Overview of Galaxy, I

Harlow Shapley studied the distribution of globular clusters and discovered that the center of the distribution was towards the star clouds in the constellation Sagittarius. He guessed that this was the true center of the galaxy.

Previously theory had placed the Sun near the center of the galaxy. The confusion was due to neglect of the interstellar dust and interstellar gas in the interstellar medium which made the old star counts used to map the distribution of stars in the sky and determine the shape of the galaxy inaccurate.

(Mention E. E. Barnard, Herschel + Fig 24.4 in text)

The main components of the Galaxy (our galaxy is called the Milky Way or simply the Galaxy with a capital "G") are:
1) the halo
2) the central or nuclear bulge
3) the disk
58. The direction of the galactic center. The circles mark the positions of globular clusters for this section of the Milky Way. One-third of all known globular clusters are in this photograph, within an area of only 2 percent of the sky. (Harvard Observatory photograph.)
61. Distribution of globular clusters. The diagram shows the distribution of globular clusters with known distances projected on a plane passing through the Sun and the galactic center perpendicular to the central galactic plane. The position of the Sun and of the galactic center are indicated. The vertical scale represents the height \( z \) of the cluster above (+) or below (-) the galactic plane measured in kiloparsecs (1 kpc = 1,000 parsecs). The horizontal scale \( x \) is measured in the same units. (Diagram prepared by Arp, reproduced in Galactic Structure, courtesy of University of Chicago Press.)
Figure 1, 2. Milky Way Plan and Side Views
The anatomy of a normal spiral galaxy is presented in these views of the Milky Way. The galaxy is centered on a compact nucleus surrounded by a roughly spherical realm of stars usually referred to as the central bulge. A spherical halo made up of scattered older stars embraces the entire galaxy; here are to be found many globular clusters. Most of the interstellar gas and dust of the galaxy, as well as most of its stars, occupy the flattened disk. The spiral arms represent portions of the disk made evident by the hosts of brightly shining new stars recently formed there. The spiral arms are depicted schematically, as our galaxy has not yet been well mapped beyond the solar neighborhood.

Figure 2

Galaxies
T. Ferris
(1982)
(See slides for more detail)

1. The Sun is located in the disk about 8000 pc (26,000 ly) from the center of the Galaxy. The disk is about 50,000 ly in radius and 2000 ly thick.

2. The halo stars are roughly spherically distributed around the center with the radius of the sphere ~ 50,000 ly. RR Lyrae stars are common in the halo.

3. The nuclear bulge is a region of old stars around 3000 ly from the center. The exact shape of the bulge is hard to determine because it is obscured from view from the position of the sun by interstellar dust. Infrared and Radio observations have recently been made which make us think the bulge is more cigar shaped than spherical.
The disk shows structure. The young stars and dust are concentrated into spiral arms. The arms seem to be the regions where stars are formed. We see short-lived very luminous stars along the arms. Radio observations of neutral hydrogen $21\text{cm}$ emission also show that gas is concentrated in the arms. Dust is common in the disk in a narrow plane ~ 400 l.y. thick and is more concentrated in the region of the disk closer to the center of the galaxy.

**Spiral Arms**

- **Two models:**
  1) density wave
  2) stochastic star formation + differential rotation

**Populations:**

1) Population I – disk + spiral arms, relatively young w/ higher metallicity
2) Population II – halo + bulge, old stars w/ lower metallicity in general. Globular clusters are Population II
Figure 1: Schematic view of Milky Way

Galaxies
T. Ferris
(1982)
Fig. 94.1 Distribution of neutral hydrogen in the plane of our galaxy. The circles are centered at the center of our galaxy, Sagittarius A, and spaced 2 kpc apart. The sun is denoted ○, and the numbers around the outside of the figure denote galactic longitudes. This map is inferred from the distribution of the radial velocities and intensities of the 21-cm line along different lines of sight, with the assumption that the observed neutral hydrogen rotates with circular symmetry about the galactic center, with rotational velocities given by the Schmidt rotation curve.

21 cm radiation map of our galaxy showing spiral arms.