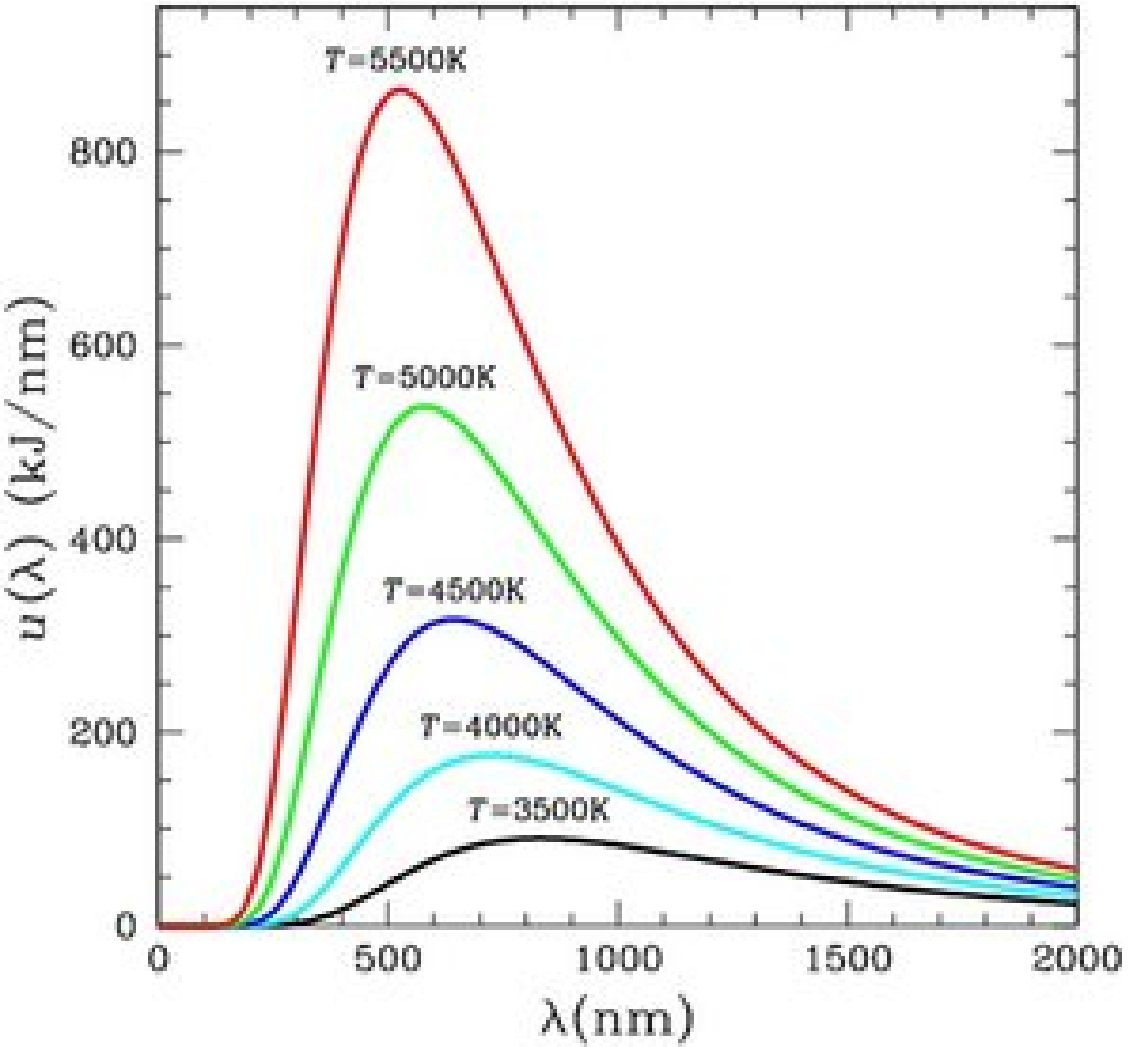
The Ultraviolet Catastrophe

Blackbody : absorbs and emits all frequencies



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Max Planck explanation:

Energies of the oscillations of electrons which gave rise to the radiation must be proportional to integral multiples of the frequency:

$$E = nh\nu$$

$$h = 6.626 \times 10^{-34}\ J.s$$

Planck could not offer a good justification for his assumption of energy quantization.

The Photoelectric Effect

The Photoelectric Effect

You will see an animation in the lectures

The Photoelectric Effect

1886 and 1887, Heinrich Hertz: ultraviolet light can cause electrons to be ejected from a metal surface.

According to the classical wave theory of light, the intensity of the light determines the amplitude of the wave, and so a greater light intensity should cause the electrons to be ejected with a greater kinetic energy.

experiment showed that the kinetic energy of the ejected electrons depends on the *frequency* of the light. The light intensity affects only the number of ejected electrons and not their kinetic energies.

Vibrations in crystals

Classical physics: molar heat capacity at constant volume (C_V) of a crystal is 3R

At high temperatures√

but for low temperatures $C_v \rightarrow 0$

Einstein:

Oscillations of atoms about their equilibrium positions are quantized

$$E = nh\nu$$

The H atom spectrum

The H atom line spectrum

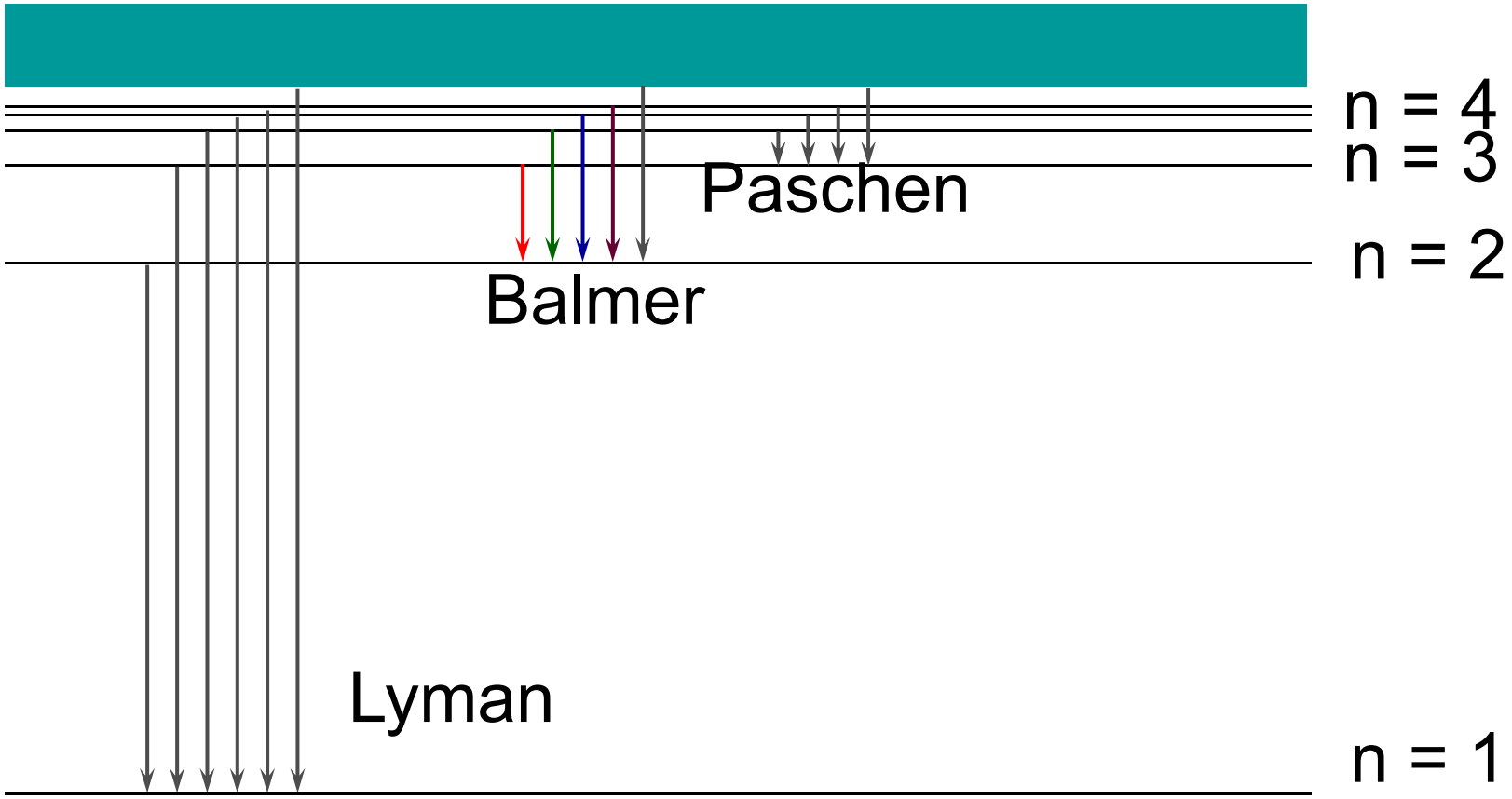
The H atom spectrum

Rydberg:

$$\nu = \frac{R_H}{h}\left(\frac{1}{n_i^2} - \frac{1}{n_o^2}\right)$$

$$\nu = 3.289 \times 10^{15}\, s^{-1}\left(\frac{1}{n_i^2} - \frac{1}{n_o^2}\right)$$

Line Spectrum



Rutherford’s experiment

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You will see a film the in the lectures