Non-local games: Tsirelson problem and its resolution by MIP*=RE.

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Abstract

Non-local games are defined by the input set of questions for Alice and Bob, the output set of answers and the predicate of the game. Alice and Bob know the rules, they are not allowed to communicate during the game but they may agree on a joint strategy beforehand. The strategies are described by the probability distributions of their answers conditioned by the input questions and they form an increasing tower of convex sets that begins with local strategies (that use only classical physics), continues with quantum strategies (that may use quantum mechanics), proceeds with approximately quantum strategies and ends up with quantum commuting strategies (that may use quantum fields theory).

In my talk I will survey the results that show the tower of strategies is strictly increasing. In particular, I will mention the result which shows that the set of quantum commuting strategies is strictly larger than the set of approximately quantum strategies. The latter strict containment answers Tsirelson's question and solves its equivalent Connes embedding problem (open for 40 years), both being a consequence of the result in quantum complexity theory stated as the equality MIP*=RE and proved by Ji-Natarajan-Vidick-Wright-Yuen paper which I will attempt to (roughly) explain in my talk.

If time permits I will briefly comment on our joint work with A. Bochniak and P. Sołtan in which we propose the framework of non-local games with quantum spaces of questions and answers and I will attempt to motivate such development invoking still unsolved mysteries related to Tsirelson's problem.