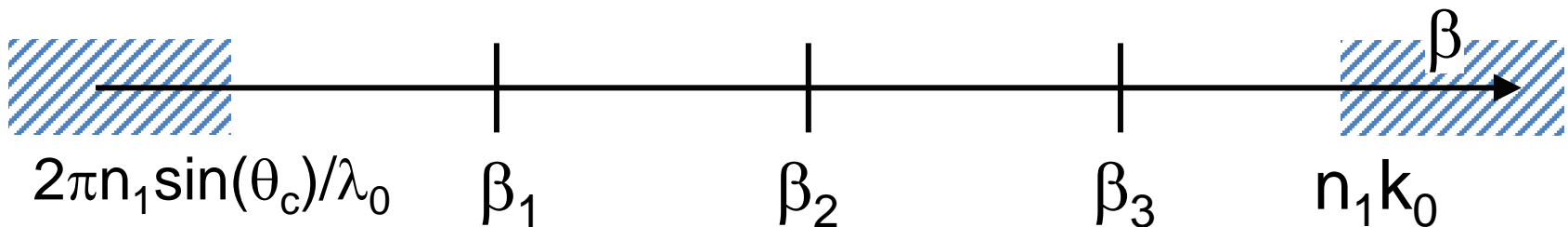
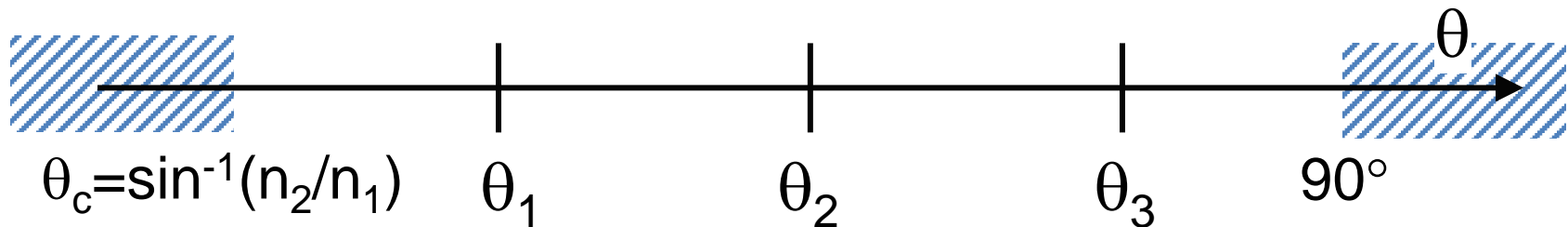
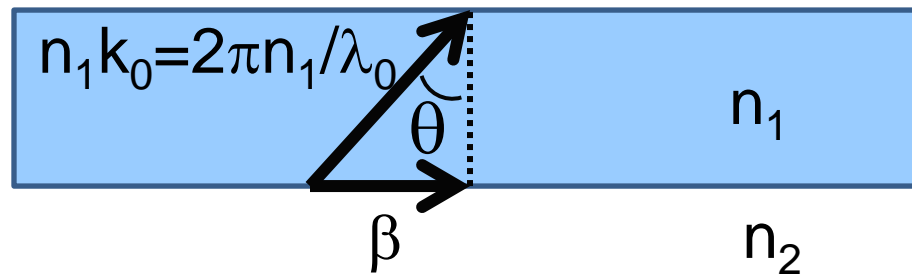
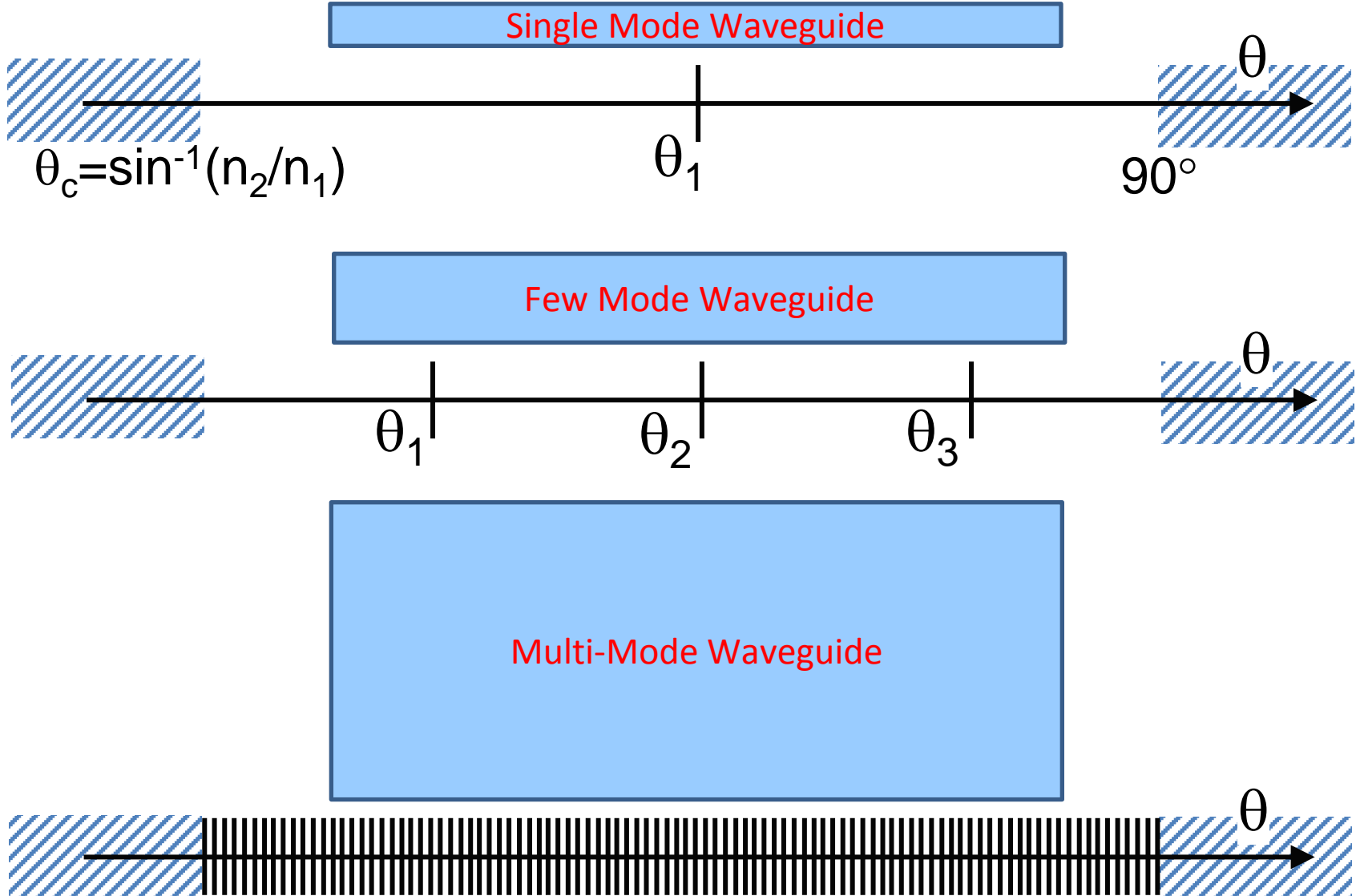


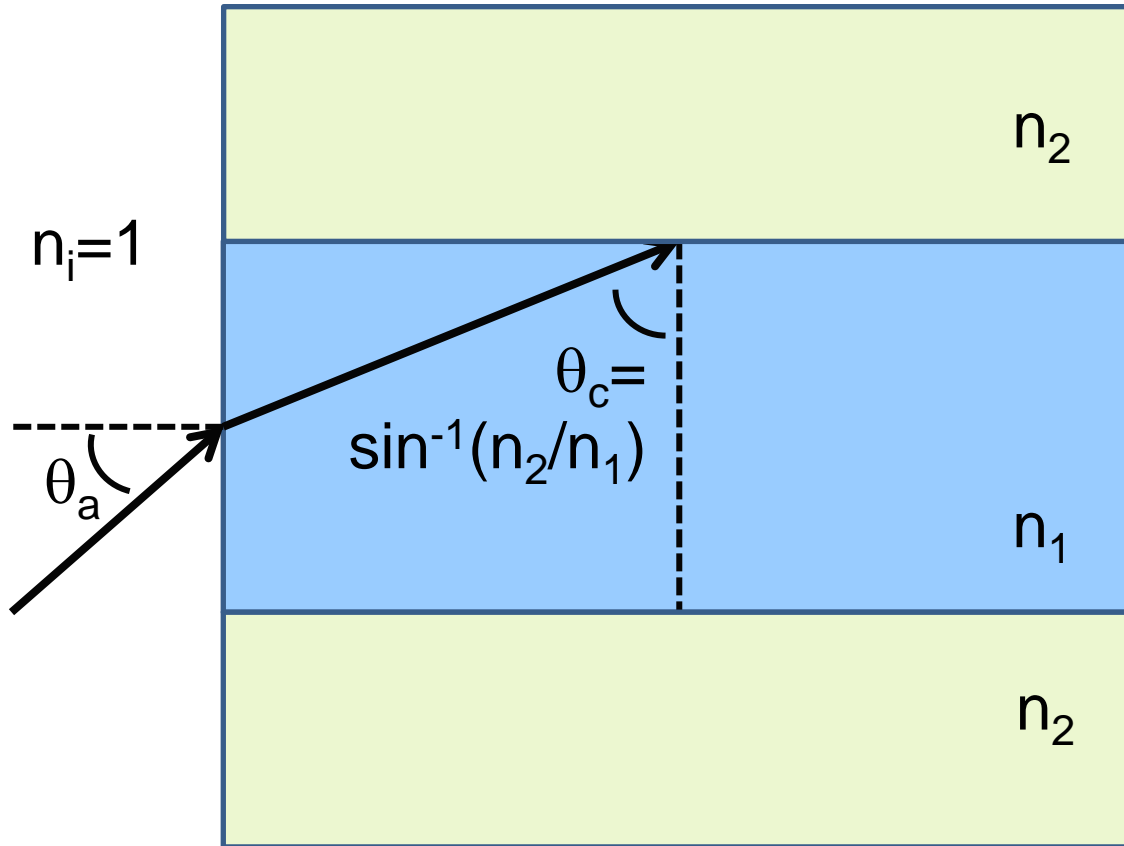
# Allowed Bouncing Ray Angles and Propagation Constants



# Allowed Bouncing Ray Angles



# Numerical Aperture



$$\theta_a = \sin^{-1} \frac{\sqrt{n_1^2 - n_2^2}}{n_i}$$

$$NA = n_i \sin \theta_a = \sqrt{n_1^2 - n_2^2}$$

- The numerical aperture is the refractive index of the medium outside the waveguide times the sine of the acceptance angle of the waveguide