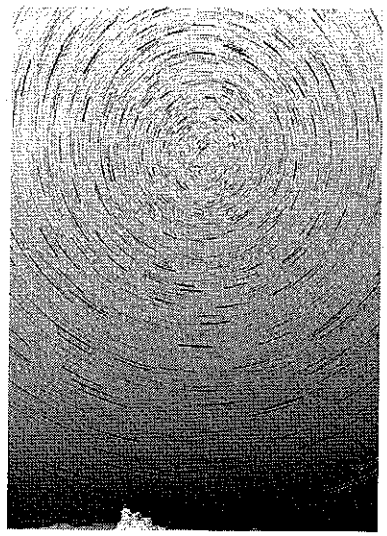
ASTRONOMY 1001. STARS AND GALAXIES

Assignment 1. **Due Date: January 26, 2011.**

1. In the 1970s Fred Hoyle and Chandra Wickramasinghe postulated that the spread of communicable diseases could be linked to the influx of viruses and bacteria from space, encapsulated in the dusty debris from comets that Earth sweeps through all the time. They argued that influenza epidemics and even the simple cold (rhinoviruses) are linked to our exposure to the pathogens as they fall to Earth from the upper atmosphere in stormy weather. Is the concept of *Diseases From Space* an example of science or pseudoscience? Explain.

2. In the time exposure image of the northern sky at right, what points mark the beginning and end of the star trails? Explain why.



3. Many cities have main streets laid out in east-west and north-south alignments.
a. Why are traffic jams on east-west streets more frequent during both morning and evening rush hours within a few weeks of the equinoxes?
b. Given your conclusion from part (a), would you rather live east or west of a city to which you commute to work by car daily?

4. Ellipses contain two axes: minor and major. Half the major axis is called the semi-major axis. What is especially important about the semi-major axis of a planetary orbit?

5. Suppose that astronomers discovered a planet orbiting a nearby star at a distance of 1 A.U. from the star with a period of exactly one year. What would astronomers conclude about the mass of the star containing the planetary companion?

6. Astronomers may describe certain celestial objects as being redshifted or blueshifted. What do such terms tell them about the objects?

7. A favourite object of observation for amateur astronomers is the double star Albireo, in which one of the components is a golden yellow and the other a bright blue. What do the colours tell you about the relative temperatures of the two stars?

8. Why do we not have ground-based gamma-ray and X-ray telescopes?

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Assignment 2. **Due Date: February 16, 2011.**

1. Some people believe that we put astronomical telescopes in orbit because doing so gets them closer to the objects they are observing. As an enlightened student taking ASTR 1001, you know better. Explain what is wrong with this popular misconception.

2. Very cool stars have temperatures around 2500 K and emit Planck spectra with peak wavelengths in the red part of the spectrum. Do these stars emit any light in the blue part of the spectrum? Explain.

3. The distances of nearby stars are measured using their parallaxes. Why is the relative uncertainty associated with a star's distance greater for stars that are farther from Earth? Hint: Astronomers have a limited precision for measuring parallax angles for stars of about $1/1000^{th}$ of an arcsecond.

4. The masses of stars are measured directly for those stars that belong to visual binary or eclipsing/spectroscopic binary systems, but most astronomers can also estimate the mass of single stars that are not members of binary systems. How can that be done?

5. The masses of stars range from 0.08 $M_{\odot}$ to 100 $M_{\odot}$, i.e. $8/100^{th}$ to 100 times the mass of the Sun. Why are there no stars with masses less than 0.08 $M_{\odot}$ or greater than 100 $M_{\odot}$?

6. What do sunspots tell us about the Sun's rotation? Be careful. This is a tricky question.

7. Under what circumstances is it possible to view the Sun's corona from Earth?

8. Very energetic radiation from stars can convert atomic hydrogen (H I) to ionized hydrogen (H II), which produces those beautiful circular regions of red glowing gas (H II regions) around young star clusters. Why does a O7 main-sequence star ionize far more interstellar hydrogen in its vicinity than does a K0 supergiant star of the same luminosity?

9. When an interstellar cloud collapses to form a protostar, the forces of gravity felt by all parts of the cloud (which follow an inverse square law) become stronger and stronger. One might argue that, under such conditions, the cloud should keep collapsing until it has zero size (a black hole). Why does that not happen?

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Assignment 3. **Due Date: March 9, 2011.**

1. We typically say that the mass of a newly formed star determines its destiny from starbirth to stardeath. But there is a frequent environmental circumstance for which that statement is not true. Identify the circumstance and explain why the birth mass of a star might not fully account for its destiny.

2. In Latin, *nova* means "new." Novae, as we now know, are not new stars. Explain how novae might have gotten their name and why they are really not new stars.

3. What is the primary reason why the most massive stars have the shortest lifetimes? (Note: The answer can be expressed in just a few words.)

4. Cepheids are highly luminous, variable stars in which the period of variability is directly related to luminosity. Explain why Cepheids are good indicators for determining stellar distances that lie beyond the limits of accurate parallax measurements.

5. Recordings show that SN 1987A (the supernova in the Large Magellanic Cloud) was detected by neutrinos on February 23, 1987. About 3 hours later it was detected in optical light. Why was there a time delay?

6. An experienced astronomer can take one look at the H-R diagram of a star cluster and immediately estimate its age. How is that possible?

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Assignment 4. **Due Date: March 30, 2011.**

1. Suppose that the quasar phenomenon is something that can occur only in a very young galaxy, say less than a billion years old, but not in older galaxies. How would that affect the observed distribution of quasars of various redshifts?

2. If extragalactic globular clusters exist as "galaxies," as what kind of galaxies would you classify them? Be specific.

3. The "zone of avoidance" is a band of sky roughly coincident with the Milky Way that is relatively devoid of galaxies. They show up a lot better in images taken with infrared light, but are still relatively infrequent. Why is that so, and what does such an observation tell us about our Milky Way Galaxy?

4. What is the classification of our Milky Way Galaxy in the Hubble scheme of classification? Justify your choice.

5. Why can we <u>not</u> use the measured radial velocities of nearby galaxies, such as the Large Magellanic Cloud and Andromeda Galaxy, to evaluate the Hubble constant, H_0?

6. Describe the evidence for a supermassive "black hole" at the centre of the Milky Way.