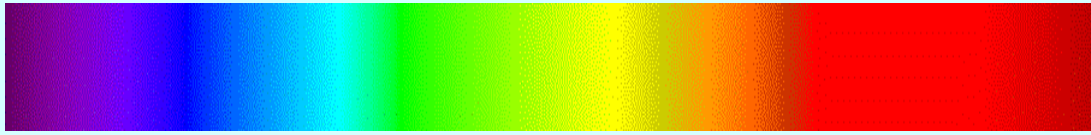
From a spectrum we can measure:

Temperature



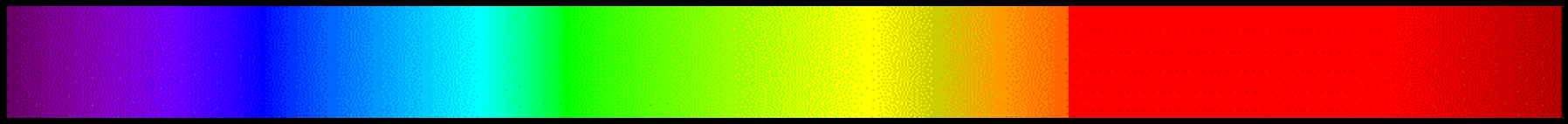
Composition

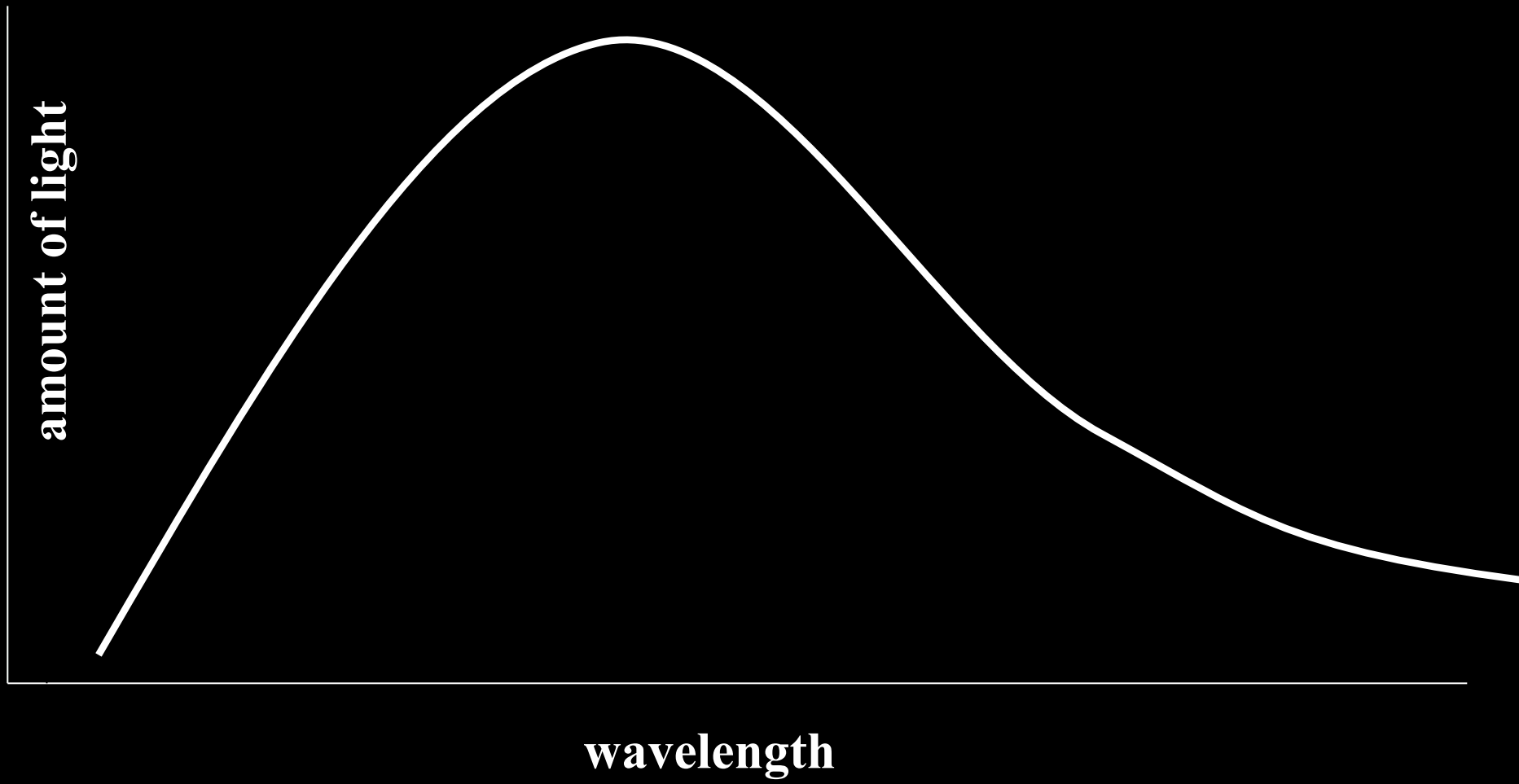
Abundance

Radial Velocity

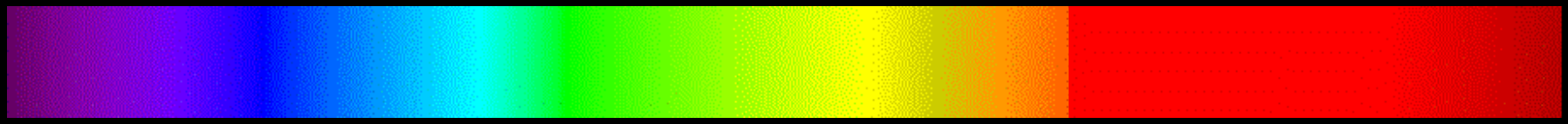
Brightness

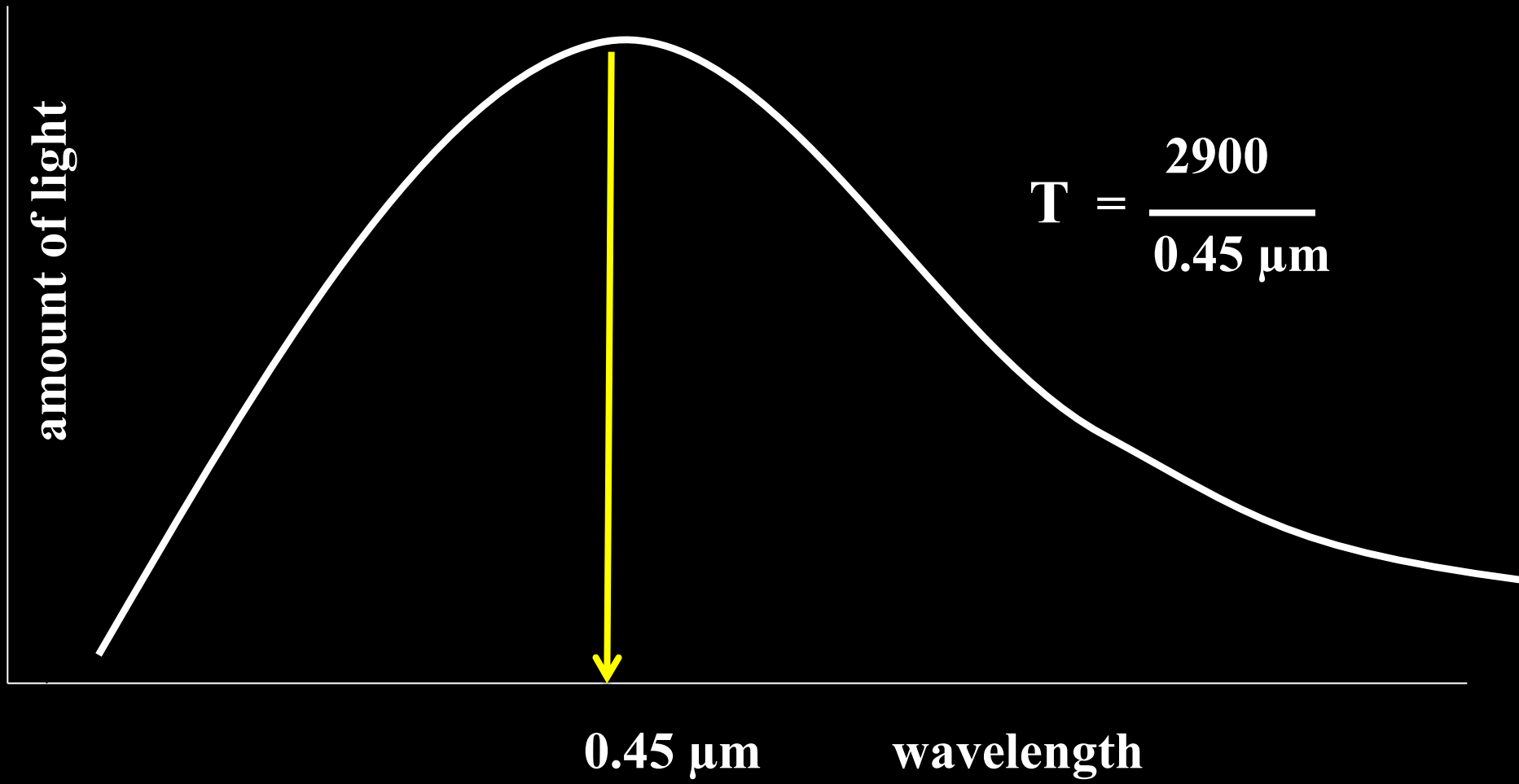
How much light at each wavelength?



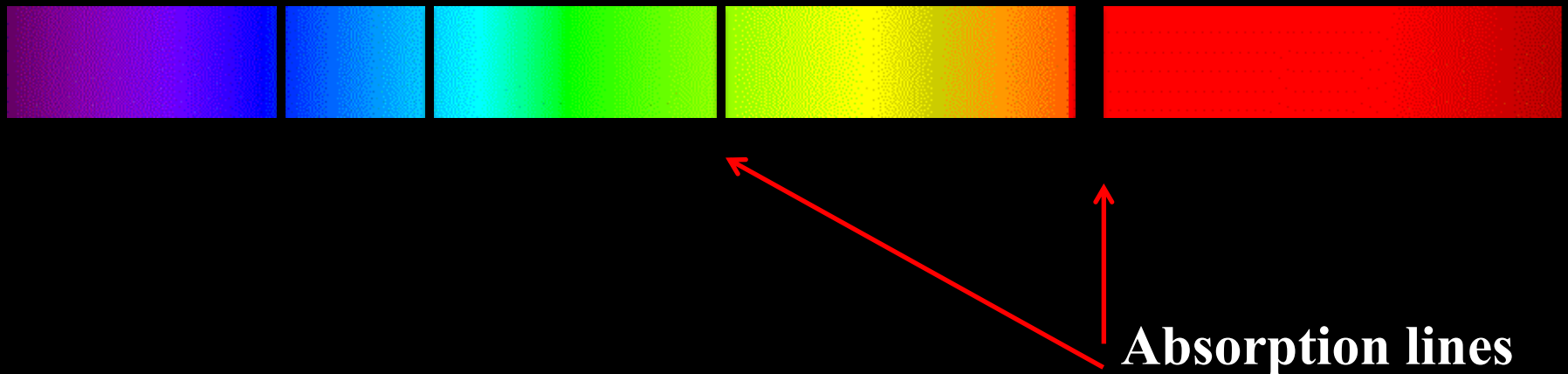


How much light at each wavelength?

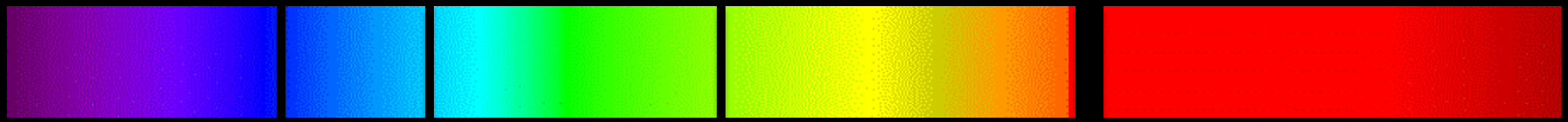


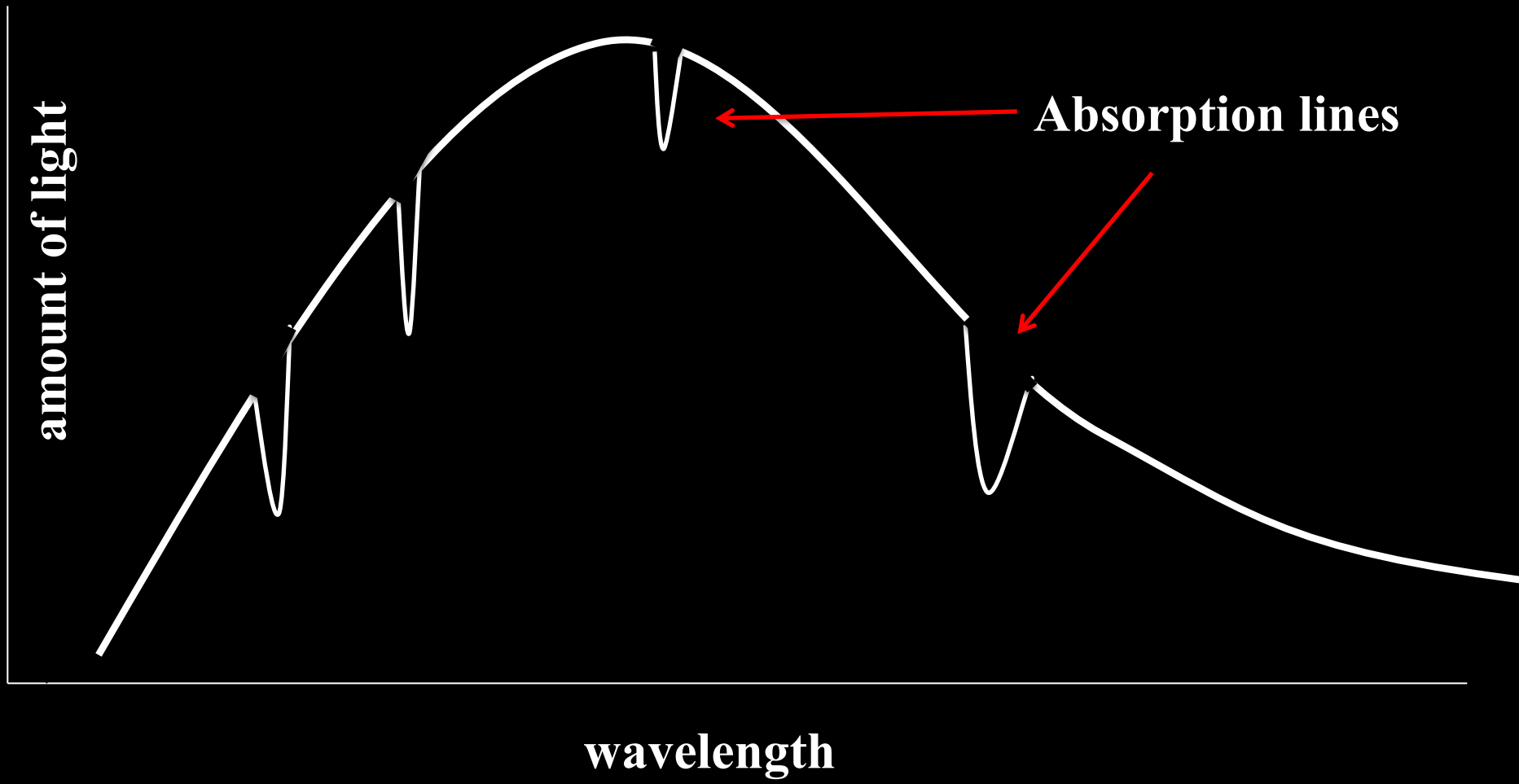


Wavelengths where the light is dimmer or absent



Wavelengths where the light is dimmer or absent





From a spectrum we can measure:

Temperature

Composition → what elements the object is made of

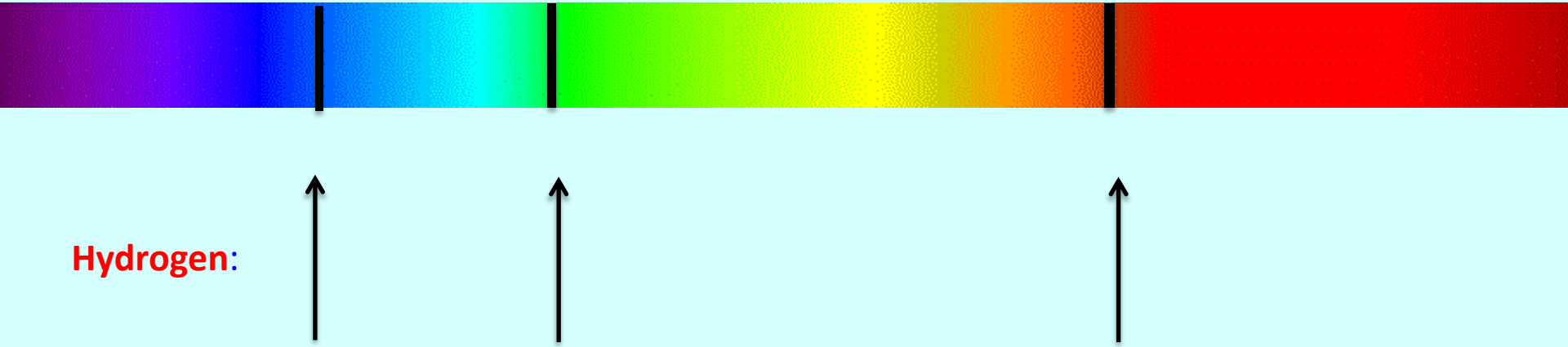
Abundance → how much of each element is there

Radial Velocity

Brightness

Composition:

Missing wavelengths of light

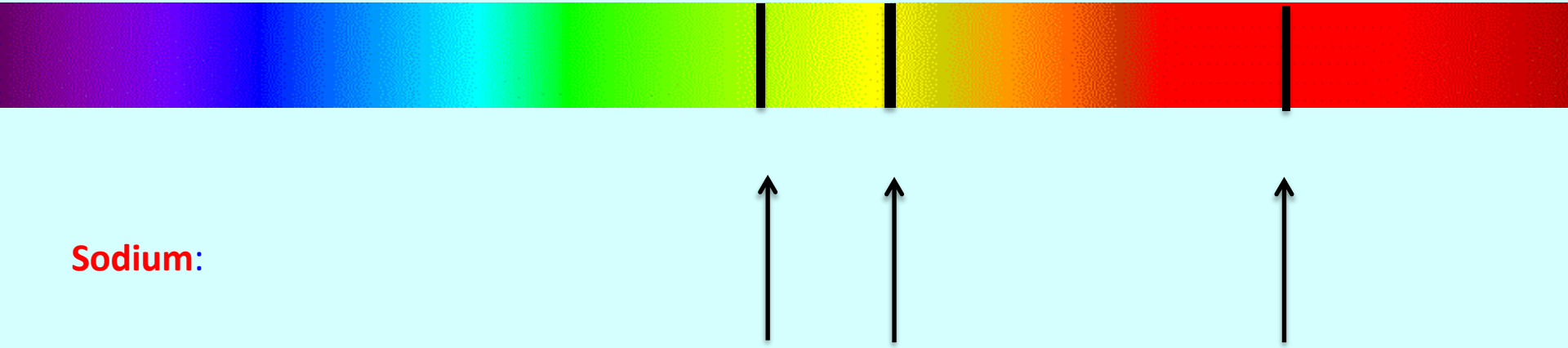


Hydrogen:

correspond to electron energies of atoms

Composition:

Missing wavelengths of light



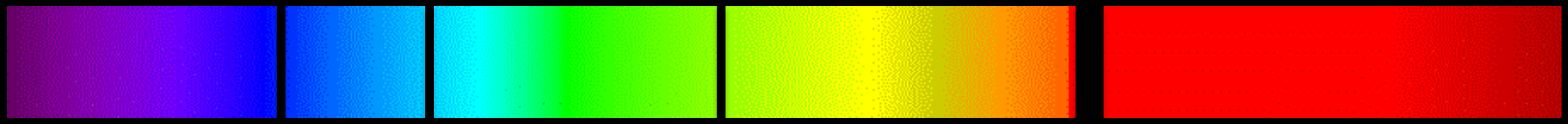
Sodium:

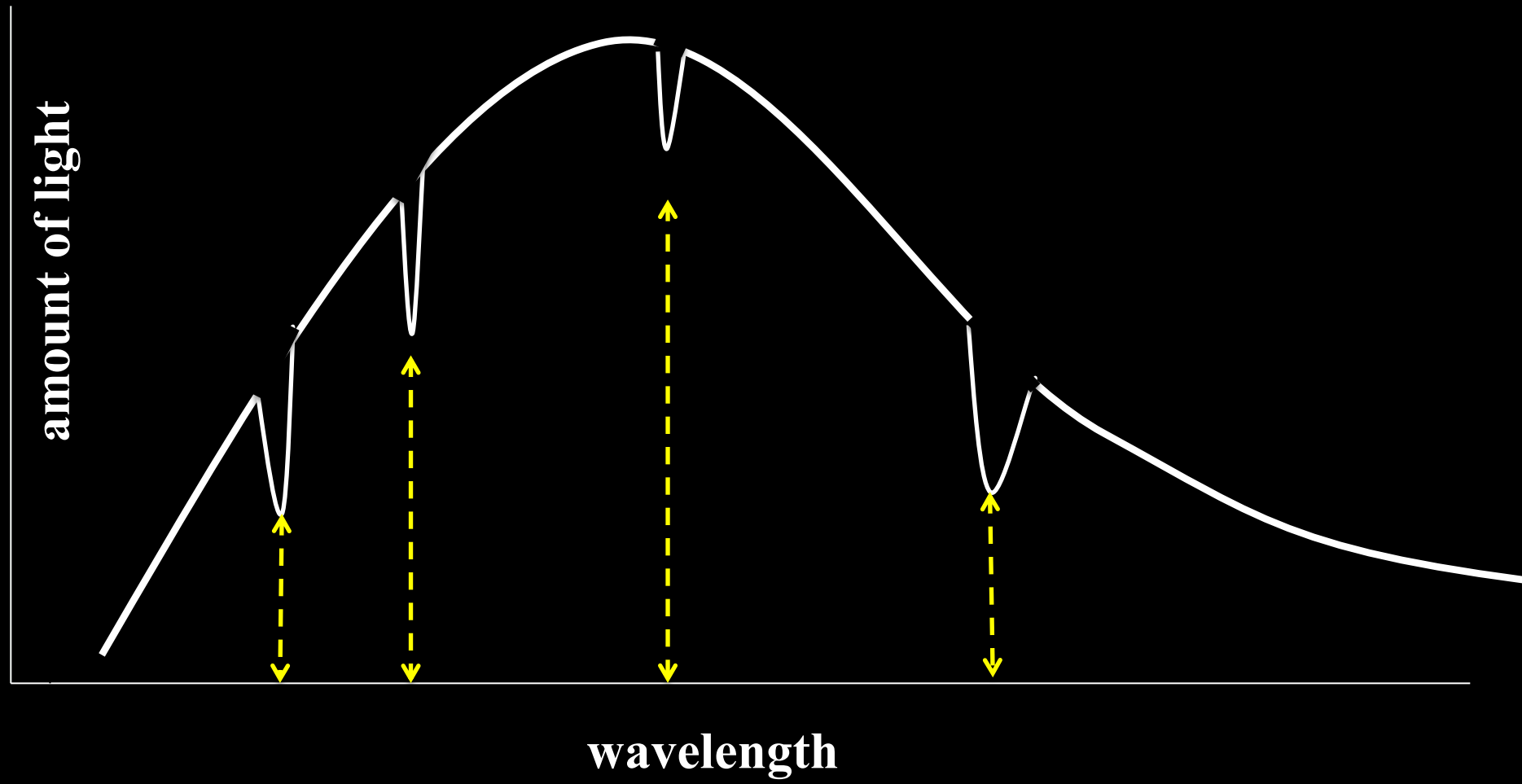
correspond to electron energies of atoms

Elements put their signature in light

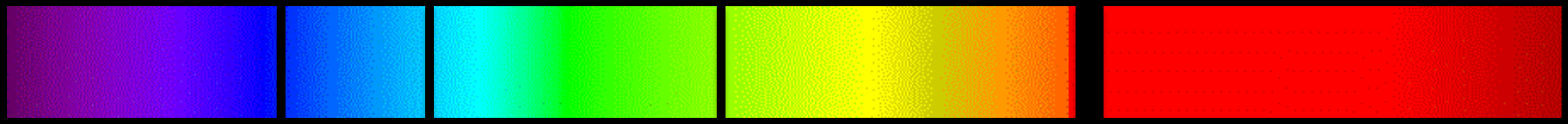
Closer look at BB curve

Wavelength gives COMPOSITION

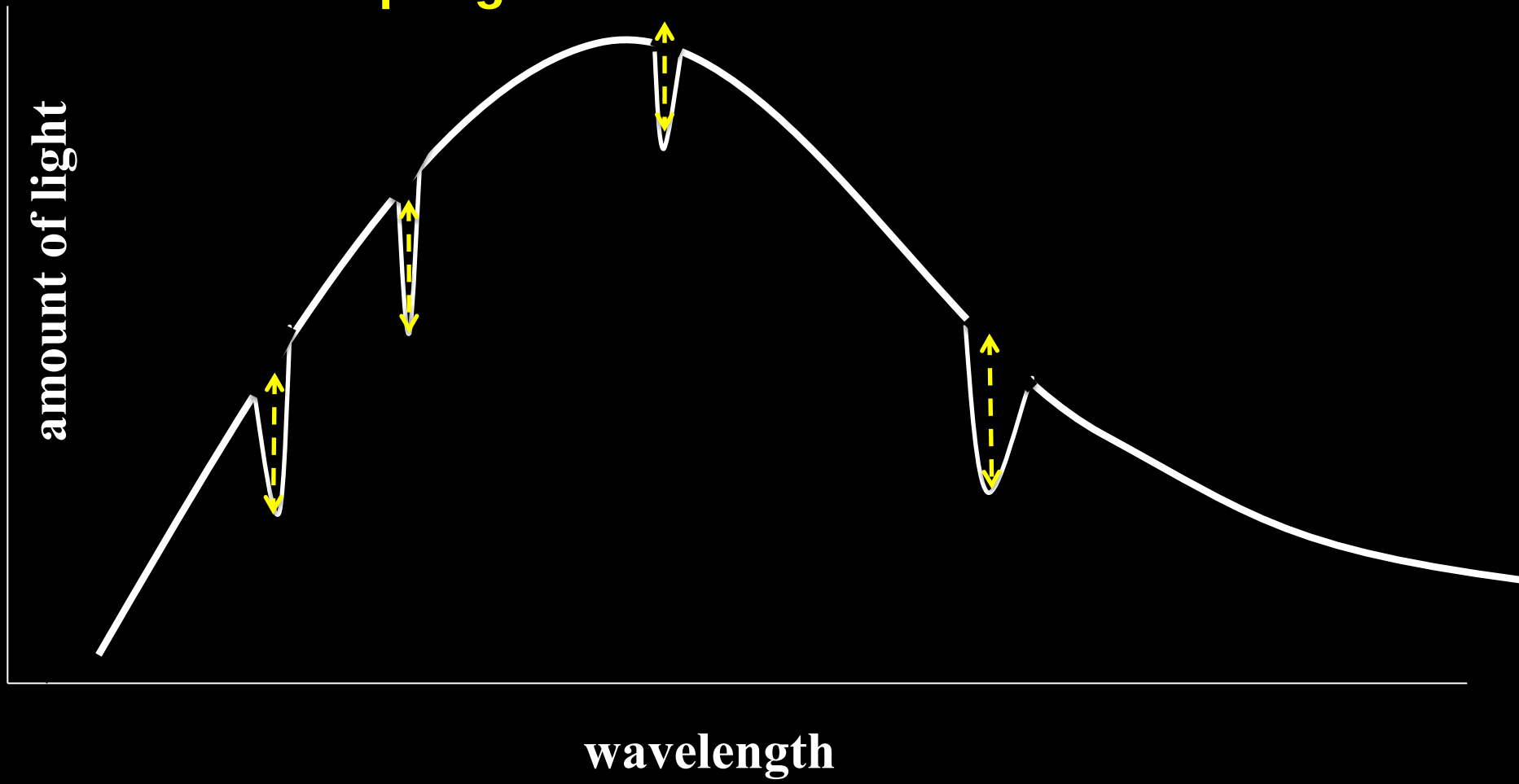




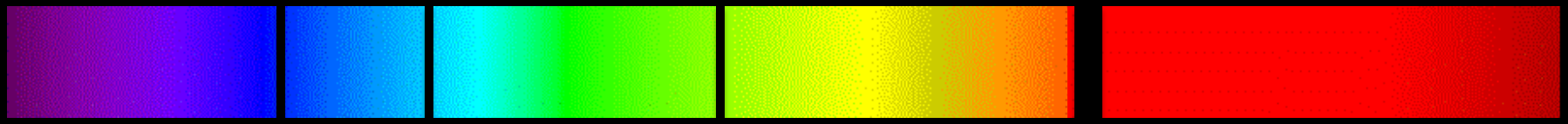
Wavelength gives composition

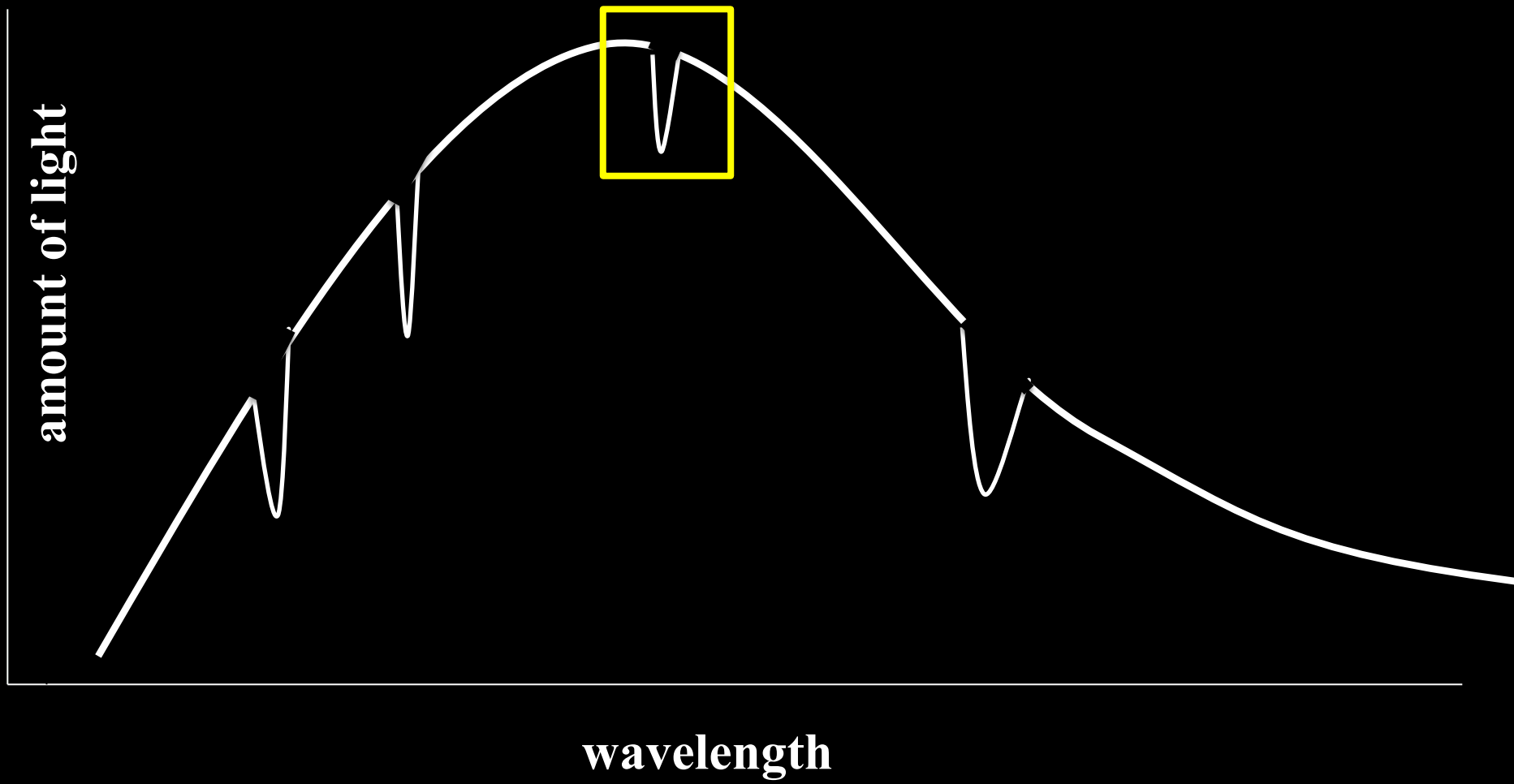


Depth gives ABUNDANCE

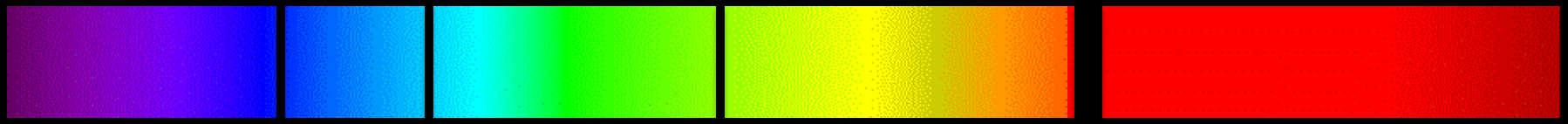


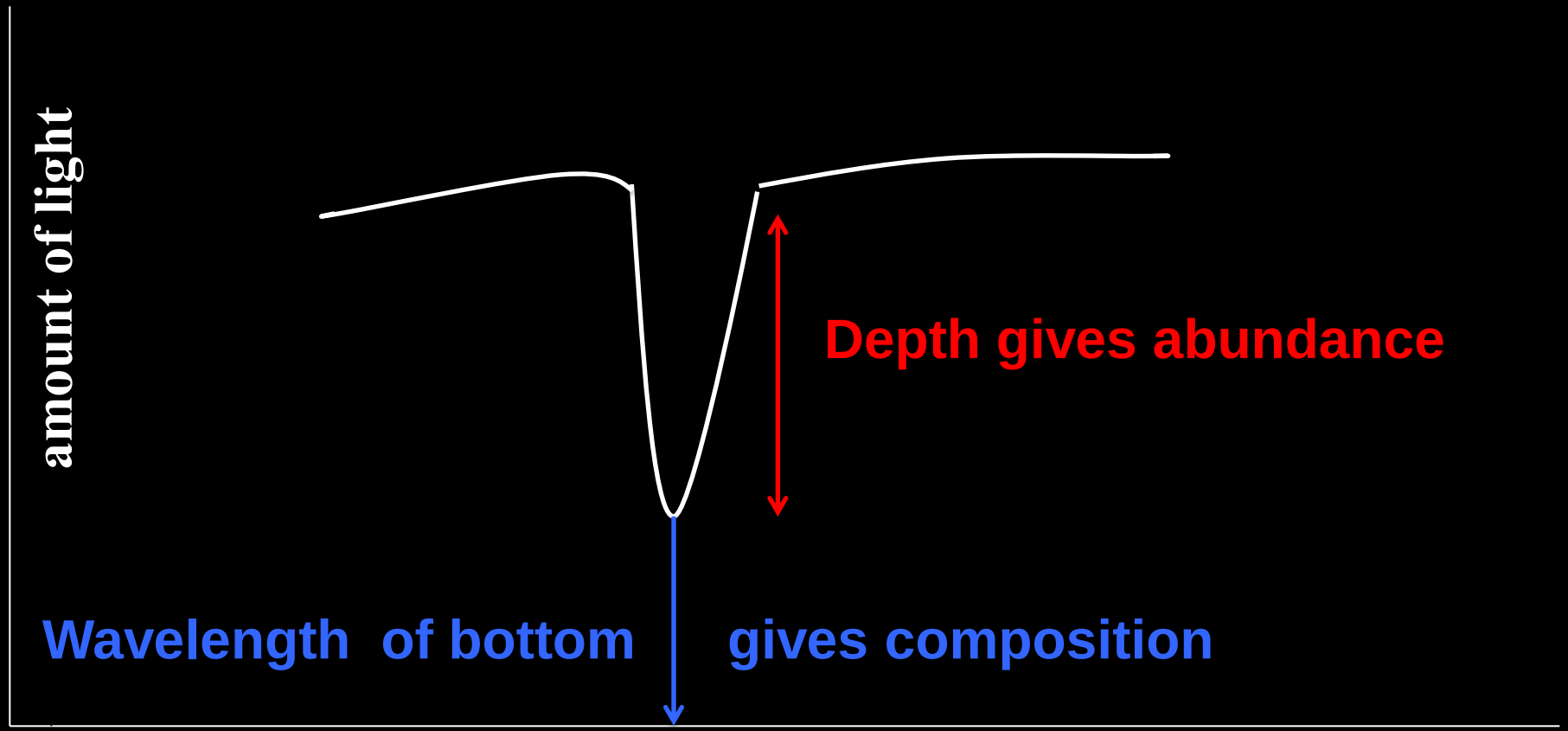
Zoom in on one “line” (absorption feature)



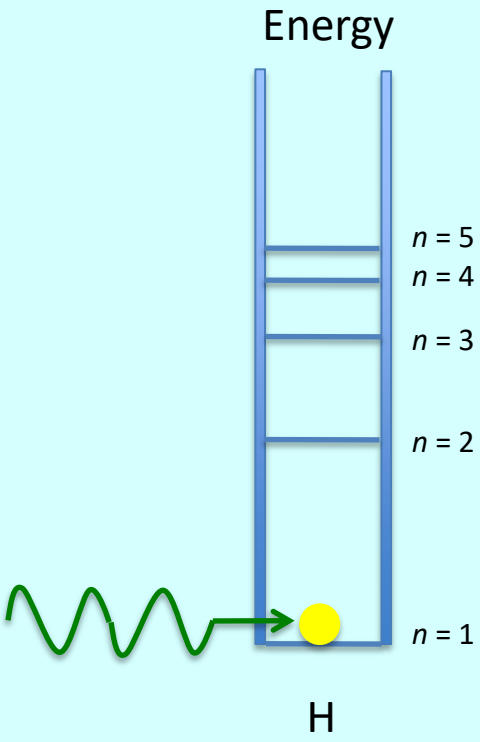


Zoom in on one “line” (absorption feature)

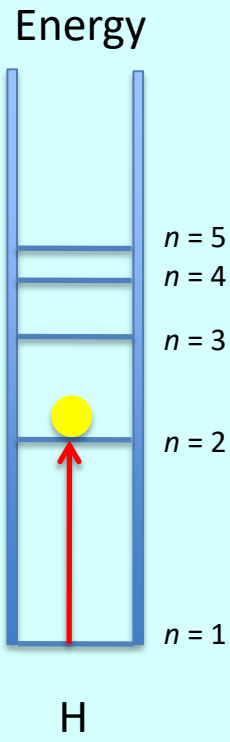




Absorption: electrons of elements grabbing light of specific λ's...



Absorption: … and jumping UP to HIGHER energy levels



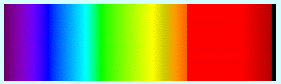
Absorption spectrum in detail

For Absorption You Need a light source behind a cloud.

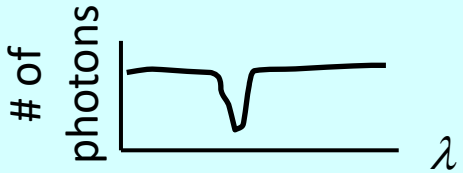
That cloud can be the atmosphere of the Sun or a Star or an Interstellar cloud. The light source is the surface of the Sun or Star.

star

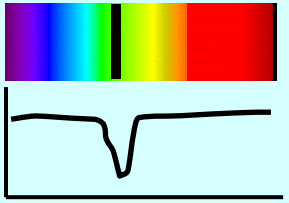
earth



All wavelengths present



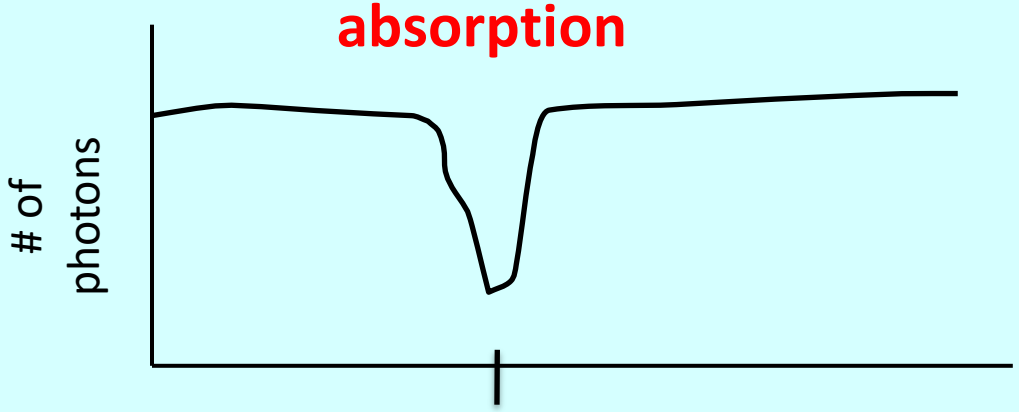
absorption



star

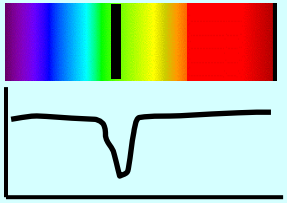
earth

absorption



Composition: the wavelength used by the electron

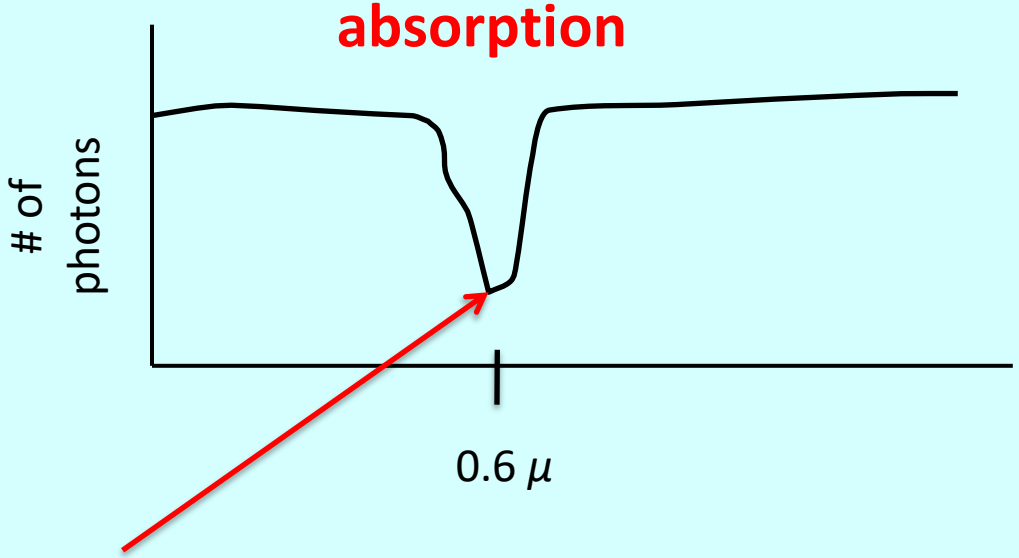
absorption



star

earth

absorption

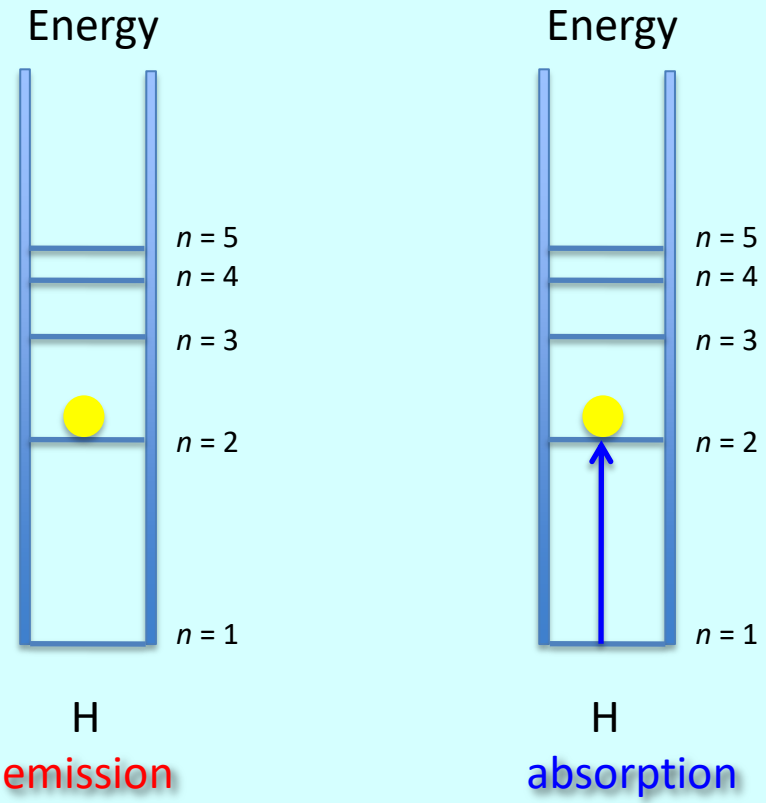


Abundance: how deep the line is

Absorption spectrum in the SUN

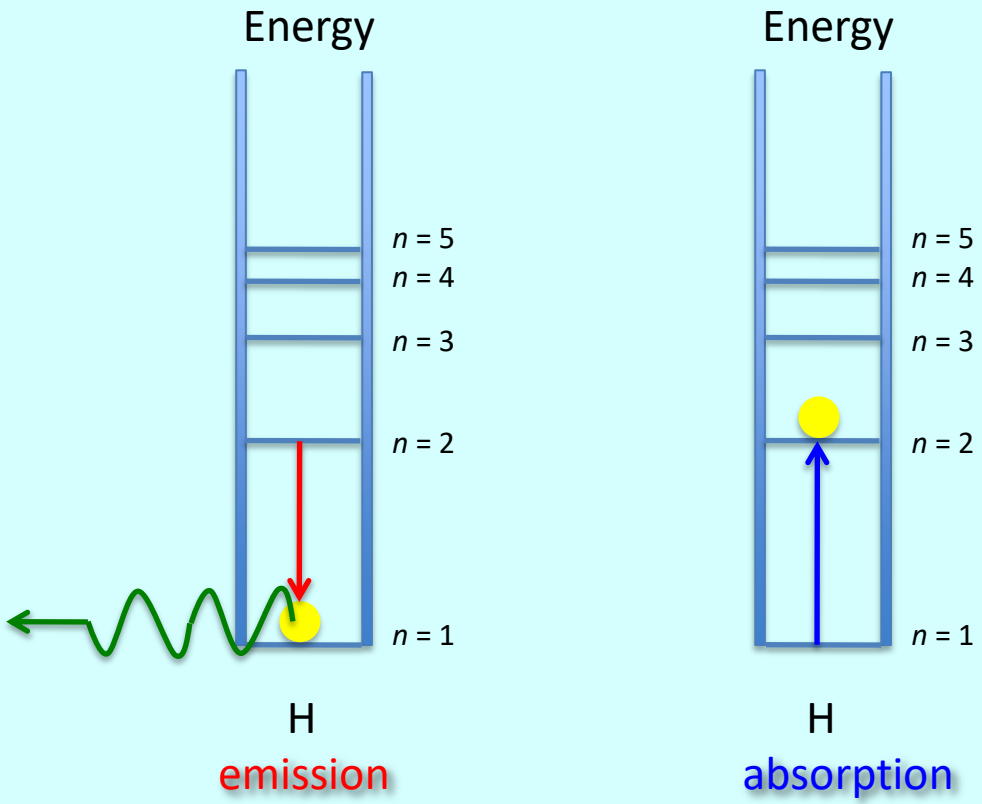
Absorption: … and jumping UP to HIGHER energy levels

Emission: letting go of specific λ 's…..



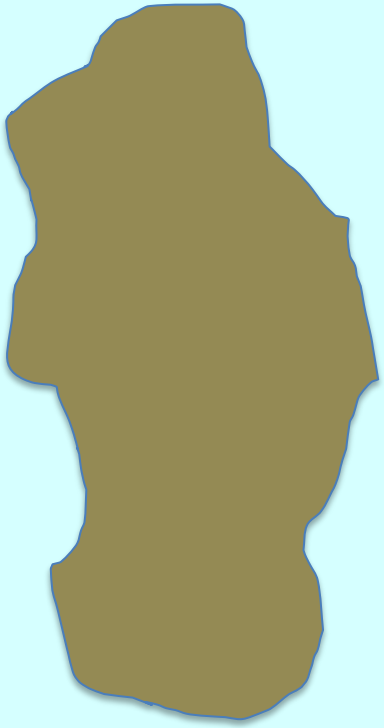
Absorption: … and jumping UP to HIGHER energy levels

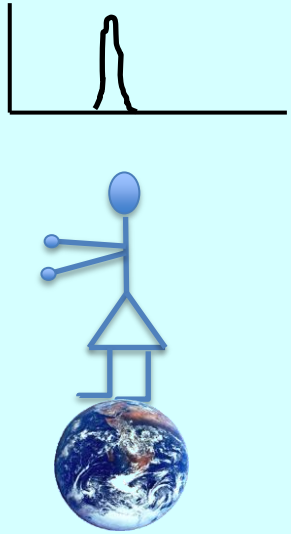
Emission: … and moving DOWN to LOWER energy levels



For EMISSION lines, all you need is a cloud of gas WITHOUT a light source behind it.

interstellar cloud





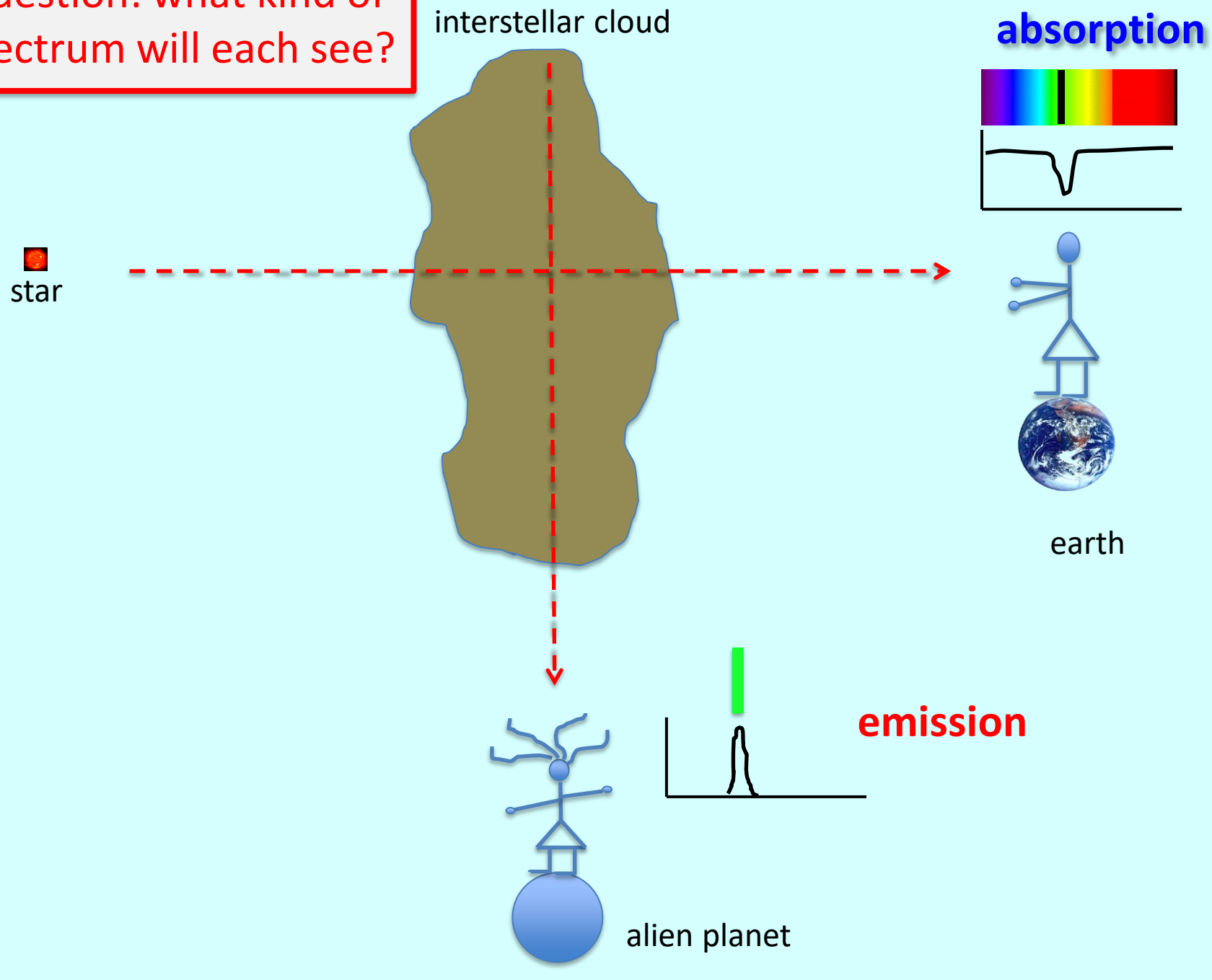
earth

Emission spectrum

Orion Star cloud emitting at many wavelengths

Orion Star cloud emitting at H, O, S

Question: what kind of spectrum will each see?



From a spectrum we can measure:

Temperature

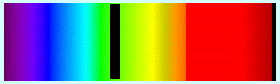
Composition

Abundance

Radial Velocity ⟶ **Doppler effect**

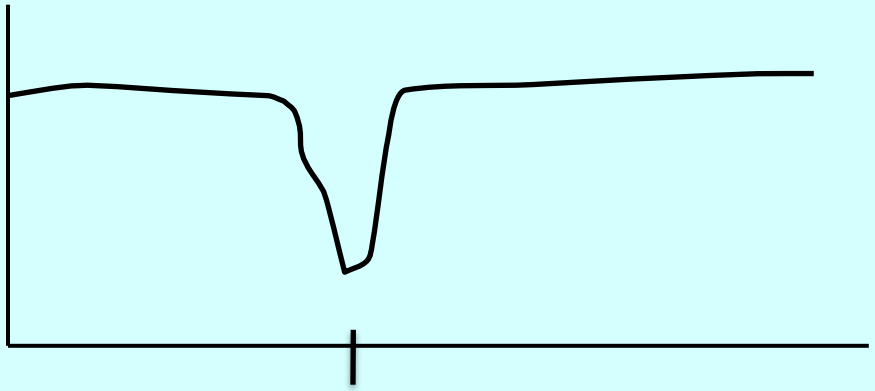
Brightness

absorption



star

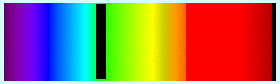
Sun or Laboratory wavelength:



0.6 μ

earth

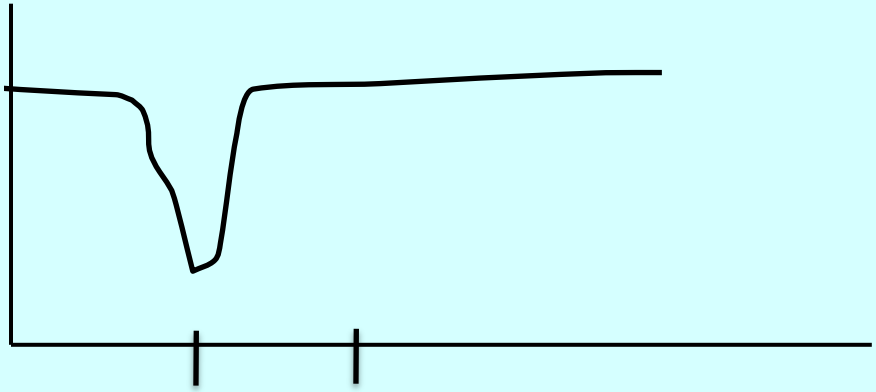
absorption



star

earth

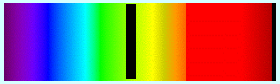
if Star is Moving TOWARD you



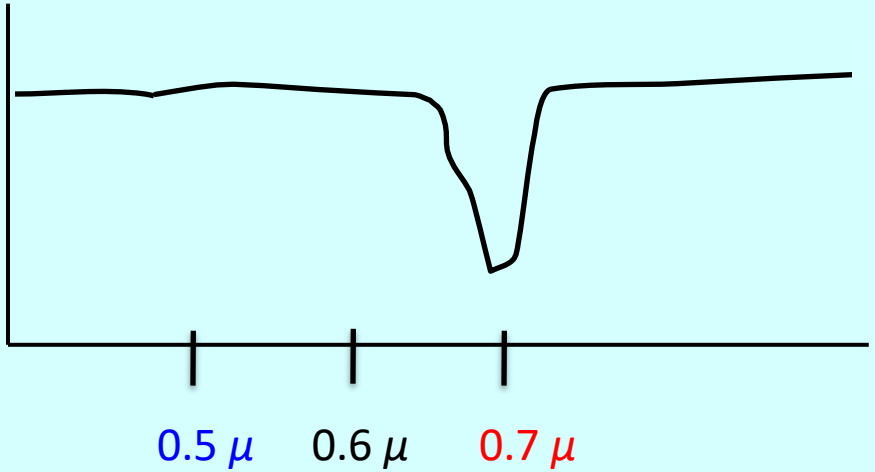
0.5 μ 0.6 μ

the absorption line is shifted to BLUER (shorter) wavelengths

absorption



if Star is Moving AWAY FROM you



the absorption line is shifted to REDDER (longer) wavelengths

Velocity

From a spectrum we can measure:

Temperature

Composition

Abundance

Radial Velocity

Brightness