

Section VI. Extragalactic Astronomy

Chapter 28. The Nature of the Nebulae (Galaxies)

Note. In this section we give a classification of galaxies and mention a few of their properties.

Note. Edwin Hubble (1889–1953) classified galaxies according to their shapes. There are *elliptical galaxies* which are ellipsoidal in shape and *spiral galaxies*. The elliptical galaxies are subdivided into E0 (spherical) to E7 (flattened). Spirals are classified according to the tightness of the arms with Sa (tight spirals with a large nucleus) to Sc (open arms with a small nucleus). The Milky Way is probably Sc. Some spirals have extensions to the nucleus and are *barred spirals*. There are also disk shaped galaxies without spiral arms, S0. We have the *tuning-fork diagram*:

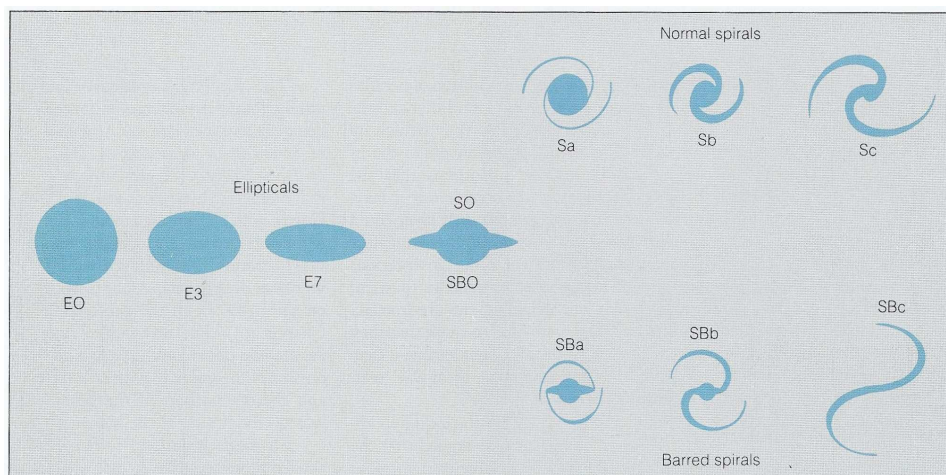


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There are also *irregular galaxies*. *Type I irregulars* show a hint of spiral arms. *Type II irregulars*, or *peculiar galaxies*, show no normal structure. The Magellanic Clouds are Type I irregulars.

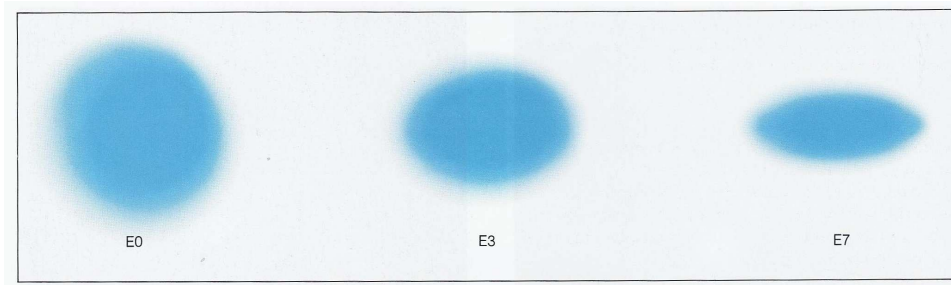


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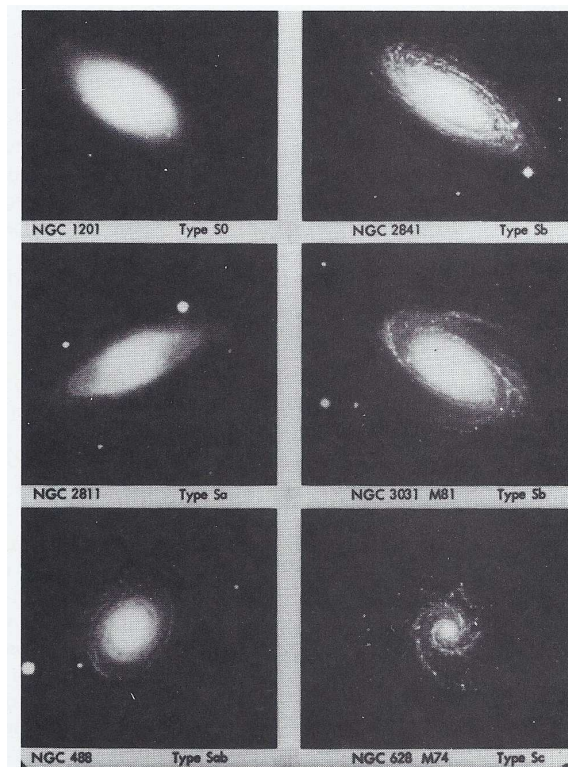


Figure 28.6 Page 547.

Note. Distance estimates to galaxies are based on a “ladder” of techniques, where the accuracy of each rung is dependent on the accuracy of the previous rungs:

1. Cepheid variables can be used for up to a few Mpc.
2. In a galaxy, the brightest stars may be used (there is some upper limit to the brightest stars, say around absolute magnitude -8).
3. Supernovas may be used (which are expected to have an absolute magnitude of about -19).
4. Apparent diameters of the galaxies can be used.
5. the Brightest galaxy in a cluster of galaxies can indicate distance.
6. The Tully-Fisher method states that the mass and luminosity of spiral galaxies are directly proportional. Mass can then be used to estimate absolute magnitude.

Note. The mass of a galaxy can be estimated from the rotational velocity of outer regions and Kepler’s Third Law. In an elliptical galaxy *velocity dispersion* (measured using the width of spectral lines) is directly proportional to mass. A binary system of galaxies is ideal since the entire mass can be calculated.

Note. Spiral galaxies are dynamic with active star formation. Elliptical galaxies have reached an equilibrium and change little; no age difference for stars is indicated. It seems stars form early in elliptical galaxies giving the shape. It also seems that a massive halo inhibits formation of a bar.