Inertial mass, rest mass and the quantum potential:de Broglie's pioneering work on the geometry of conformal rescaling

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Abstract

De Broglie is well known for his pilot wave approach, an approach he later remarked was a mistake because it did not do what he hoped it would achieve. It did not make a sharp separation between the subjective and objective elements that are fused in the wave function. With his double solution, he had hoped to achieve this distinction by attempting what Penrose now calls the 'geometrization of QM'. He already set out the generalisation of QM to relativistic Riemannian geometry, an approach explored by DeWitt who showed that by using the principle of general covariance an extra quality of energy must be added to the quantum Hamiltonian. DeWitt also referred to this extra energy term as the 'quantum potential energy'. Remarkably his paper appeared in the same volume of Physical Review as did Bohm's original hidden variable paper. This geometric approach formed the basis of de Broglie's 'double solution' which has since been developed further by Hiley and Callaghan using Clifford's geometric algebra. This enables the de Broglie-Bohm approach to be generalised to include spin and the Dirac relativistic approach. This opens up a geometric approach to quantum physics.