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Quantum measurements from the second law of thermodynamics

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The measurement postulate of quantum theory stands in conflict with the laws of thermodynamics and has evoked debate regarding what actually constitutes a measurement. With the help of modern quantum statistical mechanics, we take some first steps in formalising the hypothesis that quantum measurements are driven by the natural tendency of closed systems to maximize entropy. In this paradigm, we investigate how objective measurement outcomes can emerge within a purely unitary framework, and find that: (i) the interactions used in standard measurement models fail to spontaneously feature emergent objectivity and (ii) while ideal projective measurements are impossible, we can (for a given form of Hamiltonian) approximate them exponentially well as we collect more physical systems together into an "observer" system. We thus lay the groundwork for self-contained models of quantum measurement, proposing improvements to our simple scheme.

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