

Lecture-1. Birth of QM and discovery of energy quantization

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Birth of QM and discovery of energy quantization

- Energies of atoms and molecules are quantized existing in the form of discrete chunks called quanta.
- Quantization of energy is a fundamental aspect of our physical reality and cannot be derived but can be observed in all quantum experiments. Is fully explained by the theory of quantum mechanics.
- Key historical developments leading to the birth of QM are black body radiation, double slit experiment, photoelectric effect .

Black Body radiation

This illustration shows the properties associated with different frequency regions of electromagnetic waves. Most importantly you see that the high frequency waves carry much higher energy, these are X-ray, Gamma-ray waves and can only be generated by heating “stuff” up at very very high temperatures (e.g core of the sun)! On the other hand low frequency waves can be generated in your “microwave” which you may use to heat up that leftover pizza! The light that is visible to our eyes is located in a narrow frequency region somewhere in between.

DEFINITION: “A black body is an idealized physical body which in equilibrium (meaning constant Temperature T) both absorbs and emits every wavelength of electromagnetic radiation. Since black body is in equilibrium it emits as much energy as it absorbs. The reason its called black body is precisely because it absorbs every wavelength that hits the surface therefore appearing as 100% perfect black object. If an object has a color it is because it is reflecting certain wavelengths of light which then gets detected by our eye retina. The distribution of wavelengths.

- **Classical mechanics (CM):** Energies can take any value!
Just like climbing a continuous ramp.
- **Quantum mechanics:** Energy can only take certain discrete values! More like stairs on a staircase (e.g, $1E$, $2E$ $3E \dots$ *but not* $2.5E$ or $1.1E$). Energy is therefore quantized!

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