

## CD / ORD

**Dichroism** – phenomenon in which light absorption differs for different directions of polarization.

**Linearly Polarized Light** – direction of electric vector is constant but magnitude is modulated.

**Circularly Polarized Light** – magnitude is constant, but direction is modulated. Circularly polarized light may be either “right-handed” or “left-handed.”

**Linear and Circular Dichroism** are special kinds of absorption spectroscopy and occur at energies where absorption takes place.

**LD (Linear Dichroism)** -  $LD(\lambda) = A_{\parallel}(\lambda) - A_{\perp}(\lambda)$

Linearly polarized light oriented along the transition dipole will be absorbed strongly, light oriented perpendicular to dipole will not be absorbed.

Compare absorption parallel vs. perpendicular to helix axis.

**ORD (Optical Rotary Dispersion)** – optical activity as seen in rotation of linearly polarized light due to difference in *refractive index* of two types of circularly polarized light. ( $n_L \neq n_R$ ) ORD vs.  $\lambda$

**CD (Circular Dichroism)** – difference in *absorption* of left and right circularly polarized light. ( $\epsilon_L \neq \epsilon_R$ ) Very small effects, far UV (170 – 300 nm)

$$\Delta(\lambda) = A_L(\lambda) - A_R(\lambda) = [\epsilon_L(\lambda) - \epsilon_R(\lambda)] lc = \Delta\epsilon lc$$

Historically – CD results reported as “ellipticity”  $\theta = \Delta A (32.98)$

or molar ellipticity  $[\theta] = 3298 \Delta\epsilon$  (deg • dl/mol • dm).

For proteins,  $CD_{207\text{ nm}} \sim \% \text{ helix} = \theta / -57,000$ .

*Note: CD and ORD can be interconverted using the Kronig-Kramer relationships. Most experiments today are reported as CD results.*