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Probing quantumness with joint continuous measurements of non-commuting qubit observables LUIS PEDRO GARCIA-PINTOS, JUSTIN DRESSEL, Chapman University — In this talk we consider continuous weak measurements as a means to probe foundational issues in quantum mechanics. We consider the simultaneous monitoring of two noncommuting observables—as recently implemented by the Siddiqi group at UC Berkeley. Contrary to naive expectation, the output of such experiment can be used to simultaneously track the approximate observable dynamics. Despite this seeming realism, we also show that the readouts violate macrorealistic Leggett-Garg inequalities for arbitrarily short temporal correlations, and that the derived inequalities are manifestly violated even in the absence of Hamiltonian evolution. Such violations should indicate the failure of at least one postulate of macrorealism: either physical quantities do not have well defined values at all times, or the measurement process itself disturbs what is being measured. Despite this macrorealism violation, we construct a realistic, but epistemically restricted, model that perfectly emulates both the qubit evolution and the observed noisy signals, thus also emulating the violations.

Luis Pedro Garcia-Pintos
Chapman University

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