Supplementary Information for "Scalable Unitary Computing using Time-Parallelized Photonic Lattices"

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Note S1. Fidelity analysis on system size

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Figure S1 shows the scaling behaviours of errors ε with respect to N for different origins of system defects: resonance (Fig. S1a) and lifetime (Fig. S1b) perturbations, resonator radiation loss (Fig. S1c), and the altered zero-field condition of loop couplers (Fig. S1d). We observe scaling behaviours well approximated by power-law fitting (dashed lines in Fig. S1a-d). Notably, the synchronization scheme consistently yields superior fidelity as compared to the serial implementation.

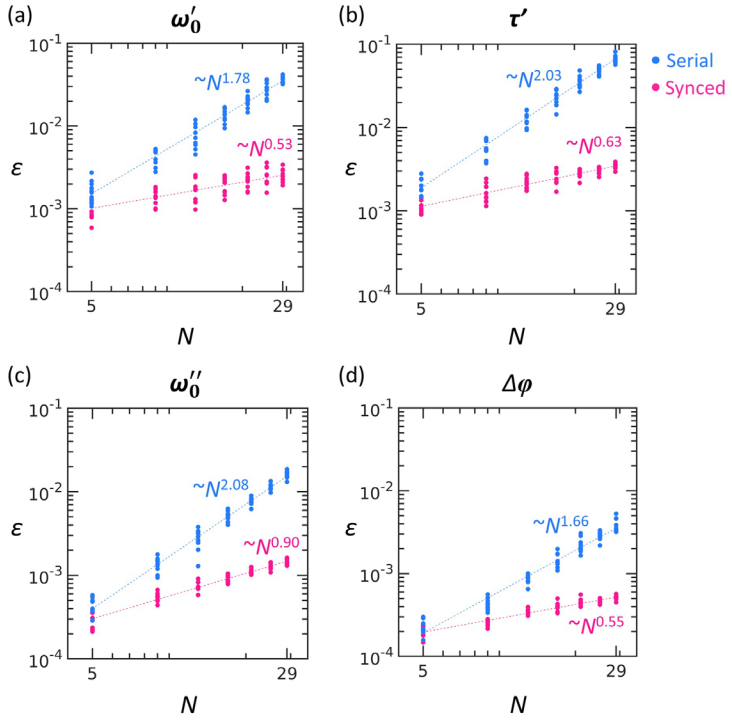

Fig. S1. Fidelity scaling. (a-d) Scaling of errors with respect to the system size N: (a) resonance fluctuations with $\sigma = 10^{-7}$, (b) lifetime fluctuations with $\sigma = 10^{-3}$, (c) resonator radiation loss with $\sigma = 10^{-8}$, and (d) phase-shift defects in loop couplers with $\sigma = 10^{-5}$. At each N, we examine 10 realizations of random Haar matrices. Dashed lines denote the power-law fitting. All the other parameters are the same as those in Fig. 4 in the main text.