Astronomical Observations (Fall 2003)
Final Exam

06 January, 2004 Tuesday 18:00~20:00

Each problem carries equally 10 points.

1. Compare with a photomultiplier, what are the advantages and disadvantages of a charge-coupled device as a photon detector? .

2. The Lulin one-meter telescope has a primary mirror diameter of 1 m and the Cassegrain optical system has a focal ratio of f/8. The AP-8 CCD camera used to take images has 1024 times 1024 pixels with 24 micron pixels. Calculate the field of view of the imager.

3. What is the "Nyquist sampling theorem"? Suppose we want to measure the waveform of the 60-Hertz AC household power supply, how fast should one sample the output current in order to fully construct the waveform?

4. What are the Kirchhoff's laws of radiation? Under what circumstances would an observer see a continual spectrum, an emission-line spectrum, or an absorption-line spectrum?

5. A photon-counting detector is used to measure a faint source against a background whose count rate is 64 s^{-1}. Assuming that the noise is random and that equal time is spent observing on and off the source, find the total integration time needed to detect a source whose strength is 2% of the background if the criterion for detection is that the signal-to-noise ratio is 2.

6. Astronomers use the 21-cm line of hydrogen to map out the structure (e.g., spiral arms) and kinematics of the Milky Way and other galaxies. Explain the emission mechanism of the 21-cm line. Why is it a good tracer of spiral arms as compared with optical observations of H II regions?

7. The atmospheric 'seeing' causes a distortion of stellar images. In a typical observatory site, a star, which should have appeared almost as a point source, would have an image of 1' in diameter. Discuss two special techniques that can be utilized to overcome the seeing effects.

8. There are now a few space-borne telescope facilities, mostly in orbits of the Earth. In the future scientists are planning to launch space telescopes deep into space orbits. Discuss the advantages and limitations of observing from space.

9. How does the spectrum of an O-type star differ from that of a K-type star? How does the spectrum of a giant star differ from that of a main-sequence star?

10. Briefly explain the following terms (a) Zeeman effect, (b) dark noise, (c) echelle spectrograph, (d) flat fielding, (e) atmospheric scintillation