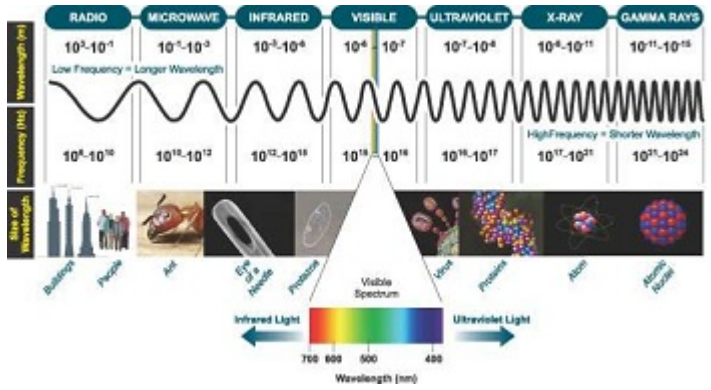
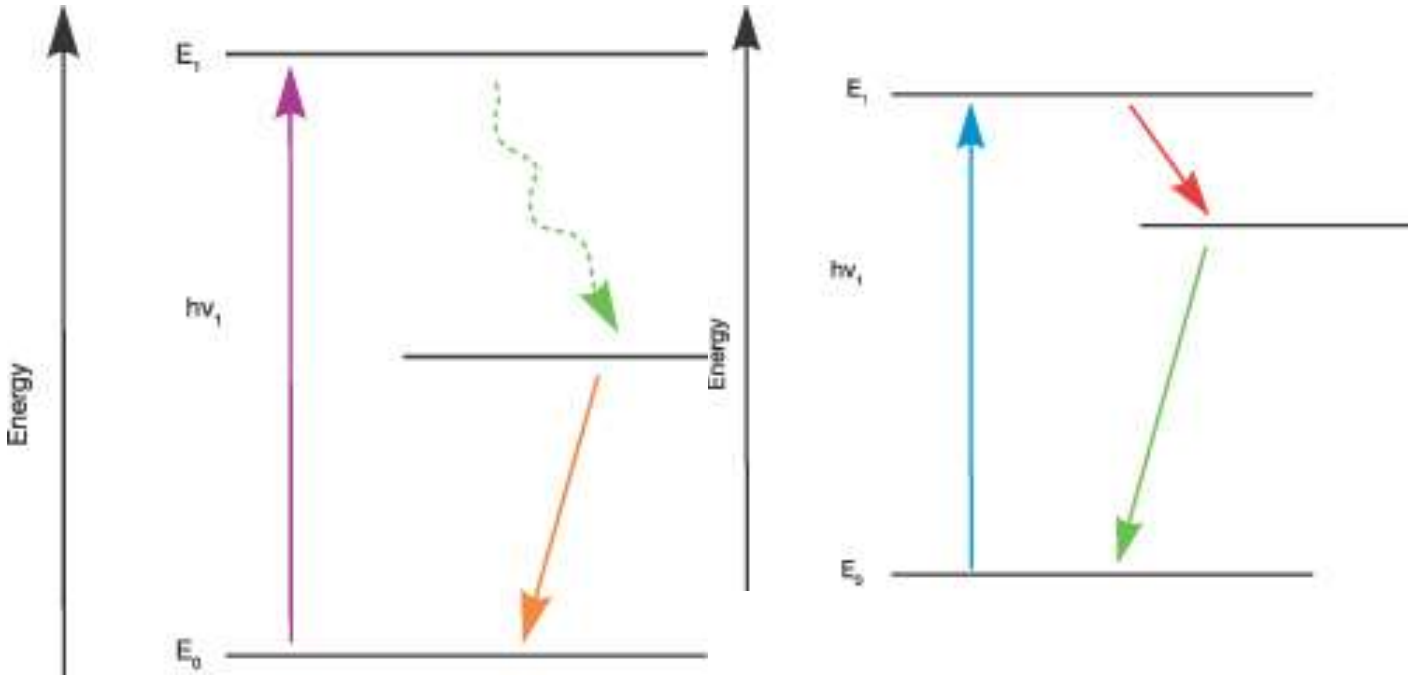
What is Light?

An overview of the properties of light



Light is part of the electromagnetic spectrum, which ranges from radio waves to gamma rays. Electromagnetic radiation waves, as their names suggest are fluctuations of electric and magnetic fields, which can transport energy from one location to another. Visible light is not inherently different from the other parts of the electromagnetic spectrum with the exception that the human eye can detect visible waves. Electromagnetic radiation can also be described in terms of a stream of photons which are massless particles each travelling with wavelike properties at the speed of light. A photon is the smallest quantity (quantum) of energy which can be transported and it was the realization that light travelled in discrete quanta that was the origins of Quantum Theory.

It is no accident that humans can ‘see’ light. The detection of light is a very powerful tool for probing the universe around us. As light interacts with matter it can be become altered and by studying light that has originated or interacted with matter, many of the properties of that matter can be determined. It is through the study of light that for example we can understand the composition of the stars light years away or watch the processes that occur in the living cell as they happen



Matter is composed of atoms, ions or molecules and it is light’s interaction with matter which gives rise to the various phenomena which can help us understand the nature of matter. The atoms, ions or molecules have defined energy levels usually associated with energy levels that electrons in the matter can hold. Light can be generated by the matter or a photon of light can interact with the energy levels in a number of ways.

We can represent the energy levels in a diagram known as a Jablonski diagram. An example of one is shown in the diagram above. An atom or molecule in the lowest energy state possible known as the ground state can absorb a photon which will allow the atom or molecule to be raised to a higher energy level state or become excited. Hence the matter can absorb light of characteristic wavelengths such as the blue light in the example on the right or the violet light in the example on the left. The atom or molecule won't stay in an excited state so it relaxes back to the ground state by several ways. In the example on the right, the atom or molecule emits two photons both of lower energy than the absorbed photon. The photons emitted will be a characteristic energy appropriate for a particular atom or compound and so by studying the light emission the matter under investigation can be determined. In the example on the left the excited atom or molecule initially loses energy by not emitting a photon and instead relaxes to the lower energy state by internal processes which typically heat up the matter. The intermediate energy level then relaxes to the ground state by the emission of a photon of orange light.You can find out information on how light is measured by visiting the scientific cameras web section.