Testing the Linearity of Quantum Mechanics

Mark Polkovnikov

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Abstract

The angular momentum, also called spin, of a particle is quantized. For macroscopic objects, this does not contradict the approximation of angular momentum being continuous. However, for a particle such as the electron a measurement of spin along any given axis can only yield two outcomes, often called "spin up" and "spin down". This happens regardless of the initial superposition (sum) of spin states of the electron before measurement. Particularly, an electron whose initial spin state is orthogonal (perpendicular) to both spin up and spin down states will have a 1/2 probability associated to either measurement outcome. One wonders whether the initial spin state truly "collapses", not depending on its history, or if an interaction between the two spin states remains after the measurement. To test this theory, a measurable action was tied to either measurement outcome. Specifically, a voltage was turned to high or 0 based on the outcome of each spin measurement. Should the above described interaction exist, one should be able to measure it over a long period of time. To 10^{-10} sensitivity, we did not find such an interaction.