

## 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:

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

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

where

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

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

Plugging in the numbers, we get

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

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

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

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

The absolute visual magnitude is therefore

$$\begin{aligned} (8) \quad M_V &= V + 5 - 5 \log d \\ (9) \quad &= -5.047 \end{aligned}$$

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