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Random quantum correlations are generically non-classical

Two observers performing binary outcome measurements on subsystems of a global system may obtain more strongly correlated results when they have a shared entangled quantum state than when they only have shared randomness. This well-known phenomenon of Bell inequality violation can be precisely characterized mathematically. Indeed, being a classical or a quantum correlation matrix exactly corresponds to being in the unit ball of some tensor norms. In the talk, I will start with explaining all this in details. I will then look at the following problem: given a random matrix of size n, can one estimate the typical value of its "classical" and "quantum" norms, as n becomes large? For a wide class of random matrices, the answer is yes, and shows a gap between the two values. This result may be interpreted as follows: correlations sampled at random close enough to the border of the quantum set are typically intrinsically quantum (i.e. outside the classical set). On the technical side, the ingredients needed to establish such result include: tensor norms on Banach spaces, random matrix theory, concentration of measure in high dimension... But no prerequisite on any of these topics will be necessary to understand the talk. (Based on joint work with C. Gonzalez-Guillen, C. Palazuelos, I. Villanueva.)