

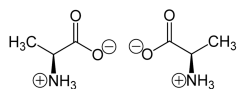
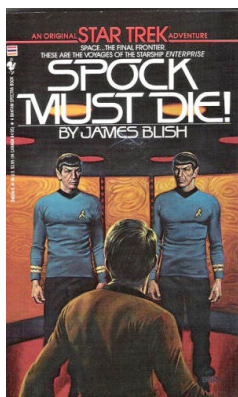
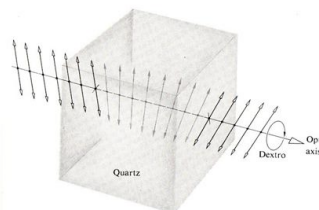
## PHY385-H1F Introductory Optics

Class 18 – Outline: Sections 8.10 to 8.13

- Optical Activity
- Faraday Effect
- Pockels Effect
- Liquid Crystals
- Jones Matrices and Jones Algebra
- [Stokes Vectors and Mueller Matrices will not be on the final exam.]

## Optical Activity

“The property, possessed by certain substances, of rotating the plane of polarization of polarized light passing through them. Optical activity is shown by asymmetric crystals which have two mirror-image forms – the rotation being to the left (laevorotatory, l-) or right (dextrorotatory, d-) respectively.”  
[[http://www.daviddarling.info/encyclopedia/O/optical\\_activity.html](http://www.daviddarling.info/encyclopedia/O/optical_activity.html)]



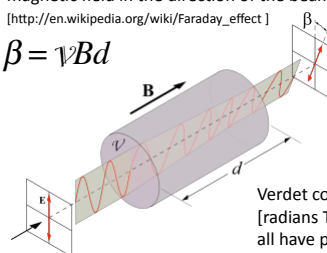
L-Alanine is levorotatory. It is an essential part of the genetic code in every strand of your DNA

D-Alanine is dextrorotatory. It is rare, bactericidal, and used in some antibiotics

## Faraday Effect

- “Faraday effect or Faraday rotation is a Magneto-optical phenomenon-- that is, an interaction between light and a magnetic field in a medium. The rotation of the plane of polarization is proportional to the intensity of the component of the applied magnetic field in the direction of the beam of light.”
- [[http://en.wikipedia.org/wiki/Faraday\\_effect](http://en.wikipedia.org/wiki/Faraday_effect)]

$$\beta = \nu B d$$



Verdet constant,  $\nu$ , is measured in [radians  $\text{T}^{-1} \text{m}^{-1}$ ]. Water, glass, air all have positive Verdet constants

## Pockels Effect

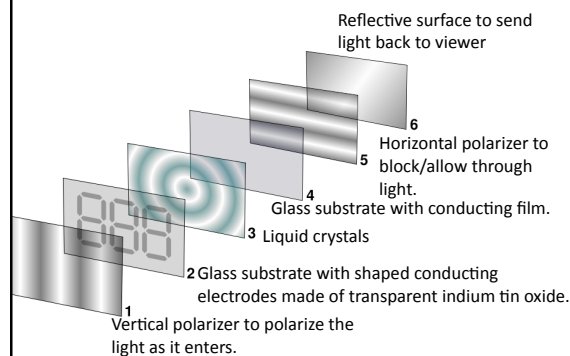
- “An electro-optical effect in which the application of an electric field produces a birefringence which is proportional to the field. The Pockels cell is used in ultrafast shutters.”
- [<http://scienceworld.wolfram.com/physics/PockelsEffect.html>]

The phase shift between the fast and slow axis linear polarization states is:

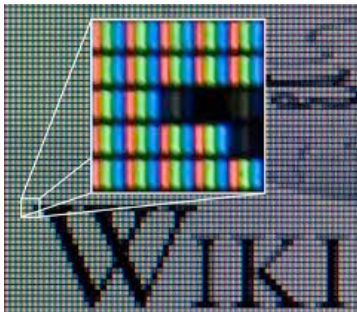
$$\Delta\phi = \frac{2\pi n_o^3 r_{63} V}{\lambda_0}$$

The crystal's electro-optic tensor element  $r_{63}$ , has units of  $\text{m/V}$ . Only piezoelectric crystals which lack a centre of symmetry may show this effect.

## Reflective Liquid Crystal Display



**Back-lit Liquid Crystal Display, with  
colour-filters on the pixels**



**5-minute In-Class Task**

- Please take out a piece of paper that you don't mind handing to me at the end
- WRITE YOUR NAME at the top of the piece of paper
- Discussion with your friends or me during this task is *encouraged!*

1. If  $E_0 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ , which direction does  $\vec{B}_0$  point?
2. Write the normalized Jones vector for the plane wave with:  

$$\vec{E} = \hat{i}E_0 e^{i(kz - \omega t)} - \hat{j}E_0 e^{i(kz - \omega t)}$$
3. What kind of polarization state is the wave of question 2?