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Direct characterization of any linear photonic device ALESSANDRO FEDRIZZI, MATTHEW BROOME, ANDREW WHITE, ARC Centre for Engineered Quantum Systems, School of Mathematics and Physics, University of Queensland, Brisbane, Australia, ROBERT FICKLER, University of Vienna, Boltzmanngasse 5, Vienna, A-1090 Austria, SALEH RAHIMI-KESHARI, TIMOTHY RALPH, ARC Centre for Quantum Computer and Communication Technology, School of Mathematics and Physics, University of Queensland, Brisbane, Australia
— Linear photonic devices comprised of simple beamsplitters and phase shifters can implement any unitary operator for quantum information processing. The significant practical challenge is to characterize such an interferometric device once it is built. Performing quantum process tomography requires the full suite of quantum tools such as N-mode quantum state preparation and measurement, and is, despite progress on more efficient methods, slow and impractical for large interferometric devices. Here we introduce a simple technique to characterize the unitary matrix of a linear photonic device using standard laser sources and photodetectors, without the requirement for active locking or single-photon sources. Our method is precise and efficient, requiring only 2N-1 measurement configurations for a N-path network. We use it experimentally to characterise an integrated 3x3 fused-fibre coupler and highlight its precision by comparing measured quantum interference patterns with those predicted using the classically-estimated unitary. We observe excellent agreement between the two experimental methods.

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