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Non-Locality and Destructive Interference of Matter Waves

Quantum mechanics with massive particles becomes an important tool for fundamental research and applied science since many previously named “Gedankenexperiments” become feasible. Neutrons are massive particles which couple to gravitational, nuclear and electro-magnetic interactions and they are sensitive to topological effects, as well. Therefore they are proper tools for testing quantum mechanics where several previously named “hidden” parameters become measurable. Widely separated coherent beams can be produced by means of perfect crystal interferometers and they can be influenced individually. Spinor symmetry, spin superposition and quantum beat effect experiments have been performed and topological phases have been observed. Recent experiments related to the decoherence problem have shown that interference effects can be revived even when the overall interference pattern seems to be incoherent. Related post-selection experiments shed a new light on questions of quantum non-locality and support the request for more complete quantum measurements in future. A more rational explanation of non-locality effects may be obtained when the plane wave components outside the wave packets are included into the discussion. This can also help to discuss entanglement and contextuality effect in a new light. In all quantum experiments more information can be extracted by more complete quantum experiments which will be important in future to get a better understanding of quantum physics. An example may be the consideration of the Compton frequency and of the proper time effect of matter waves.

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