

3.15 OLD QUANTUM THEORY AND ITS LIMITATIONS

The old quantum theory based on Planck's hypothesis could very successfully explain phenomenon like black body radiation, photo electric effect, Compton effect, variation of specific heat of solids with temperature and hydrogen spectrum, it has a number of draw backs and limitations. Some of these are :

- (i) Bohr's quantisation rules are arbitrary. The theory does not provide any physical explanation for making this assumption.
- (ii) Bohr's postulate of discrete non radiating energy states on which old quantum theory is based were empirical without any theoretical background.
- (iii) The theory could not explain the spectra of Helium and other more complex atoms.
- (iv) This theory could not explain why certain spectral lines are more intense than others. In other words, why certain transitions between energy levels have greater probability of occurrence than others.
- (v) It also does not explain fine structure of spectral lines *i.e.* why certain spectral lines consist of more than one line having slightly different wavelengths.
- (vi) The theory does not explain the process connected with spin of the electron and Pauli's exclusion principle.
- (vii) It is unable to explain dispersion of light.
- (viii) Above all it does not explain how individual atoms interact with one another to give the physical and chemical properties of matter in aggregate of macroscopic size.

All these and other difficulties have been explained on the basis of quantum mechanics, called wave mechanics or matrix mechanics.

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