THE CONCEPT OF QUANTA

Black Body Radiation

- objects emit thermal radiation (the rate of this emission increases with temperature)
  → by 2nd half of 19th century we know that this is an electromagnetic wave (IR)
- different objects:
  - reflect
  - absorb
  - emit

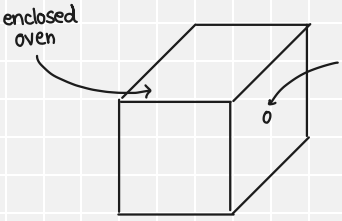
  ] more to it than just temperature!

IR radiation.
↳ hard to create a comprehensive theory!

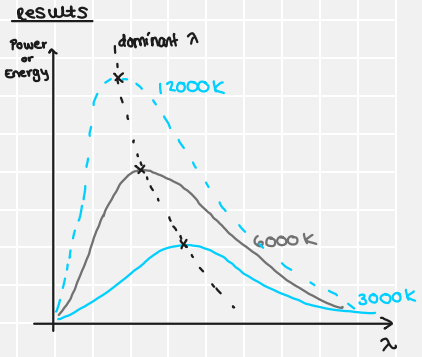
Timeline

he won a Nobel Prize for this!

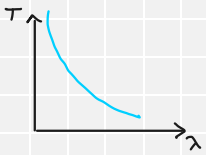
1862 - Gustav Kirchhoff
↳ coins term 'black body' : a perfect absorber/emitter of IR (no reflection)



↳ Kirchhoff measured IR emitted (cavity radiation) for different temperatures.
↳ a continuous spectrum was emitted but Kirchoff could detect the dominant λ at different temperatures.

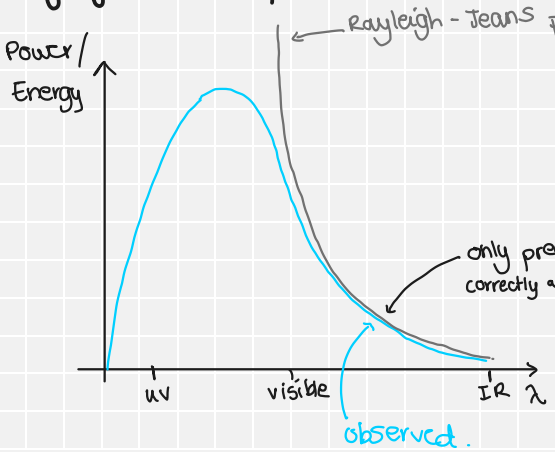


conclusion: dominant λ is inversely proportional to temperature



Late 19th Century - Stefan & Boltzmann
↳ observationally derived the Stefan-Boltzmann law] $E \propto T^4$

1899 - Rayleigh & Jeans
beyond A-level!
↳ Took theoretical approach (used concept of EM standing waves in oven)
↳ derived Rayleigh-Jeans equation



↳ at short λ, predicted infinite Power!
↳ even normal temperature objects should emit intense UV waves (and even more intense x-rays)
↳ dubbed 'ULTRAVIOLET CATASTROPHE'

THE CONCEPT OF QUANTA

1900 - Max Planck

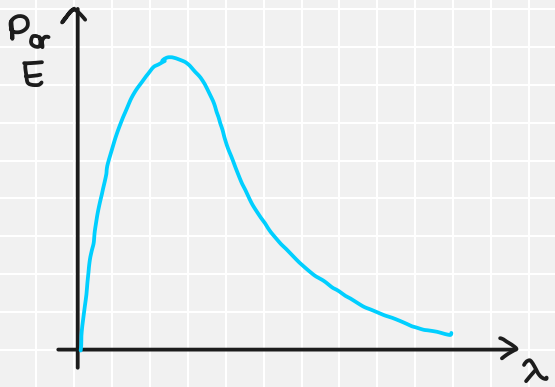
↳ suggested that the energy of Em waves is quantised:

$$E = hf$$

↳ in a black body:

- short λ have high f so emitters need more energy to even <u>begin</u> emitting Em waves of short λ!
- This solved ultraviolet catastrophe.

↳ His predictions matched observations



Other parts of course in this chapter.
Please use seperate note sheets

- concept of photons
- photoelectric effect
- Einstein's photoelectric equation
- stopping potential