Section V. The Milky Way

Chapter 25. Structure and Organization of the Galaxy

Note. In this section we study our own Milky Way galaxy.

Note. The Milky Way is a disk of 10^{11} stars. There is a large central bulge called the *nucleus*. There is a *halo* of stars and globular clusters distributed in a sphere centered at the center of the galaxy. The Milky Way is 30 *kiloparsecs* (100,000 light years) in diameter and a few hundred parsecs thick.

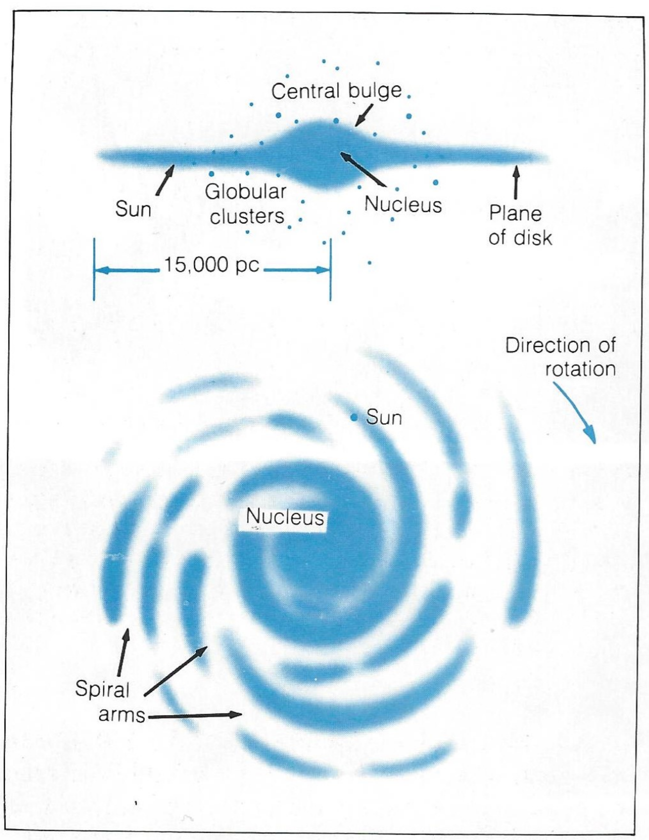

Figure 25.2. The structure of our galaxy.

Note. Now that we are dealing with larger distances, we need more long range distance indicators. *Cepheid variables* are very luminous stars which expand and contract. This causes chances in brightness. The absolute magnitude is directly proportional to the period of variation. Henrietta Leavitt used this relationship to determine the distance to the Magellanic Clouds. *RR Lyrae variables* are similar in nature, but with very short (a few hours) periods. These are also called *cluster variables*.

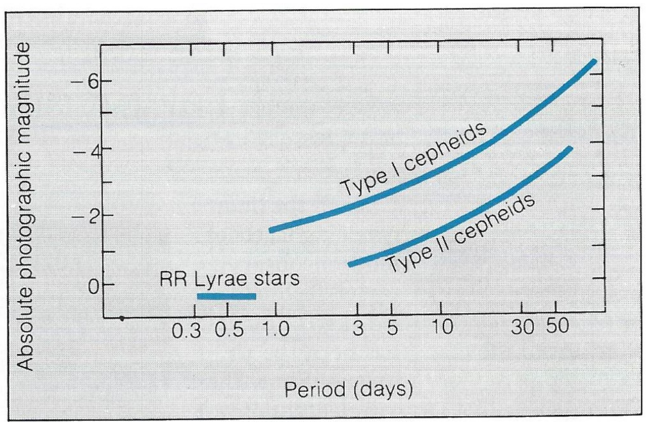

Figure 25.5. The period-luminosity relationship for variable stars.

Note. Harlow Shapley used the distribution of globular clusters to determine the Sun's position in the Milky Way. It is 10 kiloparsecs from the center.

Note. There is a differential rotation in the galaxy. The inner part rotates like a rigid object. Just inside the Sun's orbit, there is a transition zone. Beyond this, stars orbit the center of the galaxy in Keplerian orbits (speed decreases with distance here). The Sun orbits the center is 250 million years. Applying Kepler's Third Laws, we estimate the galaxy's mass at 1.3×10^{11} solar masses (say 3×10^{11}–4×10^{11} stars). However, this only includes the mass within the Sun's orbit. There may be much matter beyond the Sun's orbit.

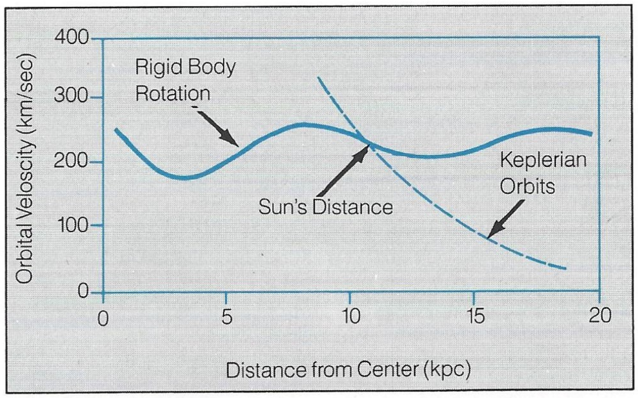

Figure 25.10. The rotation curve for the Milky Way.

Note. In appearance, the galaxy has a spiral shape. However, there are the same number of stars between the arms as within the arms. O and B type stars form preferentially in the arms, giving the spiral structure. This indicates that gases may be prevalent in the spiral arms. This is verified by radio observations of 21 cm hydrogen emissions.

Figure 25.11. Spiral structure. The Milky Way galaxy, if we could see it from the outside, resembles this galaxy in its spiral structure.

Note. The center of the galaxy lies in the direction of Sagittarius. Most stars there are cool, indicating little recent star formation. At about 3 kpc (from the center) is a spiral arm moving outward at 100 km/sec, suggesting some explosive event. Interstellar clouds near the center move very rapidly, indicating a central massive object. There is X-ray emissions from the center. It is suggested there is a 10^6 solar mass object smaller than 1 parsec. Some suggest a massive black hole. Similar arguments have been made for presence of a black hole at the center of globular clusters.

Note. The galaxy is more extended than previously thought. UV observations reveal a lot of hot, thin gas in the halo of our galaxy. It is possible there are dim stars here also. As much as 90% of the galaxy's mass may lie in the halo.

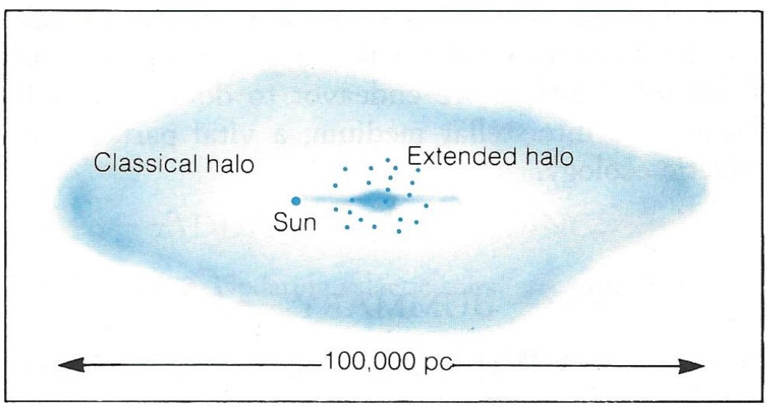

Figure 25.21. The extensive halo of the Milky Way.

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