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 (λ Scorpii), which has a surface temperature of around 22000 K. We can use the formulas:

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

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

where

$$C_{U-B} = -0.87 \tag{3}$$

$$C_{B-V} = +0.65 \tag{4}$$

Plugging in the numbers, we get

$$U-B = -1.076 \tag{5}$$

$$B-V = -0.227 \tag{6}$$

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

$$d=\frac{1}{p}=215.517\text{ pc} \tag{7}$$

The absolute visual magnitude is therefore

$$M_V = V + 5 - 5\log d \tag{8}$$
$$= -5.047 \tag{9}$$

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