

31. The frequency received is given by

$$\begin{aligned}f &= f_0 \sqrt{\frac{1-\beta}{1+\beta}} \\ \frac{c}{\lambda} &= \frac{c}{\lambda_0} \sqrt{\frac{1-0.20}{1+0.20}}\end{aligned}$$

which implies

$$\lambda = (450 \text{ nm}) \sqrt{\frac{1+0.20}{1-0.20}} = 550 \text{ nm} .$$

This is in the yellow-green portion of the visible spectrum.