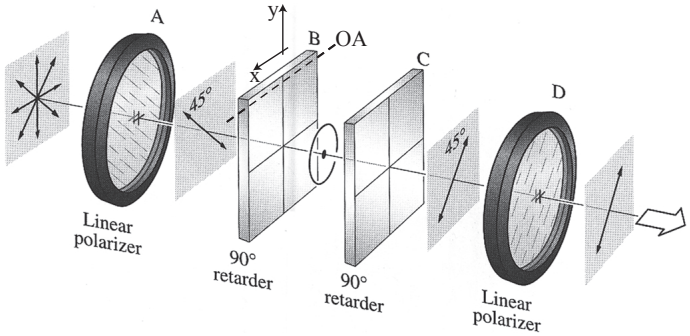
1. Matrix Representation of Polarization Changes (4 pts)

Describe in matrix representation the polarization state of light at various positions in the optical set-up sketched in the figure, where $n_\perp > n_\parallel$ in both retarders and the OA in *C* has the same orientation as indicated for *B*.



2. Polarizer and Retarder (2 pts)

You are given the polarizer and retarder, *A* and *B*, in problem 1, but you don't know which is which. How do you find out by using naturally polarized (*i.e.*, "unpolarized") light?

3. Elliptically Polarized Light (6 pts)

A ray contains *E* components with both $E_x > 0$ and $E_y > 0$ and $E_x \neq E_y$. Describe verbally and sketch what you expect for the polarization state of that ray if the relative phase angle $\Delta\varepsilon = (\varepsilon_y - \varepsilon_x)$ is continuously shifted from 0° to 45°, 60°, 90°, 135°, 180°, 225°, 270° and 315°. How does the ratio E_x/E_y affect the picture?

4. Separation of Polarization States in Calcite (3 pts)

Hecht, problem 8.34:

A calcite plate is cut such that the OA is parallel to the front face, and vertically oriented. A beam (λ_0 = 589 nm) impinges horizontally at an angle of incidence, $\varphi = 50°$. What is the angular separation of the *o*-ray ($n_o = 1.6584$) and the *e*-ray ($n_e = 1.4864$) within the plate?

5. Application of the Fresnel Equations: Reflection from Cover Slide (5 pts)

Unpolarized light hits a microscope cover slide ($n_g = 1.5$) at an incident angle of 30° against the surface normal. What is the degree of polarization, $V = \dfrac{I_p}{I_p + I_n}$ where I_p and I_n are the irradiances of polarized and "natural" (*i.e.*, unpolarized) light, after the reflection? (Refer to Hecht, section 8.6.1, which you should have studied in your reading assignment for today.)