



Claim:

$$\Delta z = t \left(\frac{n_e}{n_w} - 1 \right) + t \frac{n_e}{n_w} \left(\frac{\cos \theta_0}{\sqrt{1 - \left(\frac{n_e}{n_w} \right)^2 \sin^2 \theta_0}} - 1 \right) \quad \text{where} \quad \theta_0 = \arctan \frac{r}{z_0}$$