# Review of: "Computational substantial violation of the CHSH with close approximation of the respective quantum values"

Yuan Yao[1]

1 Cornell University

Potential competing interests: No potential competing interests to declare.

In this paper, the author provides a numerical test of the CHSH inequality in the famous Bell experiment setting. With numerical simulation, the author claims that CHSH inequality can be violated substantially and its value can come close to the quantum mechanical limit even when using a model containing local hidden variables.

Here are my comments:

The presentation in Section 2 can be improved. The author did not provide sufficient motivation for using the Glauber-Sundarshan (GS) representation and it's unclear how the various expressions presented thereof are related to the original CHSH expression. In particular, what about GS that necessitates its use here and whether the claimed violation results from particular properties of GS. Without sufficient explanation, the setup of the simulation gets unnecessarily complicated and obscures the real issue, which I'll get to in the next.

More generally, I do not think numerical sampling is really the right program for rejecting Bell's theorem. In fact, the proper statistical framework for making progress in this direction is hypothesis testing. One needs to set up the question like this:

$H_0$: local hidden variable models obey CHSH inequality.

$H_1$: local hidden variable models violates CHSH inequality.

And the best conclusion one can draw from numerical experiments is something like this: “At significance level x, we reject the null hypothesis”.

In fact, one can show with concentration inequalities that for small sample sizes, such as presented here, the probability for violation is still substantial (see, eg, Eq 3 in https://arxiv.org/abs/1207.5103).

There are a number of statements in the paper that are not sufficiently substantiated. For example the author mentions tunnelling: “As a caution, we now know that quantum particles can tunnel through a finite potential. That doesn't make face value sense either.” What is the author's intention of bringing up tunneling? What does it have to do with CHSH violation?