

# High-dimensional Bell violation up to 10 qubits on superconducting processors

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**Teemu Ojanen**

Yousef Mafi

Ali G. Moghaddam

*Tampere University, P.O. Box 692, FI-33014,  
Tampere, Finland*

[teemu.ojanen@tuni.fi](mailto:teemu.ojanen@tuni.fi)

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## Abstract

Quantum computers can be employed to probe fundamental physics, and conversely, fundamental properties of nature can be used to benchmark performance of quantum hardware. By using recent progress in minimizing the circuit depth of Fourier transform by measurement-conditioned feedforward, we prepare multiqubit states which exhibits Bell violation for systems up to 10 qubits [1]. Specifically, we consider CGLMP inequality and show that multiqubit systems exhibit robust violation of the classical bound. This constitutes presently the highest dimensional demonstration of Bell non-locality in physical systems. Moreover, we show that all the qubits in the system contributes to non-locality, which cannot be reduced to pairwise Bell violations. The proposed protocol can be employed as a device independent certification of multiqubit quantumness and the hardware performance.

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## References

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- [1] Y. Mafi, A. G. Moghaddam, T. Ojanen, in preparation