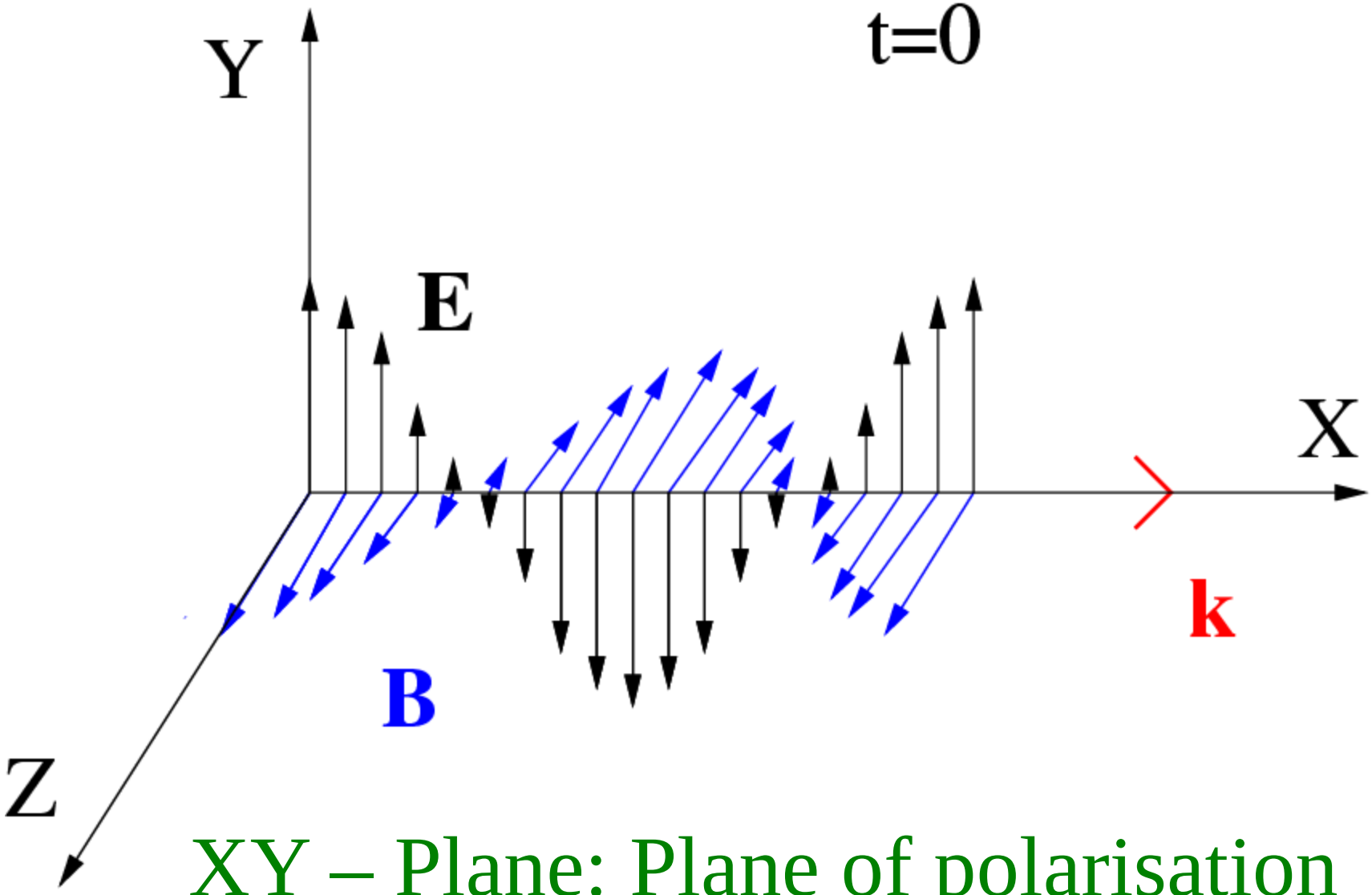
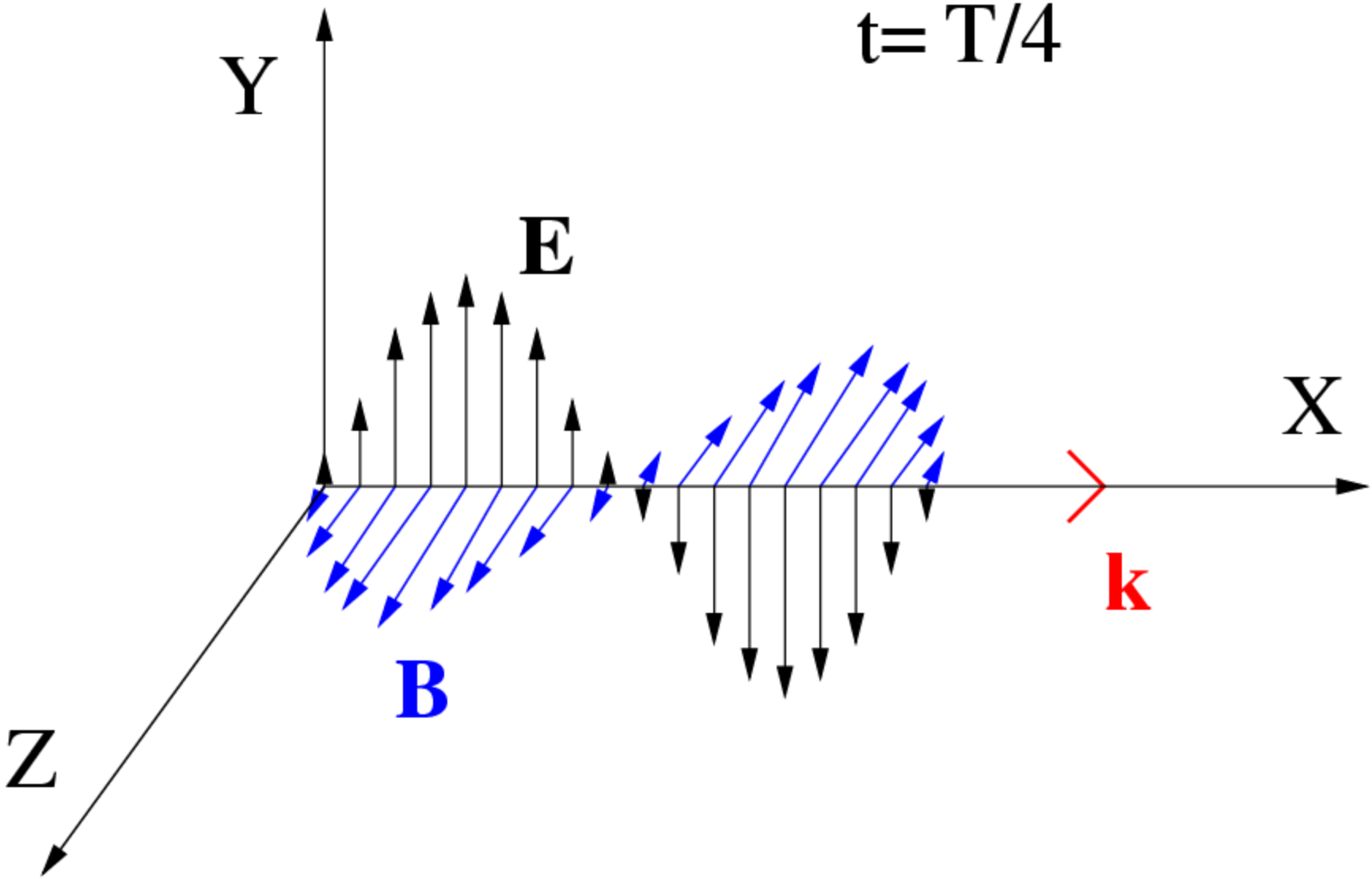
Polarisation

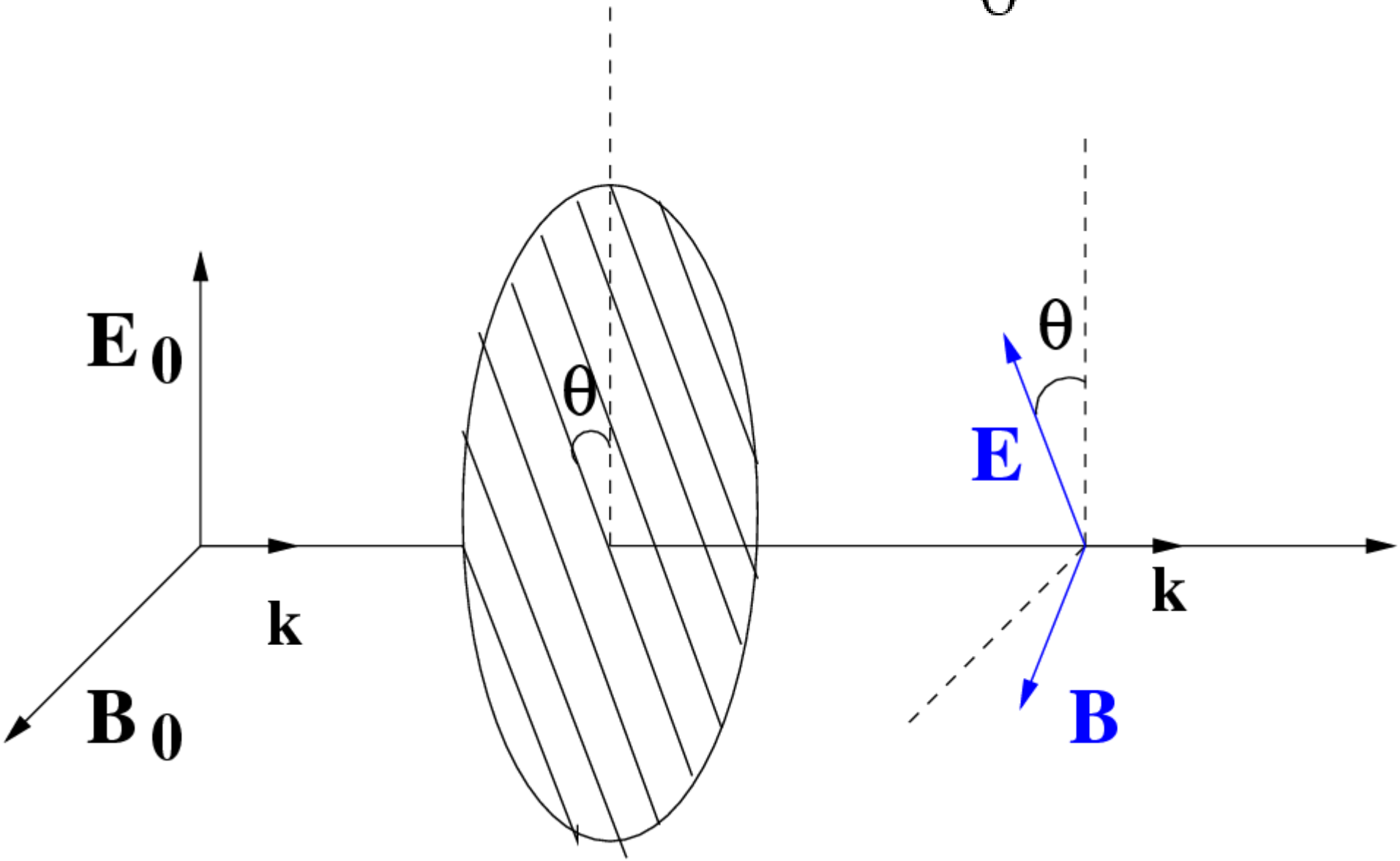


XY – Plane: Plane of polarisation

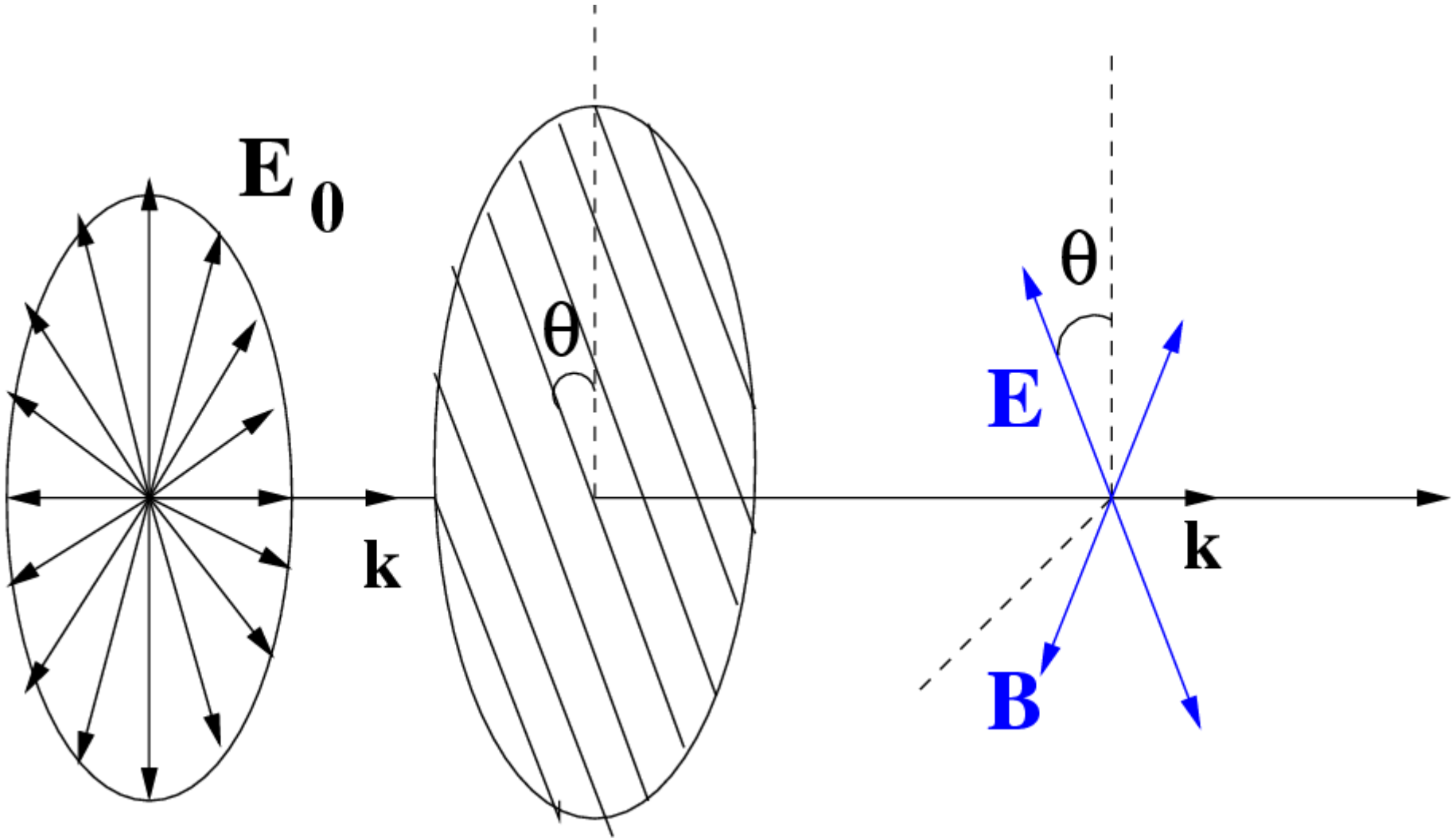

t= T/4
Y
E
X
k
B
Z

Malus law

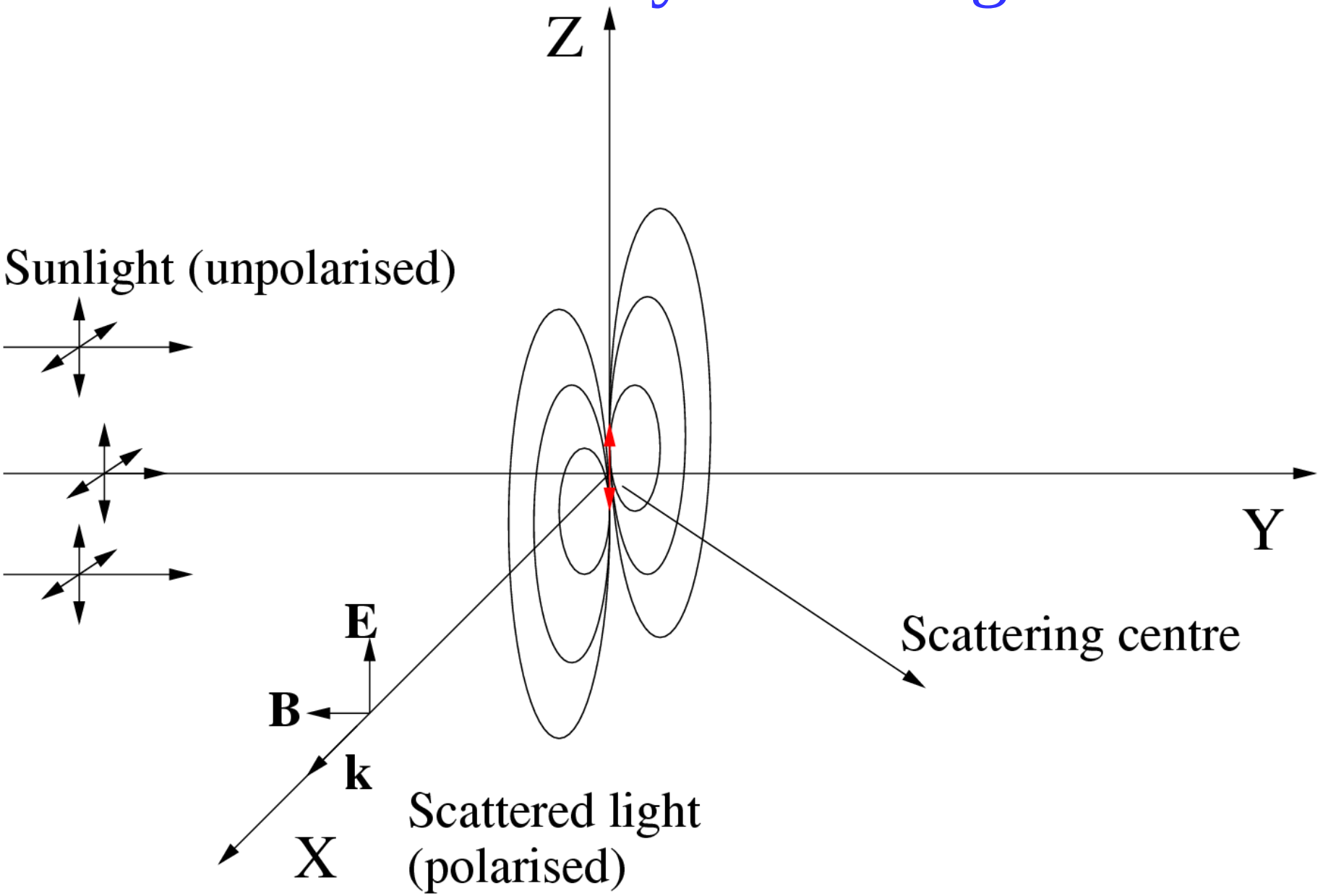
$$I = I_0 \cos^2 \theta$$



Unpolarized light $I = I_0 < \cos^2\theta >= I_0/2$



Polarisation by scattering



Rayleigh scattering $\propto \frac{1}{\lambda^4}$

Blue sky

$$\frac{\sigma_B}{\sigma_R} = \frac{\lambda_R^4}{\lambda_B^4}$$

Red Sunset / Sunrise

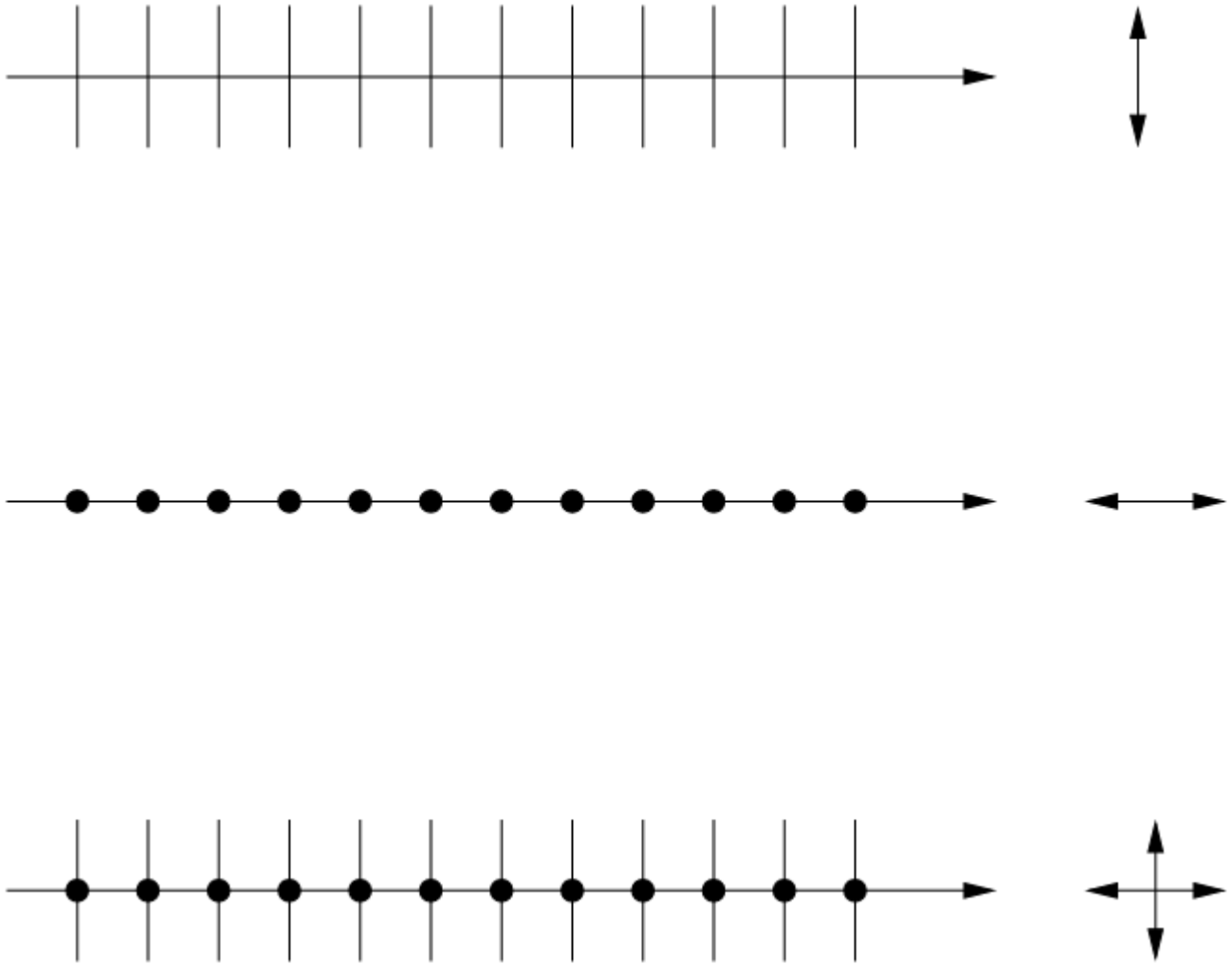
$$\sim \left(\frac{7000}{4000}\right)^4 \simeq 10$$

Degree of polarisation

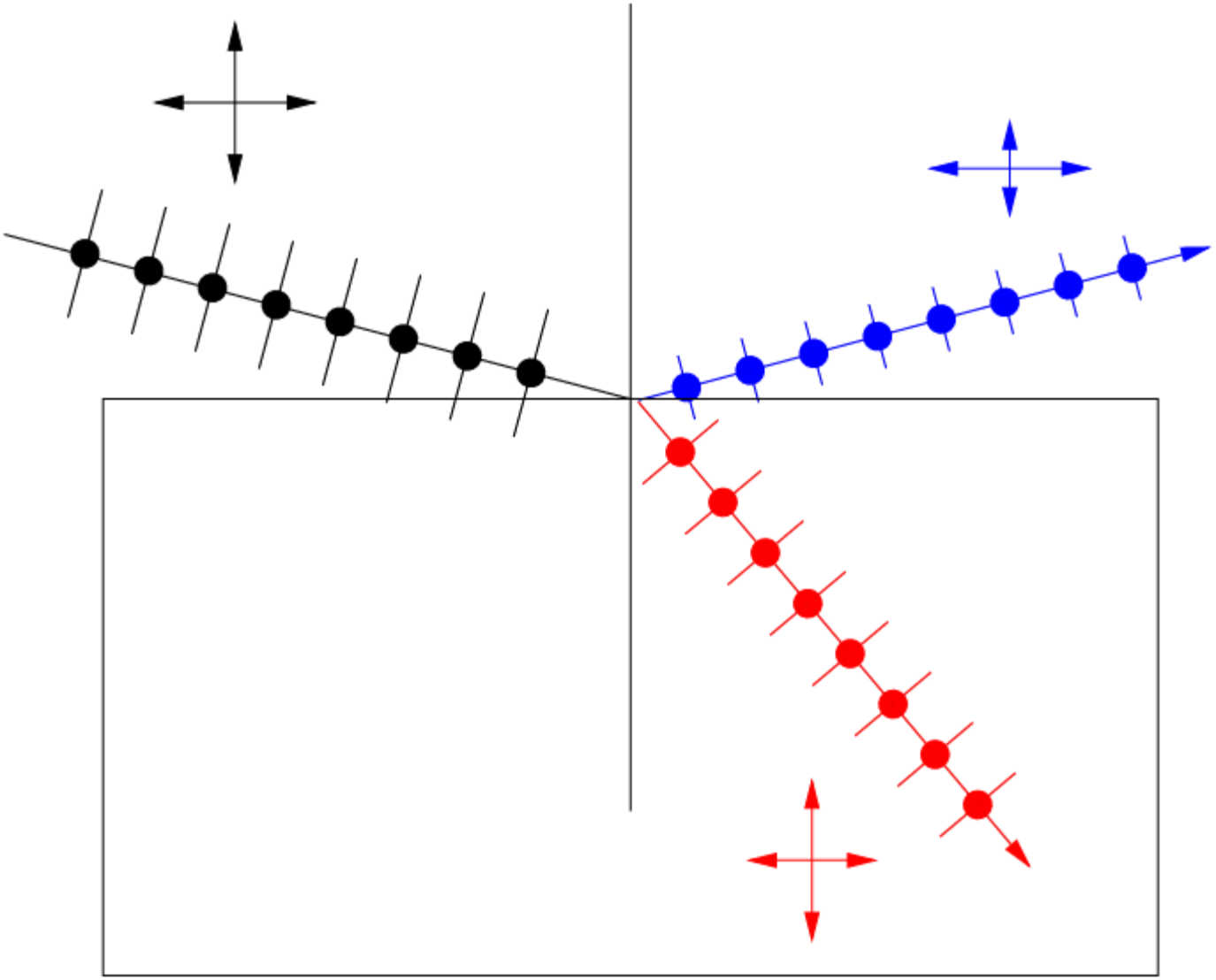
$$P = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

$$P = \frac{I_P}{I_P + I_U}$$

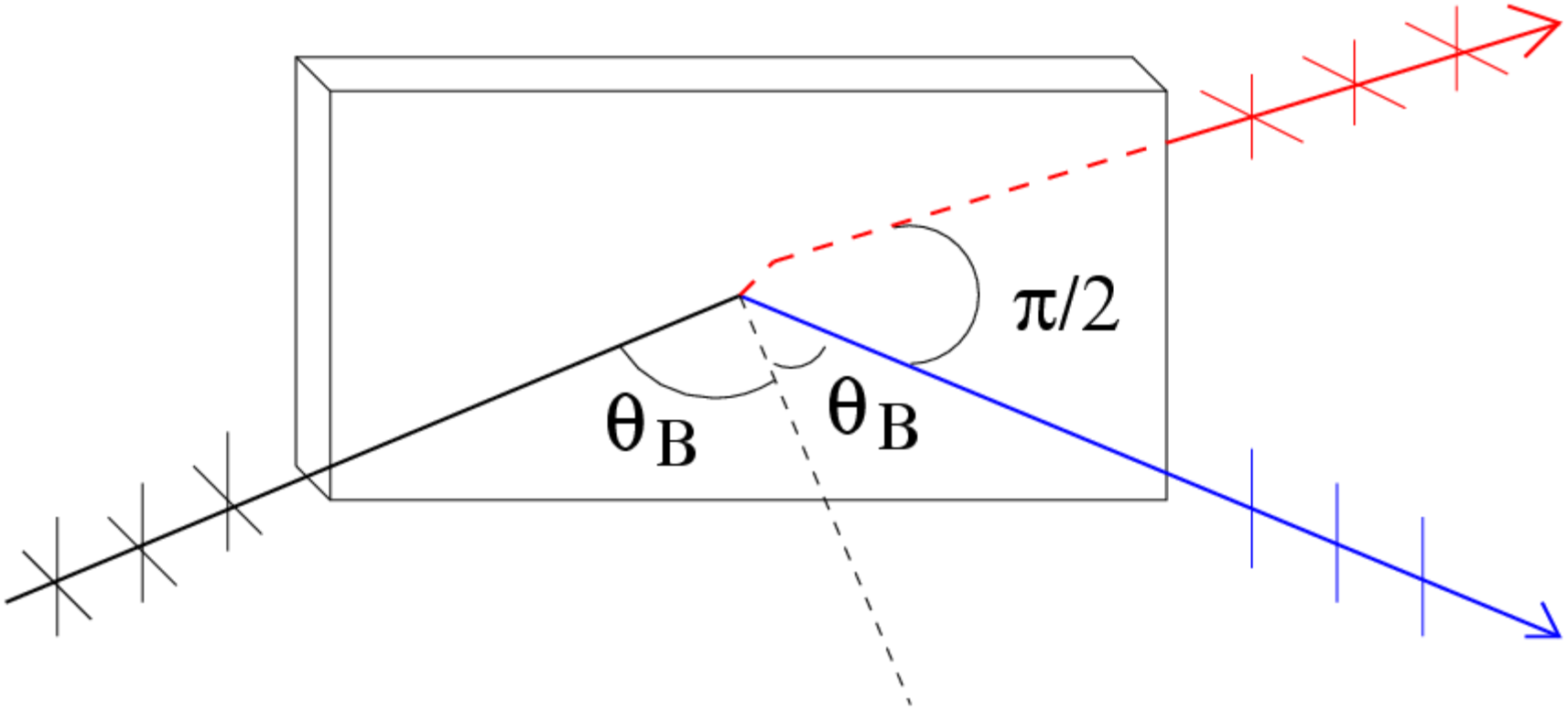
Convention



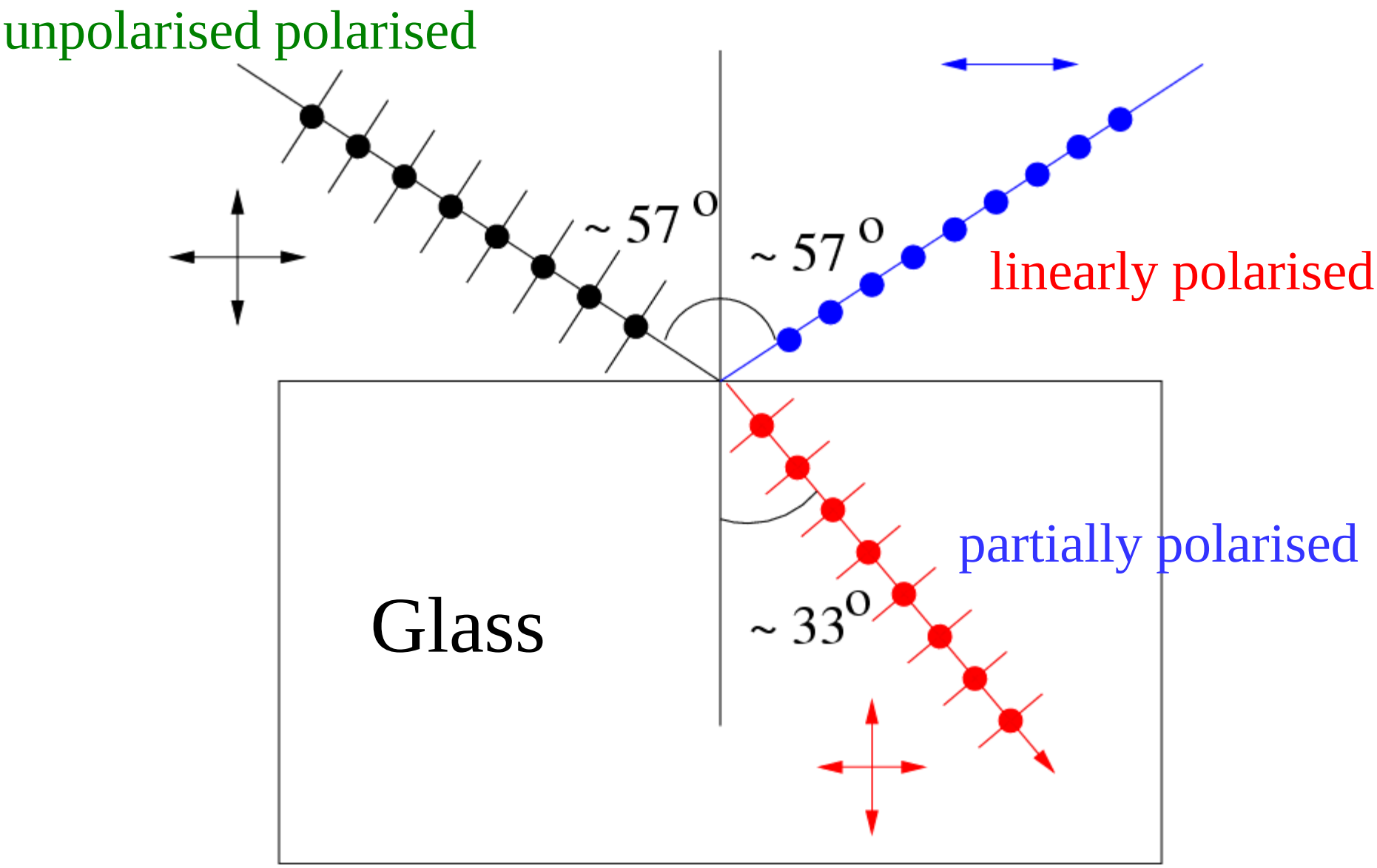
Polarisation by reflection



Brewster angle



Brewster angle



$$\frac{\sin i}{\sin r} = \mu$$

$$\frac{\sin \theta_B}{\sin(\pi/2 - \theta_B)} = \mu$$

$$\frac{\sin \theta_B}{\cos \theta_B} = \tan \theta_B = \mu$$

Brewster's law

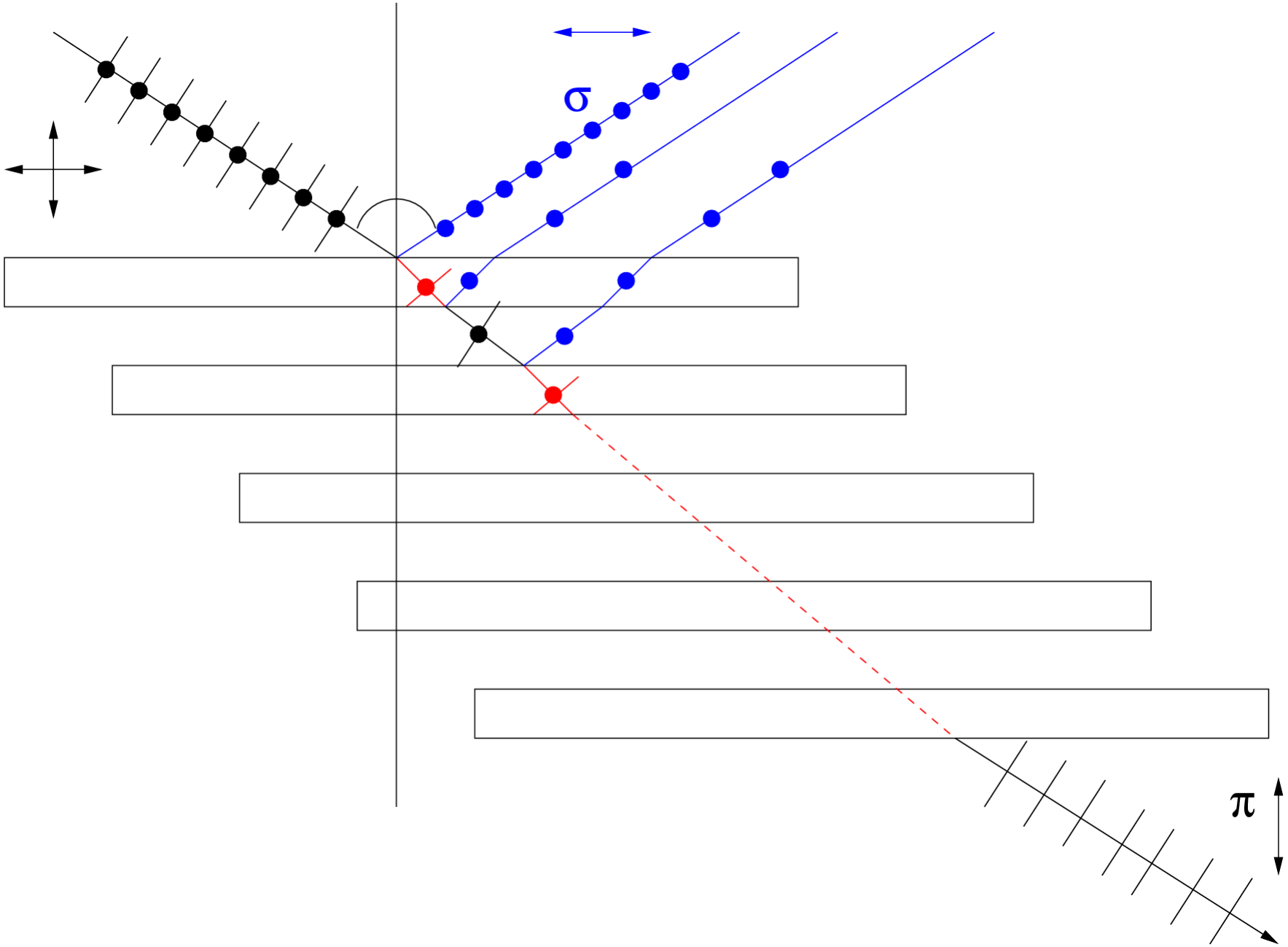
θ_B = Brewster angle

π - Polarisation

Plane of polarisation is same as plane of incidence

σ - Polarisation

Plane of polarisation is perpendicular to the plane of incidence

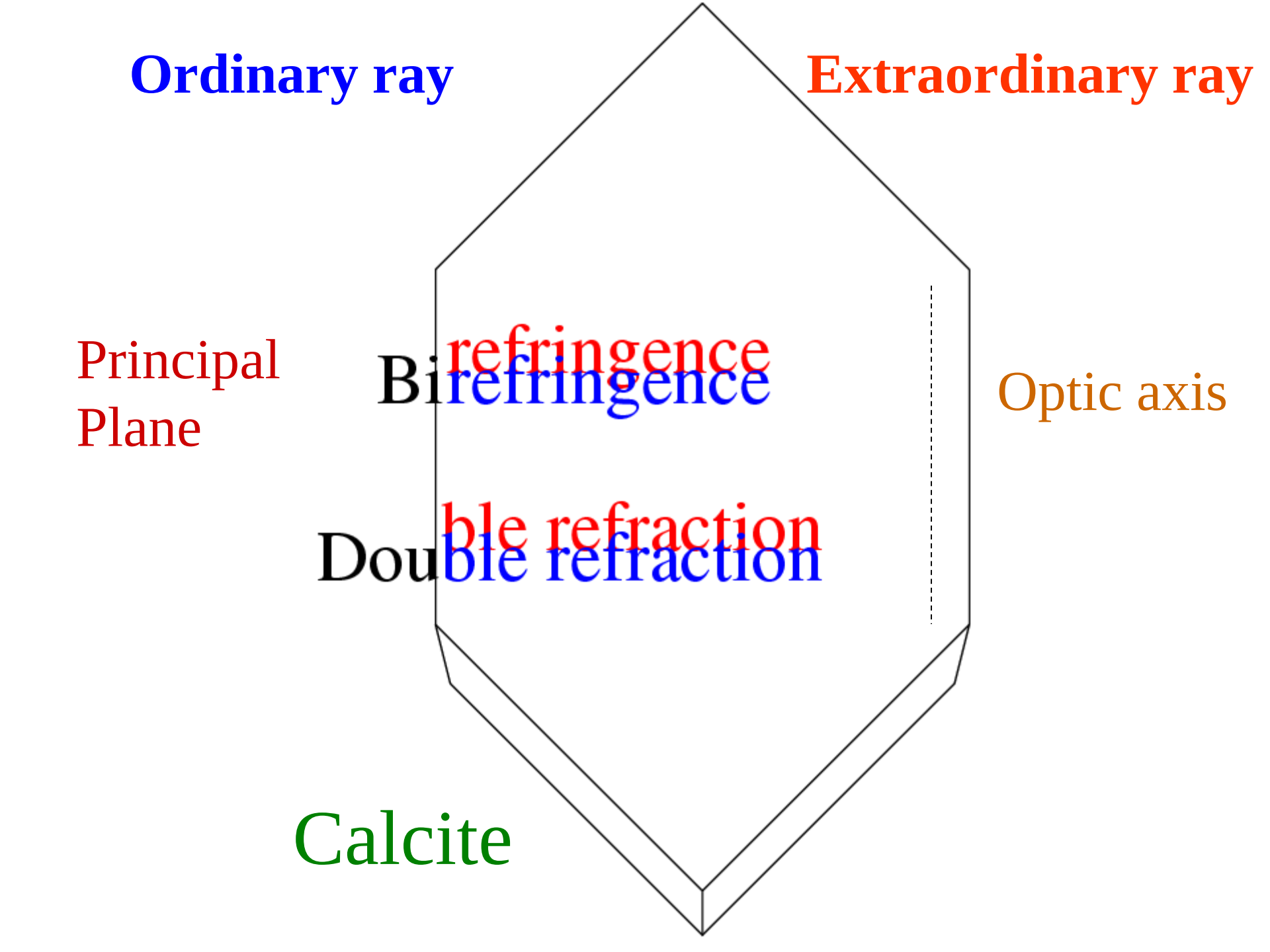

σ
π

Polarisation by double refraction

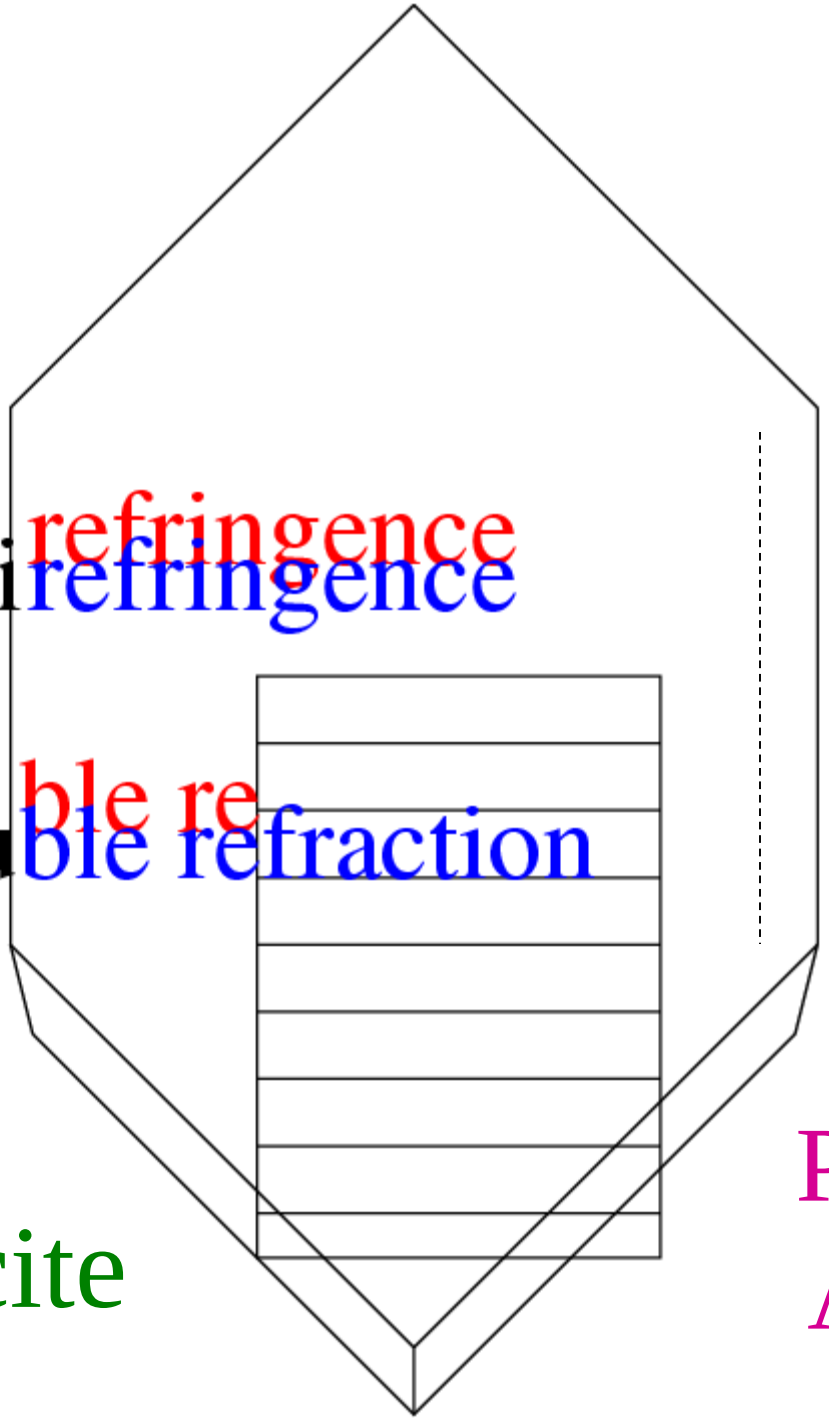
Birefringence

Double refraction

Calcite Quartz


Ordinary ray
Extraordinary ray
Principal Plane
Birefringence
Double refraction
Optic axis
Calcite

Ordinary ray
σ - polarised

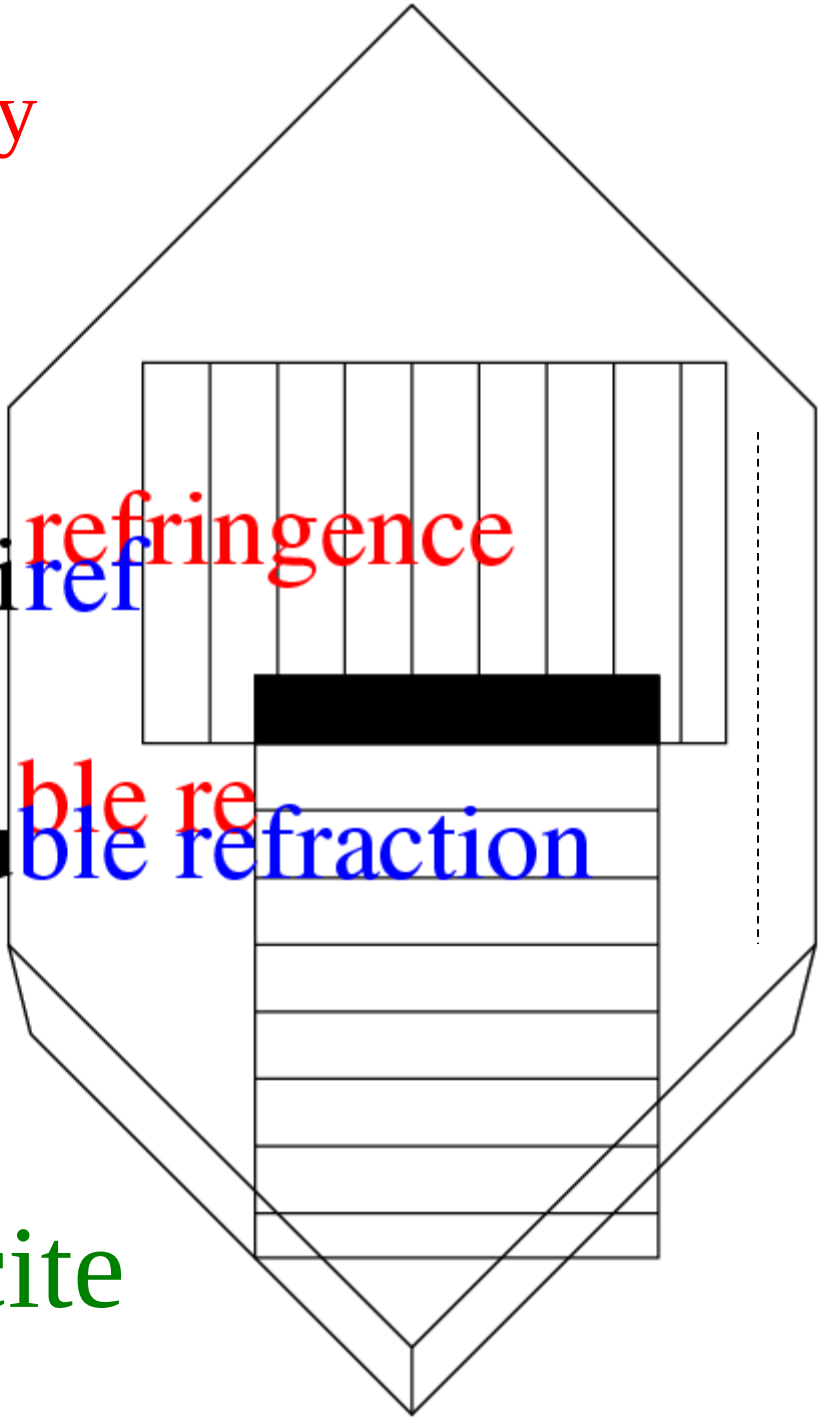


Calcite

Polariser/
Analyser

Extraordinary ray

π - polarised

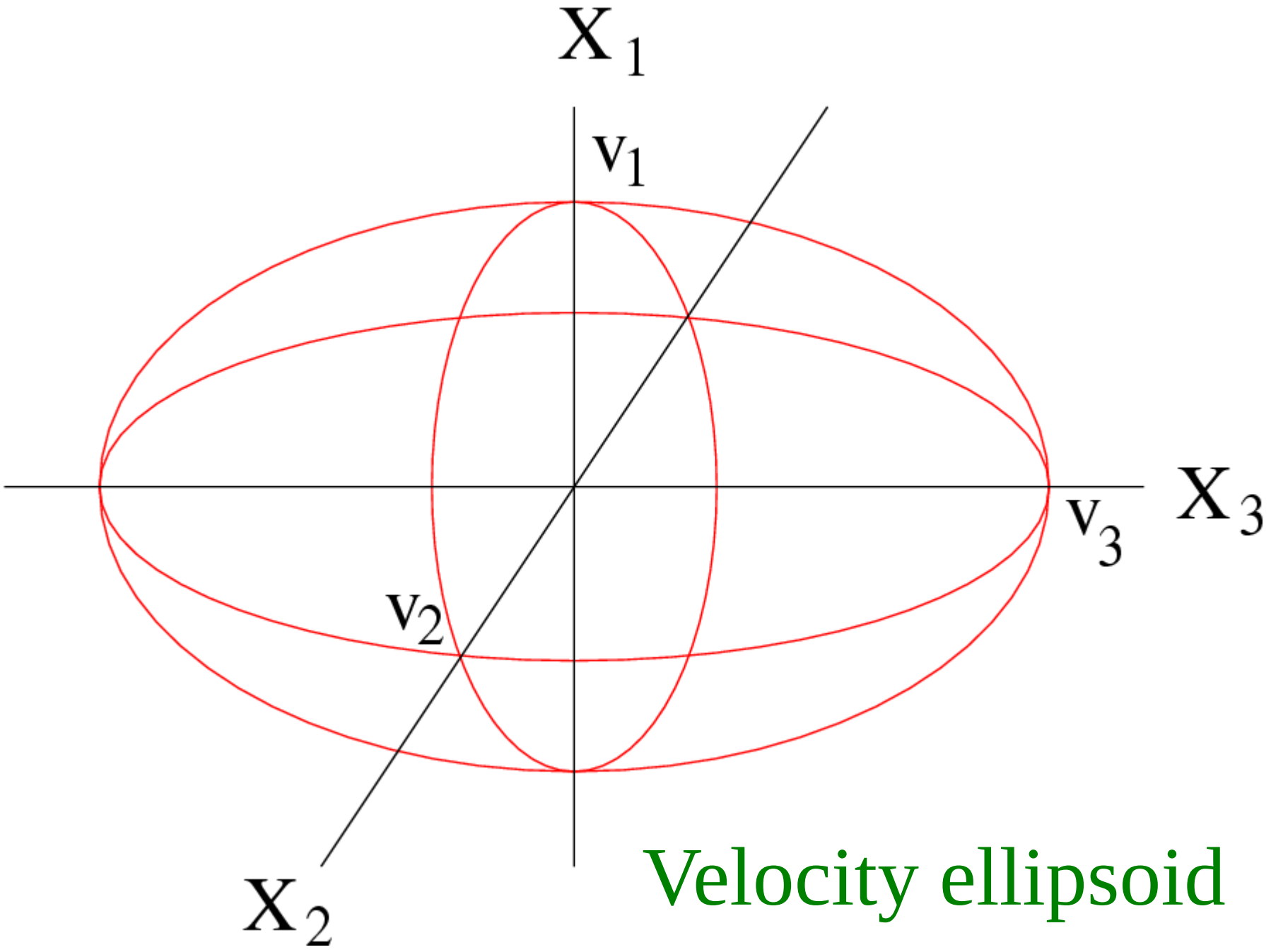


Uniaxial and Biaxial Crystals

Uniaxial : Calcite, Quartz

Biaxial: Mica

Velocity ellipsoid



Velocity ellipsoid

Uniaxial