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Elliptopes and Polyhedra: Quantum Correlations and Their Classical Simulations

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I use correlation arrays, the workhorse of Bub's Bananaworld, to analyze the correlations found in an experimental setup due to Mermin for measurements on the singlet state of a pair of spin-1/2 particles. Adopting an approach pioneered by Pitowsky and promoted in Bananaworld, I show that the class of correlations allowed by quantum mechanics in this setup can be represented geometrically as an elliptope in a non-signaling cube. I then introduce special raffles to determine which of these quantum correlations are allowed by local hidden-variable theories. The subclass of the quantum correlations that can be simulated in this way can be represented geometrically by a tetrahedron inscribed within the elliptope. I extend this analysis to the singlet state of two particles with higher spin. The class of correlations allowed by quantum mechanics in this case is still represented by the elliptope; the subclass of those whose main features I can simulate with my raffles can be represented by polyhedra that, with increasing spin, take up more and more of the volume of the elliptope. The elliptope is thus a general constraint on correlations of the kind studied in this Mermin setup, a result which predates quantum mechanics and was already recognized by the statistician Yule in 1896.