Ay 21 Slides - Jan 14

The Sersic profile

- Empirically devised by Sersic (1963) as a good fitting fn

$$I(r) = I_0 \exp(-\left(\frac{r}{\alpha}\right)^{1/n})$$

I(r) = intensity at radius r

I_0 = central intensity (intensity at centre)

α = scalelength (radius at which intensity drops by e^{-1})

n = Sersic index (shape parameter)

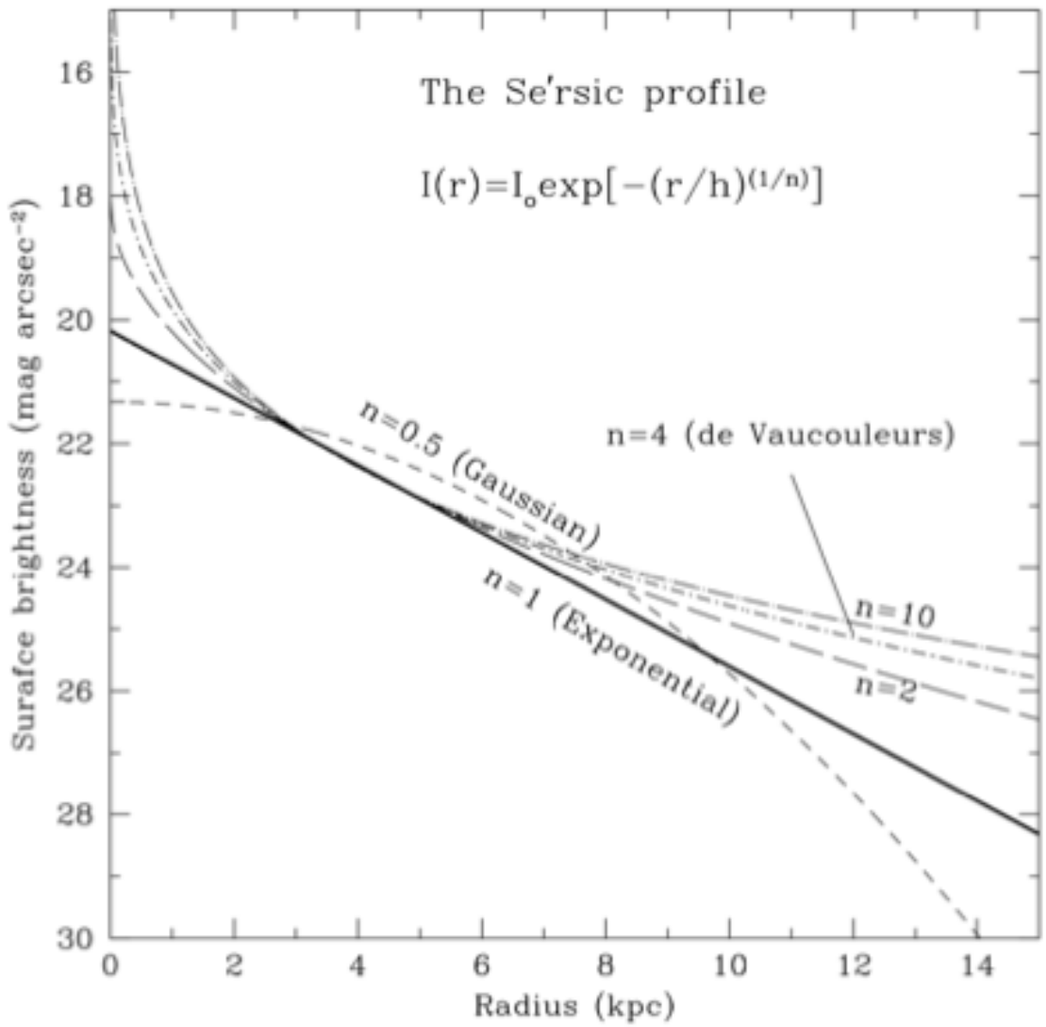
Can be used to describe most structures, e.g.,

Elliptical: 1.5 < n < 20	Bulge: 1.5 < n < 10
Pseudo-bulge: 1 < n < 2	Bar: n~0.5
Disc: n~1	

Total light profile = sum of components.

http://star-www.st-and.ac.uk/~spd3/Teaching/AS3011/AS3011_5.pdf

Sersic shapes



http://star-www.st-and.ac.uk/~spd3/Teaching/AS3011/AS3011_5.pdf

Problems With Traditional Galaxy Classification

Appearance of galaxies is strongly dependent on **which wavelength** the observations are made in.

e.g., the nearby galaxy M81:

X-ray UV Visible Near-IR Far-IR

Note: large change in appearance between the UV and the near infrared images.

Galaxies look "clumpier" in the UV, and increasingly smooth as we go to the visible and longer wavelengths.

Galaxy Luminosity Function

Bingelli, Sandage, and Tammann 1988 ARAA 26
50

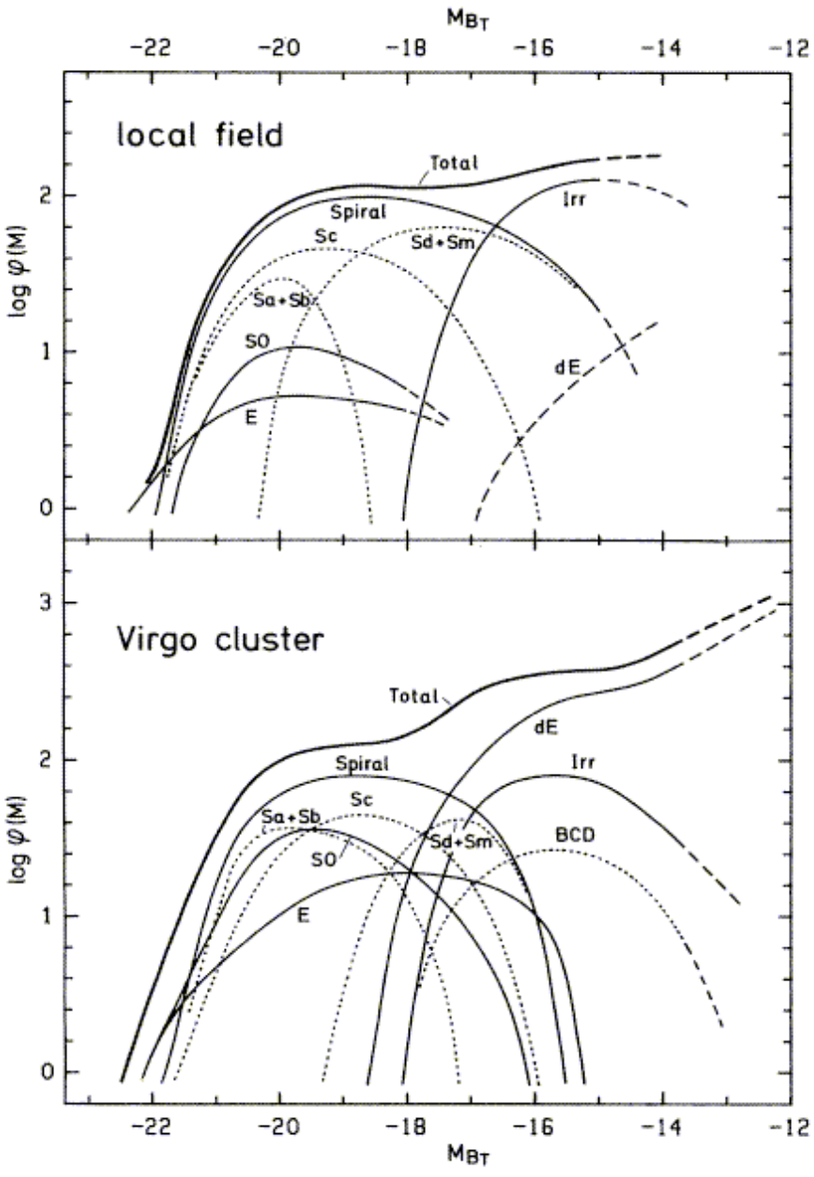
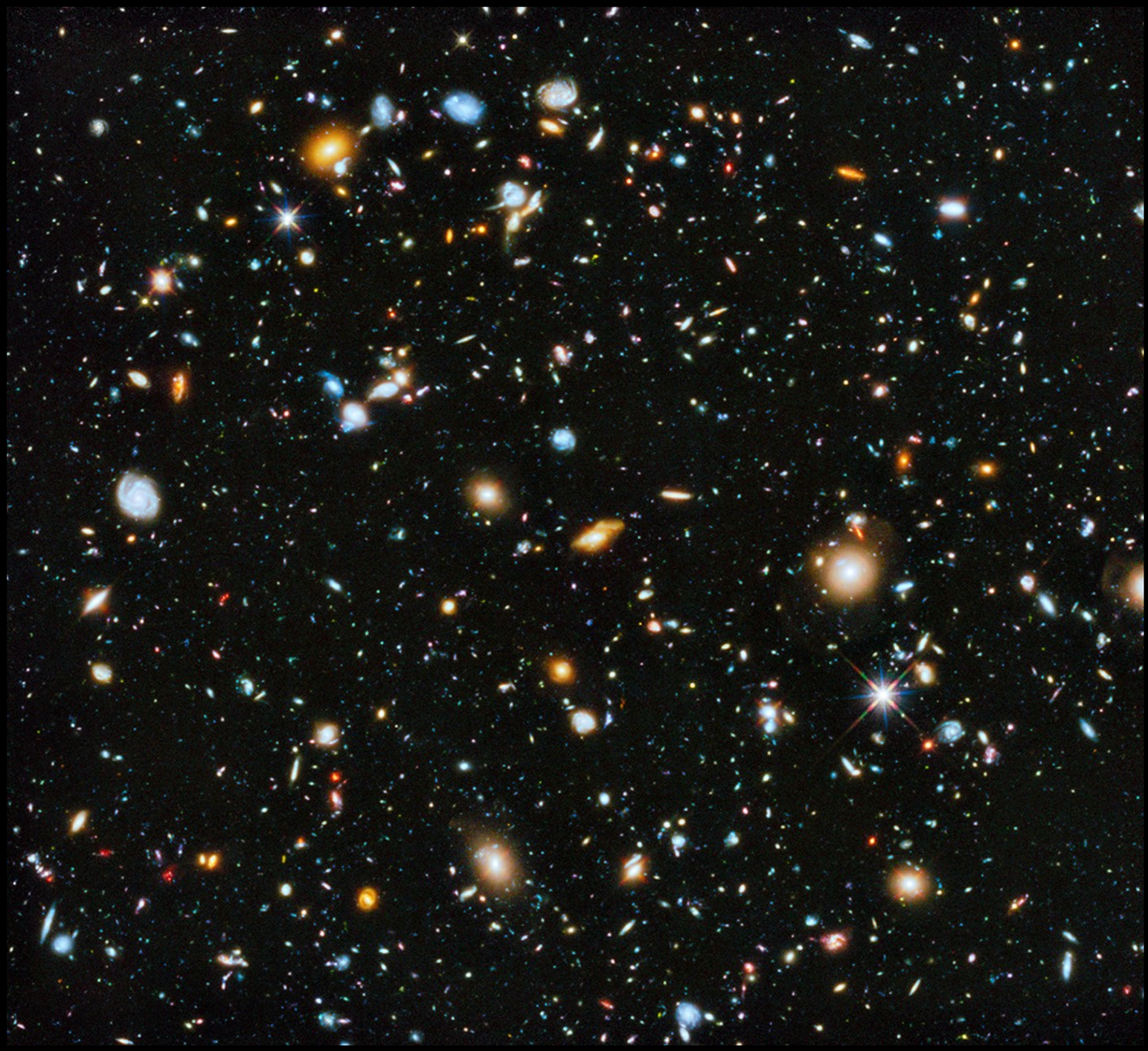
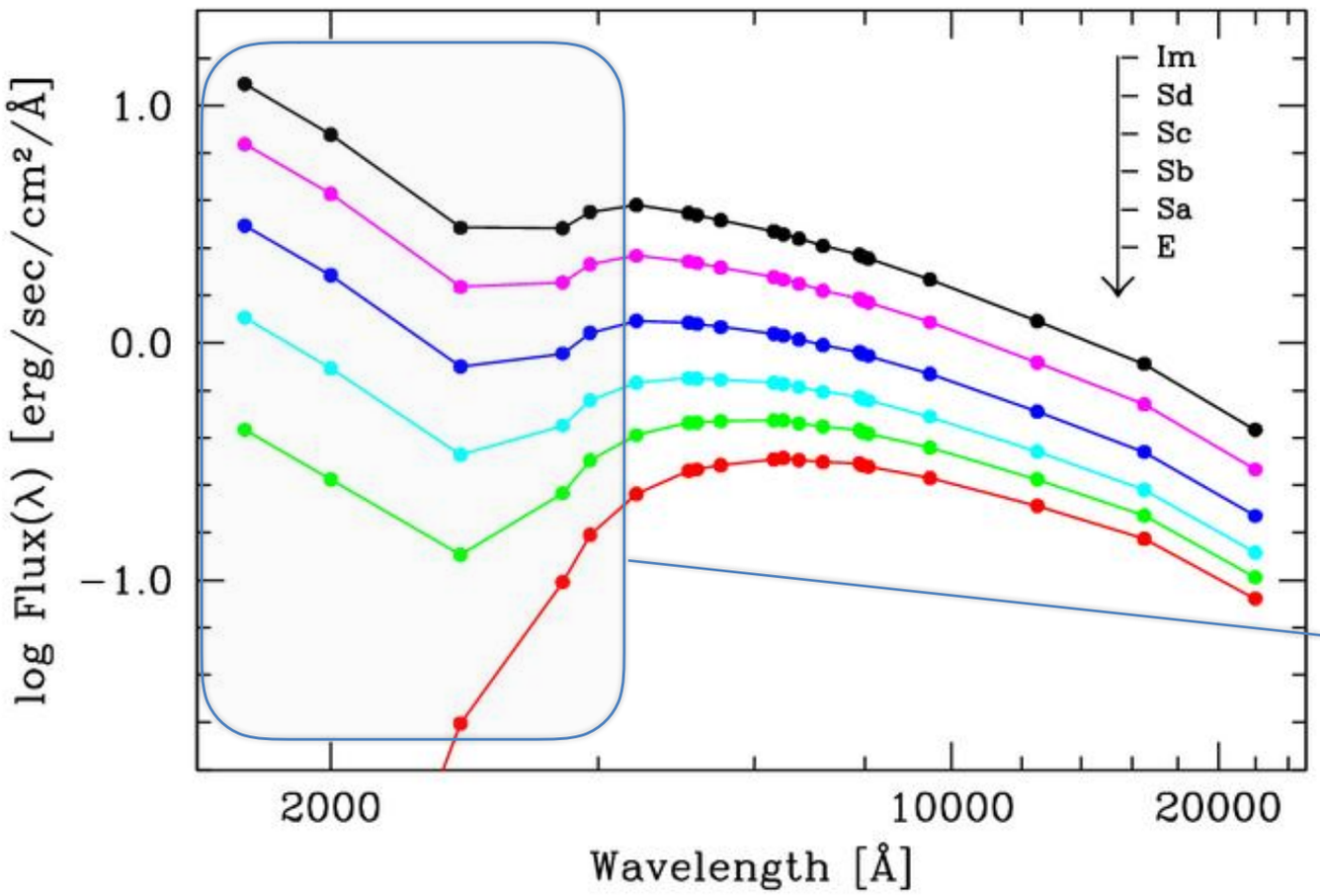


Figure 1 The LF of field galaxies (top) and Virgo cluster members (bottom). The zero point of $\log \varphi(M)$ is arbitrary. The LFs for individual galaxy types are shown. Extrapolations are marked by dashed lines. In addition to the LF of all spirals, the LFs of the subtypes Sa+Sb, Sc, and Sd+Sm are also shown as dotted curves. The LF of Irr galaxies comprises the Im and BCD galaxies; in the case of the Virgo cluster, the BCDs are also shown separately. The classes dS0 and "dE or Im" are not illustrated. They are, however, included in the total LF over all types (heavy line).



Credit: NASA/STScI- Hubble Ultra-Deep Field

Galaxy Spectral Energy Distributions vs. Hubble Type



Light from young stars

Early-Type (E) Galaxies: integrated stellar light

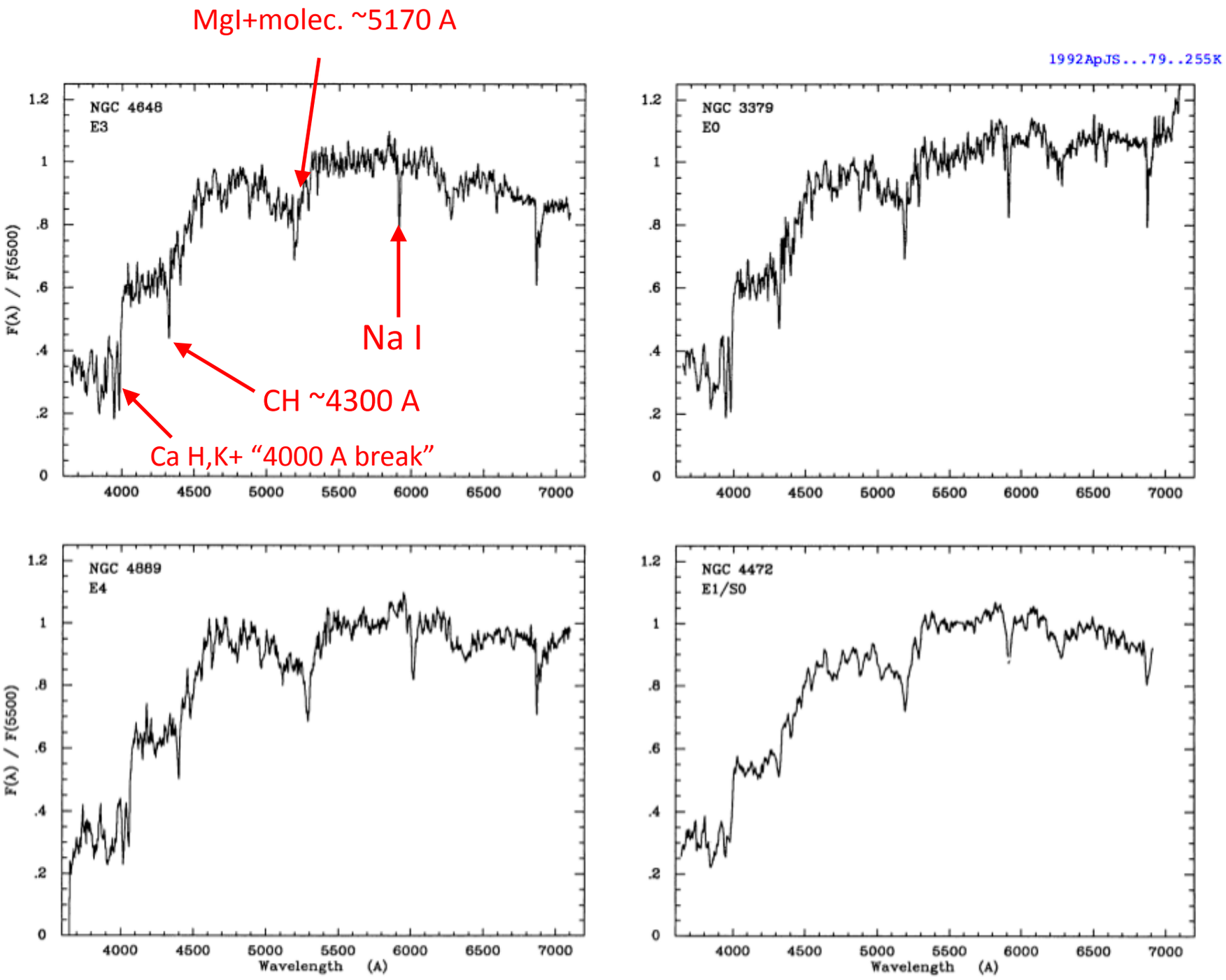


FIG. 5.—Integrated spectra of four elliptical galaxies. The spectrum of NGC 4472 (*lower right*) was obtained at lower resolution with the IRS scanner.

Kennicutt 1992, ApJS 79, 255

Prominent Nebular Emission Lines (rest-frame optical)

[OII] 3727,3729 Ratio sensitive to electron density, strong at high metallicity

[OIII] 4959,5007 Ratio fixed (1:3) but [OIII]/Hβ sensitive to ionizing source; strongest line for $Z < 0.6Z_{\odot}$

Hα/Hβ (6564/4861) First counts ionizing photons, ratio should be ~2.9 in the absence of reddening/extinction

[NII] (6549, 6585) Ratio of two lines fixed (1:3) but [NII]/Hα sensitive to metallicity

[SII] (6717, 6731) Ratio sensitive to electron density

Typical Spiral Galaxies (MW-like)

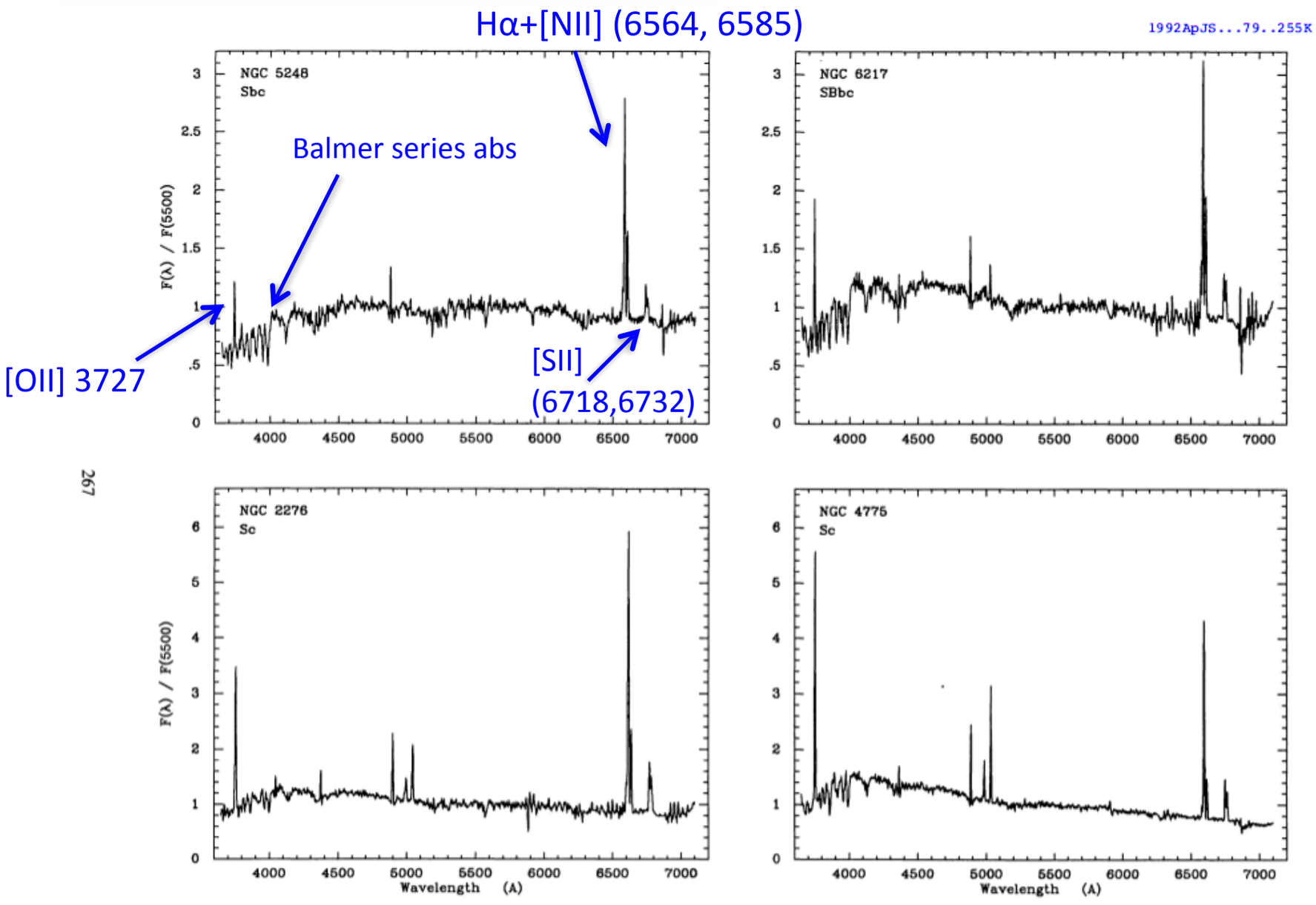


FIG. 9.—Integrated spectra of four Sbc–Sc galaxies, selected to illustrate the range in emission-line strengths and blue continuum properties. See Fig. 10 for other examples.

Kennicutt 1992, ApJS 79, 255

Irregular Galaxies- Strongly Star-Forming

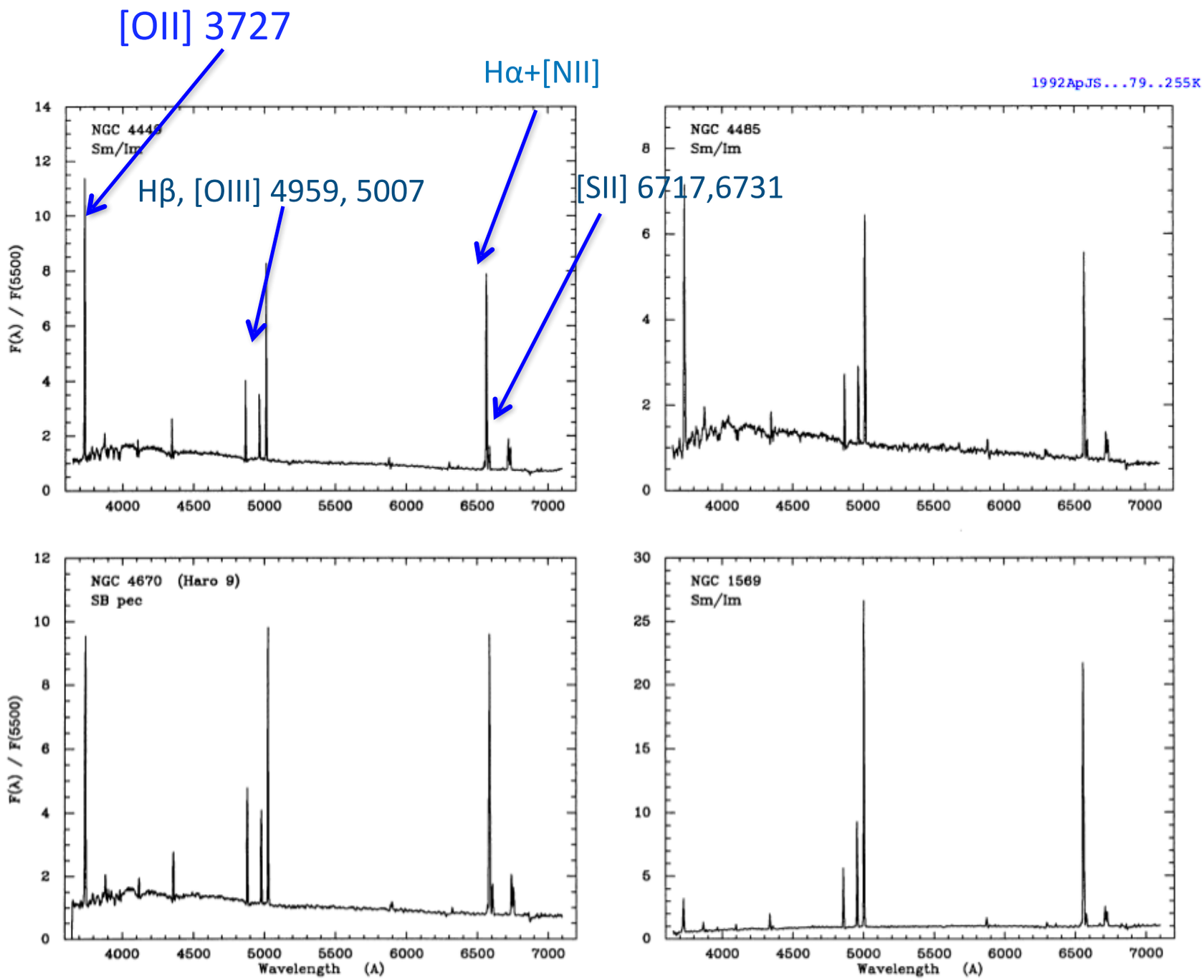


FIG. 11.—Integrated spectra of three Magellanic irregular galaxies (NGC 4449, 4485, 1569), and one peculiar galaxy with a very similar spectrum (NGC 4670).