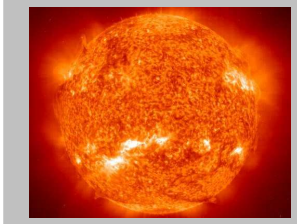
One shift...

...two shift...

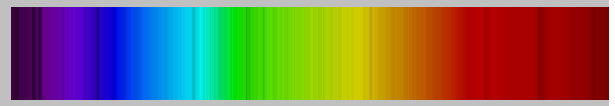
...redshift...

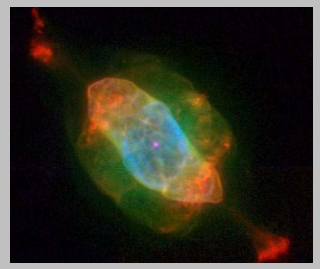
...blueshift.

(with acknowledgments to Dan and apologies to Dr. Seuss)

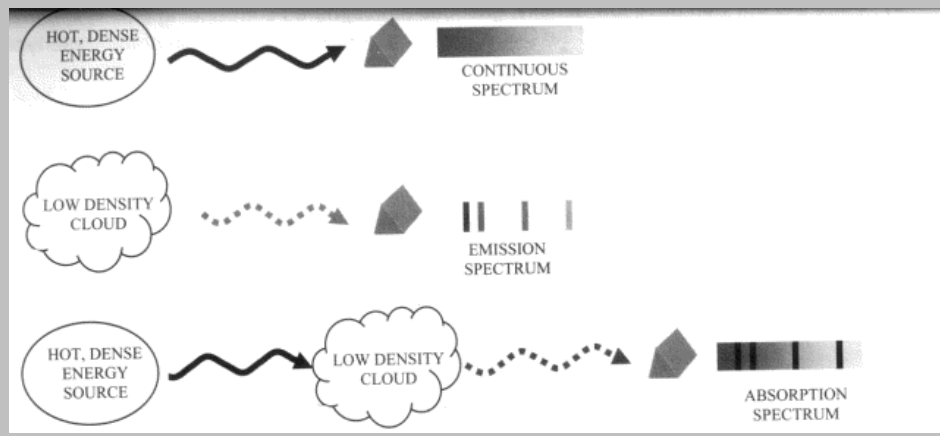


Stars: Absorption Lines

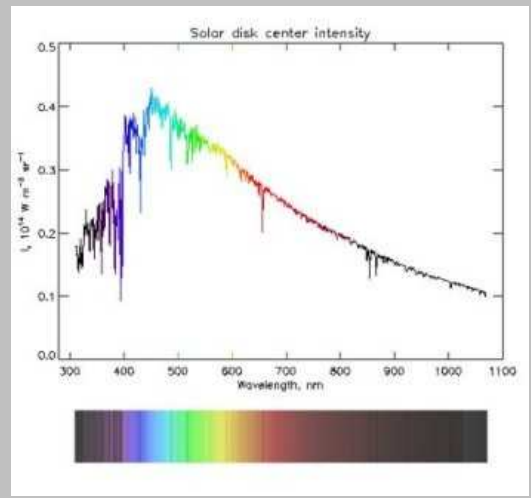




Nebulae: Emission lines

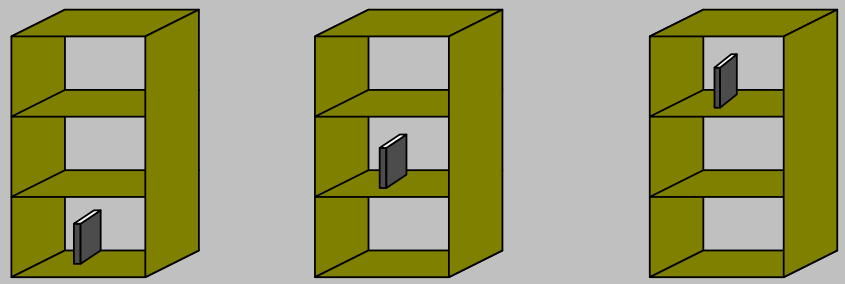


Sun's “Atmosphere”
(size exaggerated)



Electrons in atoms can only be in specified energy levels or “orbitals”.

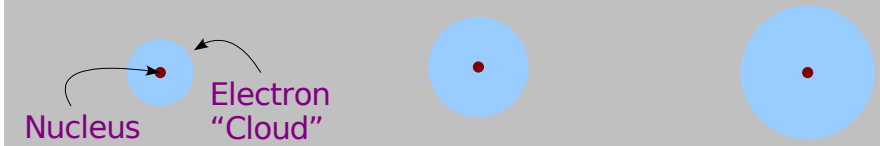
Analogy : bookcase



Ground State

First Excited State

Second Excited State



Absorption

Before

After

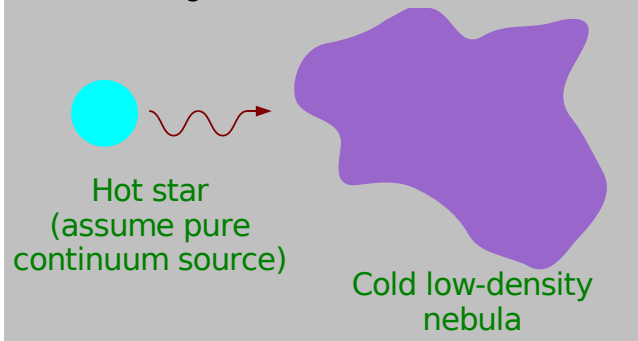
Emission

Before

After

A An Emission Spectrum
B An Absorption Spectrum
C Nothing
D Something else
E Not Enough Info

Observer 2

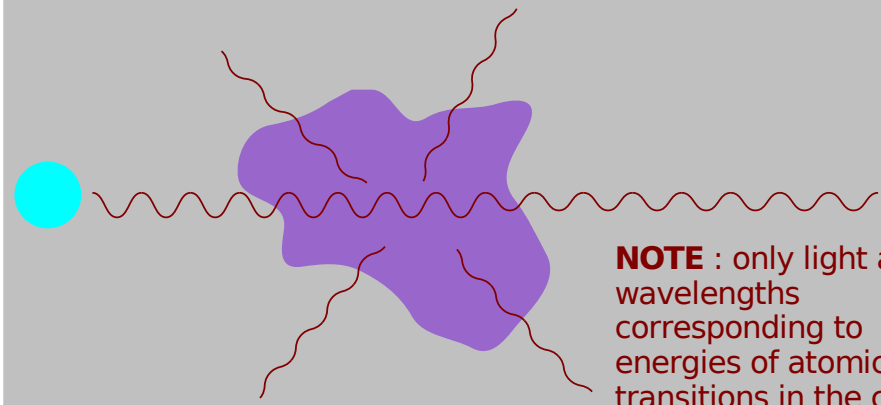


Observer 1

What does Observer 1 see? B

What does Observer 2 see? A

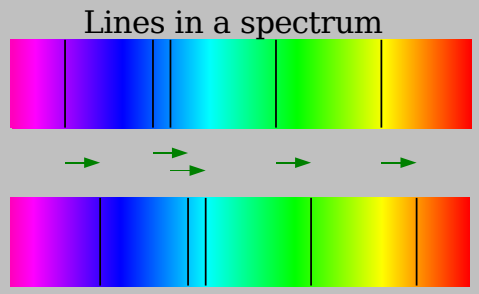
Where does the energy absorbed by atoms in the cloud go?



NOTE : only light at wavelengths corresponding to energies of atomic transitions in the cloud will be absorbed!

- It can be re-radiated away in all directions
- It may go to heating up the cloud (motion of the atoms in the cloud.

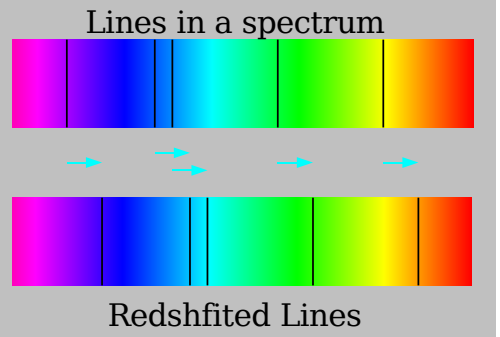
Redshift



Redshift or Blueshift

Doppler Shift
(for $|v| \ll c$)

$$\frac{v}{c} = \frac{\lambda_{obs} - \lambda_{orig}}{\lambda_{orig}}$$



λ_{obs} = observed wavelength

λ_{orig} = original (emitted or absorbed) wavelength

c = speed of light = 3×10^8 m/s = 3×10^5 km/s

v = speed of source along line of sight

v>0 : receeding

v<0 : approaching

NOTE : If this slide confuses you, ignore it!
You do not need to know or use this equation for this class!

Full Doppler shift formula for any speed :

$$z = \frac{\sqrt{1+\left(\frac{v}{c}\right)^2}}{\sqrt{1-\left(\frac{v}{c}\right)^2}} - 1 = \frac{\lambda_{obs} - \lambda_{orig}}{\lambda_{orig}}$$

Redshift or Blueshift?

What will you see?

A Redshift
B Neither
C Blueshift
D Not Enough Info

A source emits in the infrared at 11,000 Å.
You observe it in blue light at 4,500 Å. C

A source emits in the infrared at 11,000 Å.
You observe it in red light at 6,700 Å. C

A source is moving towards you at 300 km/s. C

You are moving towards a source at 300 km/s. C

...answer hazy, ask again later...