How is polarized light analysis?

Polarized light is made up of waves that vibrate in a single plane.

There are three types of polarized lights**,** linearly, circularly, and **elliptically** polarized lights. In linearly polarized light, the electric vector of light moves in a single plane along the direction of propagation.
circularly polarized light, the electric vector of light is made of two linear components perpendicular to each other, having equal amplitudes but with a phase difference of $\pi/2$. In elliptically polarized light, the electric field propagates elliptically, with unequal amplitudes and phase differences. Unpolarized light can be converted to polarized light using methods like transmission, reflection, scattering, and refraction.

- ## Ellipsoids of indices:

However, there are two types of birefringent crystals:

- uniaxial crystals: they have two main refractive indices (trigonal, quadratic and hexagonal systems).

- biaxial crystals: which have three main refractive indices (triclinic, monoclinic, orthorhombic, rhombohedral systems).

A/ The sphere:

Light waves propagate in all directions with a constant speed and a refractive index that is the same in all directions, so the wave surface of the isotropic substance is a spherical surface.

B/ Uniaxial ellipsoid.

In all anisotropic bodies, light splits and propagates at different speeds. By studying the distribution in space of these speeds (therefore the indices), we show that the sphere of isotropic media corresponds to an ellipsoid in anisotropic media.

The simplest of these ellipsoids is of revolution: it has a symmetry of revolution around a single axis called the optical axis. Example: a rugby ball.

If this axis corresponds to the largest index value of the mineral (Ng), the ellipsoid is positive uniaxial.

If this axis corresponds to the small index value of the mineral (Np), this uniaxial is negative.

A uniaxial ellipsoid has:

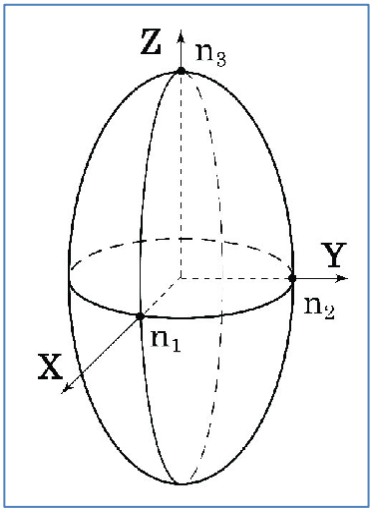
- An optical axis, also the axis of revolution of the ellipsoid.
- A cyclic plane.
- two principal axes, **np** (small index, high speed) and **ng** (large index, low speed).

A cyclic section is a plane of the mineral containing only one index. The normal to this plane is an optical axis of the crystal.

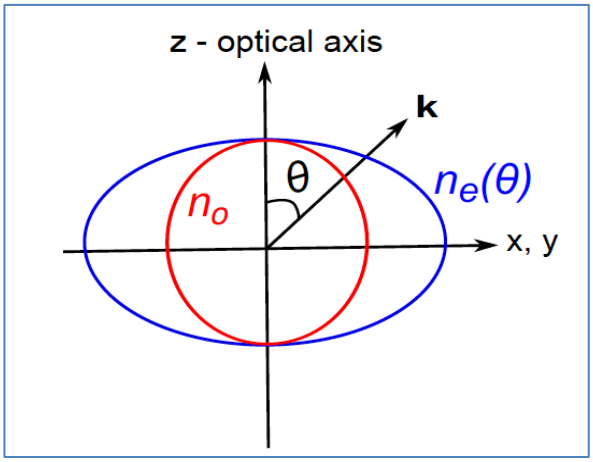
Minerals with an axis of symmetry of order > 2 have a uniaxial ellipsoid (quadratic, hexagonal, rhombohedral system)

Uniaxial medium

index depending on the direction of polarization (**Ellepsoide of indices**)



index depending on the direction of propagation (**surface of indices**)



C\ Biaxial ellipsoid:

Not all ellipsoids are of revolution. Some have any shape and are defined by their major axis (Ng), their minor axis (Np) and their intermediate axis (Nm).

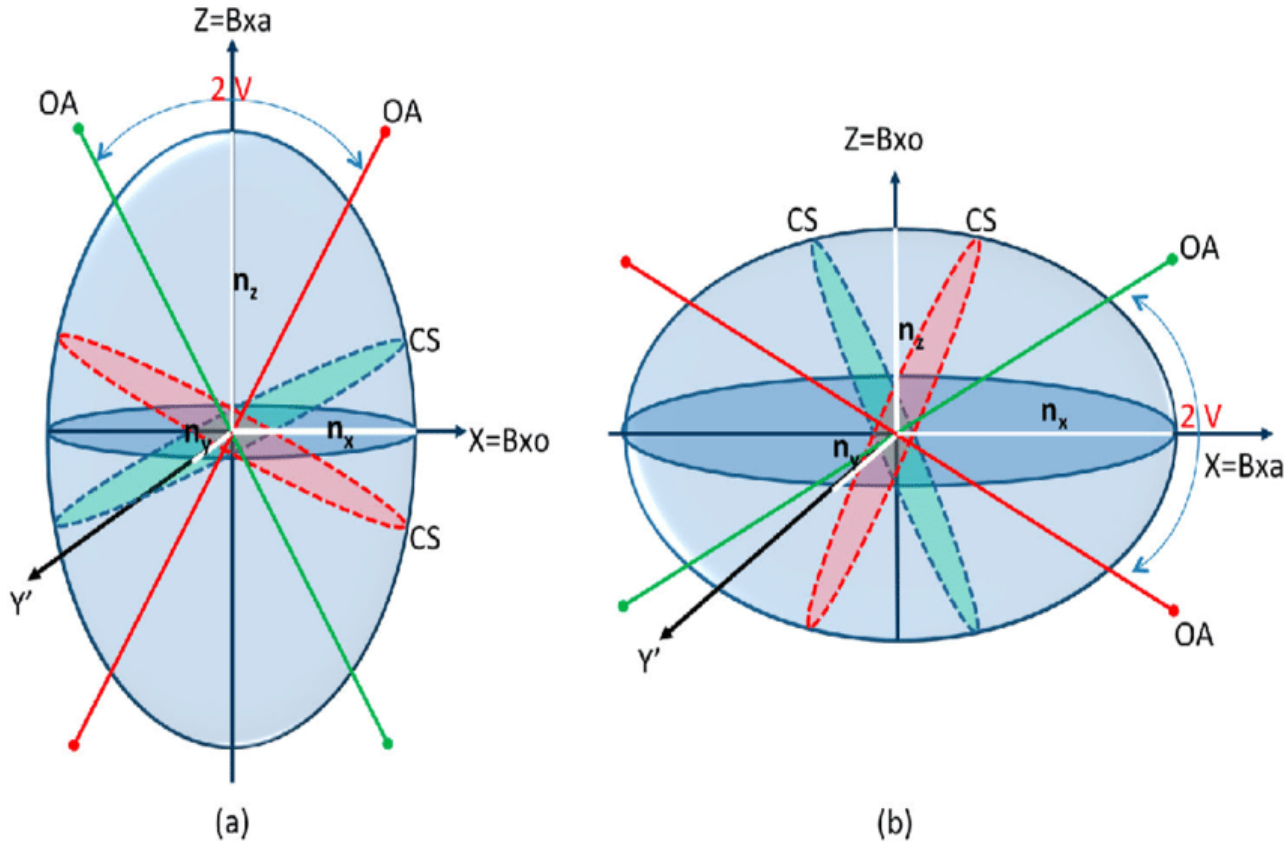
The three indices are perpendicular.

These ellipsoids no longer admit one cyclic section but two: with an optical axis orthogonal to each

of them. These ellipsoids are called biaxial.

When Ng is a bisector of the acute angle of the optical axes, the ellipsoid is **positive**

When Np is a bisector of the acute angle formed by the optical axes, the ellipsoid is called **negative.**



OA: Optic Axis

(a) Biaxial positive indicatrix (b) biaxial negative indicatrix

Biaxial Indicatrix

- Another convention used to identify the angle between the **OA**s bisected by:
  - the **X** axis as the $2V_X$ angle
  - the **Z** axis as the $2V_Z$ angle
- Angle can vary from 0 to 180°, where:

$$2V_X + 2V_Z = 180°$$

- If $2V_Z < 90°$, mineral is positive
- If $2V_Z > 90°$, mineral is negative