

So far as the complete theory is concerned all elements of the superposition exist simultaneously, and the entire process is quite continuous.

We have here ^{only} a special case of the following general principle which will hold for any situation which is treated entirely wave mechanically:

Principle: For any situation in which the existence of property R_i for one ^{part} system (S_1) will imply the later ~~existence~~ ^{existence} of property Q_i in the ^{composite system} S , in which actually S_1 possesses the superposition $\sum a_i R_i$, then the total state will be a superposition of states for which R_i and Q_i hold, superposed with coefficients a_i . In particular for any arrangement of an interaction between systems S_1 and S_2 which has the property that the initial state ψ^{S_2} will result in a later situation with total state function $\psi^{S_1+S_2}$, the result of an initial state for S_1 being $\sum a_i \psi_i^{S_1}$ will lead, after interaction, to the superposition $\sum a_i \psi_i^{S_1+S_2}$.

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This follows immediately from the superposition principle, and hence holds for any system of quantum mechanics for which the state functions obey a linear wave equation. It is thus applicable to all present theory, field or particle, relativistic or not, and is applicable to all systems regardless of size.

~~Principle: For any situation in which it will be the case that if one subsystem S_1 , of a composite system S , possesses the property R_i , then the~~

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~~Principle: For any situation in which the existence of a property R_i for one subsystem S_1 of a composite system S will imply the later property Q_i for S , then it is also true that an initial state for S_1 of the form~~

$$\Psi^{S_1} = \sum_i a_i \Psi^{S_1}_{[R_i]}$$

~~of states with the properties R_i , will result in a later state for S of the form~~

~~(in some line) \rightarrow a superposition, $\Psi^S = \sum_i \Psi_{[Q_i]}$, which is also a superposition of states with the property Q_i .~~

~~That is, for any arrangement of an interaction between two systems $S_1 + S_2$ which has the property that the each initial state $\phi^{S_1} \Psi^{S_2}$ will result in a final situation with total state $\Psi^{S_1 + S_2}$, an initial~~

~~state of S_1 of the form $\sum_i a_i \phi^{S_1}_i$ will lead, after interaction, to the superposition $\sum_i a_i \Psi^{S_1 + S_2}_i$ for the whole system.~~

~~This follows immediately from the superposition principle for solutions of the wave equation, and therefore holds for any system of quantum mechanics obeying a linear wave equation.~~

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According to (chap 6) these relative states $\xi^r(q)$ are nearly eigenfunctions for the values $g = \frac{r'}{t}$, if the degree of correlation between q and r is sufficiently high. This can be seen directly by noticing that if t is very large, or $N(r)$ sufficiently sharp (near $\delta(r)$) then $\xi^r(q)$ is nearly $\delta(g - \frac{r'}{t})$.

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Therefore (6.12) is a superposition of states $\gamma_{r'}$.
 $= \xi^r(q) \delta(r - r')$, for each of which the apparatus has recorded a definite value r' , and the system is left in approximately the eigenstate of the measurement corresponding to $g = \frac{r'}{t}$.

Principle: For any situation in which the existence of a property P_i for one subsystem (S_1) of a composite system S will imply the later property Q_i for S , and for which S_1 actually is a superposition of states with the property

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Then it is easily verified that state $\Psi_{S+A}^{-t}(q, r)$:

$$(1.2) \quad \Psi_{S+A}^{-t}(q, r) = \phi(q) n(r - qt)$$

is a solution of the Schrödinger equation:

$$(1.3) \quad i\hbar \frac{\partial \Psi_{S+A}^{-t}}{\partial t} = H_I \Psi_{S+A}^{-t}$$

for the specified initial conditions at time $t=0$.

Translating (1.2) into square amplitudes we get

$$(1.4) \quad P_t(q, r) = P_1(q) P_2(r - qt)$$

$$\text{where } P_1(q) = \phi^*(q) \phi(q), \quad P_2(r) = n^*(r) n(r)$$

$$\text{and } P_t(q, r) = \Psi_{S+A}^{-t*}(q, r) \Psi_{S+A}^{-t}(q, r)$$

We note

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Application of a special inequality (proved in §5, Appendix) to (1.7) yields the relation:

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Each of these elements $\Psi_{q'}^{-t}$ of the superposition describes a state in which the system has the definite value $q = q'$, and in which the apparatus has a state that is displaced from its original state by the amount $q't$. These elements $\Psi_{q'}^{-t}$ are then superposed with coefficients $\phi(q')$ to form the total state (1.11).

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This follows immediately from the superposition principle for solutions of a linear wave equation, ~~and~~ therefore ~~it~~ holds for any system of quantum mechanics for which the superposition principle holds, both particle and field theories, relativistic or not, and is applicable to all ~~the~~ physical systems, regardless of size.