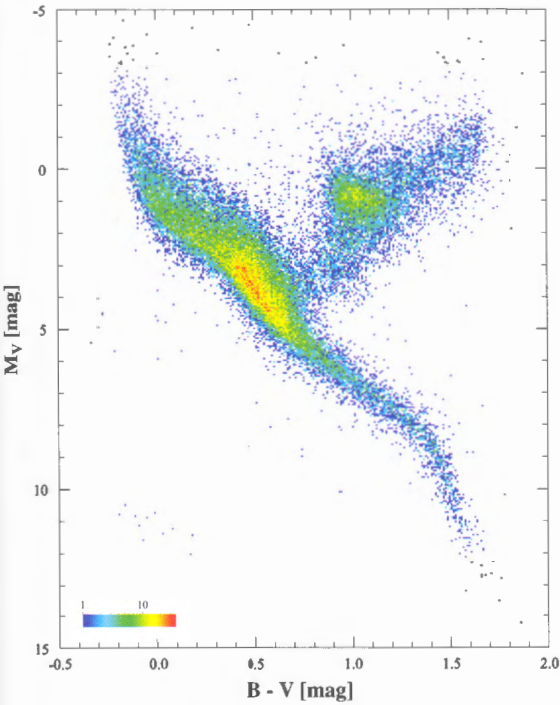
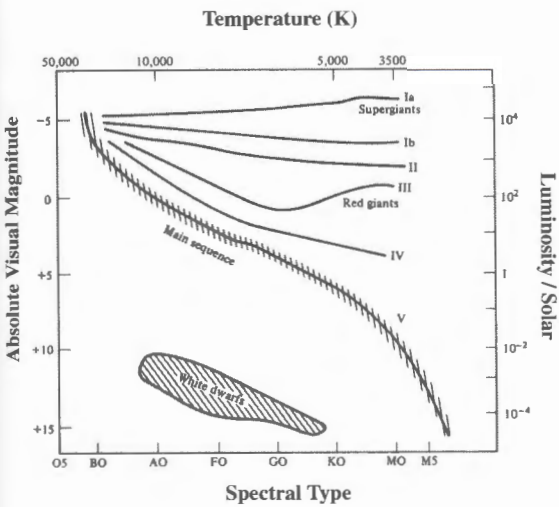
The H-R diagram

Plotting temperature (B-V, sp. type) against luminosity for a sample of stars shows that they are preferentially found in certain ranges of temp & luminosity

This is a very useful diagnostic for studies of stellar structure & evolution



(a)



(b)

Fig 3.11. (a) HR diagram for over 40 000 nearby stars studied by the Hipparcos satellite, designed to measure trigonometric parallaxes, so distances are known for all of these stars. In this figure, the color represents the number of stars in each category, with red being the most and blue being the least. (b) A schematic HR diagram, showing the main features of the actual diagrams. Luminosity classes are indicated by roman numerals. [(a) Michael Perryman, ESA, Hipparcos]

HR diagram

Most stars occupy a diagonal line reaching from hot, luminous to cool, faint called the main sequence.

They are found here because all stars spend most of their lives in this evolutionary state, corresponding to H burning to He in the star's core

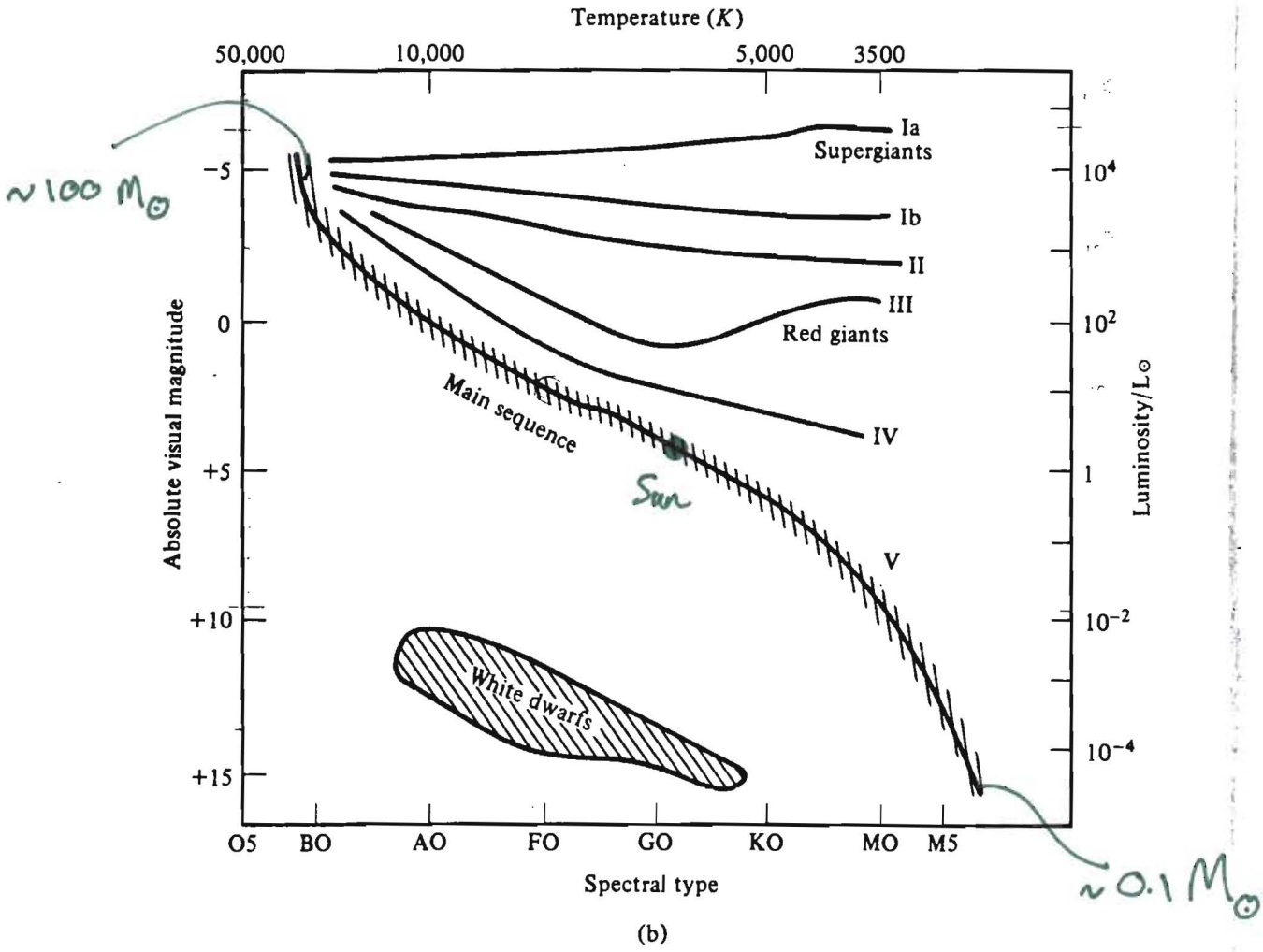


Figure 3.11 (a) *H–R* diagram. (b) Schematic *H–R* diagram. Luminosity classes are indicated by Roman numerals.

- Stars range in mass from $\sim 0.1 M_\odot$ to $\sim 100 M_\odot$

- low-mass stars on the main sequence, less massive & redder than the Sun, are the most common

Q

Recall Stefan-Boltzmann law:

$$L \propto R^2 T^4$$

At a given temperature, where will the physically largest stars be in the HR diagram?

→ highest luminosity, giants & supergiants

The stellar luminosity function

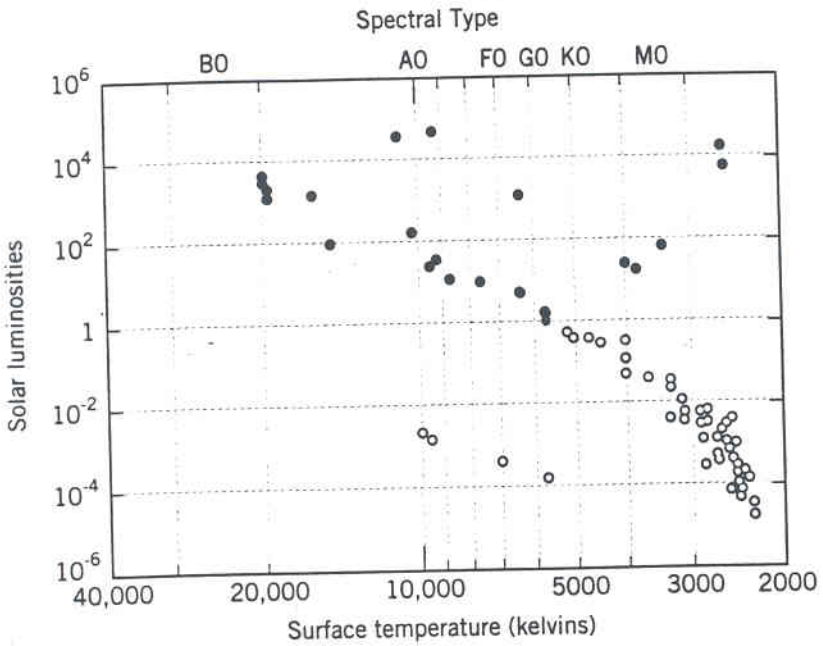
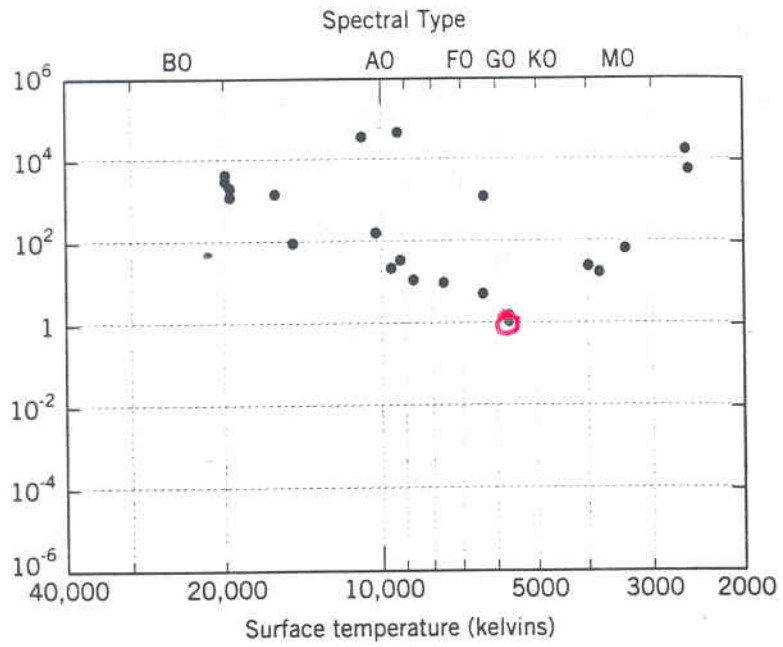


FIGURE 15–7. The data from Figures 15–5 and 15–6 have been plotted together in this diagram. Note the separation into distinct groups.



IGURE 15–6. The Hertzsprung-Russell diagram for the rightest stars in the night sky. The Sun is denoted as an range point.

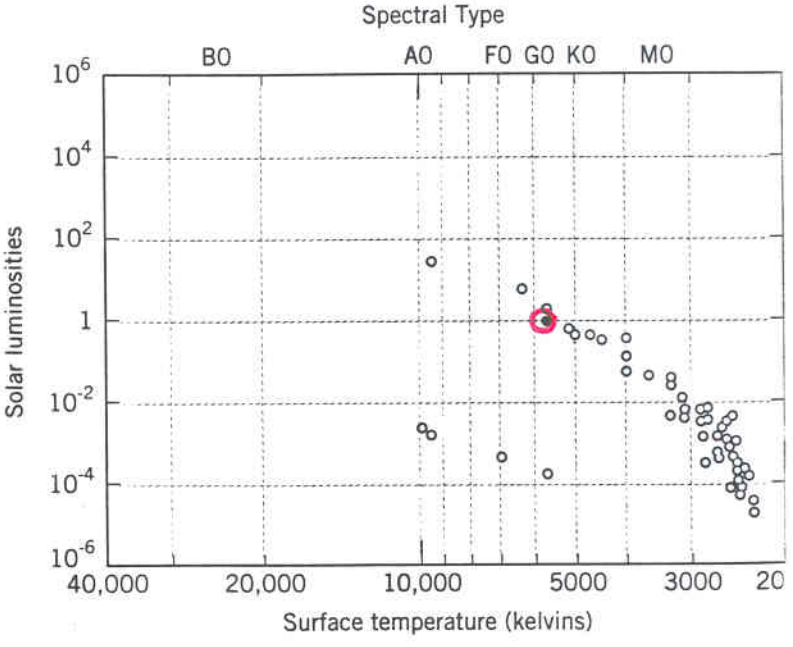


FIGURE 15–5. The Hertzsprung-Russell diagram for the stars closest to the Sun. The Sun is denoted as an orange point.

Stellar luminosity function

- The least luminous stars are the most common ones

(makes sense: the nearest known star, Proxima Centauri, has $M_V = 15$)

- This is partially initial conditions — more low mass stars are formed; and partially due to stellar lifetimes — high mass stars evolve much faster