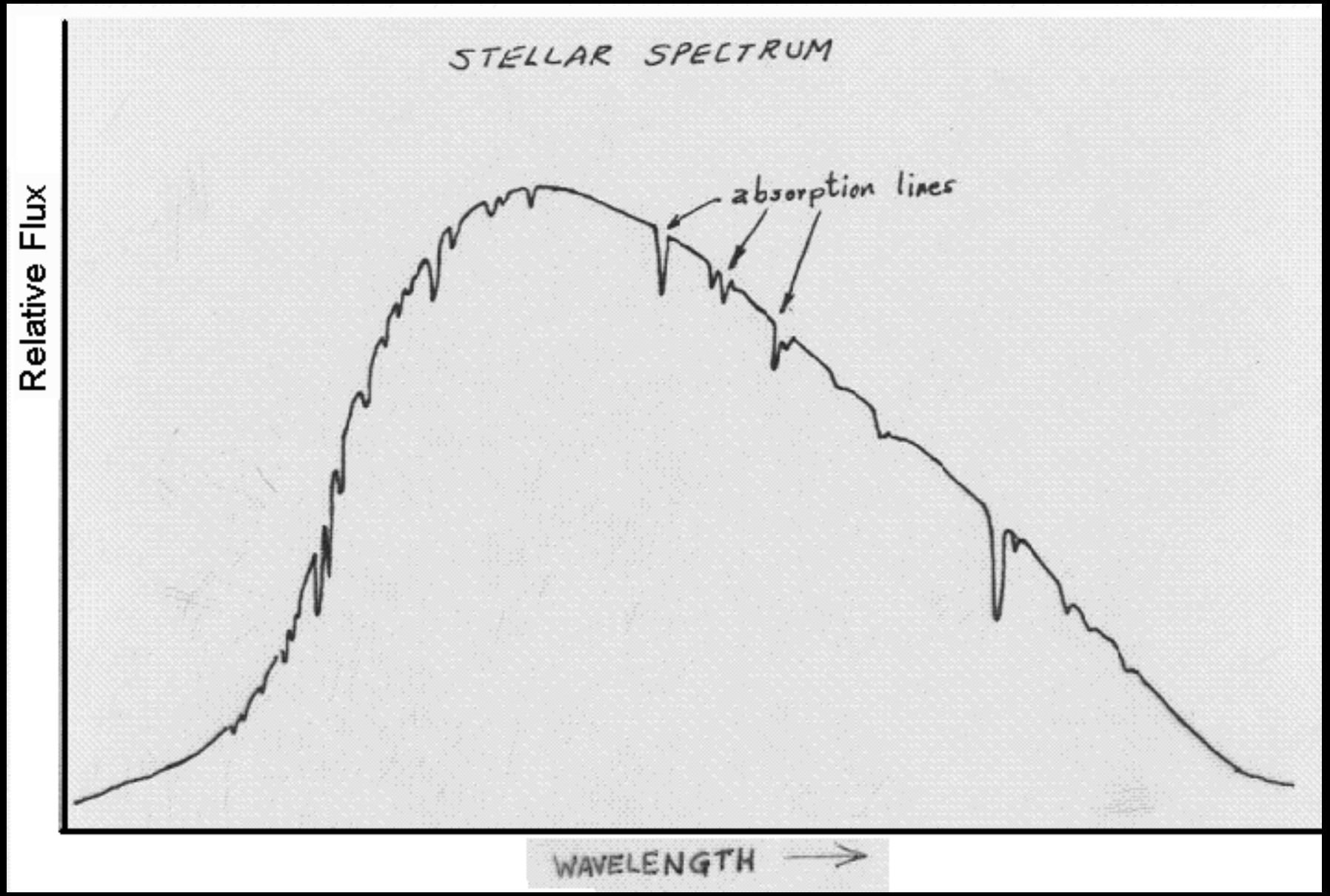
Stellar Spectra are Complex



What is going on in stars to produce this?

From Kirchhoff's Laws we know the absorption lines must be produced by a cooler layer of gas intervening between us and source of a continuous spectrum.

The source of the continuous spectrum is the surface or photosphere of a star, which is a hot gas under high pressure. This is Kirchhoff's 1st Law.

The intervening cooler gas under low pressure is the Star's atmosphere called the chromosphere. Draw schematic.

Spectrochemical Analysis

Principle of Spectrochemical Analysis: Every element consists of atoms that emit or absorb radiation at a unique set of wavelengths that are characteristic of the structure of that atom.

By matching the absorption lines in a star's spectrum with known emission lines for the different elements, we obtain the chemical composition of the star.

Results: Stars are 75% H, 22%He, 2 to 3% metals, which is all other elements, Be thru U.

COLOR INDEX (CI)

Related to surface temperature.

It is the difference between two color magnitudes. Examples of color magnitudes are U, B,V, R, and I.

The most frequently used color index is

B-V.

A value of B-V=-0.35 indicates a very hot star, whereas a value of 2.2 indicates a very cool star.

STELLAR SPECTRAL CLASSIFICATION

In 1893, the Harvard College Observatory undertook a project of photographing and cataloging the spectra of several hundred thousand stars.

This project was supported by an endowment from Henry Draper, a wealthy physician.

The spectra were assigned a classification based on the strength of Hydrogen Balmer lines.

The Balmer lines are found in the visible part of the spectrum.

The stars with the strongest Balmer lines were classified as spectral type A

- Letters were then assgined through the alphabet with decreasing strength of the Balmer lines, viz., B, C, D, etc.
- In 1926, it was discovered that line strength depended on temperature in a complex way.
- This required rearranging the letters to agree with a temperature scale rather than the strength of the Balmer lines. Some types were combined with others thereby eliminating some of the letters.

In addition, each surviving spectral type was subdivided into a decade

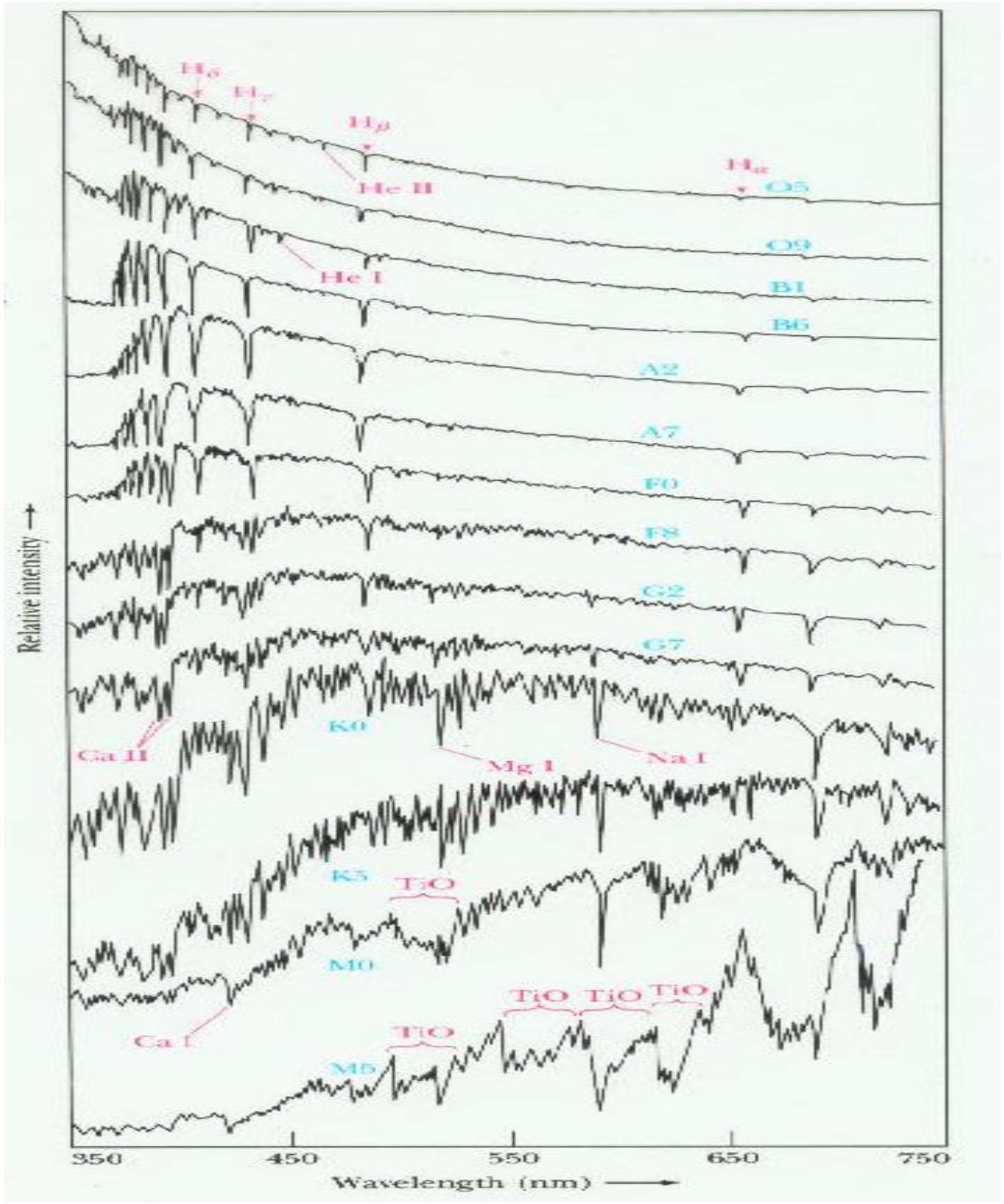
For example, B0, B1, B2 ….B9. This is a sequence of decreasing temperature.

The main spectral types that are now recognized are:

O B A F G K and M, which is sequence of decreasing temperature.

Each spectral type is divided into decades.

For example, a O9 spectral type indicates a hotter star than spectral type B0. End 2-17-005


H_δ
H_γ
H_β
He II
H_α
O5
O9
He I
B1
B6
A2
A7
F0
F8
G2
G7
K0
Ca II
Mg I
Na I
K5
TiO
M0
TiO
TiO
TiO
Ca I
TiO
M5
Relative intensity
350
450
550
650
750
Wavelength (nm)

The Atomic Theory of Stellar Spectra

Recall that both the state of excitation and stage of ionization for a given element depends on temperature.

The different ions of a given element produce uniquely different sets of absorption lines.

By applying the principles of excitation and ionization, it is possible to determinate the surface temperature of a star.

This done by comparing the relative strengths of the different spectral lines produced by the different stages of ionization for a given element.

Theory of Ion Spectra Line Strength