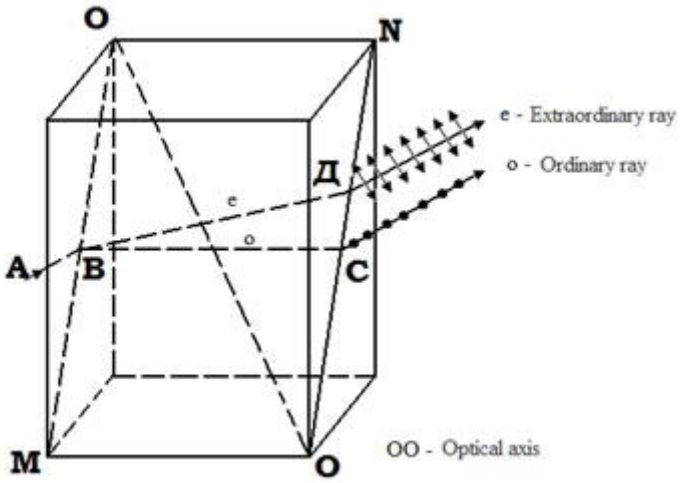
Answer on Question #50685, Physics, Optics

Describe polarization of light by double refraction. Draw o- and e- wave surfaces for calcite and quartz.

Solution:

All crystals, except for cubic crystals -isotropic crystals, are anisotropic, that is, the properties of crystals depend on the direction. The phenomenon of birefringence is: a beam of light falling on an anisotropic crystal, it is split into two beams: ordinary and extraordinary, propagating at different speeds in different directions. Anisotropic crystals are divided into uniaxial and biaxial.



In uniaxial crystals in the same direction, called the optical axis, along which the distribution is no distinction between ordinary and extraordinary rays. Any line parallel to the direction of the optical axis will also be the optical axis. Any plane passing through the optical axis and the incident beam, called the principal or main section of the crystal planes.

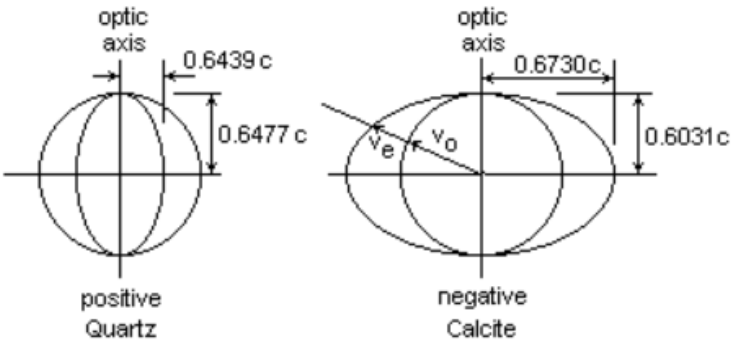
Distinction between ordinary and extraordinary rays:

- ordinary ray obeys the laws of refraction; extraordinary - no;
- ordinary beam is polarized perpendicular to the principal plane, the plane of polarization of the extraordinary ray is perpendicular to the plane polarized ordinary ray;
- Besides the optical axis of the ordinary and extraordinary rays are distributed in different directions. The refractive index n_0 ordinary ray is constant in all directions, therefore, the phase velocity of the ordinary ray is constant in all directions. The refractive index of the extraordinary ray n_e depends on the direction.

Speed difference between v_0 and v_e for all directions except the direction of the optical axis, causes the phenomenon of double refraction in uniaxial crystals. In biaxial crystals, there are two directions along which there is no double refraction.

The indices of refraction for waves polarized along a principal axis making ellipsoid that has been called the optical indicatrix or the index ellipsoid. If two indices are equal, then a plane perpendicular to the axis of the third index cuts the ellipsoid, which is now a spheroid, in a circle. Therefore, this axis is the optic axis, which is the only one. Such media are called uniaxial. If the third

index is greater than the other two, the medium is called positive, and negative otherwise. The two equal indices, or velocities, are called ordinary and denoted by a subscript "o" while the third is called extraordinary and denoted by a subscript "e."



Uniaxial Wave Normal Surfaces