INTERFERENCE PHENOMENA

The colours for an anisotropic mineral observed in thin section, between crossed polars are called interference colours and are produced as a consequence of splitting the light into two rays on passing through the mineral.

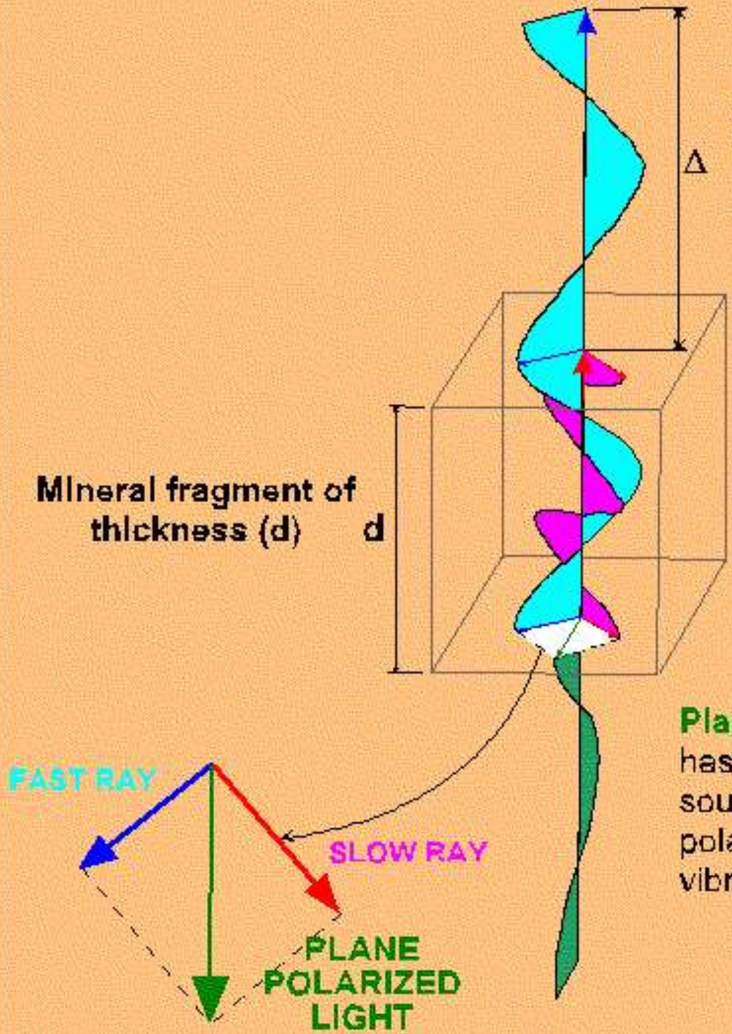
RETARDATION

Monochromatic ray, of plane polarized light, upon entering an anisotropic mineral is split into two rays, the FAST and SLOW rays, which vibrate at right angles to each other.

Due to differences in velocity the slow ray lags behind the fast ray, and the distance represented by this lagging after both rays have exited the crystal is the retardation - D.

$$\Delta = d(n_s - n_f)$$

DEVELOPMENT OF RETARDATION



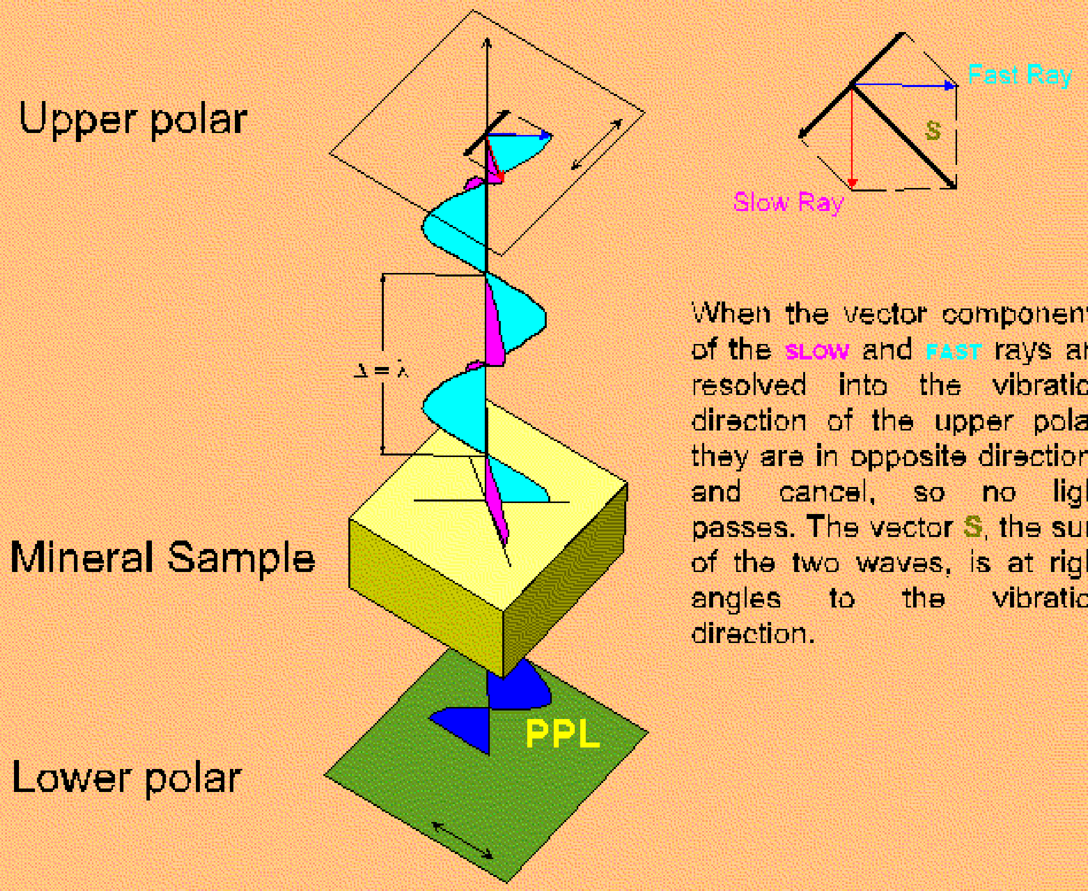
Retardation (Δ) - the amount that the **SLOW RAY** lags behind the **FAST RAY** upon exiting from the mineral

Plane polarized light which has passed, from the light source, through the lower polar, giving it a single vibration direction.

When **Plane Polarized Light** enters a mineral it is split into **SLOW** and **FAST** rays. These rays vibrate at right angles to each other and their total energy is equal to the energy of the incident ray. Both rays travel through the mineral, with the **FAST RAY** exiting the mineral before the **SLOW RAY**.

INTERFERENCE AT THE UPPER POLAR

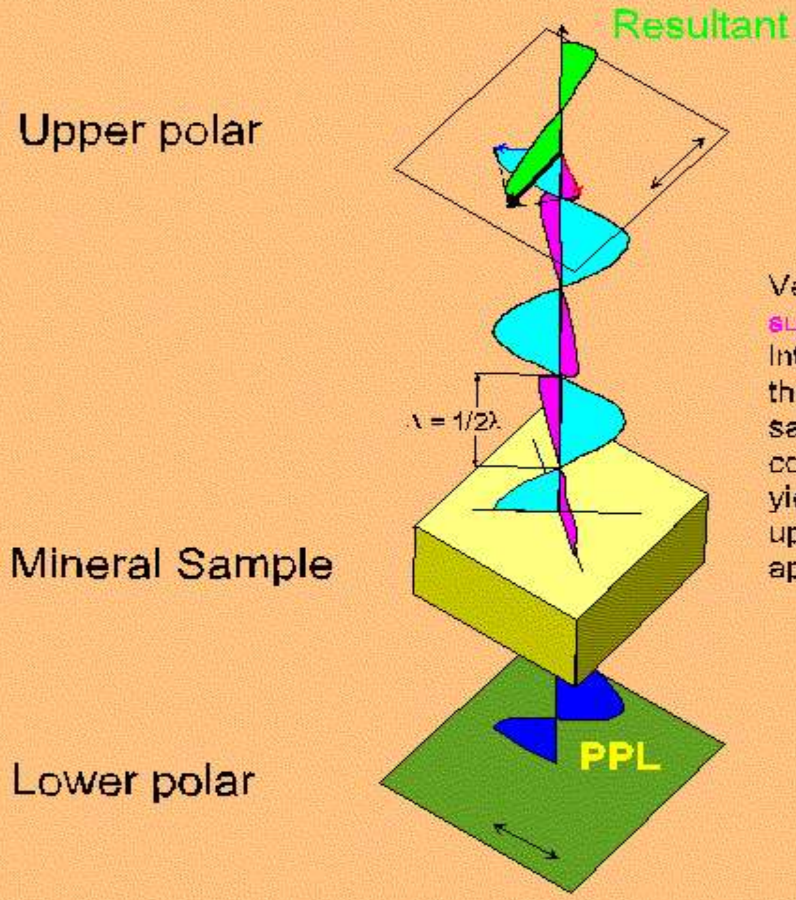
The two rays exiting the mineral are **IN PHASE**, with the SLOW RAY lagging behind the FAST RAY by one whole wavelength.



When the vector components of the SLOW and FAST rays are resolved into the vibration direction of the upper polar, they are in opposite directions and cancel, so no light passes. The vector S, the sum of the two waves, is at right angles to the vibration direction.

INTERFERENCE AT THE UPPER POLAR

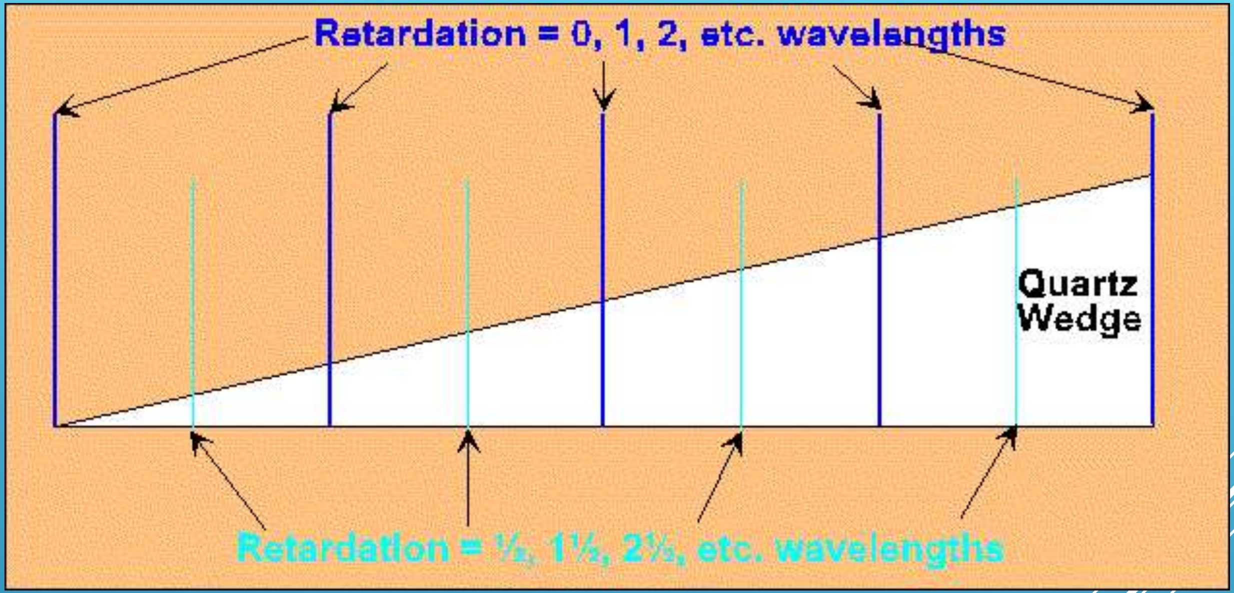
The two rays exiting the mineral are **OUT OF PHASE,** with the SLOW RAY lagging behind the FAST RAY by one half wavelength.

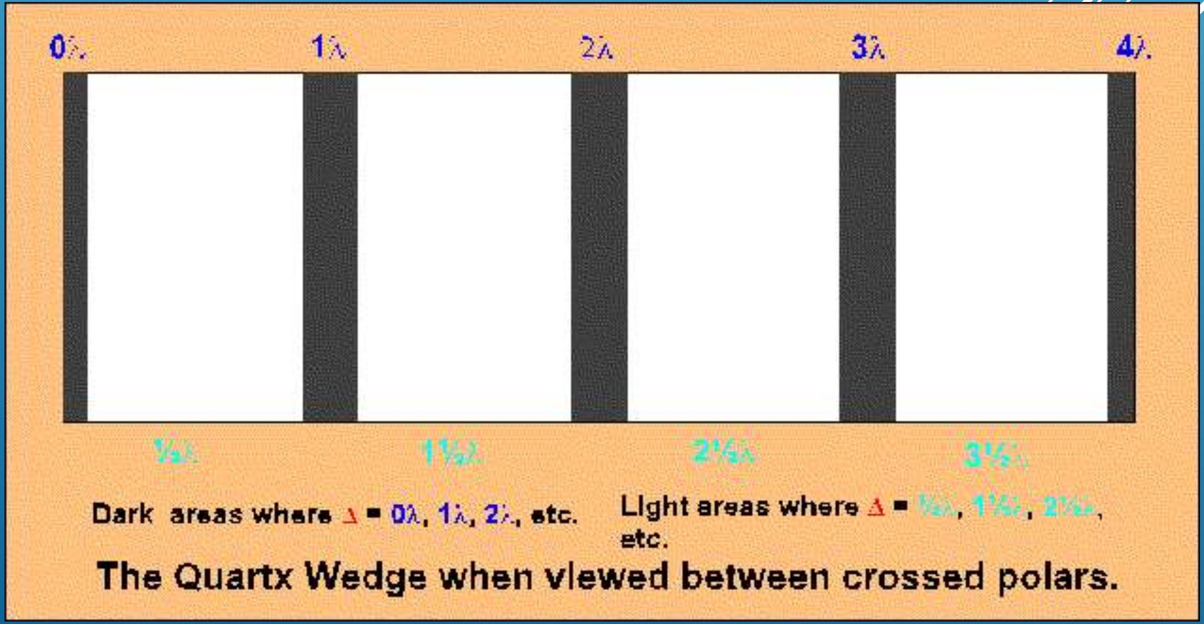


Vector components of the SLOW and FAST rays resolved into the vibration direction of the upper polar are in the same direction, so they constructively interfere to yield R, which passes the upper polar and the mineral appears bright.

(File – uppolar.ds4)

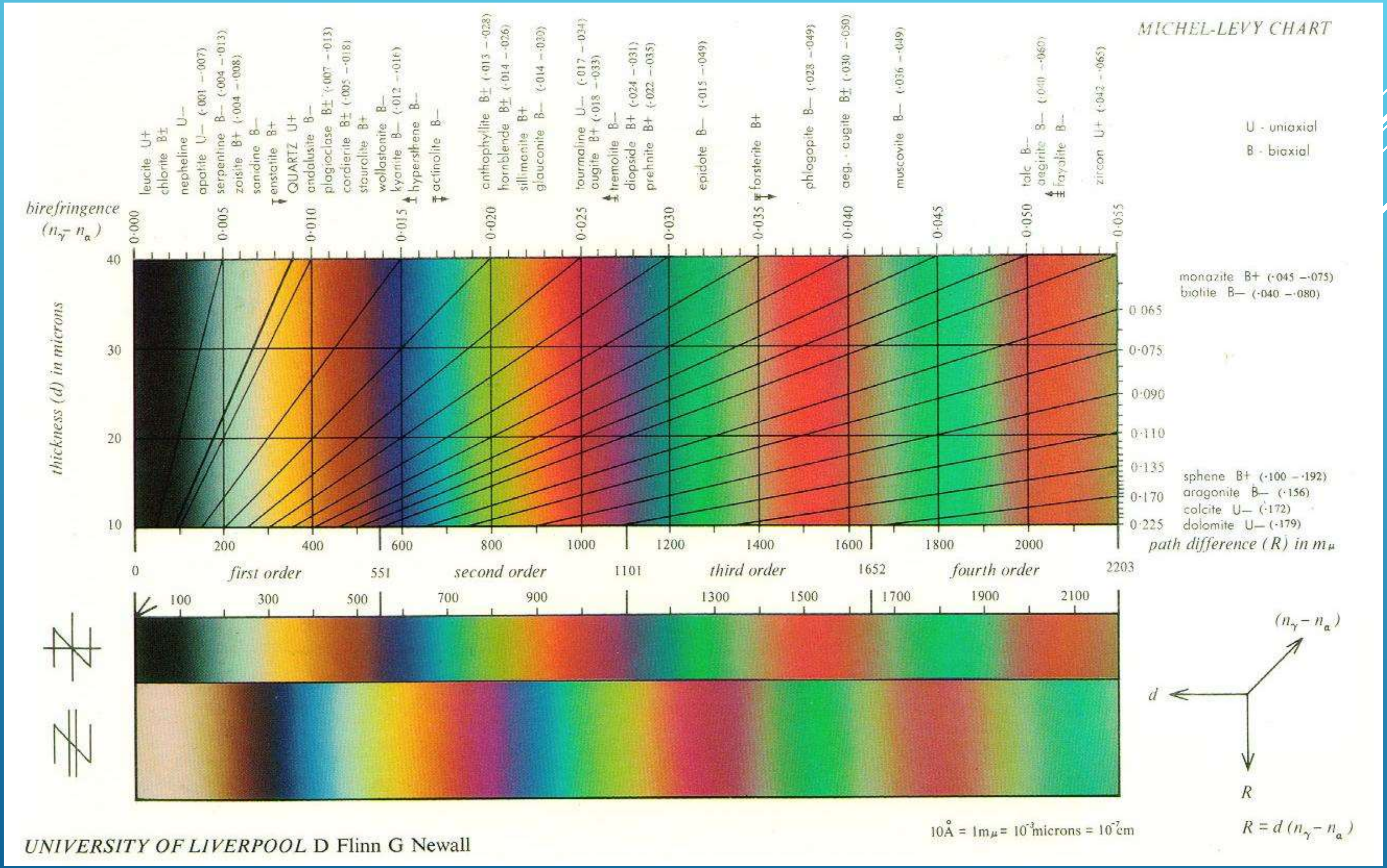
MONOCHROMATIC LIGHT





POLYCHROMATIC LIGHT

Michel Levy Chart



EXTINCTION

Anisotropic minerals go extinct between crossed polars every 90° of rotation. Extinction occurs when one vibration direction of a mineral is parallel with the lower polarizer.

As a result no component of the incident light can be resolved into the vibration direction of the upper polarizer, so all the light which passes through the mineral is absorbed at the upper polarizer, and the mineral is black.

Upon rotating the stage to the 45° position, a maximum component of both the slow and fast ray is available to be resolved into the vibration direction of the upper polarizer. Allowing a maximum amount of light to pass and the mineral appears brightest.

Types of Extinction

1. **Parallel Extinction**

   The mineral grain is extinct when the cleavage or length is aligned with one of the crosshairs.

   The extinction angle (EA) = 0°

   Orthopyroxene, biotite

2. **Inclined Extinction**

The mineral is extinct when the cleavage is at an angle to the crosshairs.

EA > 0°

clinopyroxene, hornblende

3. **Symmetrical Extinction**

   The mineral grain displays two cleavages or two distinct crystal faces. It is possible to measure two extinction angles between each cleavage or face and the vibration directions. If the two angles are equal then Symmetrical extinction exists.

   EA1 = EA2

   Amphibole, calcite

4. **No Cleavage**

   Minerals which are not elongated or do not exhibit a prominent cleavage will still go extinct every 90° of rotation, but there is no cleavage or elongation direction from which to measure the extinction angle.

   e.g.

   Quartz, olivine