



ENGINEERING PHYSICS

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ENGINEERING PHYSICS

Unit I : Review of concepts leading to Quantum Mechanics



- **Atomic Spectra**
- **Photo Electric effect**

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➤ *Suggested Reading*

1. *Concepts of Modern Physics, Arthur Beiser, Chapter 2*
2. *Learning Material prepared by the Department of Physics*

➤ *Reference Videos*

1. *drPhysicsA youtube channel*

- Atomic absorption lines are observed in the solar spectrum and referred to as Fraunhofer lines
- Robert Bunsen and Gustav Kirchhoff discovered new elements by observing their emission spectra.
- The existence of discrete line emission spectra or the absence of discrete lines in an absorption spectra

Atomic spectra

- *Continuous spectra from a source of white light*
- *Discrete emission lines*
- *Absence of lines from a continuous spectrum*



<- Continuous spectrum



<- discrete emission
line spectrum



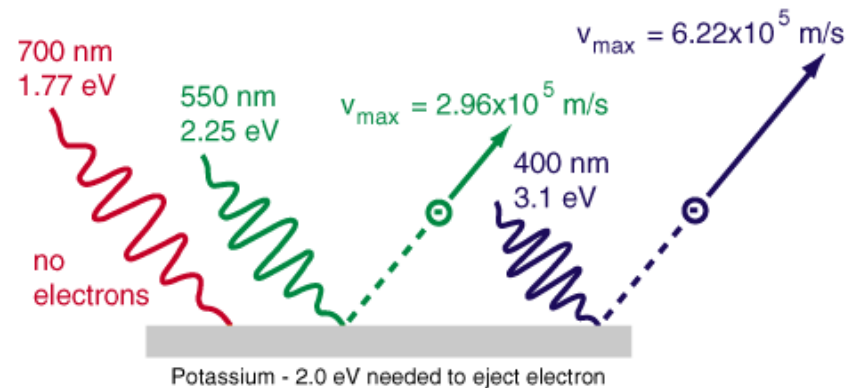
<- absorption line
spectrum

- The classical ideas of harmonic oscillators existing on the surface of the emitter result in a continuous spectrum
- Classical Physics could not explain
 - the presence of strong discrete line of a particular wavelength or
 - the absence of specific wavelengths in the case of an absorption spectra

This was one of the instances of failure of classical physics.

Photo electric effect

- *Electron emission from metals under irradiation - Photo electric effect*
- *Instantaneous emission of electrons with kinetic energy dependent on wavelength of radiation*
- *Energy of photo electrons independent of intensity of radiation*
- *Failure of EM wave theory to explain observed results*



Photoelectric effect

Photo electric effect

- *Failure of EM wave theory to explain the electron emission from surfaces*
- *The classical idea that energy of the EM wave is dependent on the amplitude of the EM was erroneous*
- *The ideas of oscillating electric fields increasing the energy of the electrons failed to explain the instantaneous electron emission*

- *Einstein brought in the idea of an the packet of energy as a particle – the photon*
- *The interaction of radiation with matter is then a case of a particle - particle interaction*
- *The energy of the photon $h\nu = W + KE$ of photo electron*
- *The dual nature of radiation confirmed from these ideas!*

The concepts which are incorrect

1. EM waves can explain discrete spectral lines
2. The spectra from the sun has the absence of certain wavelengths
3. Photo electric effect is the first proof for wave particle duality
4. Photo electric effect is observed when photons of any frequency is incident on the metal
5. The energy of the photo electron is equal to the energy of the incident photon



THANK YOU

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