YY SAGITTARII: AN ECLIPSING BINARY STAR

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Reference: Carroll, Bradley W. & Ostlie, Dale A. (2007), *An Introduction to Modern Astrophysics*, 2nd Edition; Pearson Education - Chapter 7, Problem 7.7.

The variable star YY Sagittarii is an eclipsing binary system. The V (visual) light curve is shown in Carroll & Ostlie's Fig. 7.2, and shows a maximum magnitude of 10.03, a primary minimum of 10.78 and a secondary minimum of 10.67 (values estimated from the graph). However, there is no flat bottom on the minima, which would indicate that the eclipse isn't total, that is, neither star totally obscures the other during the eclipsing periods. The inclination is given in the figure as $i = 88.89^\circ$which is around the value we might expect for a partial eclipse (that is, it's near the minimum inclination at which a partial eclipse just occurs).

We can still estimate the temperature ratio of the two stars from the formula

$$\frac{T_B}{T_A} = \left[\frac{1 - B_p/B_0}{1 - B_s/B_0}\right]^{1/4} \tag{0.1}$$

where B_0, B_p and B_s are the observed maximum, primary and secondary brightnesses. Since the eclipses aren't total, the observed values of B_p and B_s are probably larger than what they would be if the eclipses were total, so the temperature ratio won't be that accurate.

We first convert the magnitudes into brightness ratios:

$$\frac{B_p}{B_0} = 100^{(10.03-10.78)/5} = 0.50 \tag{0.2}$$

$$\frac{B_s}{B_0} = 100^{(10.03-10.67)/5} = 0.55 \tag{0.3}$$

This gives a temperature ratio of

$$\frac{T_B}{T_A} = \left(\frac{0.5}{0.45}\right)^{1/4} = 1.03 \tag{0.4}$$

As there isn't much difference between the two minima, the temperatures of the two stars are almost the same.

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