

Basil J. Hiley

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Basil J. Hiley

University of London, UK

Weak Values, Local Momentum and Tangent Groupoids

The weak value of the momentum operator gives rise to a complex number. The real part can be given a meaning in terms of the Bohm momentum, which is used to calculate streamlines often interpreted as “particle trajectories”. The appearance of an imaginary component throws doubts on this particular interpretation. I will show how the values appear from the difference between left and right translations in a non-commutative symplectic space. Together with some relatively recent mathematical results in non-commutative geometry, this suggests a dynamical geometric interpretation of quantum phenomena in which a ‘particle’ possesses internal degrees of freedom, giving a structure that is very different from that of a classical particle point particle. Nevertheless when the internal structure is neglected, the theory reduces to the usual classical Hamilton—Jacobi theory which is based on a commutative symplectic phase space. I will give an overview of this approach.

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