

Entangling remote qubits through a two-mode squeezed reservoir

A. Andrés-Juanes^{*1}, **J. Agustí**^{2,3,4,5}, **R. Sett**¹, **E. S. Redchenko**¹, **L. Kapoor**¹,
S. Hawaldar¹, **P. Rabl**^{2,3,4}, **J. M. Fink**¹

1. Institute of Science and Technology Austria (ISTA), Am Campus 1, 3400 Klosterneuburg, Austria

2. Technical University of Munich, TUM School of Natural Sciences, Physics Department, 85748 Garching, Germany

3. Walther-Meiner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany

4. Munich Center for Quantum Science and Technology (MCQST), 80799 Munich, Germany

5. Institute of Fundamental Physics IFF-CSIC, Calle Serrano 113b, 28006 Madrid, Spain

The distribution of entanglement across distant qubits is a central challenge for the operation of scalable quantum computers and large-scale quantum networks. Existing approaches rely on deterministic state transfer schemes or probabilistic protocols that require active control or measurement and postselection. Here we demonstrate an alternative, fully autonomous process, where two remote qubits are entangled through their coupling to a quantum-correlated photonic reservoir. In our experiment, a Josephson parametric converter produces a Gaussian, continuous-variable entangled state of propagating microwave fields that drives two spatially separated superconducting transmon qubits into a stationary, discrete-variable entangled state. Beyond entanglement distribution, we also show that superconducting qubits can be used to directly certify two-mode squeezing, with higher sensitivity and without the need for calibrated noise-subtraction. These results establish networks of qubits interfaced with distributed continuous-variable entangled states as a powerful new platform for both foundational studies and quantum-technology relevant applications.

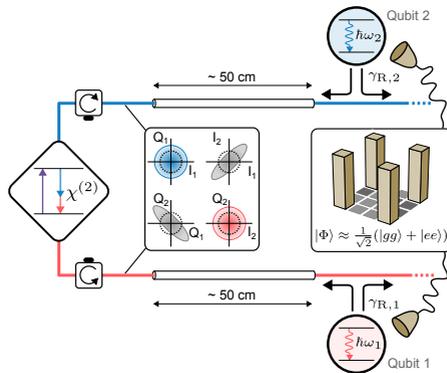


Fig. 1: Schematic of the entanglement protocol.

*Alejandro.AndresJuanes@ist.ac.at