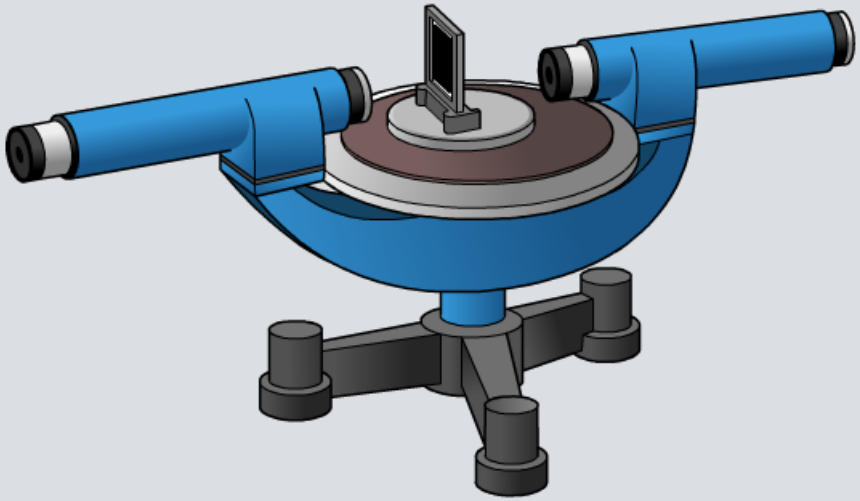
Observing Line Spectra



Incandescence

The incandescent light bulb

How could you use incandescence to explain how a conventional light bulb works?

1. A current flows through the filament.
2. The filament heats up.
3. The thermal emission of the filament moves into the visible spectrum.

Why is the incandescent light bulb not an efficient device for producing light?

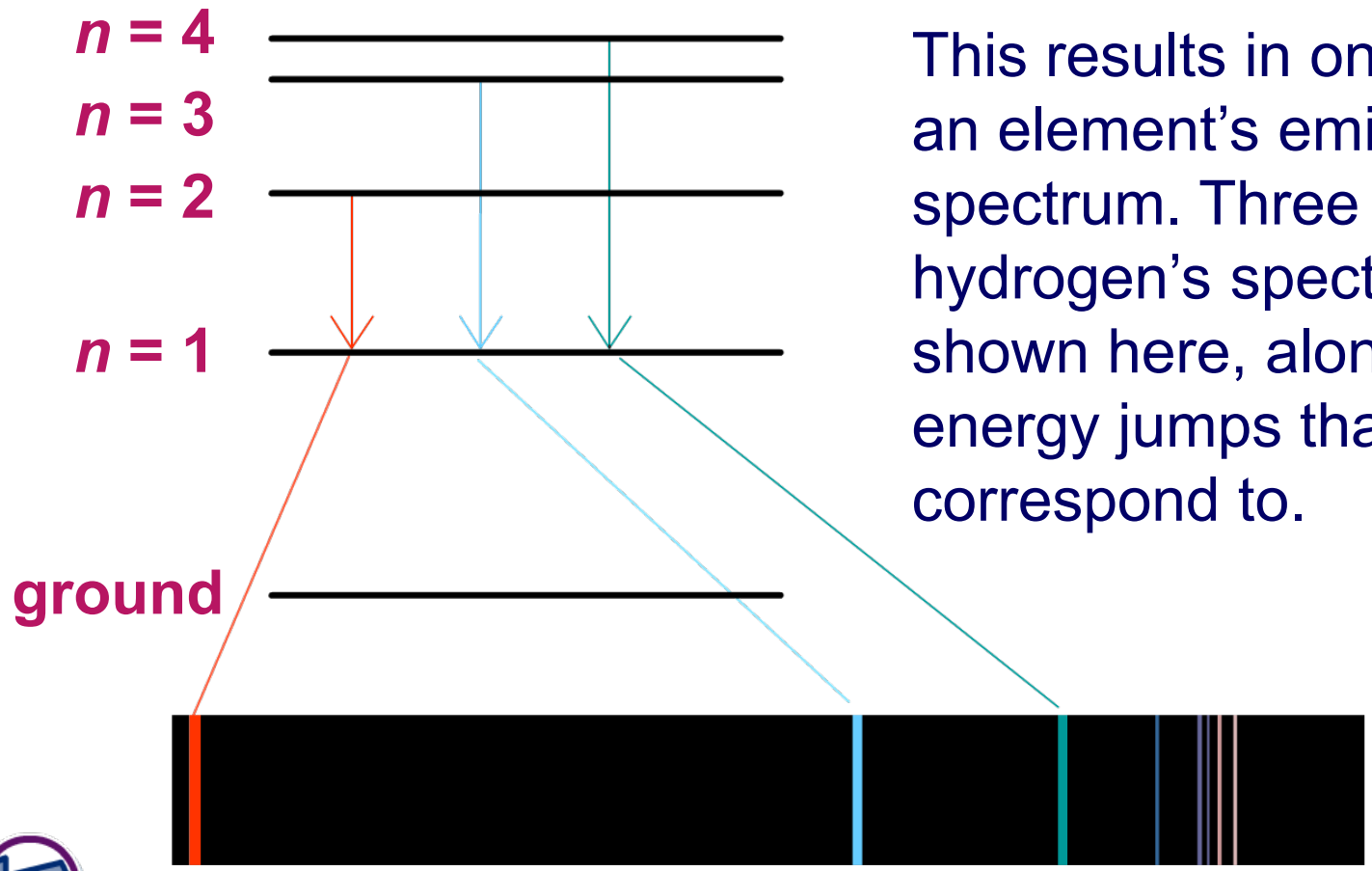
The filament's emission spectrum remains mostly in the infrared, even when it is at its hottest. Most of the bulb's energy input is therefore wasted as heat.

Emission spectra

Explaining the origin of line spectra

Dropping energy levels

Each possible drop between atomic energy levels in an atom corresponds to the emission of one specific frequency of photon.



This results in one line in an element's emission spectrum. Three lines in hydrogen's spectrum are shown here, along with the energy jumps that they correspond to.

Quantized absorption

Just as an electron can drop between energy levels in an atom, releasing a single photon, it can also jump **up** one or more energy levels if it absorbs a photon of the right energy.

Only a **single photon** of the relevant energy can cause this. It is **not** possible for an electron to "store up" energy from smaller quanta until it has enough to make the jump.

One result of this is that shining a continuous spectrum of light at a transparent material leads to a few discrete frequencies being absorbed, while the rest are transmitted. This forms an **absorption spectrum**.

H emission spectrum

H absorption spectrum

Analyzing light from a source