

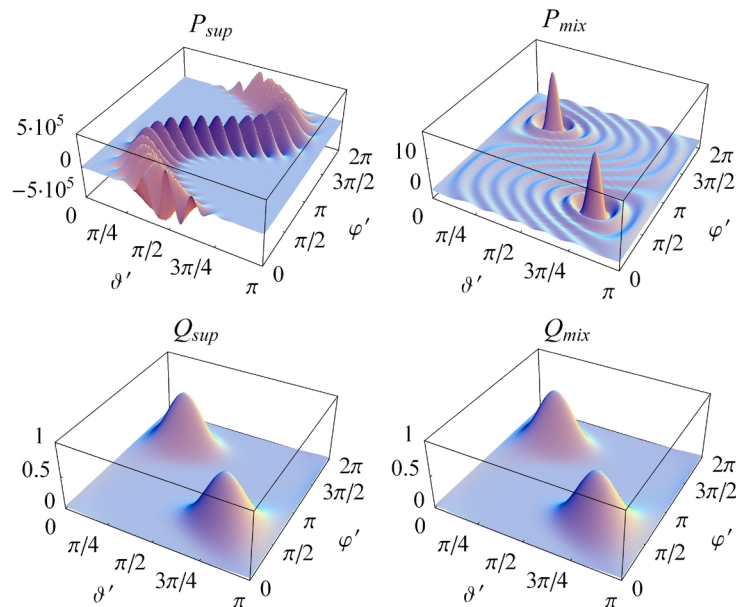
Violation of macroscopic realism in every-day life?

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The laws of physics are of quantum nature and microscopic systems cannot be described classically. But the macroscopic objects around us seem to have objective properties prior to and independent of measurement which can be inferred without altering them. Is it possible to experience a violation of this *macroscopic realism* in every-day life?

Under realistic conditions we are only able to perform *coarse-grained measurements* that do not resolve individual quantum levels of a macroscopic object. We show that this usually allows a realistic description of the object's dynamics: At every instant of time the quantum state – even if it is a macroscopic Schrödinger cat-like superposition – appears as a classical mixture and the time evolution of this mixture can be explained classically.

However, we demonstrate that there exist *non-classical* time evolutions which allow to see a violation of macroscopic realism even under classical coarse-grained measurements. The question why we then do not see such violations arises again. We finally suggest that the reason for this is that non-classical time evolutions are of high *computational complexity*. Figuratively, this means that if nature spontaneously “chooses” a time evolution, it is much more likely that a low complex, i.e. a classical, time evolution is realized and thus our every-day world appears classical under coarse-grained measurements.



The two graphs on the top show the quantum states of a Schrödinger cat-like superposition of a spin pointing to the north and to the south (left) and a classical fifty-fifty mixture in which half of the spins is along north and the other half is along south (right). Under every-day coarse-grained measurements both states have the same classical description in terms of a fifty-fifty probability distribution (bottom left and right). However, there exist non-classical time evolutions producing time-dependent superposition states that allow to violate macroscopic realism even under coarse-grained measurements.