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Experimental non-classicality of an indivisible system RADEK LAPKIEWICZ, PEIZHE LI, CHRISTOPH SCHAEFF, NATHAN LANGFORD, SVEN RAMELOW, MARCIN WIESNIAK, ANTON ZEILINGER, Institute for Experimental Physics, University of Vienna; Institute for Quantum Optics and Quantum Information, Austrian Academy of Sciences — In Quantum Mechanics, in contrast to other physical theories, not all properties can be measured simultaneously (the Heisenberg Uncertainty Principle is a manifestation of this fact). An interesting question arises as to whether there can be a joint probability distribution describing the outcomes of all possible measurements, allowing a quantum system to be mimicked by classical means. We show the first experimental evidence that even for a single three-level quantum system no such classical model can exist that correctly describes the results of a simple set of measurements as suggested by Klyachko et al. [PRL 101, 020403 (2008)]. This is the most simple system where such a contradiction is possible. It is also indivisible and as such cannot contain entanglement. Our result sheds new light on the conflict between quantum and classical physics and provides insight into the limitations of simulating quantum systems using, hidden or not, classical information.

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