PH481 Homework 3

Due: Monday, 27th of January 2020

4.63 Prove that

$$t_\perp + (-r_\perp) = 1 \qquad [4.49]$$

for all θ_i, first from the boundary conditions and then from the Fresnel Equations.

4.73* Using the results of Problem 4.72, that is, Eqs. (4.98) and (4.99), show that

$$R_\parallel + T_\parallel = 1 \qquad [4.65]$$

and

$$R_\perp + T_\perp = 1 \qquad [4.66]$$

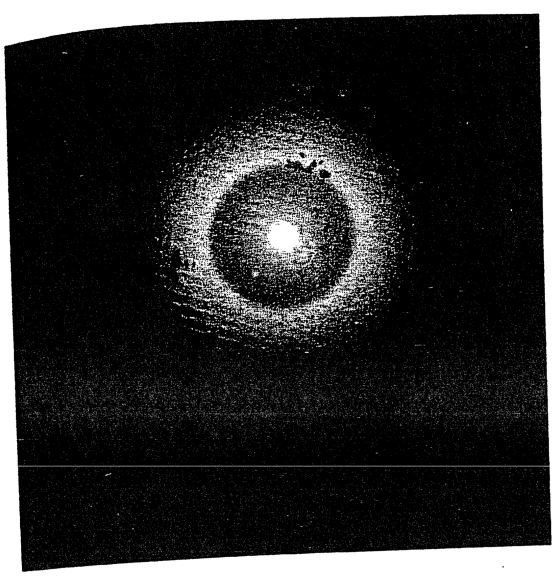
Eqns. 4.98 and 4.99 are below

$$T_\parallel = \frac{\sin 2\theta_i \sin 2\theta_t}{\sin^2(\theta_i + \theta_t)\cos^2(\theta_i - \theta_t)}$$

$$T_\perp = \frac{\sin 2\theta_i \sin 2\theta_t}{\sin^2(\theta_i + \theta_t)}$$

4.84* A fish looking straight up toward the smooth surface of a pond receives a cone of rays and sees a circle of light filled with the images of sky and birds and whatever else is up there. This bright circular field is surrounded by darkness. Explain what is happening and compute the cone angle.

4.91 Figure P.4.91 shows a laserbeam incident on a wet piece of filter paper atop a sheet of glass whose index of refraction is to be measured—the photograph shows the resulting light pattern. Explain what is happening and derive an expression for n_i in terms of R and d.



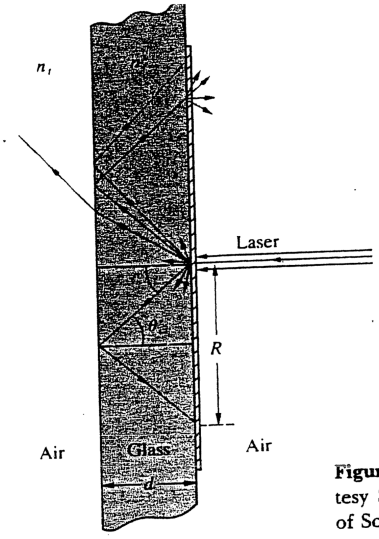


Figure 4.58 (Photo and diagram courtesy S. Reich, The Weizmann Institute of Science, Israel.)

Above is Fig. 4.91 in new edition.

4.92 Consider the common mirage associated with an inhomogeneous distribution of air situated above a warm roadway. Envision the bending of the rays as if it were instead a problem in total internal reflection. If an observer, at whose head $n_a = 1.000\,29$, sees an apparent wet spot at $\theta_i \geq 88.7°$ down the road, find the index of the air immediately above the road.