

Special and General Relativity (PHZ 4601/5606) Fall 2017 Solutions

Set 5

17. An astrophysical observation (redshift).

The equation for the redshift is

$$\begin{aligned}\lambda' &= \lambda \sqrt{\frac{1+\beta}{1-\beta}} \Rightarrow \left(\frac{\lambda'}{\lambda}\right)^2 = \frac{1+\beta}{1-\beta} \\ \left(\frac{\lambda'}{\lambda}\right)^2 - \beta \left(\frac{\lambda'}{\lambda}\right)^2 &= 1 + \beta \\ \left(\frac{\lambda'}{\lambda}\right)^2 - 1 &= \beta \left[1 + \left(\frac{\lambda'}{\lambda}\right)^2\right] \Rightarrow \beta = \frac{(\lambda'/\lambda)^2 - 1}{(\lambda'/\lambda)^2 + 1}.\end{aligned}$$

With $\lambda' = (729.2 \text{ [nm]}) m^2 / (m^2 - 4)$ given and from Quantum Mechanics books $\lambda = (364.56 \text{ [nm]}) m^2 / (m^2 - 4)$ we find

$$\beta = \frac{v}{c} = 0.6.$$