Quantum phenomena observed by neutron interferometry

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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 a proper tool for testing many interesting consequences of quantum mechanics. Widely separated coherent beams can be produced and influenced inside perfect crystal interferometers. Spinor symmetry and spin superposition experiments have been performed on a macroscopic and fundamental level [1]. Recent experiments have shown that interference effects have to be discussed in phase space rather than in ordinary space only. Interference effects can disappear in ordinary space but can be revived in complementary spaces. 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. This also opens new possibilities for quantum state reconstruction and quantum state engineering experiments. In this connection typical Schrödinger cat-like states have been identified and their sensitivity against any kind of fluctuations and dissipative effects has been investigated. Recent verifications of a confinement induced matter wave phases, the measurement of topological phases and a proof of quantum contextuality will be discussed.

[1] H.Rauch, S.A.Werner, "Neutron Interferometry", Clarendon Press, Oxford 2000