Answer on Question #38980, Physics, Other

What are the similarities and differences between Raman Effect and Compton Effect?

Answer.

Raman Effect - a type of scattering of electromagnetic radiation in which light suffers a change in frequency and a change in phase as it passes through a material medium. Raman scattering is perhaps most easily understandable if the incident light is considered as consisting of particles, or photons (with energy proportional to frequency), that strike the molecules of the sample. Most of the encounters are elastic, and the photons are scattered with unchanged energy and frequency. On some occasions, however, the molecule takes up energy from or gives up energy to the photons, which are thereby scattered with diminished or increased energy, hence with lower or higher frequency. The frequency shifts are thus measures of the amounts of energy involved in the transition between initial and final states of the scattering molecule.

Compton Effect - the reduction in the energy of high-energy photons when they are scattered by free electrons, which thereby gain energy. The phenomenon occurs when the photon collides with an electron; some of the photon's energy is transferred to the electron and consequently the photon loses energy $h(\nu_1 - \nu_2)$, where h is the Planck constant and ν_1 and ν_2 are the frequencies before and after collision. As $\nu_1 > \nu_2$, the wavelength of the radiation increases after the collision. Furthermore, when an electron with relativistic energy collides with an infrared or visible photon, the electron gives energy to the photon; this process is called inverse Compton scattering.

Conclusions

Similarities:

In the Raman Effect and Compton Effect, a photon is scattered inelastically (meaning it has a different, lower, energy after scattering than before) from an atom or molecule.

Differences:

Raman Effect is the inelastic scattering of a photon on a **bound electron**, with the electron being excited to a higher bound state (i.e., raising an electron to a higher energy level).

Compton Effect is based on inelastic scattering of photons on **free (unbound) electrons**. When the photon is scattered inelastically from an atom or molecule, it causes ionization, i.e., ejecting an electron from the atom or molecule.