Frequent Observations Accelerate Decay: The anti-Zeno Effect

A. G. Kofman and G. Kurizki

Department of Chemical Physics, Weizmann Institute of Science, 76100 Rehovot, Israel

Reprint requests to Prof. G. Ku.; E-mail: Gershon.Kurizki@weizman.ac.il

Z. Naturforsch. **56 a,** 83–90 (2001); received February 6, 2001

Presented at the 3rd Workshop on Mysteries, Puzzles and Paradoxes in Quantum Mechanics, Gargnano, Italy, September 17 - 23, 2000.

The quantum Zeno effect (QZE) is the striking prediction that the decay of *any* unstable quantum state can be inhibited by sufficiently frequent observations (measurements). The consensus opinion has upheld the QZE as a *general* feature of quantum mechanics which should lead to the inhibition of *any* decay. The claim of QZE generality hinges on the assumption that successive observations can in principle be made at time intervals too short for the system to change appreciably. However, this assumption and the generality of the QZE have scarcely been investigated thus far. We have addressed these issues by showing that (i) the QZE is principally unattainable in radiative or radioactive decay, because the required measurement rates would cause the system to disintegrate; (ii) decay *acceleration* by frequent measurements (the anti-Zeno effect – AZE) is much more ubiquitous than its inhibition. The AZE is shown to be observable as the enhancement of tunneling rates (e. g., for atoms trapped in ramped-up potentials or in current-swept Josephson junctions), fluorescence rates (e. g., for Rydberg atoms perturbed by noisy optical fields) and photon depolarization rates (in randomly modulated Pockels cells).

Key words: Quantum Decay; Quantum Measurements; Zeno-Effect; anti-Zeno-Effect; Quantum Tunneling.