

PHOTONICS & SPECTRAL ANALYSIS

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SPECTRAL ANALYSIS

An emission spectrum is generated when an element loses part of its energy to change orbit, while an absorption spectrum is generated when an element assumes energy to pass to the external orbit.

Each element has its own emission and absorption spectrum and so by analysing them the element is identified

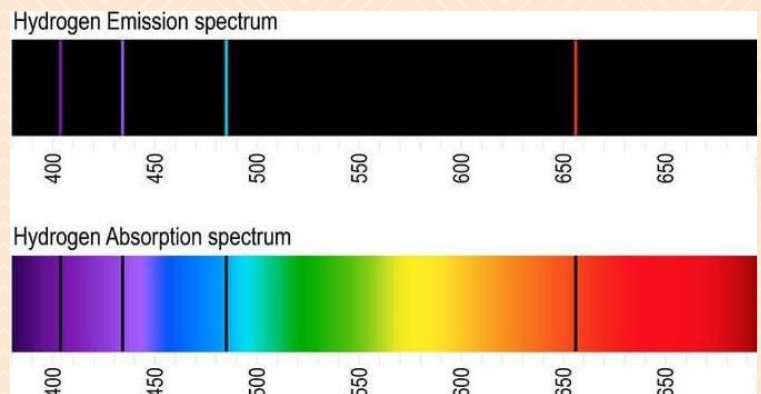


Figure 1. The spectrum of hydrogen atom. Credits: ThoughtCo.

PHOTONICS

At the present time, photonics, a light technology, defined also as the physical science of light generation, detection and manipulation, gains a central role in our world, in order to develop and create new tools and new job opportunities. The photonics employs lasers, electro-optical devices and fibre-optics. Its applications are several, such as agriculture, medicine, construction, aerospace and also spectral analysis.

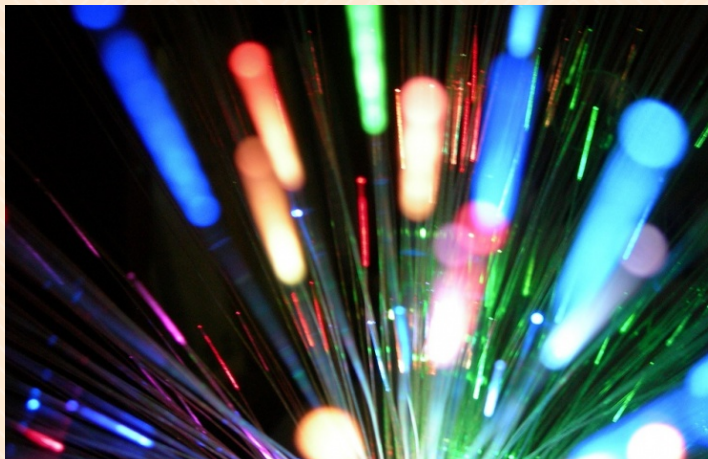


Figure 2. Photonics, the first device that recomposes light. Credits: ildenaro.it.

APPLICATIONS

FOOD

Photonics is becoming a major player in the Agri-food industry. The speed and accuracy of light sources will greatly help farmers and food specialists improve their products. It is used in the implementation of precision agriculture, where variables and outcomes can be predicted and monitored.

Specific examples include the use of optical and photonic technologies to help determine protein levels and optimal harvest times, map water quality, screen crops for contaminants and monitor soil health.

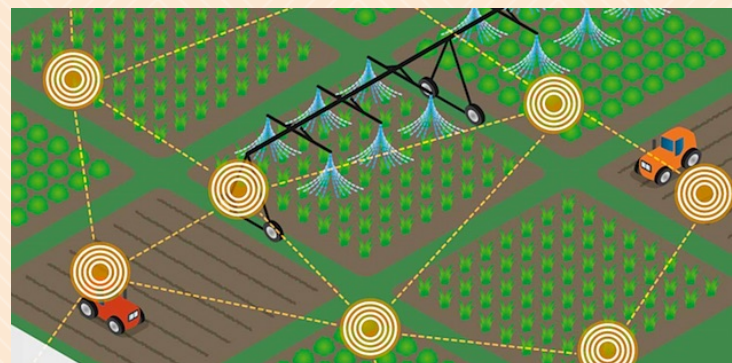


Figure 3. Precision farming. Credits: Duurzaamnieuws.

ASTRONOMY

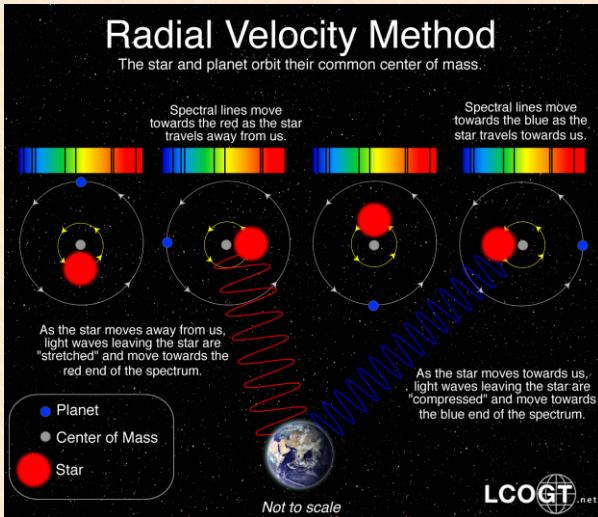


Figure 4, Doppler effect, Credits: astrofiscayfisica

The Doppler effect represents the change in frequency of sounds, light and other wave forms. When a star moves away from us we will see a redshift. The wavelengths become longer, so we will have a lower frequency, which implies a red colour.

Blue shift is the contrary, the star moves towards us. The wavelengths become shorter, which means a higher frequency, and therefore a blue colour.

The universe is expanding due to the fact that most distant stars show redshift.

MEDICINE: 3D TECHNOLOGY

In medicine, photons and spectral analysis are used on a daily basis to ensure our health and life quality. On the left side of the image is the brain before treatment. The right side is 9 months after the start of the treatment. With 3D technology tumours are illuminated with short pulses of light at two different wavelengths using a laser. Inside the body, the light pulses are absorbed and converted into ultrasonic waves. Whether the treatment is shrinking the tumour can be determined thanks to this.

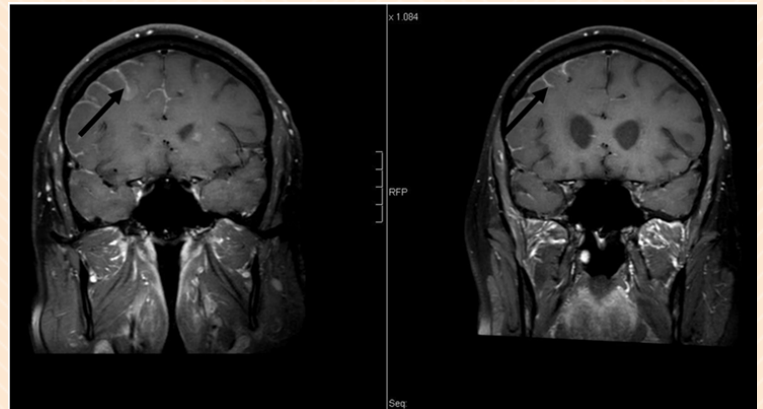


Figure 5. 3D technology. Credits: frontiers in Oncology.

DOPING

Doped optical fibers are used in the field of telecommunications to transport signals using light instead of copper wires. In order to compensate for the transmission loss, optical amplifiers increase the power of the optical signal without converting it to an electric signal. Thanks to the emission of signal photons, the electrons in the excited ions emit new photons amplifying the signal.

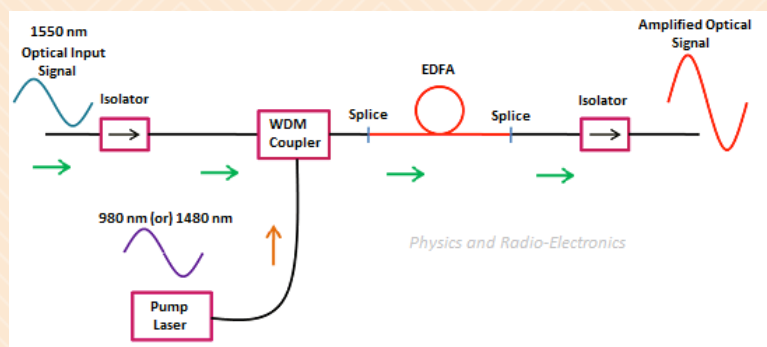


Figure 6. Erbium Doped Fiber Amplifier. Credits: Physics and Radio-Electronics.