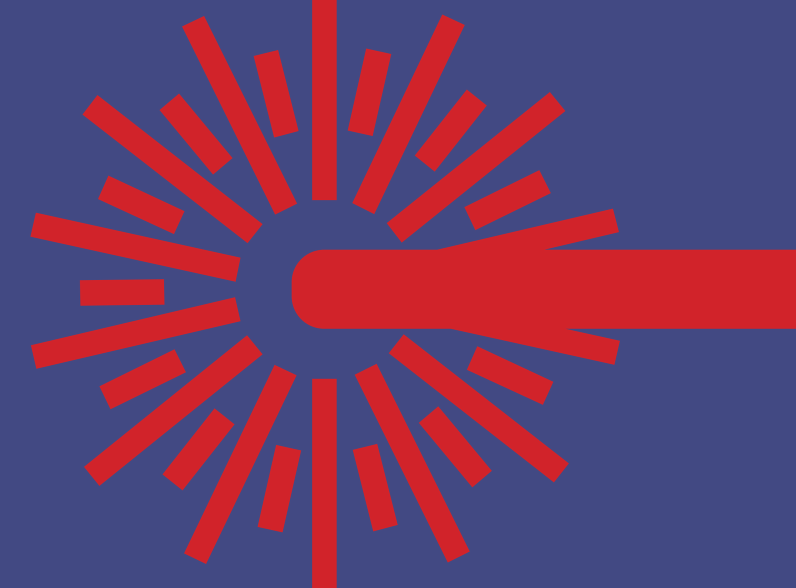
JOURNEY of a PHOTON: from Spark to Spectra

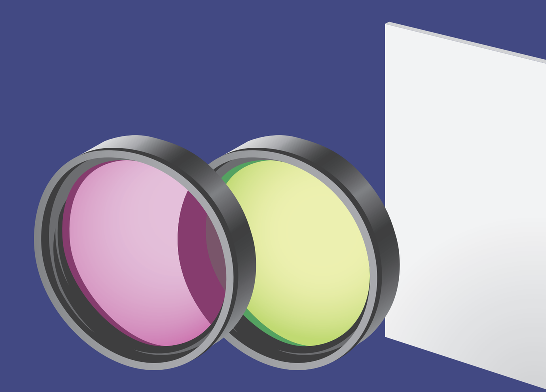
1 AN EXCITING START

- The photons used in spectroscopy encounter many components and undergo various changes before registering as spectra in software. What happens to these photons once they enter an Ocean Insight spectrometer? The journey starts here.
- Photons are created through reactions in the sun or stars, or emitted from lamp bulbs, LEDs or lasers. Each photon is created with a specific wavelength, which it will carry throughout its lifetime.



2 A BUMPY ROAD TO THE SLIT

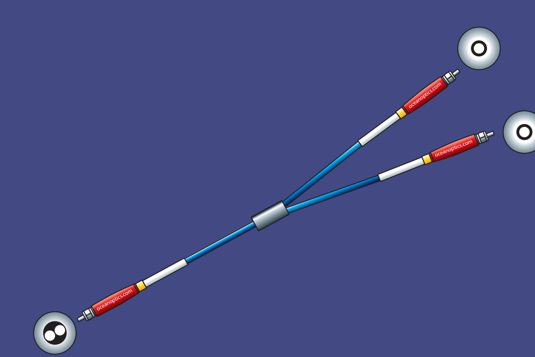
- As photons travel through space, they may be reflected, transmitted or absorbed by materials they encounter.
- Different materials will reflect, transmit or absorb photons of different wavelengths, so each interaction will filter, redirect or eliminate photons of various wavelengths.



Photons in Action

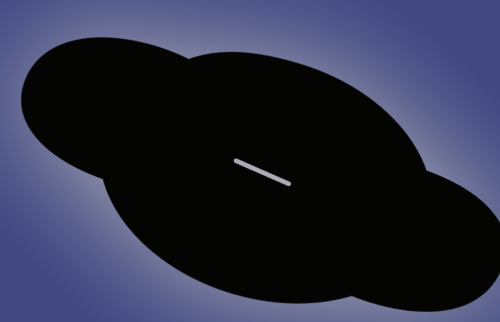
Learn how people are connected by light – measuring it, moving it, applying it – in pursuit of research, education and knowledge. Visit the **Knowledge Hub** at **oceaninsight.com**.

3 A GUIDED PATH



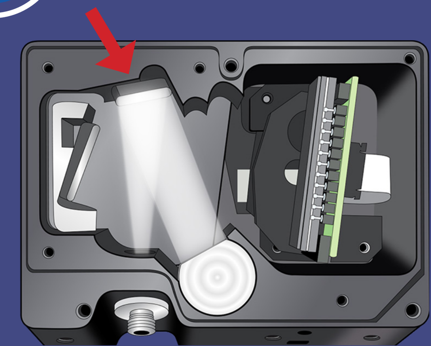
- Fiber optic cables route light from one point to another, without interference from ambient light.
- The light is guided to the spectrometer via the SMA 905 connector. Its bulkhead provides a precise locus for the optical fiber and slit.

4 SINGLE FILE, PLEASE



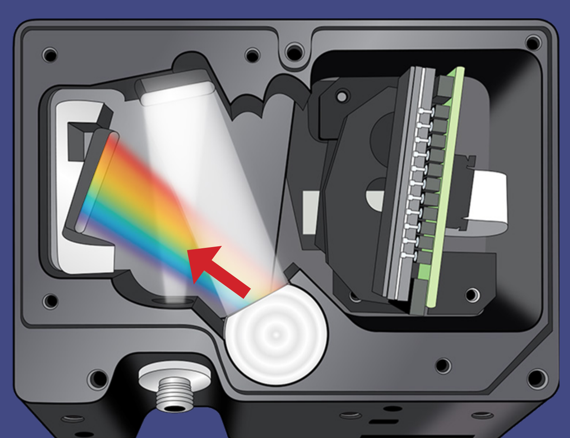
- The slit is a very narrow aperture through which a stream of well-directed photons traveling in a consistent direction can flow.
- The wider the slit, the more photons can get through, but at the expense of reduced optical resolution.

5 COLLIMATION



- Photons entering through the slit are diverging in space. A collimating mirror aligns their path for top efficiency.
- Collimation ensures all photons are traveling parallel to each other, and won't scatter in unwanted directions.

6 DIFFRACTION



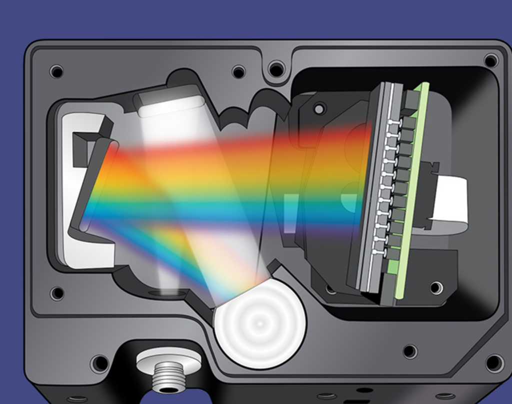
- The collimating mirror reflects photons to the diffraction grating, which splits the photons by wavelength.
- This is the most important step in separating the collected light by wavelength, so that each wavelength can be measured discretely.

Spectroscopy on the Move

With advances in detectors, microprocessors and fiber optics, spectroscopy is no longer confined to the lab.

- Measuring fruit quality in sorting facilities
- Monitoring radiation during space travel
- Determining soil and water quality
- Exploring the effects of lighting on marine habitats
- Monitoring crop health from drones and airplanes

7 FOCUS CAREFULLY



- The diffraction grating spreads light across the focusing mirror, which then focuses light at each wavelength onto the detector.
- The detector is a linear array of CCD pixels – a 1-dimensional line where each pixel collects photons from a very narrow range of wavelengths.

8 THERE IS ALWAYS A TRADE-OFF

- **Smaller range = higher resolution**
- **Larger range = lower resolution**

Learn how spectroscopy can help you unlock the unknown.
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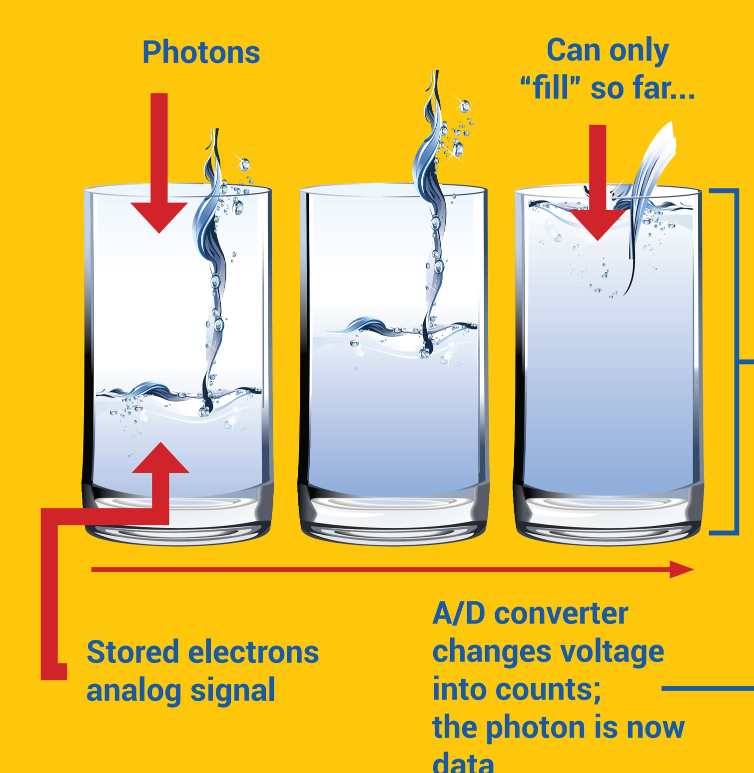
9 CHARGE!

- Each pixel acts as a well that collects photons of a specific wavelength range.
- At the start of each integration period, the well is "full" of voltaic charge.
- The longer the integration time, the more photons can be collected. Once the charge is fully depleted, that pixel is "saturated" and no new signal can be collected.
- As each photon strikes the detector, its energy is released; we will not see it again.



10 ENTER THE MATRIX

- At the end of an integration, the charge level is read from all the pixels on the detector.
- This read-out (still in analog volts) is passed into an ADC (Analog-to-Digital Converter), which converts each pixel's voltage into "counts."
- This is when the photon becomes data. As one journey comes to an end in the spectrometer, a transformation to electronics and software takes us on a new path – and a story for another time.

ONE JOURNEY ENDS, ANOTHER BEGINS

This concludes our photon's journey. From its creation, to its travels within the spectrometer, to its arrival at the detector pixel cell, the photon navigates an inevitable path. As each photon's "fate" is recorded and digitized into data, additional stops along the way lead us to graphable spectra in a format we can understand.

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