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Wavepacket Collapse, Amplification, and Actionable Information

WOJCIECH ZUREK, Los Alamos — An unknown state of a single quantum system cannot be discovered, as it is re-prepared; the system jumps into an eigenstate of the measured observable. As was recently demonstrated [1], this and other symptoms of the wave-packet collapse follow for pure states from unitarity (that does not, of course, allow for a literal collapse) and from repeatability of measurements: Together they impose discreteness underlying quantum jumps. We consider macroscopic, open system (e.g., an apparatus). Its microstates can change when copied/measured, provided coarse-grained macrostate still represent the same measurement record. We show that such repeatably accessible macrostates (e.g. of an apparatus pointer) correspond to orthogonal subspaces [2]. This symmetry breaking yields the discreteness that underlies quantum jumps. It emerges from the core quantum postulates plus repeatability (prerequisite for amplification) in macroscopic, open quantum systems including measuring devices, where (in contrast to microsystems) repeatability is paramount.

[1] WHZ, Quantum origin of quantum jumps ... PRA 76, 052110 (2007), arXiv:quant-ph/0703160
[2] WHZ, Wave-packet collapse ... and actionable information PRA 87, 052111 (2013), arXiv:1212.3245

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