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Universal Linear Optics: A Testbed for Optical Quantum Logic CHRIS SPARROW, Centre for Quantum Photonics, University of Bristol, UK and Department of Physics, Imperial College London, UK, JACQUES CAROLAN, CHRISTOPHER HARROLD, NICHOLAS RUSSELL, GRAHAM MARSHALL, JOSHUA SILVERSTONE, MARK THOMPSON, JONATHAN MATTHEWS, JEREMY O'BRIEN, ANTHONY LAING, Centre for Quantum Photonics, University of Bristol, UK, ENRIQUE MARTIN-LOPEZ, Nokia Technologies, Cambridge, UK, PETER SHADBOLT, Department of Physics, Imperial College London, UK, NOBUYUKI MATSUDA, NTT Basic Research Laboratories, NTT Corporation, Japan, MANABU OGUMA, MIKITAKA ITOH, TOSHIKAZU HASHIMOTO, NTT Device Technology Laboratories, NTT Corporation, Japan — Linear optics is a promising platform for scalable quantum information processing. We demonstrate a single reprogrammable optical circuit that is sufficient to implement all possible linear optical protocols up the size of the circuit [Carolan et al., Science, 349, (2015)]. The system is an ideal testbed for rapidly prototyping new linear optical quantum gates, and testing known protocols in experimentally realistic scenarios. We use the device to perform a series of postselected and heralded quantum logic gates including a new scheme for heralded bell state generation, a key primitive in measurement-based linear optical quantum computation. We propose and demonstrate techniques for efficiently and accurately characterising and verifying these gates operation. The ability to rapidly reprogram linear optical devices promises to replace a multitude of existing and future prototype systems, pointing the way to applications across quantum technologies.

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