Refraction

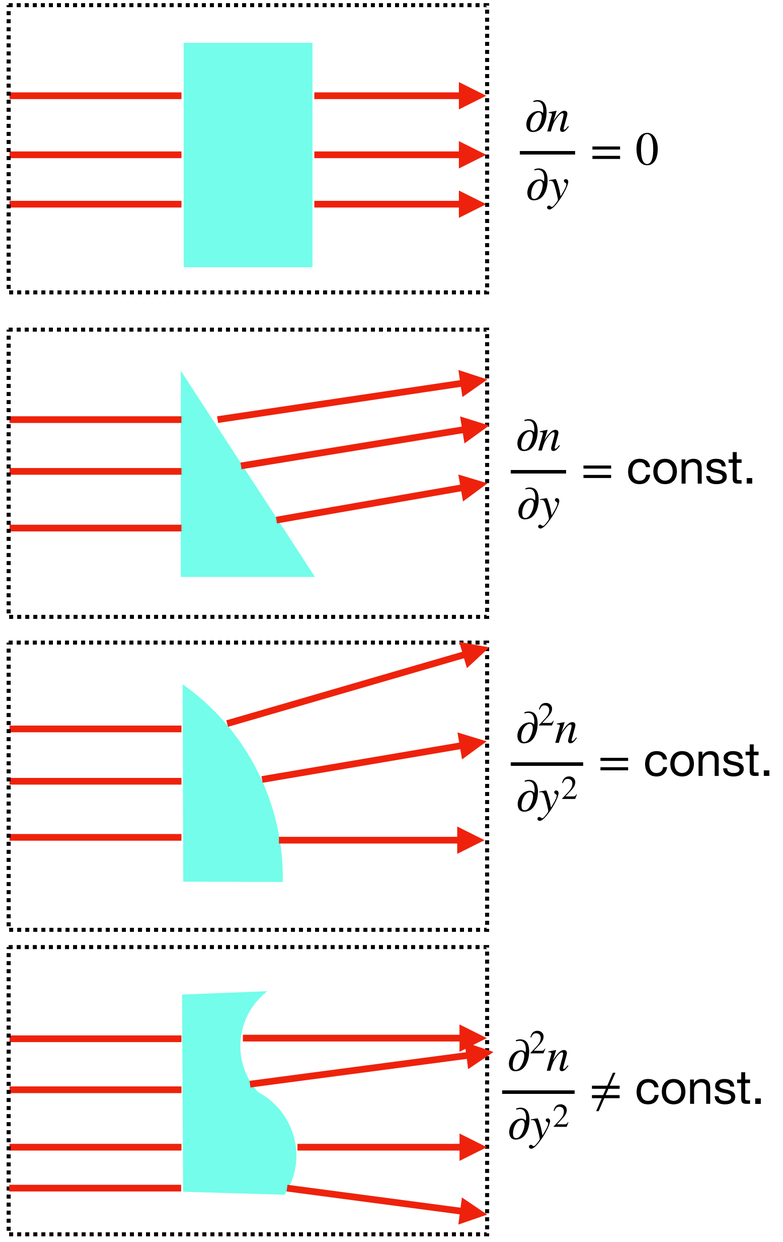
[In the convention where z is along the optical axis]

A collimated beam travels through a test region with non-uniform index of refraction. Suppose the index of refraction does not depend on x, so $n(y, z)$. Then, from Fermat's principle and Euler-Lagrange equations,

$$\frac{\partial^2 y}{\partial z^2} = \frac{1}{n}\frac{\partial n}{\partial y}$$

A gradient in the index of refraction along y (RHS) causes the light to change direction (LHS)

We assume that $\partial y/\partial z$ is negligible because the change in n is small



Schlieren

- With an empty test field: (1) the first mirror creates a collimated beam that passes through the test field, (2) the second mirror and lens images light from the test area (a collimated beam) onto the viewing plane.