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# Delayed measure quantum eraser with orbital angular momentum

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Wave-particle duality is one of the most intriguing features of quantum mechanics that has been traditionally investigated through modern variations of Young's double slit experiment. When the paths of the double slit are marked with orthogonal polarisations of light, the path information is revealed and no interference pattern is observed. However, the interference can be erased with a complimentary analysis of the polarisation. Here we generalise the concept of path, showing that it need not be physical but can be abstract and employ another degree of freedom (DoF). Alternatively, we replace the paths with the orbital angular momentum (OAM) DoF and use polarisation as the marker. Then, the interference fringes due to OAM interference are observed in the azimuthal direction with a frequency proportional to the amount of OAM carried by the photon. We show this by generating hybrid entanglement between polarisation and OAM. First, we generate OAM entanglement using spontaneous parametric down conversion where a high frequency photon is absorbed by a non-linear crystal and produces two correlated lower frequency photons. Then we employ geometric phase control to convert the OAM of a twin photon to polarisation. Finally, we show that just as in Young's double slit, it is possible to distinguish and erase the OAM of a twin photon through polarisation control of its twin. In addition we also perform the experiment in a delayed measure scheme where the polarisation measurement is performed after the interference is analysed.

## Apply to be<br> considered for a student <br>   award (Yes / No)?

Yes

## Level for award<br> (Hons, MSc, <br>   PhD, N/A)?

MSc

## Main supervisor (name and email)<br>and his / her institution

Andrew Forbes
andrew.forbes@wits.ac.za
University of Witwatersrand

## Would you like to <br> submit a short paper <br> for the Conference <br> Proceedings (Yes / No)?

No

**Primary author:** Mr NAPE, Isaac (Structured Light Lab, School of Physics, University of Witwatersrand)

**Co-authors:** Prof. FORBES, Andrew (University of Witwatersrand); Mr NDAGANO, Bienvenu (University of the Witwatersrand)

**Presenter:** Mr NAPE, Isaac (Structured Light Lab, School of Physics, University of Witwatersrand)

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