

Limitations of Old Quantum Theory :-

The quantum theory based on Bohr's quantum condition and Wilson-Sommerfeld quantum rule is known as old quantum theory. It is unable to explain some problems e.g., energy states of hydrogen atom, particles in infinite square well, harmonic oscillator, etc. The main limitations of the old quantum theory are as follows :-

- (a) It is not applicable to non-periodic system.
- (b) It can't explain the relative intensities of the spectral line.
- (c) The spectral lines of hydrogen molecule and normal helium atom can't be explained by this theory.
- (d) The theory does not account the spin motion of the electron ~~rotation~~ and the Pauli's exclusion principle.
- (e) Even after applying the selection rule $\Delta n_{\phi} = \pm 1$, Sommerfeld theory can't give the ^{Account} actual number of spectral lines.
- (f) Sommerfeld method of elliptical orbits gives the correct total (n) of possible azimuthal quantum numbers but the actual values are incorrect.

spectroscopic studies reveals that the azimuthal quantum number can take the value zero so that the total values are $0, 1, 2, \dots, (n-1)$. So a new azimuthal quantum number l is introduced where $l = n_{\phi} - 1$.

A satisfactory explanation of the above difficulties has been provided by new quantum mechanics.

Vector Atom model

The old quantum ~~mechanics~~ theory formulated by Bohr-Sommerfeld could not explain the anomalous Zeeman effect, P-B effect, Stark effect etc, which were discovered in subsequent years. To provide satisfactory explanation of the above effects, a new model called VECTOR ATOM MODEL was proposed. The main contributors to the vector atom model are Bohr, Sommerfeld, Uhlenbeck, Goudsmit, Pauli, Stern and Gerlach.