50. THE SPIN OF THE PHOTON

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(Nature, 128, 817, 1931)

Recently a number of papers have appeared on the question as to whether the phenomena of polarization of light can be explained by the assumption of a 'spin' of the photon. Kastler and Frisch deduce from their experiments that the photon possesses no spin, and Kastler argues further that the phenomena of polarization should be explained on statistical grounds. Raman and Bhagavantam, on the other hand, argue that the interesting results obtained by Bär and Hanle on the reversal of the state of polarization of Raman lines when observed in the direction of propagation of the primary beam can be explained only on the assumption that the photons possess spin. They seem to link circular polarization definitely with a spin of the photon about the line of propagation.

The arguments of Frisch and Kastler are based upon the Sommerfeld-Rubinowicz explanation of the selection principle for the azimuthal quantum number (principle of conservation of angular momentum of atom plus photon), but applying the same principle, and the principle that the atom-magnet can orient itself in any direction making certain definite quantised angles with the external field (as proved by Stern and Gerlach's experiment), it can be shown that the absorption of Zeeman components can never disappear with reversal of the field, but it will be modified on passing through two fields, whether parallel or antiparallel. Hence the experiments of Frisch or Kastler cannot be interpreted in the way supposed by them and show no light on the question of the spin. Secondly, and this is more important, a discussion of the Zeeman effect of the $\pi$-components of the $D_1$ line, assuming that the principle of conservation of angular momentum holds during radiation, shows that there may be photons without any 'spin' whatsoever, although they may show polarization. It therefore seems unjustifiable to describe polarization with the aid of a 'spin'. It appears that Bär and Hanle's results should be explained in some other way than that proposed by Raman and Bhagavantam.

A full discussion will appear later.

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1 Frisch, Zeit. für Physik, vol. 61, p. 626; Kastler, Jour. de Physique, May 1931; Raman and Bhagavantam, Nature, 128, July 18, 1931.
2 Naturwiss., vol. 19, p. 463, 375; 1931.