Dear Editors,

Please find enclosed our article "Comparing continuous and discrete Wigner approximations for spin dynamics" which we would like to submit for your consideration to publish in Physical Review A.

Accurate numerical tools are urgently needed to simulate the dynamics of quantum matter. However, evaluating the accuracy of results obtained from these tools is difficult even for dynamics of spin models, which are some of the most ubiquitously measured dynamics in experiments, due to the number and complexity of correlations.

In our article, we compare the results of spin model dynamics obtained from the continuous and discrete truncated Wigner approximation (TWA and dTWA respectively) with exact analytical and numerical solutions. By comparing all components of the spin-spin correlations on an equal footing via geometric visualization tools recently introduced in the literature, we provide insights into the nature of Wigner approximations, and show that the comparison of TWA and dTWA is nuanced. Specifically, Wigner approximations often capture the development of spin correlations only along two out of three orthogonal directions, and completely miss the correlations along the third. We also find that in some conditions, TWA better captures the directions in which spins have correlations. Our work paves the way to better enable researchers to choose the approximations that are most suited to capture the features they are interested in.

We thank you for your consideration. We think suitable referees for our paper include Michael Kastner, Johannes Schachenmayer, Asier Pineiro-Orioli, Arghavan Safavi-Naini, Thomas Gasenzer, Martin Gärttner, and Anatoli Polkovnikov.

Sincerely,

Bhuvanesh Sundar,
Kenneth C. Wang,
Kaden R. A. Hazzard