

Abstract Submitted
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Localizing and observing Kochen-Specker quantum contextuality using weak measurements.¹ MORDECAI WAEGELL, JEFF TOLLAKSEN, Institute for Quantum Studies, Chapman University, YUJI HASEGAWA, STEPHAN SPONAR, TOBIAS DENKMAYR, HERMANN GEPPERT, Atominstut, TU-Wien, INSTITUTE FOR QUANTUM STUDIES COLLABORATION, RESEARCH GROUP OF DR. YUJI HASEGAWA COLLABORATION — Experimental tests of the Kochen-Specker (KS) theorem conventionally require a set of different measurement settings, and the test can furthermore be applied to an arbitrary prepared state. These experiments show that nature is contextual, but they do not indicate which specific observables must behave nonclassically. We show that, using pre- and post-selected states from within a set of projectors that prove the KS theorem, it is possible to identify another specific projector in the set that behaves nonclassically, in this case because it has an anomalous weak value. We explore specific KS sets that gives rise to the Quantum Pigeonhole Effect (QPE), and use weak measurements on a large ensemble of identically pre- and post-selected neutrons to verify the QPE, and also to measure the anomalous weak value of the nonclassical projector. We construct a new contextuality inequality based on the recent result of Pusey showing that any projector with a negative weak value is a proof of contextuality, and show that our measured weak value is many standard deviations below zero.

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Mordecai Waegell
Chapman Univ

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