4-11. What is a protosun? What causes it to shine? Into what does it evolve?

A protosun is a forming sunlike star at an early stage when it is a dense concentration of matter at the center of a solar nebula, a nebula destined to evolve into a sunlike star. Such an object shines because it has become sufficiently heated by the release of gravitational energy as it has contracted. Such an object will evolve into a sunlike star.

4-13. (a) What is meant by “accretion?” (b) Why are the terrestrial planets denser at their centers at their surfaces?

(a) “Accretion” is the process in which a body grows by colliding with and absorbing many smaller bodies, most of them very small by comparison with the growing object. Many of the smaller bodies have grown themselves by accreting even smaller bodies. (b) The terrestrial planets have been compressed in their central regions by the weight of the weight of the tremendous overburder of material which they support.

4-14. Explain how our current understanding of the formation of the solar system can account for the following characteristics of the solar system: (a) All planetary orbits lie in nearly the same plane. (b) All planetary orbits are nearly circular. (c) the planets orbit the Sun in the same direction in which the Sun itself rotates.

The solar nebula, out of which the entire solar system formed, initially had a great deal of internal random motion which gradually was eliminated by internal friction until only a net angular motion (rotation) remained, with all of the material rotating in the same direction. As this nebula then continued to contract and form a major central condensation (the protosun) with rotating outer nebular material, all of this material continued to rotate in that common direction. Subsequent contraction became inhibited in a direction toward the common axis of rotation, but not parallel to that axis where it caused the material to settle into a common plane (the planetary orbital plane). Collisions during the accretion process tended to cancel motions which were inward or outward, leaving only circular motion. Of course the common direction of rotation of this early system also caused the forming planets to continue to rotate about that common axis in the original direction of rotation.

4-16. What are the differences between radial velocity and the transit method of extrasolar planet detection?

The radial velocity method relies upon the observer’s ability to detect the small motions of the parent star toward or away from the observer as it revolves about the mass center of its system. The transit method relies upon the observer’s ability to detect the small reductions in light reaching him/her due to an orbiting exoplanet transiting or passing between the parent star and the observer.