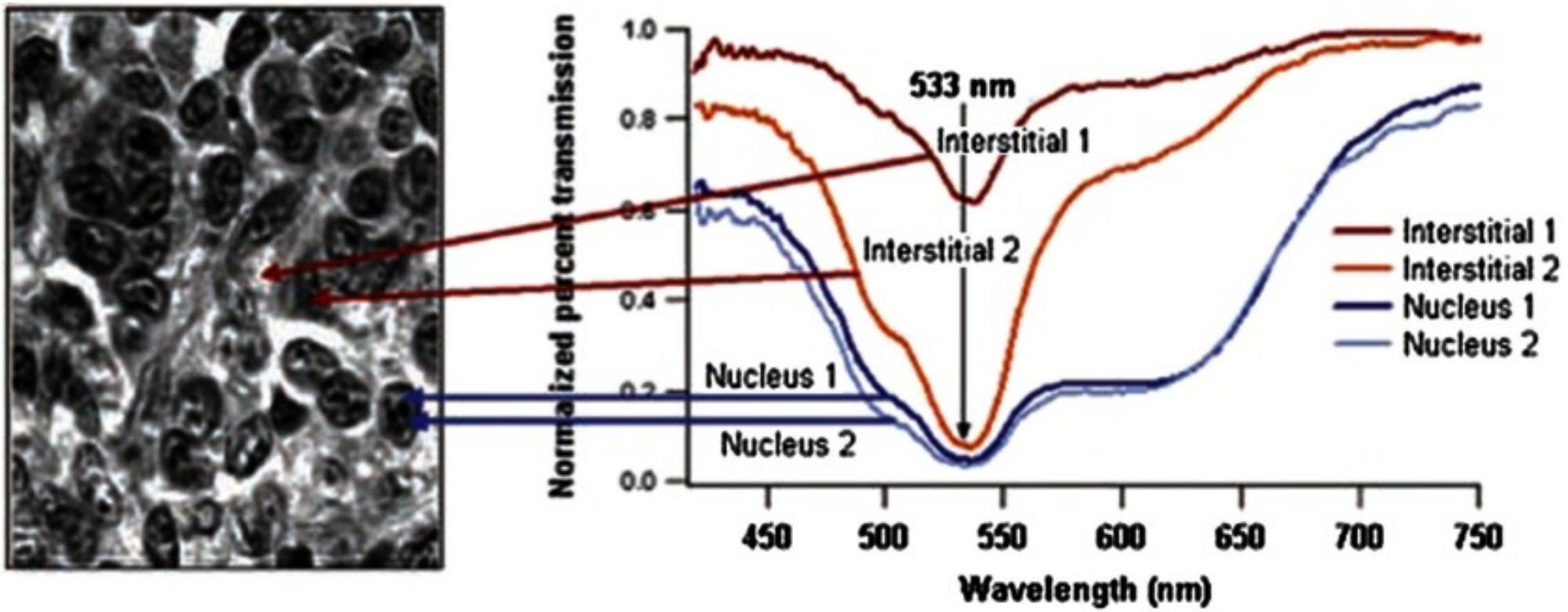

560 nm

Satellites and drones



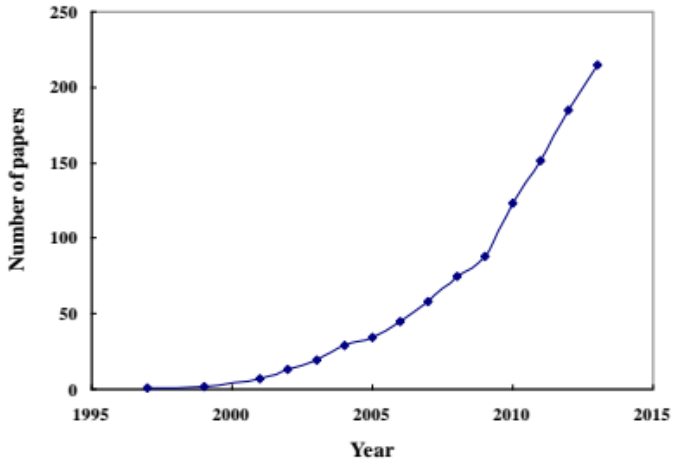
Biometrics (iris, retina, fingerprints, faces,...)

Medicine…


Normalized percent transmission
1.0
0.8
0.6
0.4
0.2
0.0
533 nm
Interstitial 1
Interstitial 2
Nucleus 1
Nucleus 2
450
500
550
600
650
700
750
Wavelength (nm)
Interstitial 1
Interstitial 2
Nucleus 1
Nucleus 2

Food industry…

Figure 1. The number of publications about hyperspectral imaging applications in food.



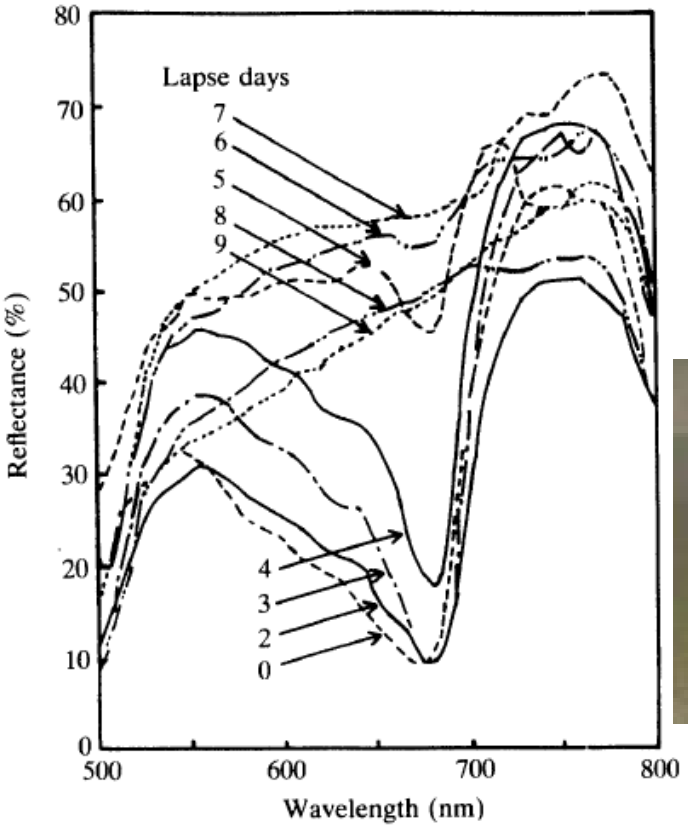
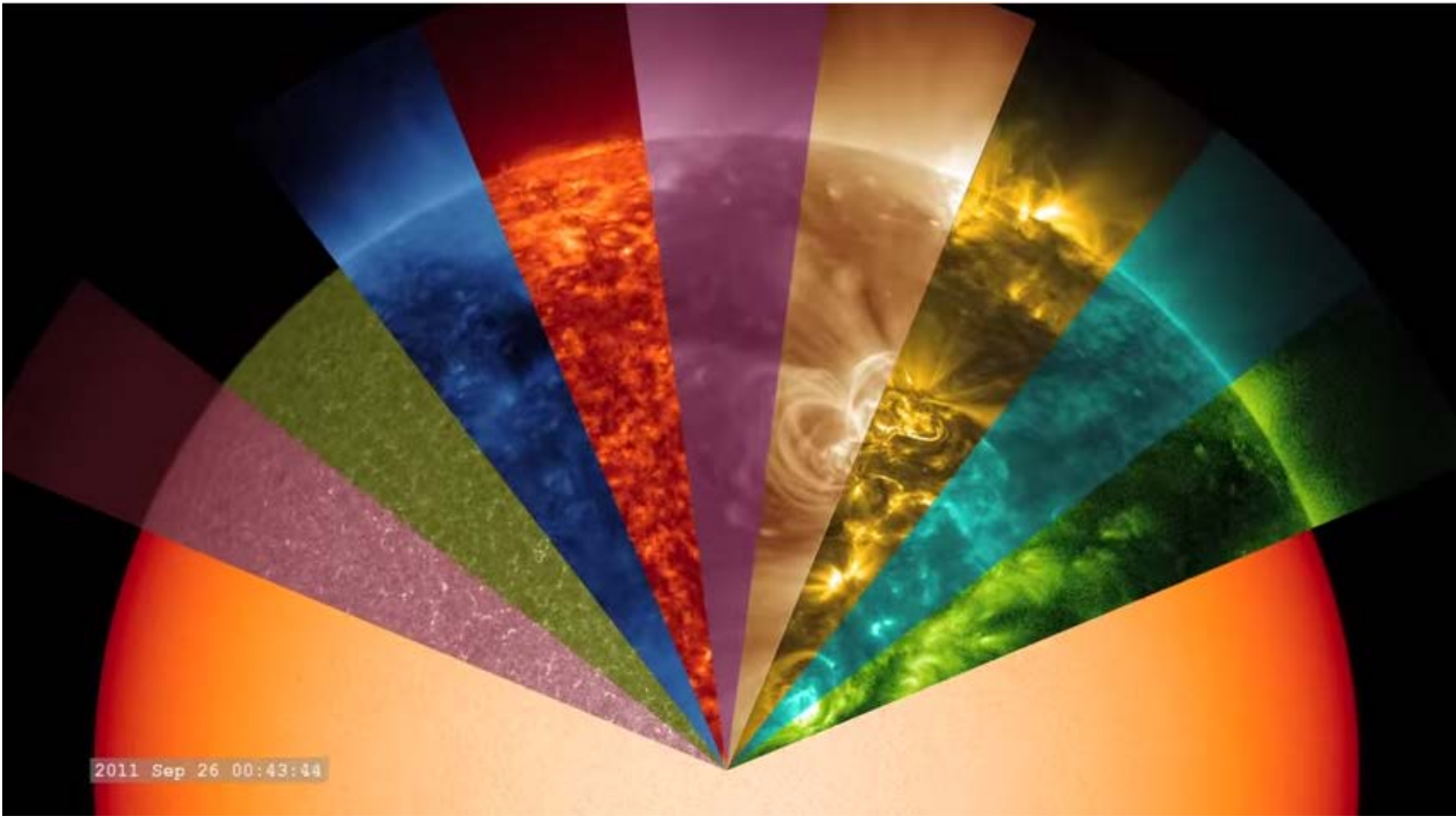


Fig. 1. Spectral reflectance curves for different colors of bananas during ripening.

Astronomy…



And much more to discover….

That is the reason for the Assignment #1….