Optical Spectroscopy for Brand Authentication and Security

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GILDEN Photonics Ltd

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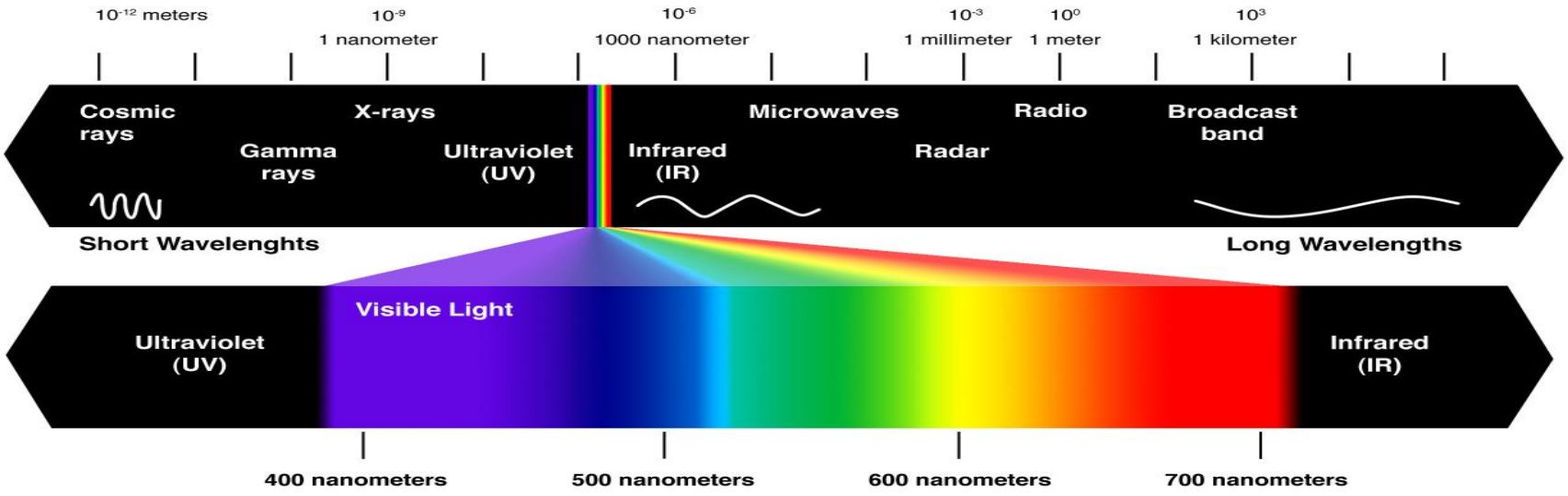

develop & produce optical spectroscopy equipment, and hyper-spectral imaging solutions

making optical spectroscopy possible at reasonable price, and eliminating any undue profit-seeking

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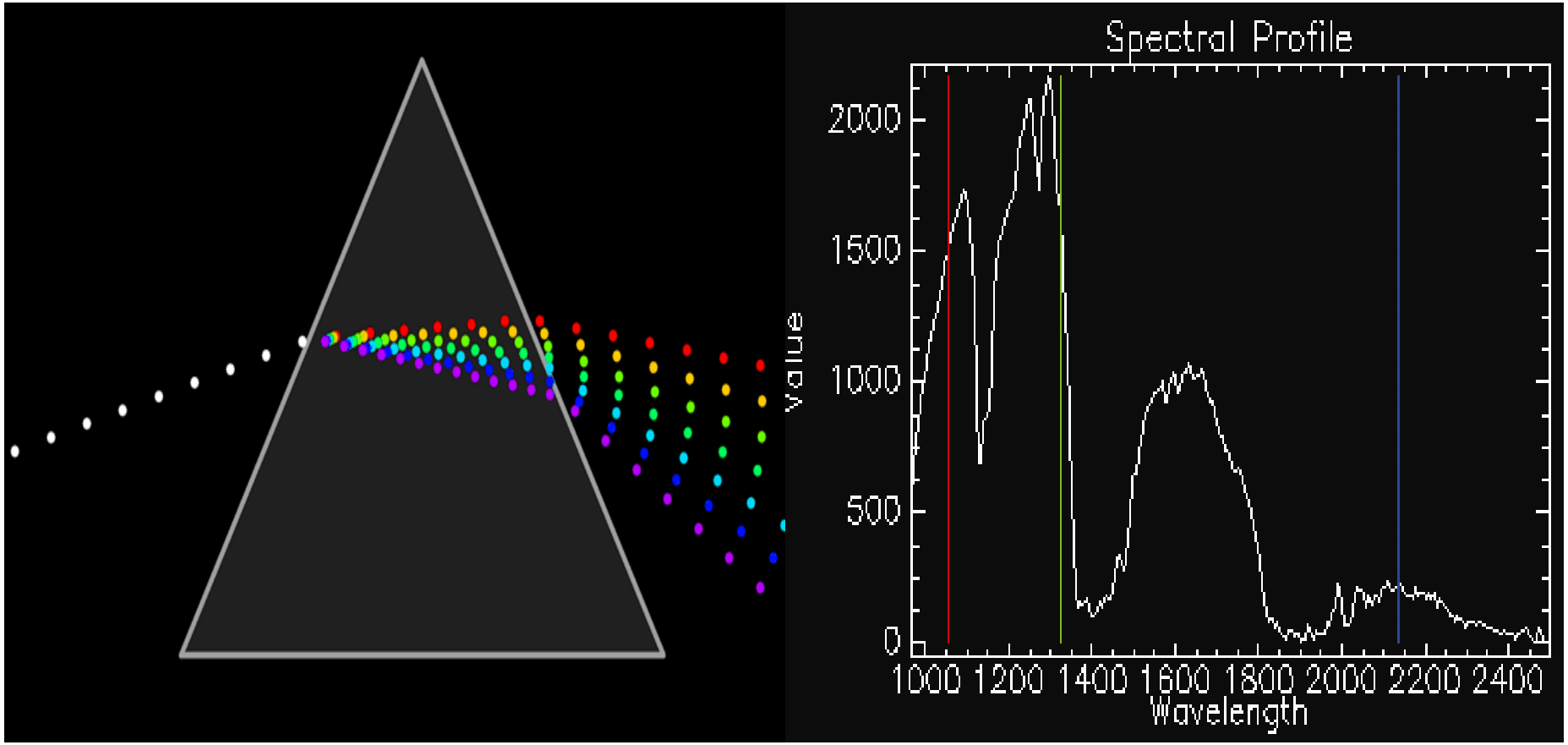
What is Optical Spectroscopy ?



Phosphors / Up-conversion

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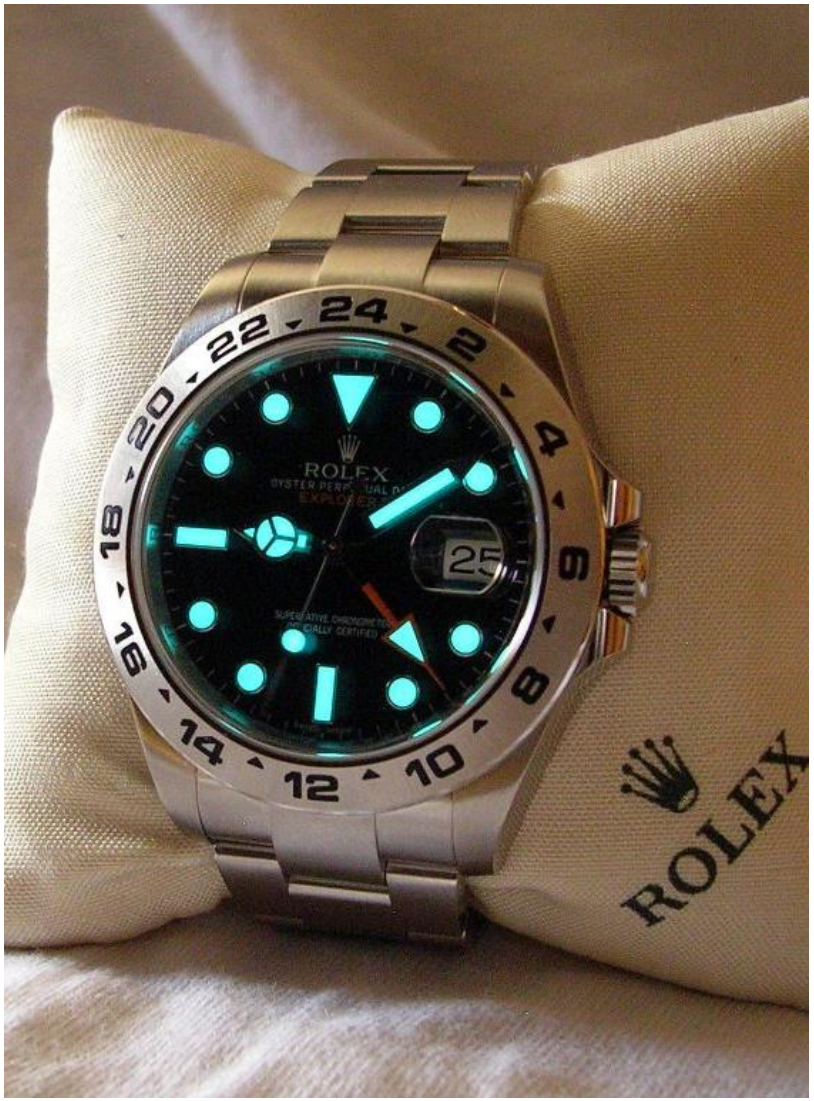
- Up-conversion first proposed in 1959
- First demonstrated 1966
- Commonly used to look at IR lasers
- Solar cells
- Bio-markers
- *Increasing interest in using it for security marking*
- Spectral and time-resolved measurement.



Typical materials

Emission colour (mode)	Phosphor type	Chemical composition	Basic excitation band, *mkm*	Basic emission band, *mkm*	* IR to VIS conversion, %
IR	FAM-810/1000-1	Y_2O_2S: Er	1,50-1,60	0,80-1,02	-
BLUE	FCD-475-2	Y_2O_2S: Yb, Tm	0,90-0,98	0,46-0,48	0,02
GREEN	FCD-546-1	La_2O_2S: Er, Yb	0,90-1,07	0,54-0,56	0,2
	FCD-546-2	Y_2O_2S: Er, Yb	0,90-1,07	0,54-0,56	0,2
	FCD-546-3	YF_3: Er, Yb	0,90-1,00	0,54-0,56	0,2
RED	FCD-660-2	Y_2O_3-YOF: Er, Yb	0,90-0,98	0,64-0,68	2,0
	FCD-660-3	YOCl: Er, Yb	0,90-0,98	0,64-0,68	3,0
	FCD-660-4	YbOCl: Er	0,90-0,98	0,64-0,68	3,0

* at IR excitation power 1,0 W/cm^2

Complex photo-physics

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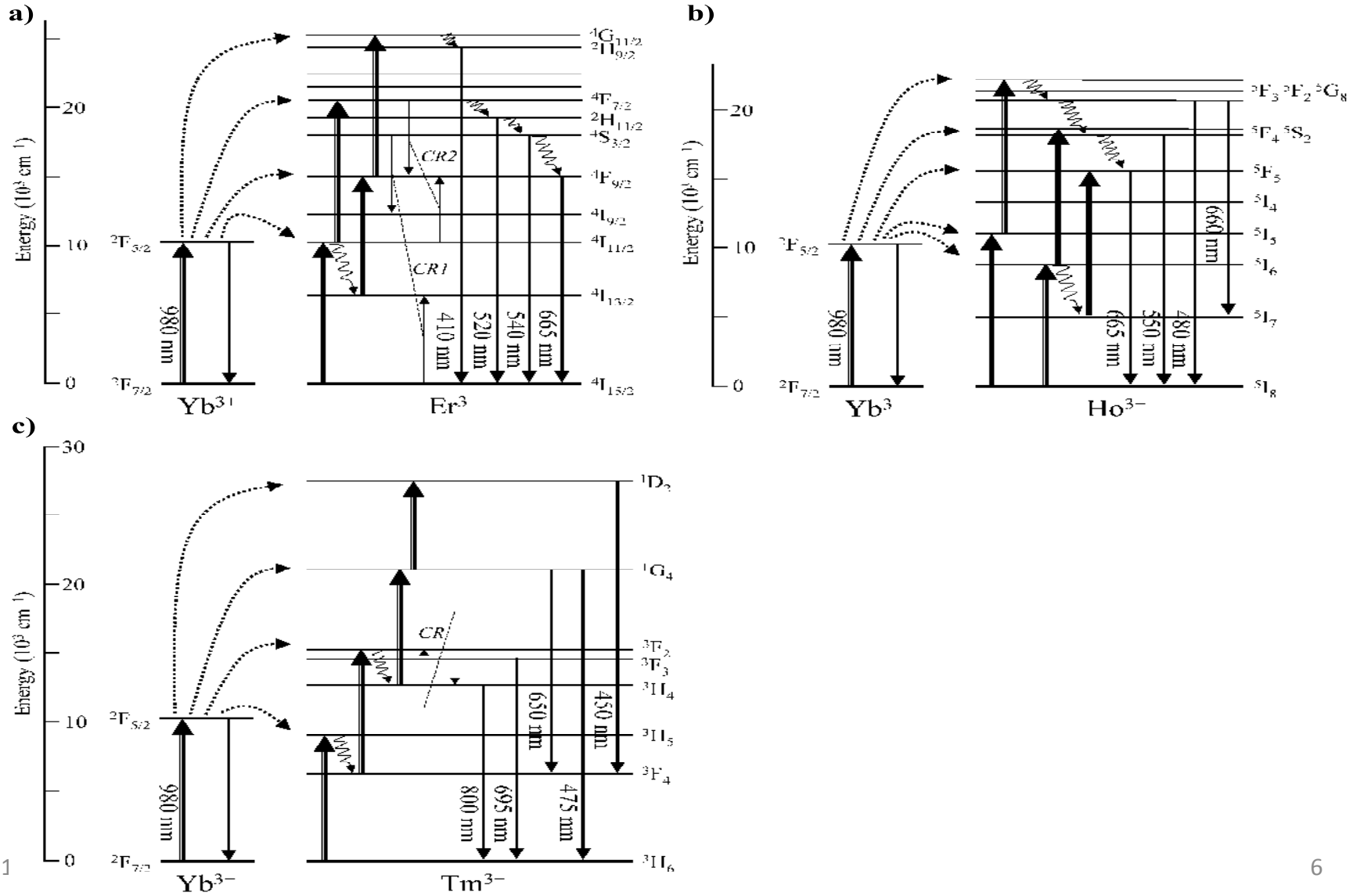
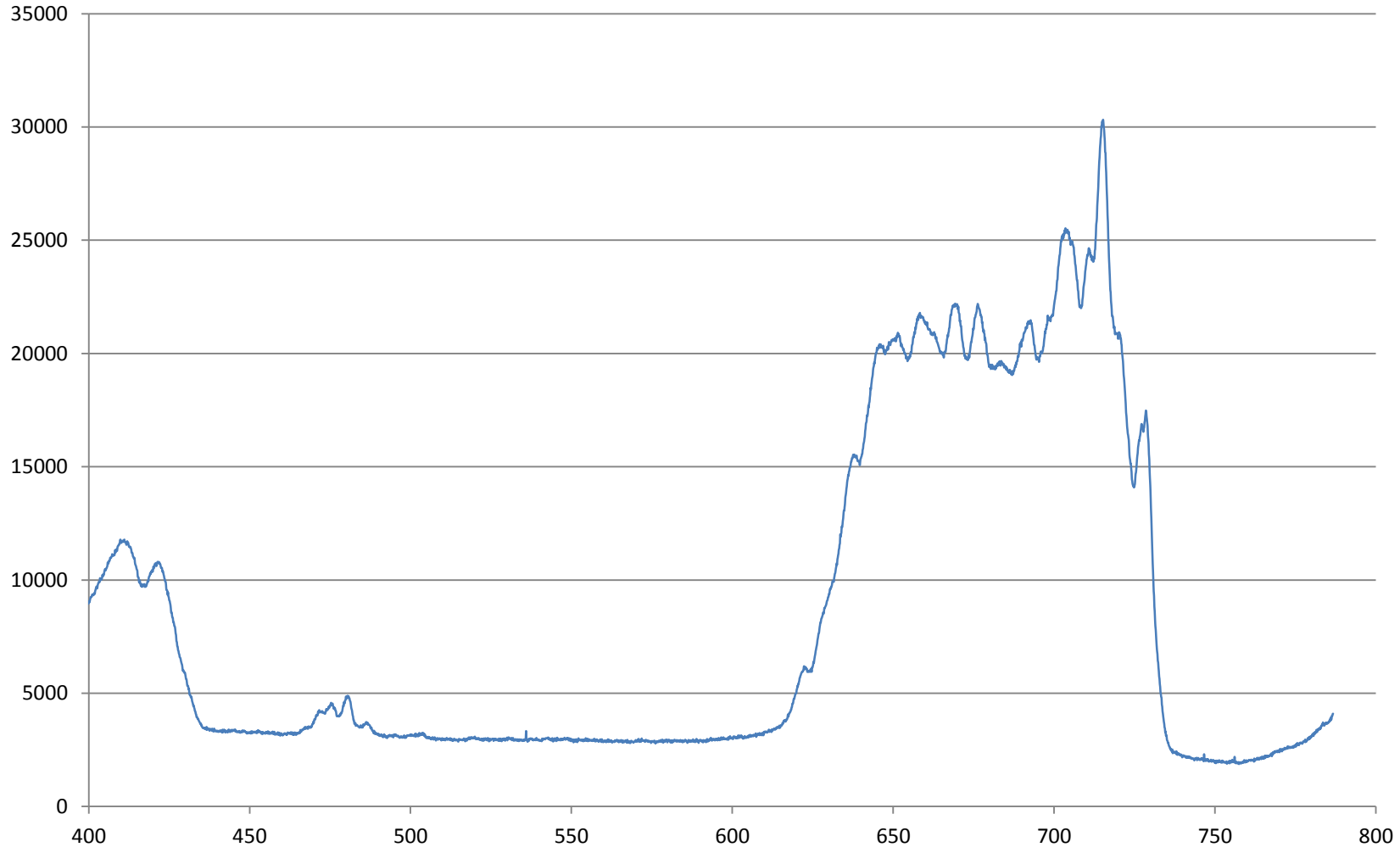
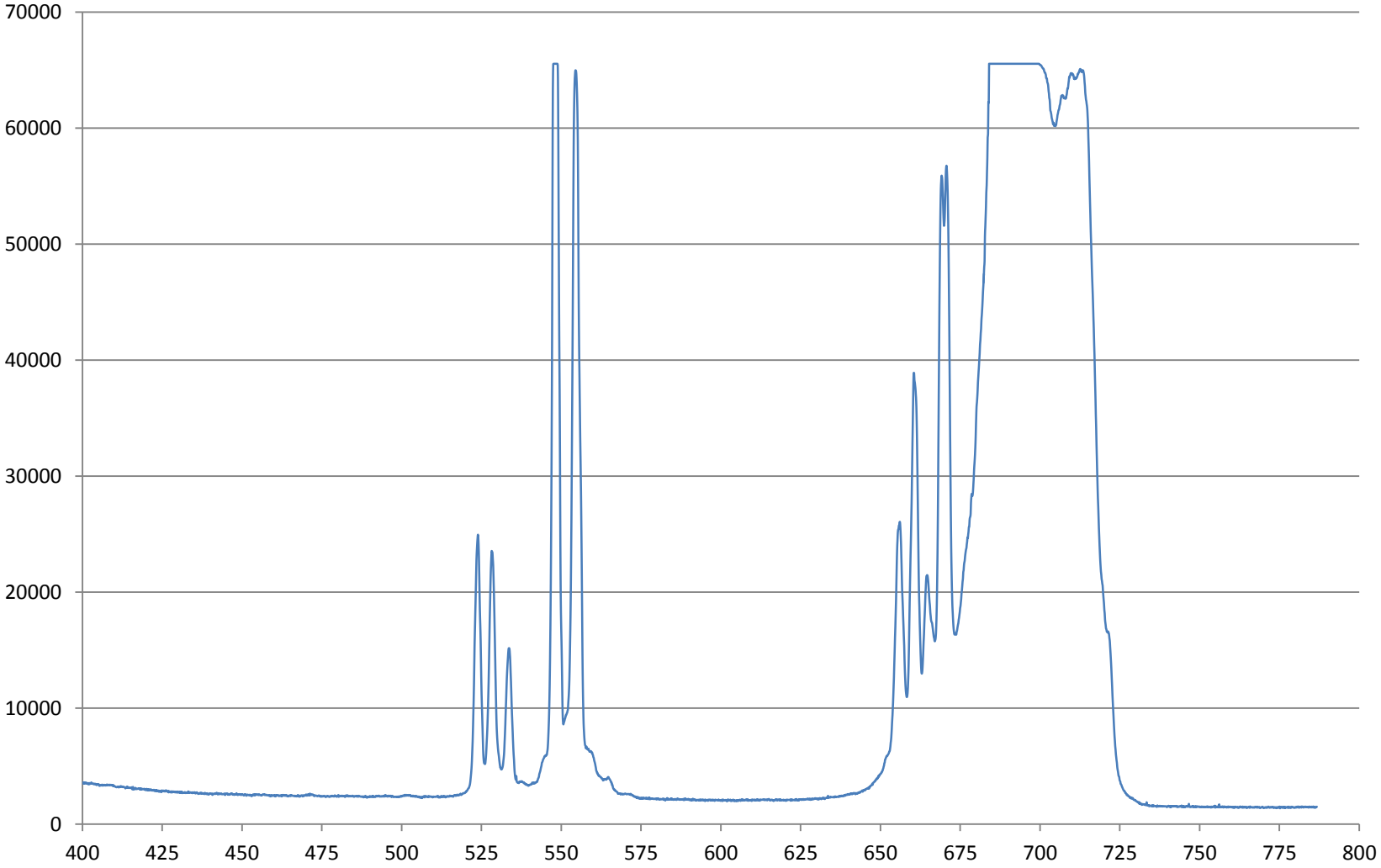


BLUE


35000
30000
25000
20000
15000
10000
5000
0
400
450
500
550
600
650
700
750
800

GREEN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425
450
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525
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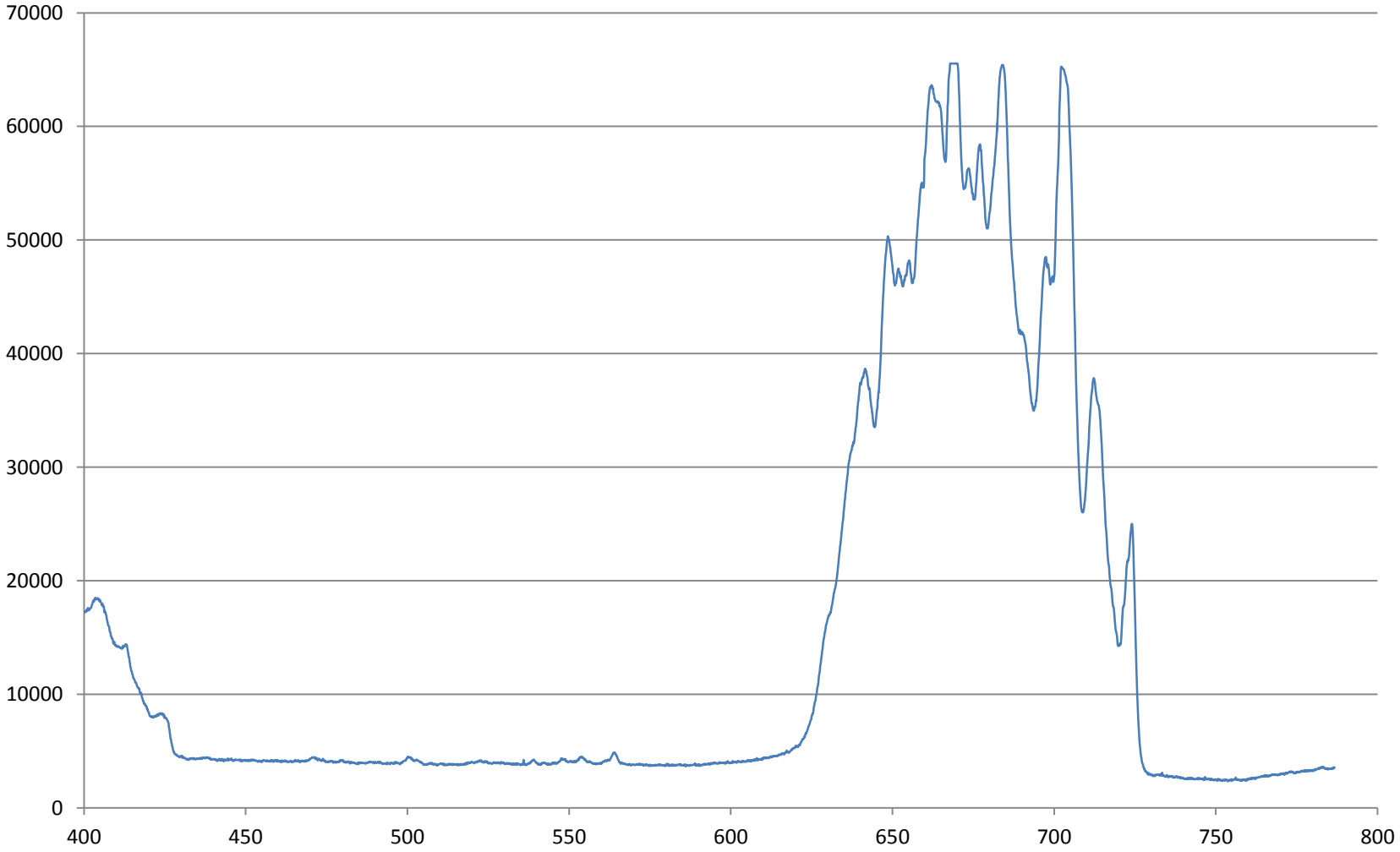
575
600
625
650
675
700
725
750
775
800

Red


70000
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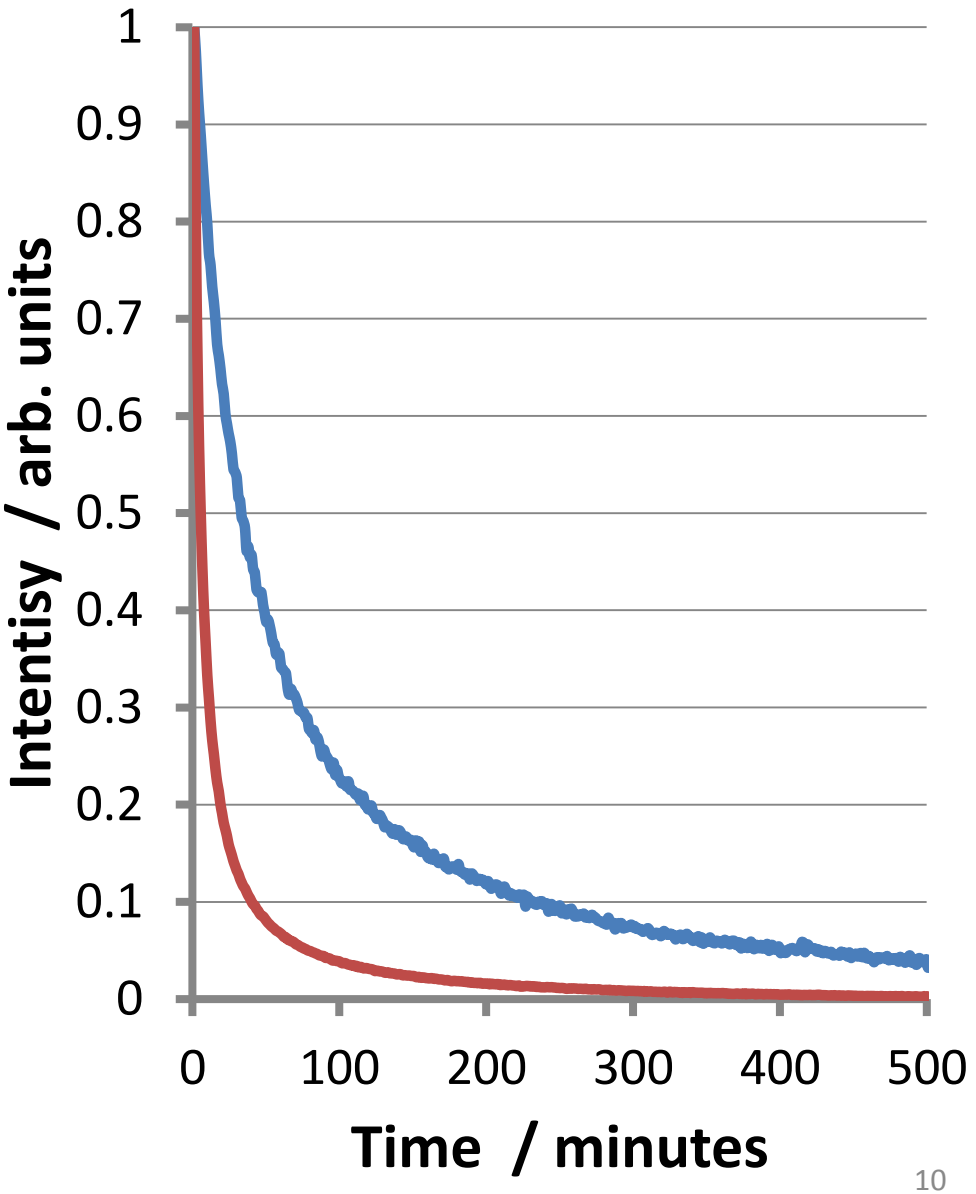
Time-Resolved

Phosphorescence Lifetime

- Absolute Quantity
- Unique to the sample:
  - *Fingerprint*
- Quality control
- Security



Quantum Efficiency

- QE = (Photons In) / (Photon Out)
- Can be measured:
  - Powder,
  - Ink, or
  - Ink on surface
- Integrating Sphere + Powder / film holder

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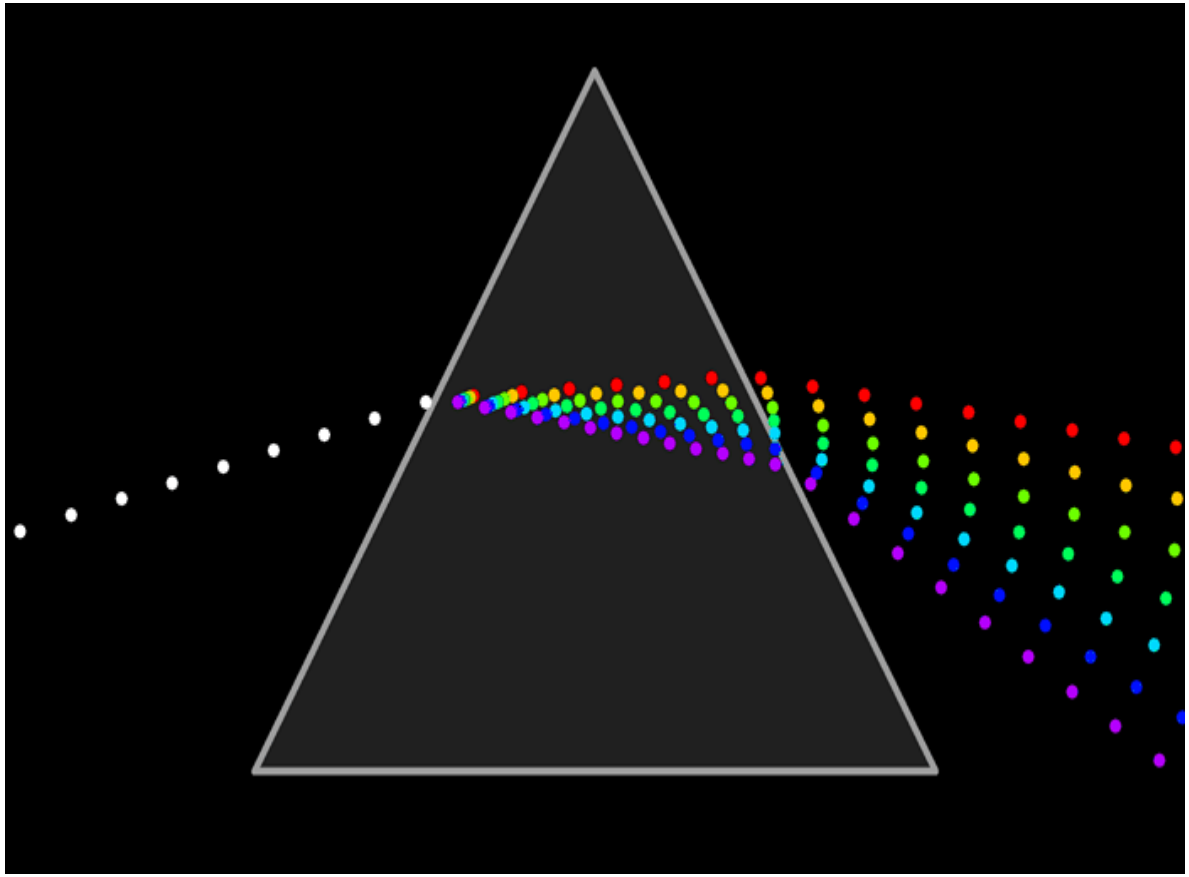
What is Hyper-Spectral Imaging ?

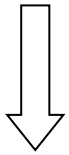


Pixel content

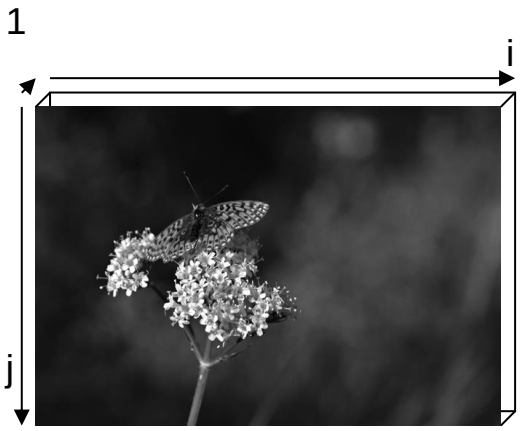
Grey scale image

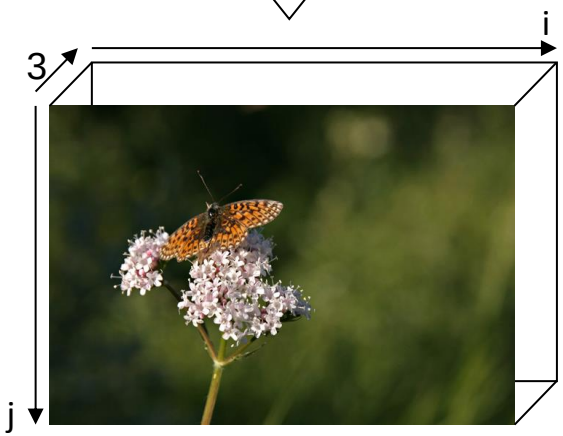
RGB image

Hyperspectral image



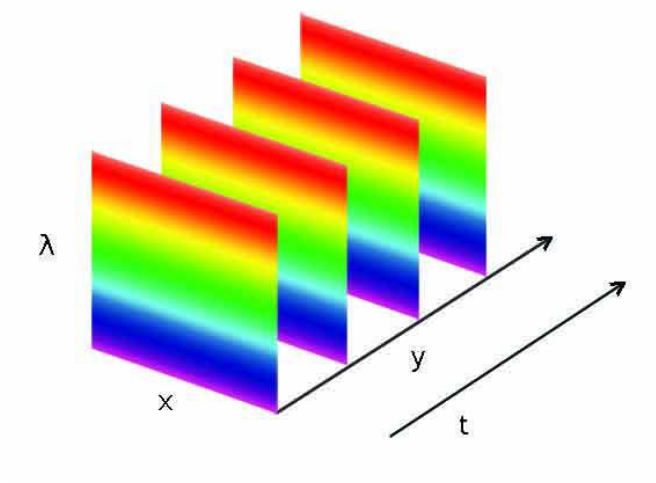
Digital representation





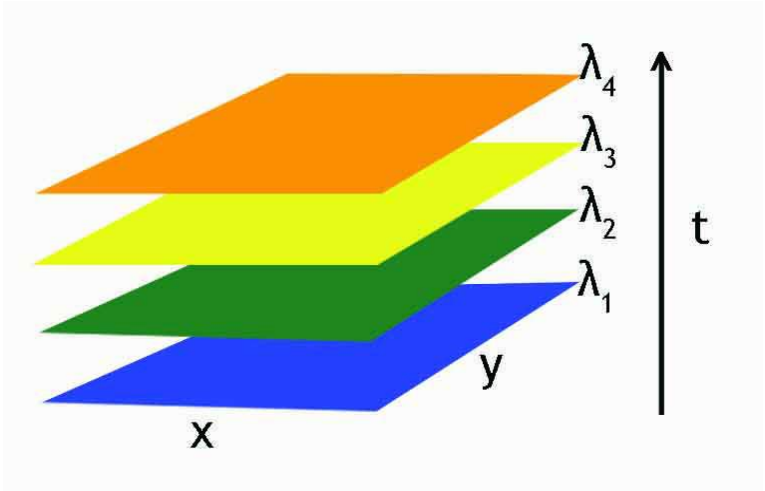
Main approaches to Hyper-Spectral Imaging

Pushbroom



Full spectral data simultaneously, with spatial line scanning over time. Imaging spectrograph+2D array detector.

(Tunable) filter



2D image at a time, with wavelength scanning over time.
Filter+imaging optics+
2D detector array.

Hyperspectral Imaging Operation

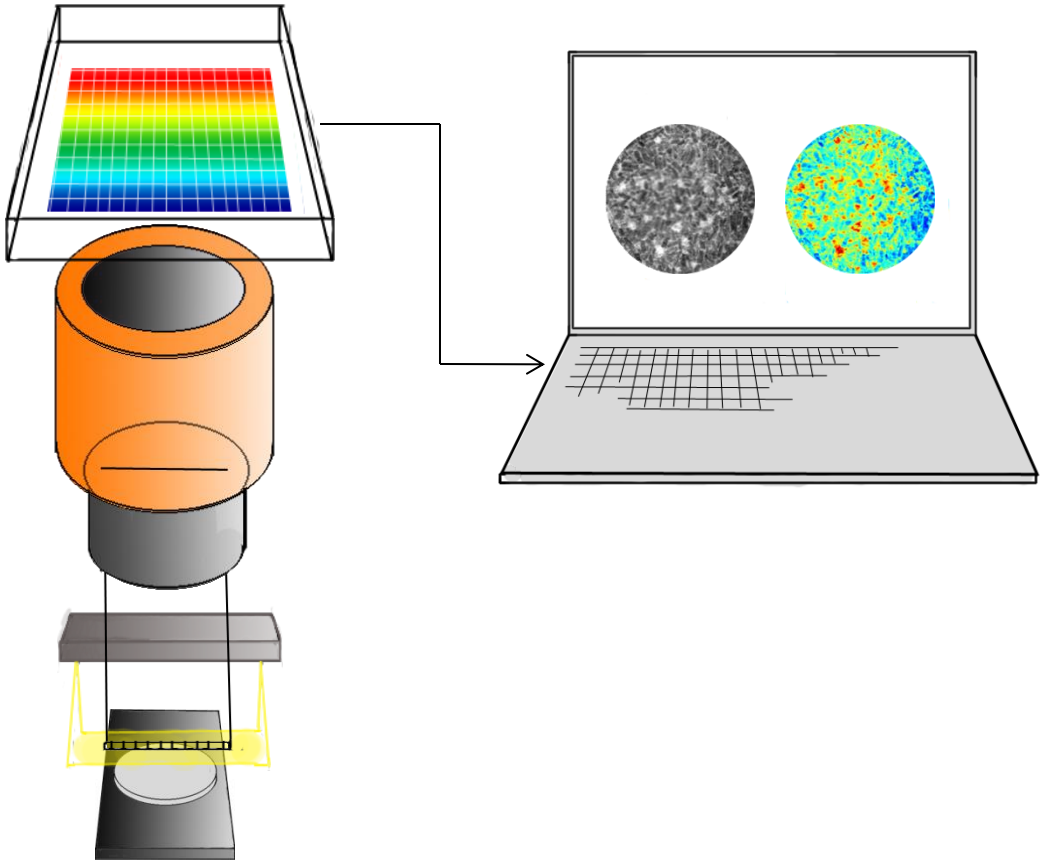
Camera with 2D detector array

Imaging spectrograph with input slit

Fore lens

Line light source

Sample stage



Conclusion:

- Optical Spectroscopy can provide:
  - Security Tagging by
    - Spectra
    - Luminescence Lifetime
    - Quantum Yield
    - Spectral imaging on production line
  - Brand Authentication and Security

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Setting the new standard in
OPTICAL SPECTROSCOPY