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On the Geometrization of Quantum Mechanics

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Nonrelativistic quantum mechanics is commonly formulated in terms of wavefunctions (probability amplitudes) obeying the static and timedependent Schrödinger equations. Despite the success of this representation of the quantum world, the introduction of a waveparticle dichotomy is required in order to reconcile theory with experiments. The first deterministic (and nonlocal) description of quantum dynamics was introduced by L. de Broglie and D. Bohm. According to this theory, a pilot wave is guiding the time evolution of deterministic particles in configuration space. In this talk, I propose a geometrization of quantum mechanics that describes the time evolution of particles as geodesic lines in a Finsler's space, whose curvature is derived from a homogeneous time-dependent Lagrangian that includes the effect of the nonlocal Bohmian quantum potential. The dynamics is formulated in an extended configuration space of coordinates and velocities while time is risen to the rank of an additional generalized coordinate. This geometrical formulation of quantum mechanics is consistent with quantum measurements and provides an alternative interpretation of quantum mechanics in terms of deterministic trajectories, making the concept of wavefunction collapse (of the Copenhagen interpretation) for the emergence of the classical world superfluous. In addition, in analogy with general relativity, this formulation allows to incorporate all quantum effects into the geometry of space-time opening new possibilities for a unification of the two theories. The geometrical formulation is then applied to the study of the (self) scattering of an electron by a hydrogen atom and a double slit, revealing the role of the phase space curvature in the generation of the interference pattern.

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