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Robust Weak Measurements JEFF TOLLAKSEN, George Mason University, YAKIR AHARONOV, George Mason University, University of S. Carolina, and Tel Aviv University — We introduce a new type of weak measurement which yields a quantum average of weak values that is robust, outside the range of eigenvalues, extends the valid regime for weak measurements, and for which the probability of obtaining the pre- and post-selected ensemble is not exponentially rare. This result extends the applicability of weak values, shifts the statistical interpretation previously attributed to weak values and suggests that the weak value is a property of every pre- and post-selected ensemble. We then apply this new weak measurement to Hardy's paradox. Usually the paradox is dismissed on grounds of counterfactuality, i.e., because the paradoxical effects appear only when one considers results of experiments which do not actually take place. We suggest a new set of measurements in connection with Hardy's scheme, and show that when they are actually performed, they yield strange and surprising outcomes. More generally, we claim that counterfactual paradoxes point to a deeper structure inherent to quantum mechanics characterized by weak values (Aharonov Y, Botero A, Popescu S, Reznik B, Tollaksen J, Physics Letters A, 301 (3-4): 130-138, 2002).

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