TRINITY COLLEGE FOR WOMEN
NAMAKKAL
Department of Physics

QUANTUM MECHANICS

23PPH05-EVEN Semester

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POSTULATES OF QUANTUM MECHANICS

POSTULATE 1- The State

The state of a system is discribed by a wavefunction $\psi(r,t)$.

EXPLANATION. For a single particle,the wave function is a function only of position r and time t,and is written $\psi(r,t)$.The wavefunction $\psi(r,t)$ gives the complete knowledge of the behavior of the particle.

Similarly , wavefunction $\psi(r,t)$ gives the stationary state which is independent of time.

POSTULATE 2-Operators

Every physical observable is associated with a linear Hermition operator

EXPLANATION.The result of measurements is a number. The eigen values of a Hermition operator are real,which justifies their use.

The linearity condition stems from the superposition principle.

POSTULATE 3-Eigenvalues

In any measurement of the observable associated with operator A the only values a that satisfy the eigen value equation

$$A\,\psi = a\,\psi$$

This is the postulate that the values of dynamical variables are quantized in quantum mechanics although it is possible to have a continuum of eigenvalues in the case of unbound states. If the system is in an eigen state of A with eigenvalue a then any measurement of the quantity A will always yield the value a

Although measurement will always yield a value the initial state does not have to be an eigenstate of A An arbitrary state can be expanded in the complete set of eigenvectors of A $\psi=a\psi$

In this case measurement of A will yield one of the eigenvalues but we don t know which one The probability of observing the eigenvalue ai is given by the absolute value of the square of the coefficient.The third postulate also implies that after the measurement of yields some value the wavefunction collapses into the eigenstate that corresponds to ai If ai is degenerate collapses onto the degenerate subspace Thus the act of measurement affects the state of the system and this has been used in many elegant experimental explorations of quantum mechanics eg Bell s theorem.

POSTULATE 4-Expectation Values

If a system is in a state described by the normalised wavefunctionψ then the average value of the observable corresponding to A is given by

$$\langle a \rangle = \psi^{*} A \psi \, d\tau$$

POSTULATE 5-Time development of a Quantum system

The wave function or state function of a system evolves in time according to the time dependent Schrodinger

$$H \psi = i \, h/2 \, d \psi/dt$$

POSTULATE 6- Antisymmetry

The total wavefunction must be antisymmetric with respect to the interchange of all coordinates of one fermion with those of another Electronic spin must be included in this set of coordinates The Pauli exclusion principle is a direct result of this antisymmetry

THANK YOU

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