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### **Bell and Beyond: Exploring the Limits of Nonlocality**

PAUL KWIAT, University of Illinois at Urbana-Champaign

Today, nonlocality is considered a fundamental aspect of quantum mechanics. While a full loophole-free Bell test has not yet been completed, recent experiments closing the detection loophole with photons have shown that this landmark experiment is close to being realized. In addition to showing quantum mechanics is nonlocal, Bell tests can address future theories beyond quantum mechanics. For example, the chained Bell inequality can be used to limit the predictive strength of any future theory limited only by causality. In this talk, we will describe our high-quality photon entanglement source that we used to experimentally close the detection loophole, and discuss the subtleties of potential additional loopholes. In addition, we have used our source to probe the nonlocal aspects of quantum mechanics, and theories beyond quantum mechanics, by performing a plethora of unique Bell tests. We use these tests to show that entanglement and nonlocality are different resources, that no causal theory can have predictive power greater than  $57 \pm 0.05\%$ , and that quantum mechanics must have a complex phase.