GALAXY SPECTRA

Recall the appearance, stellar populations & colors of galaxies along the Hubble sequence.

What would the spectrum of an elliptical galaxy look like? An S0?

One of my research projects is to look for K giants in the Milky Way halo. One of the contaminants in the survey is distant, unresolved elliptical galaxies. How will their spectra differ from K giants?
Figure 1.1 Optical spectra of main-sequence stars with roughly the solar chemical composition. From the top in order of increasing surface temperature, the stars have spectral classes M5, K0, G2, A1, and O5 - G. Jacoby et al., spectral library.

The temperatures of O stars exceed 30,000 K. Figure 1.1 shows that the strongest lines are those of He II (once-ionized helium) and C III (twice-ionized carbon); the Balmer lines of hydrogen are relatively weak because hydrogen is almost totally ionized. The spectra of B stars, which are cooler, have stronger hydrogen lines, together with lines of neutral helium, He I. The A stars, with temperatures below 11,000 K, are cool enough that the hydrogen in their atmospheres is largely neutral; they have the strongest Balmer lines, and lines of singly ionized
6.3 Stellar populations and gas

Unlike spiral and irregular galaxies, elliptical galaxies contain blue stars; the brightest stars are red giants, and stars of the AGB (see Section 1.1). We cannot see individual stars more distant than about 20 Mpc; even in the closest ellipticals, we are limited to the AGB stars and those near the tip of the red giant branch. The integrated spectra of ellipticals, such as that in Figure 6.17, show deep absorption lines of heavy elements such as calcium and magnesium, similar to the K star spectrum in Figure 1.1. There is little light below 3500 Å and none in the far UV.


Figure 6.17 Spectrum of an elliptical galaxy; compare with those in Figure 1.1, and those of disk galaxies in Figure 5.24 - A. Kirk.
What will the spectrum of a spiral look like?

or S0?
be higher than in the late-type Sc galaxies, inviting the conclusion that early-type spirals are in general faster rotators. But the most luminous Sc galaxies are rare, and there is none close to the Milky Way. Later surveys further afield revealed very luminous and rapidly rotating Sc galaxies: $V_{\text{max}}$ depends mainly on luminosity, through the Tully-Fisher relation.