Compton's phenomenon - what it proves, the benefit

This article was checked by pedagogue

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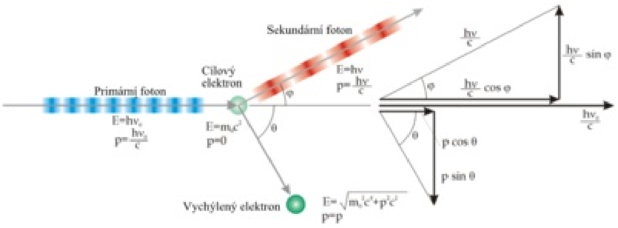
Checked version of the article can be found here (https://www.wikilectures.eu/index.php?title=Compton%27s_phenomenon_-_what_it_proves,_the_benefit&oldid=337276).

See also comparation of actual and checked version (https://www.wikilectures.eu/index.php?title=Compton%27s_phenomenon_-_what_it_proves,_the_benefit&diff=-&oldid=337276).



Compton effect

The Compton effect (Compton scattering or also incoherent scattering) is the interaction of a photon **γ radiation** with a **free** or **weakly bound [[electron]]em**, during which part of the photon's energy is transferred to the electron. During this interaction, the electron acquires kinetic energy and starts to move in a direction deviated from the original direction of the path of the primary photon by the angle **φ**. The scattered photon (secondary photon) with lower energy (ie with a larger wavelength) is deflected by the angle **ψ**. The event can be repeated several times until the photon loses so much energy that the probability of its extinction photoelectric effect prevails.

It mostly does not depend on the proton number of the material of the substance. It depends on the electron density (the number of electrons per cm^3).

Compton scattering is the predominant interaction at energies from 0.1 to 10 MeV.

What the Compton Effect Proves

The Compton phenomenon, or Compton scattering, cannot be explained on the basis of the wave properties of radiation (from this point of view, the wavelength of the scattered radiation should be the same as the original one). It is therefore one of the phenomena proving the existence of **photonu'**. The experiment proving the Compton effect also confirmed that photons can behave both as **particles** and as **waves**.

History and contribution

Compton scattering was discovered in **1922** by Arthur Holly Compton (1892-1962) while conducting research on the scattering of X-rays by particles lights. In 1922, he published his experimental and theoretical results, and in **1927** he received the Nobel Prize for this discovery. His theoretical explanation of the phenomenon now known as Compton scattering differs from classical theories and requires the use of special relativity and quantum mechanics, which were barely comprehensible in his time. At first his results were considered very controversial, but later his work was recognized and had a strong influence on the development of quantum theory.

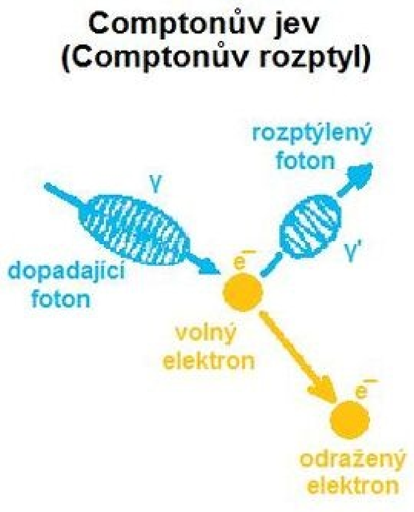
Using the Compton effect

- **Use in radiotherapy**

  Compton scattering is used in **radiotherapy** (irradiation), where living matter interacts with high-energy radiation (gamma radiation, RTG). When photons affect tissues, energy is lost in one of three ways: photoelectric effect, Compton scattering or the formation of electron-positron pairs. In clinical radiotherapy, the most common and therefore the most important of these mechanisms is Compton scattering, in which photons interact with valence electrons of tissue atoms. During such an interaction, not only photons are scattered, but at the same time (thanks to the supplied energy) an electron is torn from the valence layer, i.e. ionization.
  The biological effects of radiotherapy consist in the targeted damage of DNA e.g. formed free radicals (primarily hydroxyl radicals formed by ionization of molecules water).

- **Use in Spectroscopy**

  The Compton effect is used in the detection of ionizing radiation. It is used in scintillation detectors to detect gamma radiation.



Compton scattering

- **Usage in Astronomy**

  Compton scattering is also used in **astronomy**. An example is the Compton Gamma Ray Observatory(Compton Gamma Ray Observatory, abbreviated Compton GRO or CGRO), this observatory took pictures of the most energetic processes in the universe, such as solar flare, gamma ray burst, pulsary, nova and supernova explosions, black holes etc. CGRO was equipped with a set of sensors, one of which was the *Compton Imaging Telescope* (Imaging Compton Telescope, COMPTEL), which used Compton scattering to study and analyze gamma rays in the energy range of 1 to 30,000,000 eV. This device made it possible to determine with great accuracy the direction and energy of the original gamma photon, as well as the reconstruction of the image and energy spectrum of the source of the given radiation.

Links

Related Articles

- Compton phenomenon - what is it
- Compton scattering
- Photoelectric effect
- Wave-corpuscular dualism

External links

- Compton Gamma Observatory
- Compton Gamma Ray Observatory Science Support Center (https://heasarc.gsfc.nasa.gov/docs/cgro/cossc/)
- Principles of radiation therapy (http://www.thymic.org/uploads/reference_sub/02radtherapy.pdf)
- The Compton Effect - Compton Scattering and Gamma Ray Spectroscopy (http://www.phys.utk.edu/labs/modphys/Compton%20Scattering%20Experiment.pdf)
- Compton's effect (muni) (https://is.muni.cz/th/78026/prif_m/IV.3.pdf)

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