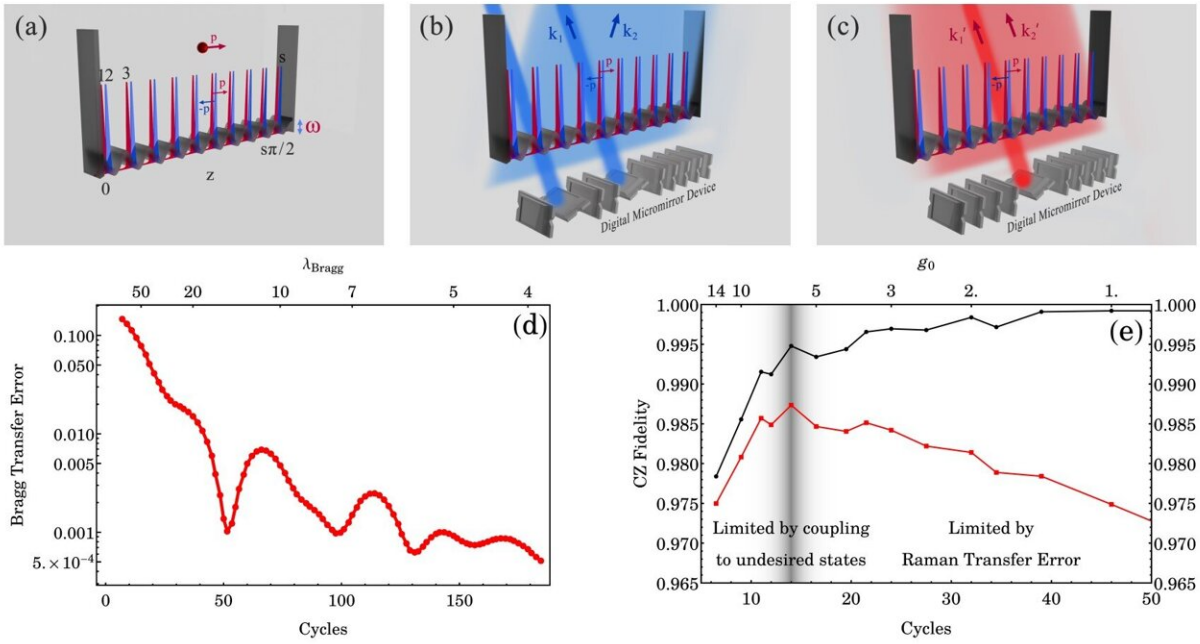
Physicists propose time crystal-based circuit board to reduce quantum computing errors

June 21 2024, by Bob Yirka



Credit: *arXiv* (2024). DOI: 10.48550/arxiv.2406.06387

A trio of physicists, two with Uniwersytet Jagielloński in Poland and one with Swinburne University of Technology in Australia, are proposing the use of temporal printed circuit boards made using time crystals as a way to solve error problems on quantum computers. Krzysztof Giergiel, Krzysztof Sacha and Peter Hannaford have written a paper describing their ideas, which is currently available on the *arXiv* preprint server.

Quantum computers promise to revolutionize computing—unfortunately, they are still in their infancy, and no one has yet been able to build one that could be used in a truly meaningful way. Efforts to build the desired types have been stymied by various hurdles, most of which are deemed likely solvable. However, one major hurdle that worries researchers is the enormous number of errors that are generated on such computers along with the good results.

Errors on quantum computers happen when qubits interact while running calculations. Such interactions lead to the degradation of their quantum states and the information they hold. In this new effort, the research trio has developed an idea that would allow the qubits to work together in a way that prevents their interactions from leading to degradation.

The idea proposed by the team involves creating what they describe as a temporal circuit board—it would be made using ultracold atoms that move around in repeating patterns similar in form to those seen with normal crystals, forming what the researchers describe as time crystals.

They suggest that under such a scenario, the qubits would remain spread out as they reside in a quantum computer and always in motion, allowing them to cross paths with other qubits and interact with them in ways that would not lead to degradation. Such a design, they note, would also allow distant qubits to interact in ways that are not possible with current designs—and that, they suggest, would allow for more complex processing options.

The research trio has not yet built such a computer but claims they are working on one that will be based on the use of ultracold potassium to make the time crystals.

More information: Krzysztof Giergiel et al, Time-tronics: from temporal printed circuit board to quantum computer, *arXiv* (2024). DOI:

10.48550/arxiv.2406.06387