

The Controversy on Photons and the Hanbury-Brown & Twiss Experiment

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Abstract:

One can think that the hypothesis of existence of the photons was established through the experimental results carried out by Robert A. Millikan (1868-1953), who confirmed the Einstein's equation of the photoelectric effect in 1915, and by Arthur H. Compton (1892-1962), who showed that for explaining the X-rays scattering by matter it was necessary to consider the corpuscular nature of radiation in 1923. Nevertheless, the history of the photon concept is not as linear as it may seem. Throughout the twentieth century, the demand for the concept of photon was challenged at least by the following physicists: Guido Beck (1903-1988) in his paper *Zur Theorie des Photoeffekts* published in 1927, Erwin Schrödinger (1887-1961) in *Über den Comptoneffekt* published in 1927, Gregor Wentzel (1898-1978) in *Zur Theorie des photoelektrischen Effekts* published also in 1927, John Newton Dodd (1922-2005) in *The Compton effect – a classical treatment* published in 1983, Janez Strnad (1934 –) in *The Compton effect – Schrodinger's treatment* published in 1986, Willis Eugene Lamb (1913-2008) and Marlan orvil Scully (1939 –) in *The Photoelectric Effect Without Photons* of 1969, and again by Lamb in his paper *Anti-photon* published in 1995.

On the other hand, never before the need of such a concept was felt as in current times. For instance, *The International Society for Optical Engineering* has organized conferences since 2003 whose interests is already described in their title, *The Nature of Light: What is the Photon?* According to the editors of the 2005 conference, “We all know that for centuries light has been playing a crucial role in the evolution of both sciences and technologies and the field is becoming ever more important every day” (Roychoudhuri, Creath and Kracklauer, p. ix).

Therefore, to write its history would be more welcome and instructive for helping us to understand how the concept of photon was built and fully accepted throughout the twentieth century. Three experiments and the debates about them were landmarks in the history of optics in this century. They were performed by the British Robert Hanbury-Brown (1916-2002) & Richard Twiss (1920-2005) in 1956, by the American John Clauser (1942 –) in 1974, and by the French team led by Alain Aspect (1947 –) in 1986. These experiments had in common, according to Greenstein and Zajonc (1997), attempts of detecting the anti-coincidences, that is, a null result would be an evidence in favor of single photons. Only with Aspect's experiments such a result was achieved. In this talk, I intend to focus on the Hanbury-Brown and Twiss experiment and its early reception, which includes its origins in astronomy and its implications for the creation of quantum optics as a theoretical sub-field of physics.