

ASTRONOMY 020

Problem Set #9

Due: November 21, 2003

1. In this problem, we will calculate the relative sensitivity of the 10 meter Keck telescope observing an object for 1 hour versus the human eye. Take the aperture of the eye to be 1 cm, and note that the human eye only integrates for 0.2 s before sending a signal to the brain. Take the Quantum Efficiency (QE) of the CCD on Keck to be 1.0, and that of the human eye to be 0.01.
 - (a) What is the ratio of the number of photons collected by Keck to that collected by the human eye?
 - (b) What is the ratio of signal-to-noise?
2. Zeilik & Gregory, Chapter 9, problem 9.
3. Zeilik & Gregory, Chapter 9, problem 13.

Practice problems:

1. Zeilik & Gregory, Chapter 9, problem 15.
Answer: The ratio of signals is $S_{\text{Keck}}/S_{\text{Palomar}} = 280$.
2. Zeilik & Gregory, Chapter 9, problem 18.
Answer: Using Wien's Law, we find that for $T = 300$ K, the blackbody emission peaks at $\lambda_{\text{max}} \approx 10 \mu\text{m}$. So the telescope, dome, and atmosphere (all at about $T = 300$ K) are emitting profusely at the same wavelength we are trying to observe. This is not a problem when observing at visible wavelengths, since the blackbody emission for $T = 300$ K is quite low at visual wavelengths.