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Einstein and Boltzmann

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In 1916 Einstein published a remarkable paper entitled "On the Quantum Theory of Radiation"[1] in which he obtained Planck's formula for black-body radiation by introducing a new statistical hypothesis for the emmision and absorption of electromagneic radiation based on discrete bundles of energy and momentum which are now called photons. Einstein radiation theory replaced Maxwell's classical theory by a stochastic process which, when properly interpreted, also gives well known statistics of massless particles with even spin.[2] This quantum distribution, however, was not discovered by Einstein but was communicated to him by Bose in 1924. Like Boltzmann's classical counterpart, Einstein's statistical theory leads to an irreversible approach to thermal equilibrium, but because this violates time reversal, Einstein theory can not be regarded as a fundamental theory of physical process.[2] Apparently Einstein and his contemporaries were unaware of this problem, and even today this problem is ignored in contemporary discussions of Einstein's treatment of the black-body spectrum.

[1]A. Einstein "On the Quantum theory of Radiation," Phys. Zeitschrift 18 (1917) 121. First printed in Mitteilungender Physikalischen Gesellschaft Zurich. No 18, 1916. Translated into English in Van der Waerden "Sources of Quantum Mechanics" (North Holland 1967) pp. 63-77.

[2]M. Nauenberg "The evolution of radiation towards thermal equilibrium: A soluble model which illustrates the foundations of statistical mechanics," American Journal of Physics 72 (2004) 313