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Quantum Phase Transitions detected by a local probe using Time Correlations and Violations of Leggett-Garg Inequalities FERNANDO GOMEZ, Universidad de los Andes, JUAN MENDOZA, University of Oxford, FERNEY RODRGUEZ, Universidad de los Andes, CARLOS TEJEDOR, Universidad Autnoma de Madrid, LUIS QUIROGA, Universidad de los Andes — We introduce a new way of identifying quantum phase transitions of many-body systems by means of local time correlations and Leggett-Garg inequalities. This procedure allows to experimentally determine the quantum critical points not only of finite-order transitions but also those of infinite-order as the Kosterlitz-Thouless transition that is not always easy to detect with current methods. By means of an analytical calculation on a general spin-1/2 Hamiltonian, and matrix product simulations of one-dimensional XXZ and anisotropic XY models, we argue that finite-order quantum phase transitions can be determined by singularities of the time correlations or their derivatives at criticality. The same features are exhibited by corresponding Leggett-Garg functions, which remarkably indicate violation of the Leggett-Garg inequalities for early times and all the Hamiltonian parameters considered. In addition, we find that the infinite-order transition of the XXZ model at the isotropic point can be revealed by the maximal violation of the Leggett-Garg inequalities.

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