ARTICLE

GENERALIZED COMPTON EFFECT

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The Compton effect equations were derived and verified experimentally in 1922 analyzing the collision of x-ray photons, with energies around several kilo electron volts (keV), and conduction electrons with energies of a few electron volts (eV). For many years this was considered as the only case of interest, that is, where the energy of the photons were greater than that of the electrons. It was during the second half of the last century that the so called "inverse Compton effect", involving the collision of relativistic electrons with laser light photons, was developed. It is interesting to regard both situations above as limiting cases of a unique equation which is derived from the relativistic equations for energy and momentum conservation in their general form. The generalized Compton effect is thus the collision of a photon and an electron (or, for that matter with any charged particle) regardless of their energy. The Compton effect occurrence in astrophysical scenarios or in the laboratory is presented here for ranges of photons and electrons energies spanning twenty two orders of magnitude, in order to illustrate the importance of this generalized effect. Examples are the generation of high energy gamma photons (around TeV's) and electrons as observed in cosmic radiation, the experiments of photonuclear reactions with gamma ray photons of hundreds MeV's of energy, or the conversion of laser photons in x-ray photons. The beams thus produced have similar properties as a laser beam, such as high intensity and collimation and high degrees of monochromaticity and polarization.