prof. Vidya Sagar
Department of Physics
Raja Singh College, Siwan

Production of Circularly-polarised Light.

The circularly-polarised light can be produced by allowing, plane-polarised light to fall normally on a quarter-wave plate such that the vibrations in the plane-polarised light make an angle of 45° with the optic axis of the plate. In this case the incident light is divided into E and O components of equal amplitudes $A\cos 45°$ and $A\sin 45°$.

Let $A\cos 45° = A\sin 45° = a$. As the quarter-wave plate introduces a phase difference of $\pi/2$, the two components may be written as

$$x = a\sin(\omega t + \pi/2) = a\cos\omega t$$

and $$y = a\sin\omega t$$

The resultant vibration is therefore given by

$$x^2 + y^2 = a^2$$

which represents a circle. Hence the light emerging from the 1/4 plate is circularly-polarised.

Detection:— The circularly-polarised light, when seen through a rotating Nicol, shows no variation in intensity. It thus resembles unpolarised light. Hence to confirm that the given light is circularly-polarised it is first passed through a 1/4 plate and then through the rotating Nicol. The light now shows a variation

in intensity with zero minimum.

If the given light were unpolarised, it would have remained unchanged by the $\lambda/4$ plate. Hence on passing through the Nicol the light would have shown no variation in intensity.

Suppose a beam of plane-polarised light falls normally on a doubly-refracting Crystal plate such that the direction of the vibration makes an angle other than 0, 45° or 90° with the optic axis of the crystal. Then the light emerging from the plate is elliptically polarised.

If the thickness of the plate is such that it produces a phase difference δ between the O and E wave, where

$$\delta = \pi/2, 5\pi/2, 9\pi/2, - - - - -$$

then the emerging light is left-handed elliptically polarised with axes of ellipse along a perpendicular to the optic axis. If however the phase difference is

$$\delta = 3\pi/2, 7\pi/2, 11\pi/2 - - - - -$$

the emergent light is right-handed elliptically polarised.

Thus to Convert left polarised light in to right polarised light, a phase difference of π must be introduced in the given light. Hence the given light must be passed normally through a $\lambda/2$ plate which introduces a phase difference of π.