

## SHAULA (LAMBDA SCORPII)

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Reference: Carroll, Bradley W. & Ostlie, Dale A. (2007), *An Introduction to Modern Astrophysics*, 2nd Edition; Pearson Education - Chapter 3, Problem 3.19.

As another example of calculating the colour indices of a star using the blackbody radiation rate, we'll look at the star Shaula ( $\lambda$  Scorpii), which has a surface temperature of around 22000 K. We can use the formulas:

$$U - B = -2.5 \log \frac{\lambda_B^5 \left( e^{hc/\lambda_B k_B T} - 1 \right) \Delta \lambda_U}{\lambda_U^5 \left( e^{hc/\lambda_U k_B T} - 1 \right) \Delta \lambda_B} + C_{U-B} \quad (1)$$

$$B - V = -2.5 \log \frac{\lambda_V^5 \left( e^{hc/\lambda_V k_B T} - 1 \right) \Delta \lambda_B}{\lambda_B^5 \left( e^{hc/\lambda_B k_B T} - 1 \right) \Delta \lambda_V} + C_{B-V} \quad (2)$$

where

$$C_{U-B} = -0.87 \quad (3)$$

$$C_{B-V} = +0.65 \quad (4)$$

Plugging in the numbers, we get

$$U - B = -1.076 \quad (5)$$

$$B - V = -0.227 \quad (6)$$

The measured values given by Carroll & Ostlie are  $U - B = -0.90$  and  $B - V = -0.23$  so the blackbody values are quite close to those measured.

The apparent visual magnitude of Shaula is  $V = 1.62$  and its parallax as measured by Hipparcos is  $0.00464''$ . The distance of Shaula from Earth is therefore

$$d = \frac{1}{p} = 215.517 \text{ pc} \quad (7)$$

The absolute visual magnitude is therefore

$$M_V = V + 5 - 5 \log d \quad (8)$$

$$= -5.047 \quad (9)$$

If it were 10 parsecs from Earth, it would be the second brightest object (after the moon) in the night sky, outshining even Venus.