Follow-Up

A certain unnamed physics professor was arrested for running a stoplight. He said the light was green. A pedestrian said it was red. The professor then said: "We are both being truthful; you just need to account for the Doppler effect !"

How fast would the professor have to go to see the light as green?

$(\lambda_{green} = 500\ nm,\ \lambda_{red} = 600\ nm)$

A) $540\ m/s$ B) $5.4 \times 10^4\ m/s$ C) $5.4 \times 10^7\ m/s$ D) $5.4 \times 10^8\ m/s$

Relativistic Doppler effect: $f' = f\sqrt{\dfrac{1+\beta}{1-\beta}}$

$$\frac{f'}{f} = \frac{600}{500} = \sqrt{\frac{1+\beta}{1-\beta}} \rightarrow 36(1-\beta) = 25(1+\beta) \rightarrow \beta = \frac{11}{61} = 0.18$$

Note approximation for small β is not bad: $f' = f(1+\beta) \rightarrow \beta = \dfrac{1}{5} = 0.2$

$c = 3 \times 10^8\ m/s$ -> $v = 5.4 \times 10^7\ m/s$ → Change the charge to speeding!