A new understanding of the Compton effect

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In the Compton effect as originally interpreted, a hypothetical particle known as the photon strikes a free electron, which recoils with the energy, $M V^2/2$. The photon, of original energy $h F$, loses energy in the interaction, so that its final energy becomes $h F'$, its difference in energy being, of course, $M V^2/2$. On the basis of this fact, and by measurements of the angle at which the photon recoiled, Arthur Compton showed that the laws of conservation of energy and conservation of momentum adequately described the interaction if the momentum of the electron were taken as $M V$, while the momentum of the photon would be $h F/c$, where h is Planck's constant and c is the speed of light. The hypothetical particle, the photon, however, would have to have some paradoxical properties, inasmuch as spherical symmetry for the elastic interaction in the center-of-mass system would require that such a particle would travel at constant speed in the center of mass frame of reference, instead of in the source system, or laboratory frame of reference wherein the speed has heretofore been taken as constant, and wherein the photon was emitted and detected (*). To avoid such a paradox, one should consider whether conservation of energy and momentum are not possible when light is considered as being waves, not particles.

(*) The photon is said to be in a frame of reference if its speed with respect to that frame is c, that is, if its source is rigidly associated, or resting, in the frame.

For analytical purposes, assume that light is isotropically propagated with respect to its source in the laboratory frame, at c speed in all directions. Next, assume that an inertial frame, C S, is moving away from the source of photons toward a stationary electron in the laboratory frame, with a uniform $V/2$ velocity, where V is to be the velocity with which the electron recoils in the laboratory. Then in C S, the photon speed before the Compton collision is $c - V/2$, and after impact is $c + V/2$. Prior to collision, the electron moves toward C-S with a speed $V/2$, but after the interaction it moves away at $V/2$ speed. Hence, the mechanical interaction is spherically symmetrical with respect to C S, but the light propagation is spherically symmetrical with respect to the laboratory. This accurately describes the test as conducted.

At the point of impact in C S, the interaction is completely elastic, with no net transfer of kinetic energy occurring. The electron, and hence the photon, depart both with the same momentum and energy as they came. This elastic collision corresponds in the source frame to a simple Doppler effect of reflection from the impact point in C S. Assume head-on impact. Then:

$$F' = F\,(1 - V/2\,c)/(1 + V/2\,c) \qquad (1)$$

Now from conservation of energy:

$$h\,(F - F') = M\,V^2/2 \qquad (2)$$

From conservation of momentum:

$$h\,(F + F') = M\,V\,c \qquad (3)$$

Adding (2) and (3):

$$F = M\,V\,c\,(1 + V/2\,c)/2\,h \qquad (4)$$

Subtracting (2) from (3):

$$F' = M\,V\,c\,(1 - V/2\,c)/2\,h \qquad (5)$$

And dividing (5) by (4):

$$F' = F\,(1 - V/2\,c)/(1 + V/2\,c) \qquad (6)$$

Now equation (1) is the Doppler effect for a wave reflected by a mirror that is receding at $V/2$ velocity in a stationary aether. Equation (6), by contrast is for a photon propagated in a fixed aether with respect to the laboratory frame, which photon bounced off of a moving electron at the instant it happened to be resting the the C S frame. It entails conservation of energy and of momentum as calculated by Newtonian dynamics, and it is identically equal to equation (1).

The velocity of light from the above identity is demonstrated to be c in the inertial source frame, $c - V/2$ in the C S frame, and $c - V$ in the final electron frame, which confirms the Galilean composition of velocities and which makes the Einstein composition untenable. Furthermore, this experiment establishes the source of the light as a preferred system of reference with respect to which Maxwell's electromagnetic equations are valid, and makes Einstein's principle of Lorentz covariance untenable.

Finally, by demonstrating unequivocally that photons are waves propagated in a medium instead of particles, as heretofore assumed from this experiment, it renders Heisenberg's uncertainty principle untenable and Bohr's principle of complementarity superfluous.

By setting F' equal to zero in (6), it can be immediately deduced that annihilation energy of $h\,F = 2\,M\,c^2$ for the photon will result in pair production, in exact accord with experiment. Other surprising confirmations of this theory will be the subject of subsequent papers.