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# Quantitative measurements of the purity and dimensionality of high dimensional entagled states

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Quantum information processing beyond the traditional 2-dimensional qubit states has recently become topical, benefiting numerous applications such as quantum computing, quantum ghost imaging, quantum cryptography and quantum teleportation with high information capacities. The need to accurately characterize key performance parameters, such as the dimensionality of the encoding basis or the purity of an entangled state, is an essential step towards deploying any quantum protocol that uses high dimensional entanglement as a resource. Quantum state tomography takes far too long as the measurements scale to the fourth power with increasing dimensions while a simple spectral decomposition is not sufficient to confirm entanglement. Here, we present a simple to implement approach that scales linearly with dimensions and returns the purity and dimensionality of a quantum state accurately. In our approach a set of conditional measurements return visibilities that can be used in a simple fitting procedure to infer the purity and dimensions of the system. Our technique advances the toolbox for accurate characterisation of entangled quantum states. We demonstrate the technique in the orbital angular momentum and pixel (coordinate) basis using photons generated from spontaneous parametric down conversion.

## Apply to be considered for a student ; award (Yes / No)?

Yes

## Level for award;(Hons, MSc, PhD, N/A)?

PhD

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