lecture - (4) QM - 1 (1)

23 Sep, 2009

* The postulates of Quantum Mechanics.

now we will connect the experimental results with the mathematical formalism discussed so far.

Since we have not talked about the (density operator), the first version is not complete. But good enough. —

(1) Every physical system is associated with a Hilbert space $\mathcal{E}$. (the vectors of this space ~~is~~ called kets)

(2) Every pure state of a physical system is associated with a definite ray in $\mathcal{E}$. (the definition comes later)

(In practice, we often represent the state of a system by some nonzero ket lying in the ray)

(3) Every measurement process (~~which~~ can be carried out) on the system corresponds to a complete Hermitian operator A.

(4). The possible results of the measurement are the eigenvalues of A, either the discrete $a_1, a_2 ..$ or the continuous ones $a(\nu)$.

(5). In the discrete case, $\text{Prob}(A = a_n) = \dfrac{\langle \psi | P_n | \psi \rangle}{\langle \psi | \psi \rangle}$

P_n is the projection operator onto $\mathcal{E}_n$ corresponding to a_n.

the eigenspace

$|\psi\rangle$ is any nonzero ket in the ray representing the state of the system.

- In the continuous case, $\text{Prob}(a_0 \le A \le a_1) = \dfrac{\langle \psi | P_I | \psi \rangle}{\langle \psi | \psi \rangle}$

P_I is the projection operator corresponding to $I = [a_0, a_1]$

6. After a measurement with discrete outcome $A = a_n$, the system is represented by the ket $\underbrace{P_n|\underbrace{\psi}_{\text{before}}\rangle}_{\text{after}}$

- the system is in an eigenstate of A with eigenvalue a_n after the measurement.
- For the continuous case, with outcome $a_0 \leq A \leq a_1$

  the system becomes $P_I|\psi\rangle$

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postulate 5 $\rightarrow$ statistical nature of QM

postulate 6 is called the collapse postulate. and it is the most strange one.