Scattering

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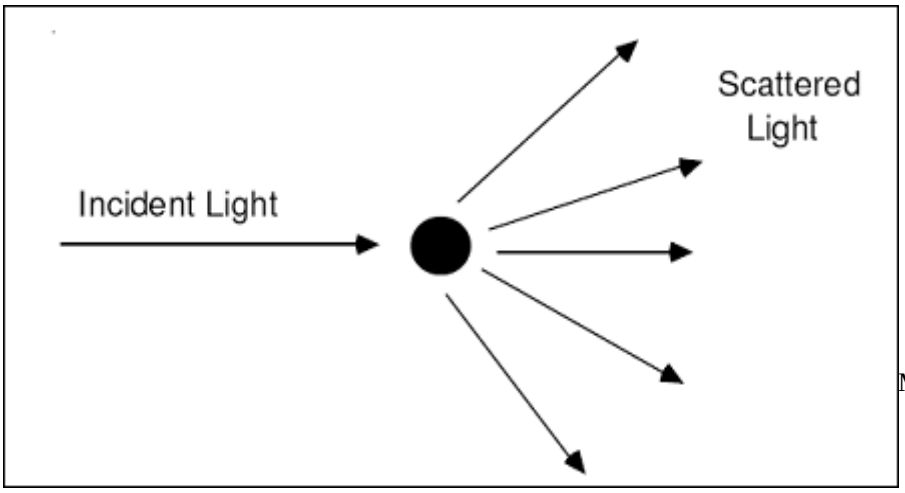
Introduction to Scattering

What is scattering?

Scattering is the redirection of light that is caused by the light's interaction with matter. The scattered electromagnetic radiation may have the same or longer wavelength (lower energy) as the incident radiation. It may also have a different polarization.



Most of our contact with the external world takes due to a scattering or deflection of waves or particles by objects. Scattering is a type of randomised reflection off of a rough surface.

The blue color of the sky is due to scattering. In this case, water droplets effectively scatter all of the wavelengths of visible light in all directions. The atoms present in the atmosphere, including in nitrogen, oxygen, and water vapor, separate the sun's white light into its many constituent colors, and scatter them throughout the atmosphere. The wavelength of the blue light scatters better than the rest, and therefore predominates over the other colors in the light spectrum, and makes the sky appear blue to us.

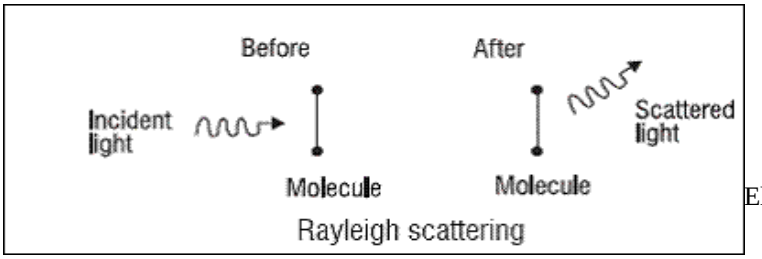
Single and multiple scattering

Scattering can be single or multiple. Single scattering happens when radiation or a wave is scattered by only one localized scattering center. If groups of scattering centers redirect a wave, the radiation will scatter many times, which is known as multiple scattering.

Further Classifications of Scattering

Scattering can be further classified as elastic and non-elastic.

Elastic scattering:

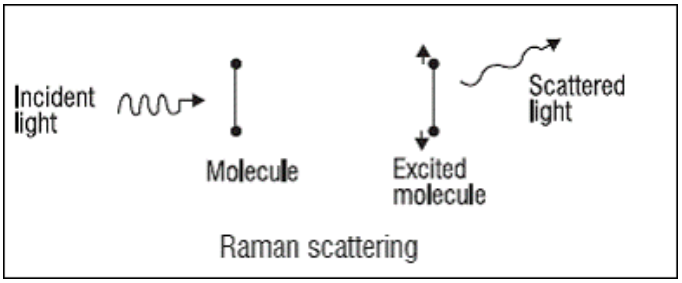


Elastic scattering is responsible of the sky's blue color during the day. In cases of elastic scattering, the kinetic energy of the incident particles is conserved, and only their direction of propagation is modified. This modification happens due to interaction with other particles and/or a potential).

If the dimensions of a scatterer are much smaller than the wavelength of light, as are for example the dimensions of a molecule, then the scatterer can absorb the incident light and quickly reemit the light in a different direction. When the reemitted light has the same wavelength as the incident light, the process is called Rayleigh scattering.

Inelastic scattering:

In cases of inelastic scattering, the kinetic energy of incident particles is not conserved, and some energy of the incident particles is lost or gained.



If the reemitted light has a longer wavelength then the incident light, then the molecule is left in an excited state, and the process is called Raman scattering. In Raman scattering, secondary photons of longer wavelength are emitted when the molecule returns to the ground state.

Raman scattering is a type of inelastic scattering. In these cases, a molecule simultaneously absorbs and emits a photon.

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Reference links:

- http://www.hyperphysics.phy-astr.gsu.edu/hbase/ke.html
- http://www.plaza.ufl.edu/dwhahn/Raman Scattering Theory.pdf –
- http://www.en.wikipedia.org/wiki/Reflection_(physics)
- http://www.physics.about.com/od/lightoptics/f/photon.htm -

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