External and internal wave functions: a form of Double-Solution Theory

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We propose an interpretative framework for quantum mechanics corresponding to the specification of Louis de Broglie's double-solution theory. The principle is to decompose the evolution of a quantum system into two wave functions: an external wave function corresponding to the evolution of its center of mass and an internal wave function corresponding to the evolution of its internal variables in the center-of-mass system. Mathematical decomposition is only possible in certain cases because there are many interactions linking these two parts. In addition, these two wave functions will have different meanings and interpretations.

The external wave function *"pilots"* the center of mass of the quantum system: it corresponds to the Broglie pilot wave. When the Planck constant tends to zero, it results mathematically from the convergence of the square of the module and the phase of the external wave function to a density and a classical action verifying the Hamilton-Jacobi statistical equations. This interpretation explains all the measurement results, namely those yielded by interference, spin measurement (Stern and Gerlach) and non-locality (EPR-B) experiments.

Our interpretation of the internal wave function corresponds to the one proposed by Schrödinger at the Solvay Congress in 1927. For Schrödinger, the particles are extended and the square of the module of the (internal) wave function of an electron corresponds to the density of its charge in space. We show that there are many arguments in favor of this interpretation, which, like the previous one, is deterministic.

We show that this double interpretation makes it possible to reassess the relationships between relativity and quantum mechanics under a new paradigm.