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**Quantum Chaos and Entanglement in Atomic Spin Systems**

POUL JESSEN, University of Arizona

Chaotic behavior is widespread in nature and plays a role in many scientific disciplines. In classical physics, chaos is characterized by hypersensitivity of the evolution to initial conditions (the "butterfly effect"). Remarkably, this definition is fundamentally at odds with quantum mechanics, in part due to the uncertainty principle and in part due to the Schrödinger equation which preserves the overlap between quantum states. This disconnect has motivated a longstanding search for quantum signatures of chaos, including dynamical signatures such as the generation of entropy and entanglement. I will discuss an experiment [1] in which we realize a common paradigm for quantum chaos - the quantum kicked top - and observe its behavior directly in quantum phase space. Our system is based on the combined electronic and nuclear spin of a single Cs atom and is therefore deep in the quantum regime. We nevertheless find good correspondence between the quantum dynamics and classical phase space structures, and obtain the first experimental evidence for dynamical entanglement as a signature of chaos.

[1] "Quantum signatures of chaos in a kicked top", S. Chaudhury et al., Nature Vol. 461, 768 (2009).