Here, $\lambda = 700$ nm, the observed wavelength of light; λ_0=400 nm, the wavelength of light seen when the Enterprise is at rest; v is the velocity of the Enterprise, an unknown; and c is the speed of light, a steady 3×10^5 km/s. Plugging in these values yields:

$$\frac{v}{c} = \frac{700 \text{ nm} - 400 \text{ nm}}{400 \text{ nm}} = \frac{300 \text{ nm}}{400 \text{ nm}} = \frac{3}{4}$$

Multiplying both sides of the equation by c results in the answer:

$$v = \frac{3}{4}c$$

This is an excellent preparation for the next part of the question:

Express your answer first as a fraction of the speed of light, then as km/s, then as mph. Does the starship have to move towards or away from you to produce this effect?

We're in luck. We've already expressed the answer as a fraction of the speed of light (3/4ths to be precise). Now, to get the answer in kilometers per second, we just multiply the speed of light in km/s by 3/4: $0.75 \times 3 \times 10^5$ km/s=2.25×10^5 km/s. To convert to miles per hour, we must perform handy dimensional analysis:

$$2.25 \times 10^5 \frac{\text{km}}{\text{s}} \times \frac{1 \text{ mile}}{1.6 \text{ km}} \times \frac{3600 \text{ s}}{1 \text{ hr}} \approx 5.1 \times 10^8 \text{ mph}$$

Zounds!

3. *Astra's Son is cooler and fainter than the Sun. If it is two-thirds as hot (4000K), at what wavelength does its radiation peak?*

   Aha! A classic Wein's Law Problem! Again, $\lambda_{max} = 3 \times 10^6$nm K$/T$. Taking $T = 4000$K yields λ_{max} =750 nm, which is just past red into the infrared.

   If it is half as big, how much less total energy than our Sun does it radiate?

   Another classic problem; this time using Stellar Luminosity Relation:

$$L \propto R^2 T^4$$