

34. (a) From $f = c/\lambda$ and Eq. 38-30, we get

$$\lambda_0 = \lambda \sqrt{\frac{1-\beta}{1+\beta}} = (\lambda_0 + \Delta\lambda) \sqrt{\frac{1-\beta}{1+\beta}} .$$

Dividing both sides by λ_0 leads to

$$1 = (1+z) \sqrt{\frac{1-\beta}{1+\beta}} .$$

We solve for β :

$$\beta = \frac{(1+z)^2 - 1}{(1+z)^2 + 1} = \frac{z^2 + 2z}{z^2 + 2z + 2} .$$

(b) Now $z = 4.43$, so

$$\beta = \frac{(4.43)^2 + 2(4.43)}{(4.43)^2 + 2(4.43) + 2} = 0.934 .$$

(c) From Eq. 45-19,

$$r = \frac{v}{H} = \frac{\beta c}{H} = \frac{(0.943)(3.0 \times 10^8 \text{ m/s})}{0.0193 \text{ m/s} \cdot \text{ly}} = 1.5 \times 10^{10} \text{ ly} .$$