nature portfolio

Peer Review File

Native qudit entanglement in a trapped ion quantum processor

Editorial Note: This manuscript has been previously reviewed at another journal that is not operating a transparent peer review scheme. This document only contains reviewer comments and rebuttal letters for versions considered at *Nature Communications*.

REVIEWERS' COMMENTS

Reviewer #1 (Remarks to the Author):

I read the revised manuscript and the authors' reply, and I believe the authors have satisfactorily addressed the previous comments. With the transfer, I can recommend its publication in Nature Communications.

Reviewer #2 (Remarks to the Author):

The authors have carefully and thoroughly responded to comments from both reviews given for their earlier submission, and revised the manuscript accordingly. I have no further comments on the manuscript.

The paper extends previous control of qudits to demonstrate two-qudit entanglement that generates entanglement between >2 states in each qudit, and this is a significant achievement. The paper includes appropriate information and references to assess the significance of such techniques for quantum computation/simulation, and I recommend publication in Nature Communications.