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Breaking the intra-cavity degeneracy of vortex modes

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**Abstract content
 (Max 300 words)
Formatting &
Special chars**

We investigate an intra-cavity approach for the realisation of arbitrary orbital angular momentum (OAM) mode selection of opposite handedness by implementing a technique of spin angular momentum (SAM) to OAM coupling through a q-plate. It is well known that the spatial intensity distribution of laser modes with opposite handedness (such as +1 and -1) in their helicoidal wavefronts are indistinguishable and in the context of a laser cavity they also possess identical intra-cavity losses. The discrimination of either mode thus proves improbable and is accredited to the degeneracy of this set of angular modes. While many studies claim pure OAM mode selection, they suffer from inconclusive confirmation on the state of OAM at the output. In this study we show the controlled intra-cavity selection of pure OAM LG₀₁ modes of opposite handedness and demonstrate it experimentally. With this we also present a direct approach to realise LG₀₁ modes of radial and azimuthal polarisation states, respectively.

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

Yes

**Level for award
 (Hons, MSc,
 PhD)?**

PhD

**Main supervisor (name and email)
and his / her institution**

Prof Andrew Forbes, aforbes1@csir.co.za, CSIR

**Would you like to
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 Proceedings (Yes / No)?**

No

Primary author: Mr NAIDOO, Darryl (CSIR)

Co-authors: Prof. FORBES, Andrew (CSIR); Dr DUDLEY, Angela (CSIR); Dr LITVIN, Igor (CSIR)

Presenter: Mr NAIDOO, Darryl (CSIR)

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