3. Hidden variables interpretation.

He is the position (Altenkirch's 9 - introduction) that it is not a complete description of the system. It is assumed that the exact complete description, which would involve further (hidden) parameters, would lead to a deterministic theory, from which the probabilistic aspects arise as a result of our ignorance of these extra parameters in the form of unknown as in classical statistical mechanics. It is therefore regarded as a description of an ensemble of systems and not a single system. Einstein, Bohm, Meso and Sengal proponents proponents of this interpretation include.

Einstein hopes that a theory along the lines of his general relativity, where all of physics is reduced to the geometry of a space-time continuum, could satisfactorily explain quantum effects. In such a theory a particle is no longer a simple object but possesses an enormous amount of structure, i.e. it is thought of as a region of space-time of high curvature. It is conceivable that the interactions of particles could depend in a sensitive way on the details of this structure, which then play the role of the "hidden variables." However, these theories are non-linear and it is extremely difficult to obtain any conclusive results. Nonetheless, this possibility cannot be discounted.

Bohm considers it to be a real force field, acting on a particle which always has a well-defined position and momentum (satisfying the Schrödinger equation) but is not pictured as any remnant of analogous electromagnetic field satisfying Maxwell's equations, acting on a particle. The field is in a 3- or 4-dimensional space.
With this interpretation, Bohm succeeds in showing that in all actual cases of observation, the best predictions that can be made are those of the usual theory, so that no experiments could ever rule out his interpretation in favor of the ordinary theory. Our main criticism of this view is on the grounds of simplicity, namely, if one holds the view that it is a real field, the associated particle is superfluous since as we have shown, the wave theory is itself satisfactory.

Wigner or Suigo have developed a theory which is more closely tied to the foundation of quantum mechanics. From the set of all linear, non-degenerate, Hermitian operators, which have complete sets of eigenstates, a subset \( I \) is chosen such that no two members of \( I \) commute, and every element outside \( I \) commutes with at least one element in \( I \).

It is then a maximal sub-base of non-commuting, non-degenerate operators, i.e., it contains precisely one operator for each eigenvalue of the principal axes of the Hilbert space for the system. It is postulated that each of the operators of \( I \) corresponds to an independent observable, which can take any of the real numerical values of the spectrum of the operator. This in turn means that a theory is a theory of infinitely many hidden variables, since a system is pictured as possessing at each instant a definite value for every one of these "hidden" (or "deterministic") variables, with the changes in these values obeying statistical laws. However, the changes of any one of these variables with time depends upon the state of the other variables, so that it is impossible to ever discover by measurement the complete set of values for a system (since only one variable at a time can be observed). Therefore statistical ensembles are introduced, which specify the distribution...
The values of the observables are independently distributed, by means of a measure on a "differential space." It is then shown that the resulting statistical theory is in accord with the usual form of quantum mechanics, in which the values of all of the observables are related to points in a "differential space" which is Hilbert space containing measures to which each differential space coordinate is statistically independent, normally distributed. It is then shown that the resulting statistical dynamics is in accord with the usual form of quantum theory.

Whether or not these theories are appealing, and might conceivably become important should future discoveries indicate serious inadequacies in the present scheme (i.e., the Copenhagen model) might be modified to encompass new experiences. But from our present view it is clear that a number of present cases are unnecessarily more cumbersome to work with than the conceptually simpler theory based on pure wave mechanics. Nevertheless, these theories have great importance simply because they illustrate that "hidden variable" theories are
A stochastic theory which emphasizes the particle rather than wave aspects of quantum theory has been investigated by Dopf.