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Diffusive interactions between photons and electrons, an application to cosmology

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The last century has seen tremendous improvements in our understanding of electromagnetism. An important discovery was made by Einstein in 1916, who combined thermodynamics and atomic physics to predict stimulated emission. The quantization of Maxwell's Equations yielded a powerful tool, Quantum Electrodynamics, which produced extremely accurate predictions as well as explained a large variety of optical phenomena that were discovered and studied during the late 20th century.

In order to understand the details of light-propagation over cosmological distances, it is important to consider every effect that can modify the properties of light. In the 1970s and 80s, the development of the laser triggered a series of important experiments on radiative optical forces, atomic cooling, the dipole force, quantum standing wave, superimposed traveling waves, and ponderomotive forces on electrons.

I will discuss these processes and describe how they affect light propagation in intergalactic space through a 'stimulated transfer process'. Specifically, diffusive properties of electron-photon interactions produce a global energy loss of the photons that appears as a redshift. Although the photon redshift is very small, an Atom-Interferometer can detect small changes in energy as a result of the interactions. I will discuss how the energy change can be measured through the momentum given to the atoms.

Based on the average number density of electrons in intergalactic space and the interaction cross section of the stimulated transfer process, an approximate value of the Hubble constant can be derived from fundamental optics theory, supporting the idea that a more complete understanding of light-matter interactions leads to a very different interpretation of the universe.

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