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FARADAY EFFECT AND BIREFRINGENCE

WHEN plane polarised light is incident on a birefringent crystal placed in a magnetic field with the electric vector parallel to one of the principal planes of vibration of the crystal, the emergent light is, in general, elliptically polarised. The major axis of the emergent ellipse is inclined at an angle ψ to the plane of vibration of the incident light, which is given by the equation,[1]

$$\tan 2\psi = \frac{\sin 2\gamma \sin \Delta}{\cos^2 2\gamma + \sin^2 2\gamma \cos \Delta},$$

where

$\Delta = \Delta_0 t = t\sqrt{\delta_0^2 + (2\rho_0)^2}$ and $\tan 2\gamma = 2\rho_0/\delta_0$. Δ_0 is the relative phase retardation per unit length, δ_0 the phase retardation when there is no magnetic field, ρ_0 the rotation per unit length when there is no birefringence and t is the thickness of the specimen.

It can be shown by suitable algebraic manipulation that, when δ_0 is small,

$2\psi = 2\rho\ (1 - \delta^2/3\,!)$, where $\rho = \rho_0 t$ and $\delta = \delta_0 t$;

and when $2\rho/\delta$ is small, $\tan 2\psi = (2\rho \sin \Delta)/\delta$.

As it is easy to measure ψ and ρ with the aid of a half shade, these formulæ would prove extremely useful in the determination of the photoelastic constants of isotropic solids. One measures ρ the rotation for a particular value of the magnetic field when the solid is not strained, and again ψ the rotation with the same field and a known applied stress. Then δ can be easily evaluated from the last two equations. As 2ρ is, in general, small, the two equations cover the range of values of δ usually met with.

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1. Pockels, *Lehrbuch der Krystall-optik*, 1906.