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back to namelist

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Multipath Interference Tests of Quantum Mechanics

Quantum mechanics can be considered a special case of the class generalized probabilistic physical theories. One way of classifying general probabilistic theories is to look at how they deviate from classical probabilistic theories based on classical ensembles, distributions and random variables. Quantum mechanics, for example, deviates because it derives probabilities from wavefunctions and thus exhibits interference. By virtue of Born's rule, all interference terms stem from pairs of paths. Other probabilistic theories could go beyond that [1] and allow higher-order interference terms, thus violating Born's rule.
Using multipath interferometers [2,3] our bound on the deviation from ordinary quantum interference is approaching 10-5 , with a good part of the uncertainty originating from our limited accuracy in determining detector nonlinearity [4].
We also use our multipath interferometers to test for the generalization of quantum mechanics in terms of the underlying numbers, i.e. whether hypercomplex quantum mechanics is allowed or not [5]. Waveguide interferometers with integrated shutters are approaching the required high interference visibilities.
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