Azimuthal Decomposition of Optical Modes

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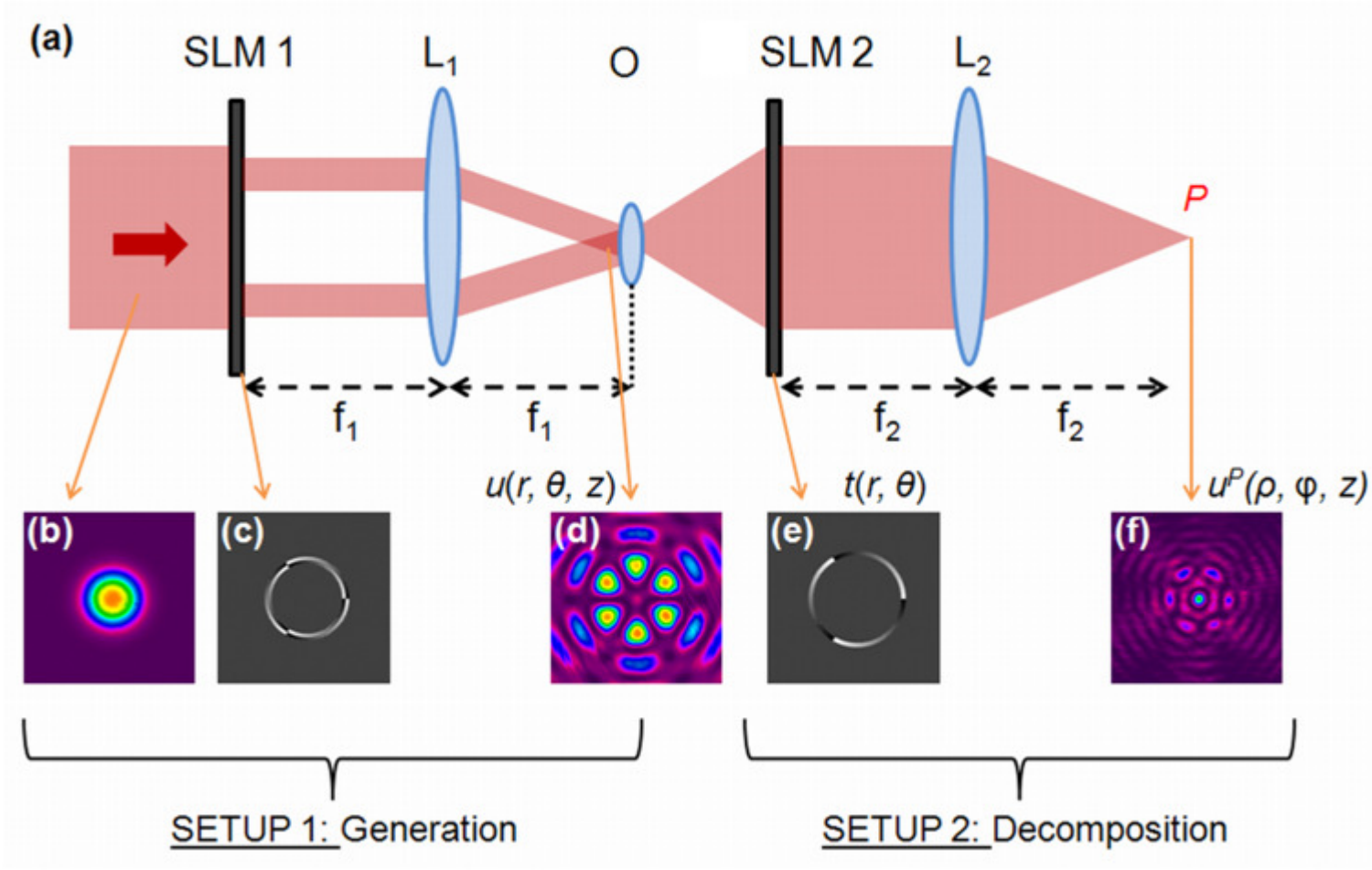
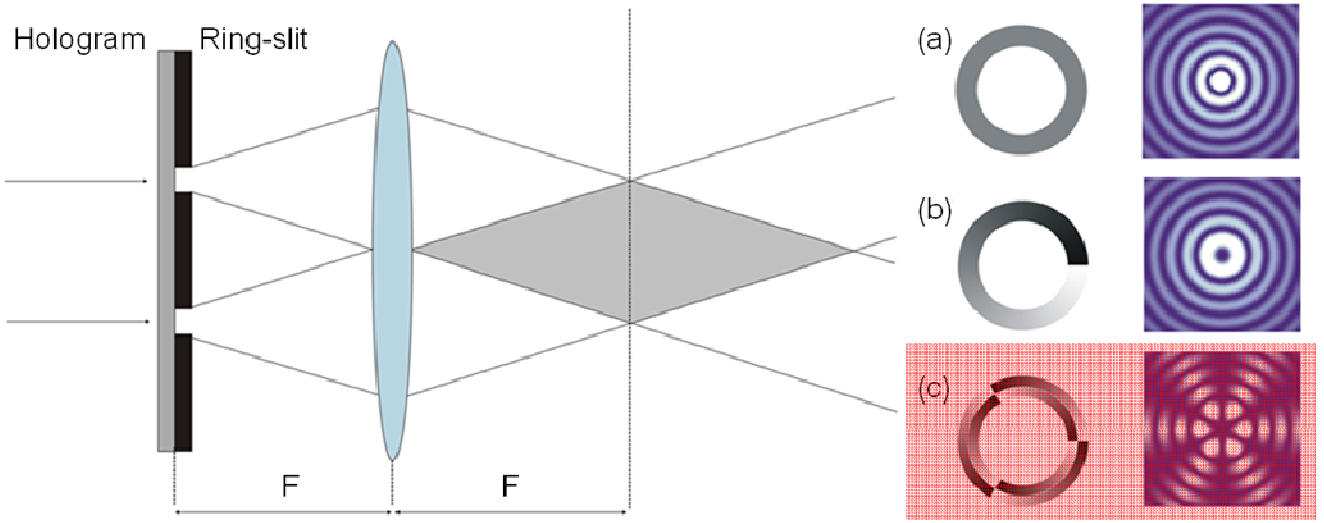
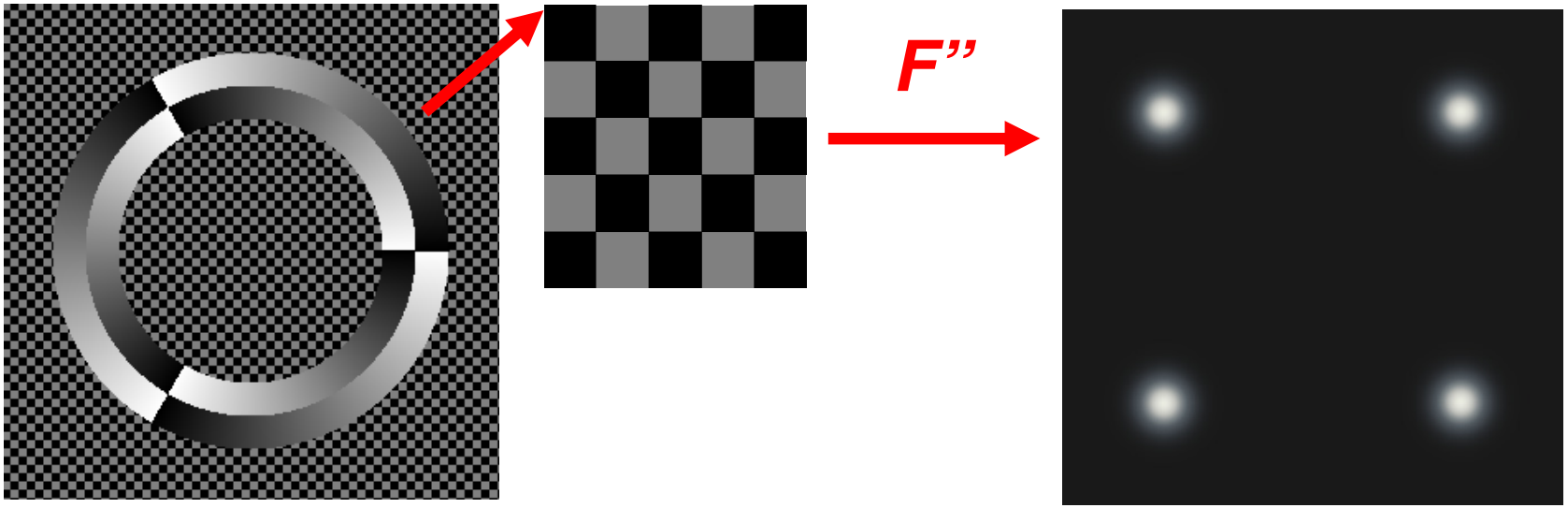
our future through science

To decompose the azimuthal modes we need two steps: generation and decomposition

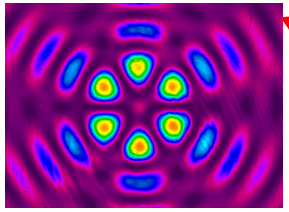


An azimuthally-varying phase (bounded by a ring-slit) placed in the spatial frequency domain produces a higher-order Bessel beam

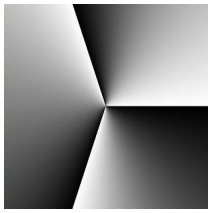


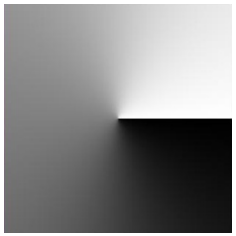
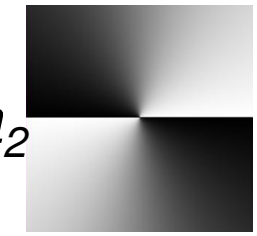
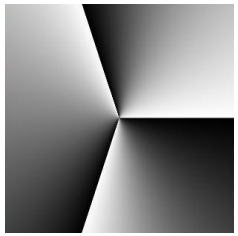


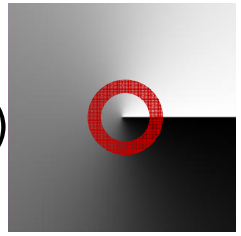
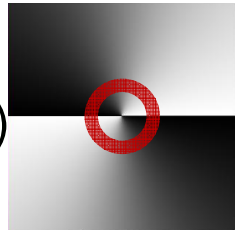
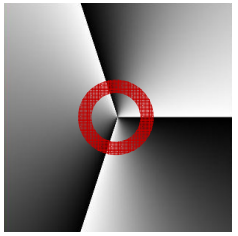
To decompose the azimuthal modes as a function of the radial coordinate, an annular ring restricts the azimuthal match-filter



$$u(r,\phi,z) = \frac{1}{\sqrt{2\pi}} \sum_l a_l(r,z) \exp(il\phi)$$

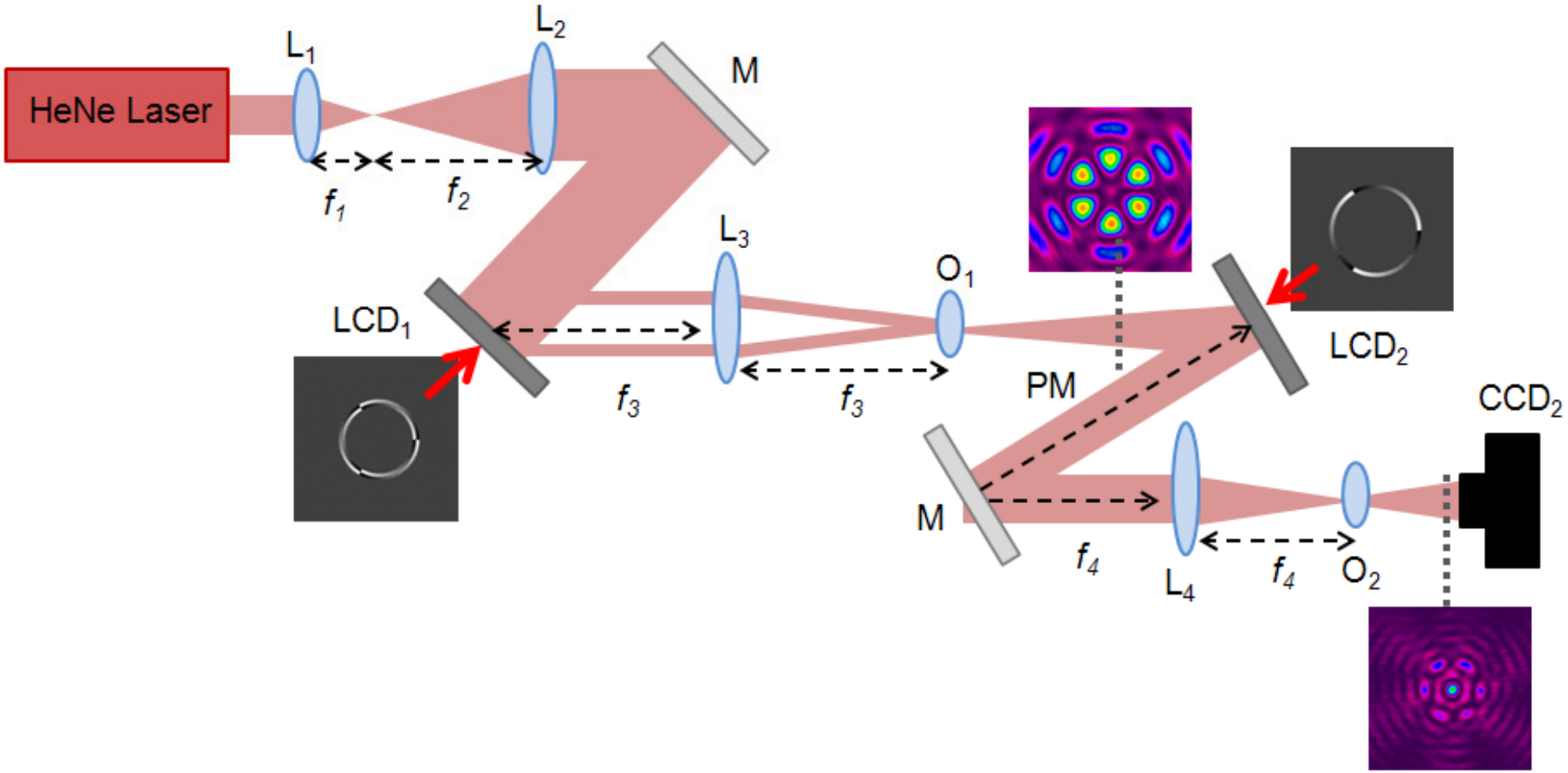


$u(\phi)$ = a_1  + a_2  + a_3 

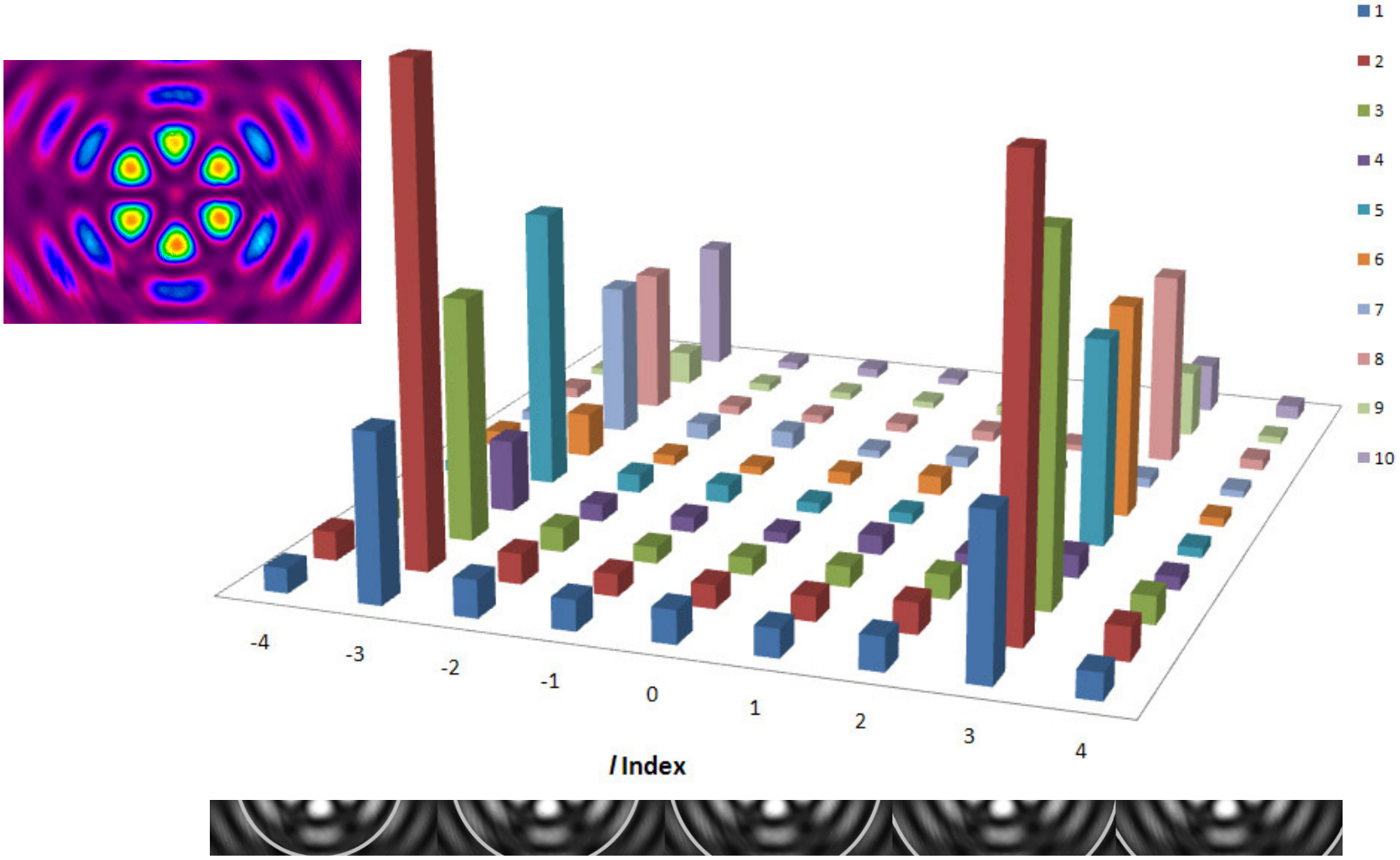
$u(r,\phi)$ = $a_1(r)$  + $a_2(r)$  + $a_3(r)$ 

$$a_n(r,z) = \frac{1}{\sqrt{2\pi}} \int_0^{2\pi} u(r,\theta,z) t(r,\theta) d\theta$$

The experiment for extracting the local azimuthal modes requires only two SLMs



Although the field has no global azimuthal mode, its local azimuthal modes vary radially across the field

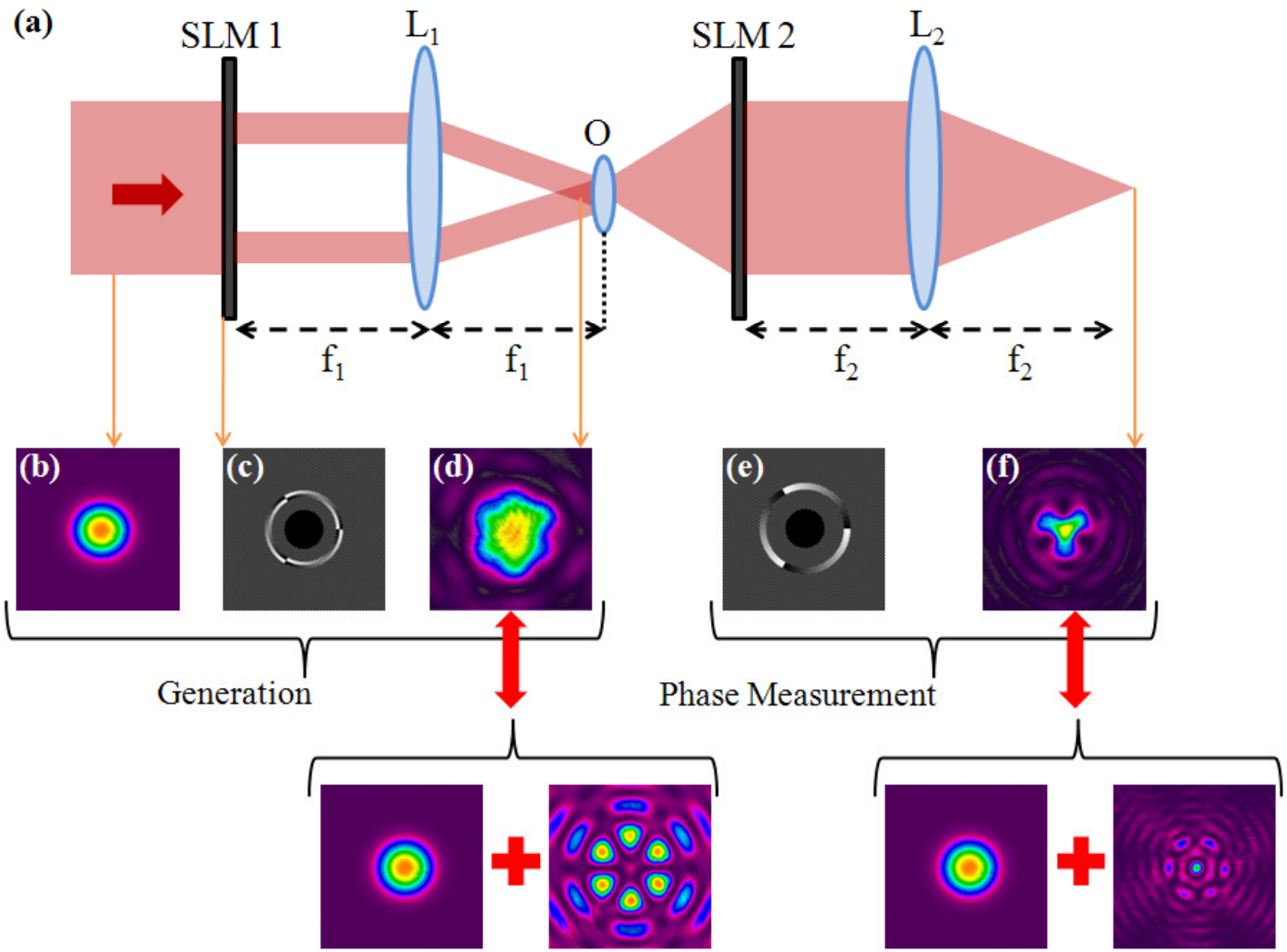


Opt. Express **19**(18), 16760-16771 (2011)

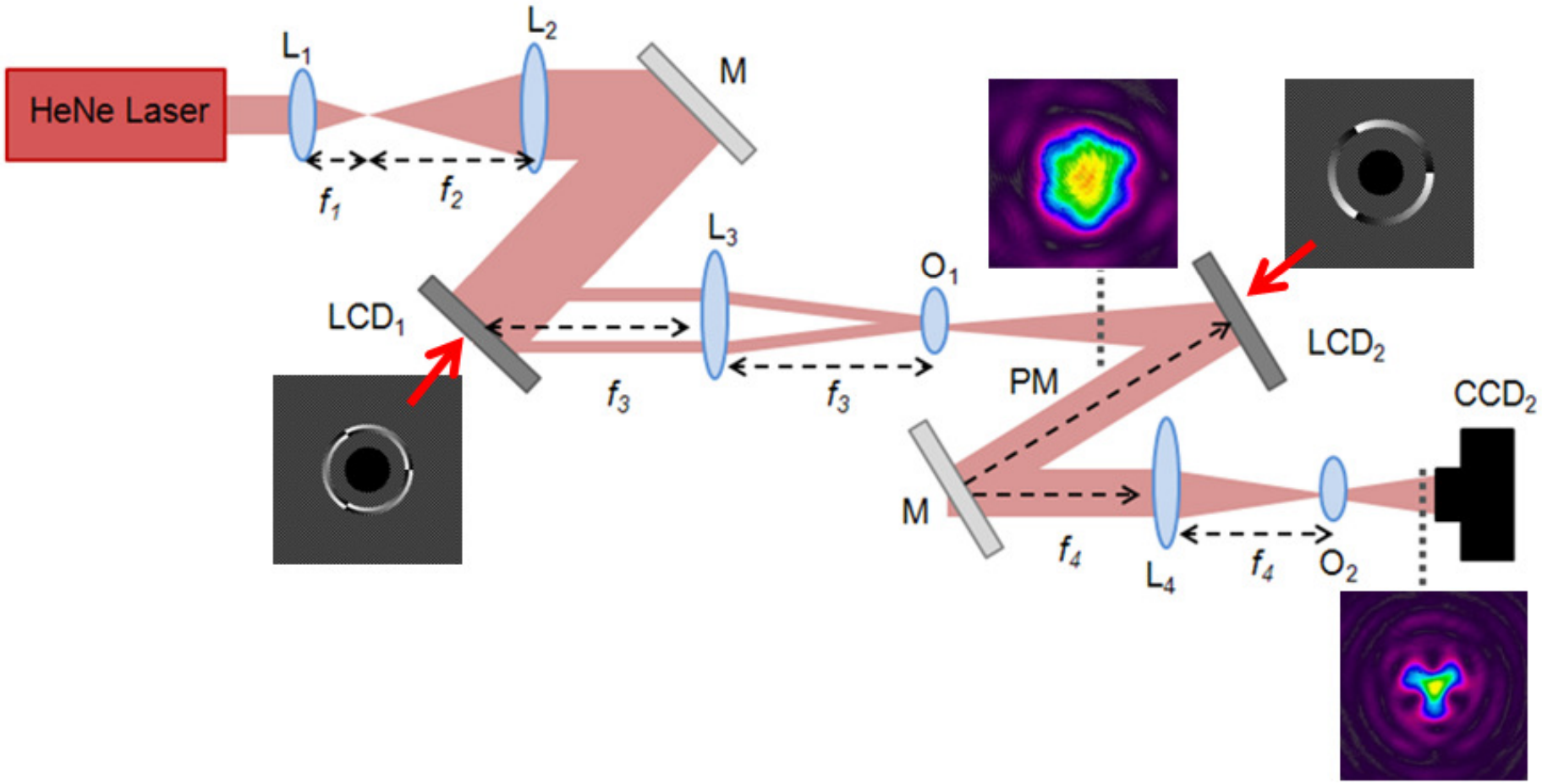
The phase delay is extracted by interfering a selected azimuthal mode with a reference mode

$$I_l(\Delta\theta_l) = \left|a_l(R) + g\right|^2 = a_l^2(R) + \left|g\right|^2 + 2a_l(R)\left|g\right|\cos[\Delta\theta_l(R) - \alpha]$$

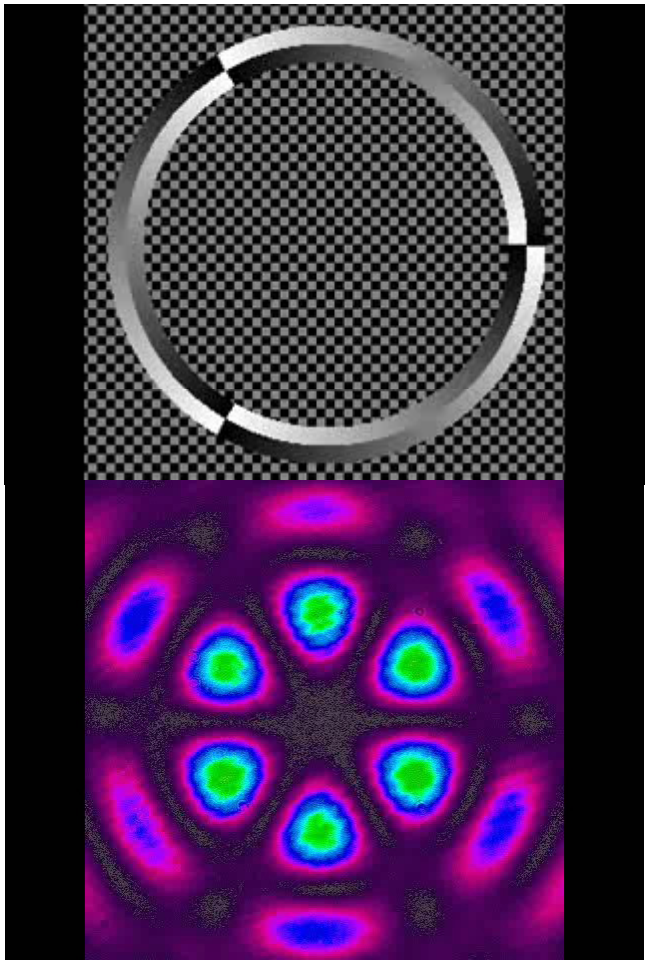
$$g = \left|g\right|\exp(i\alpha)$$

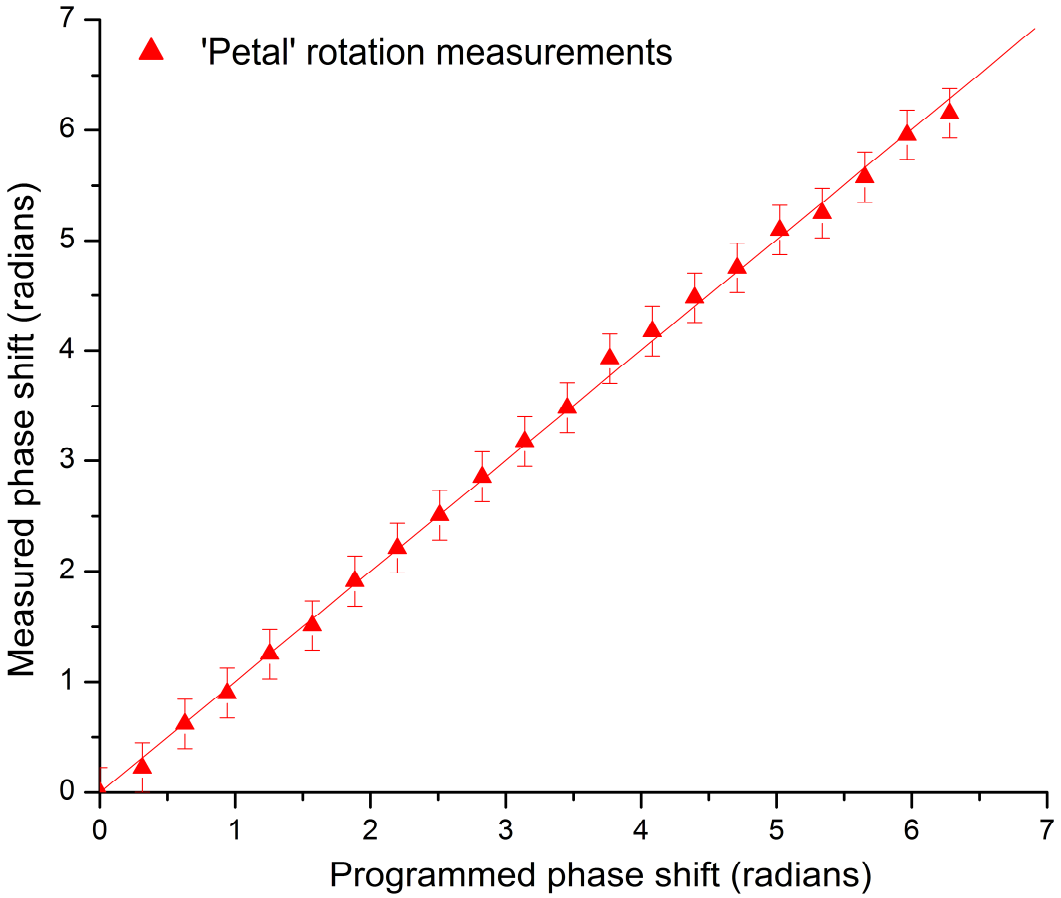


The experiment for extracting the phase delays for each azimuthal mode requires only two SLMs



The technique was tested by scanning through a phase shift from 0 to 2π in one of the azimuthal modes





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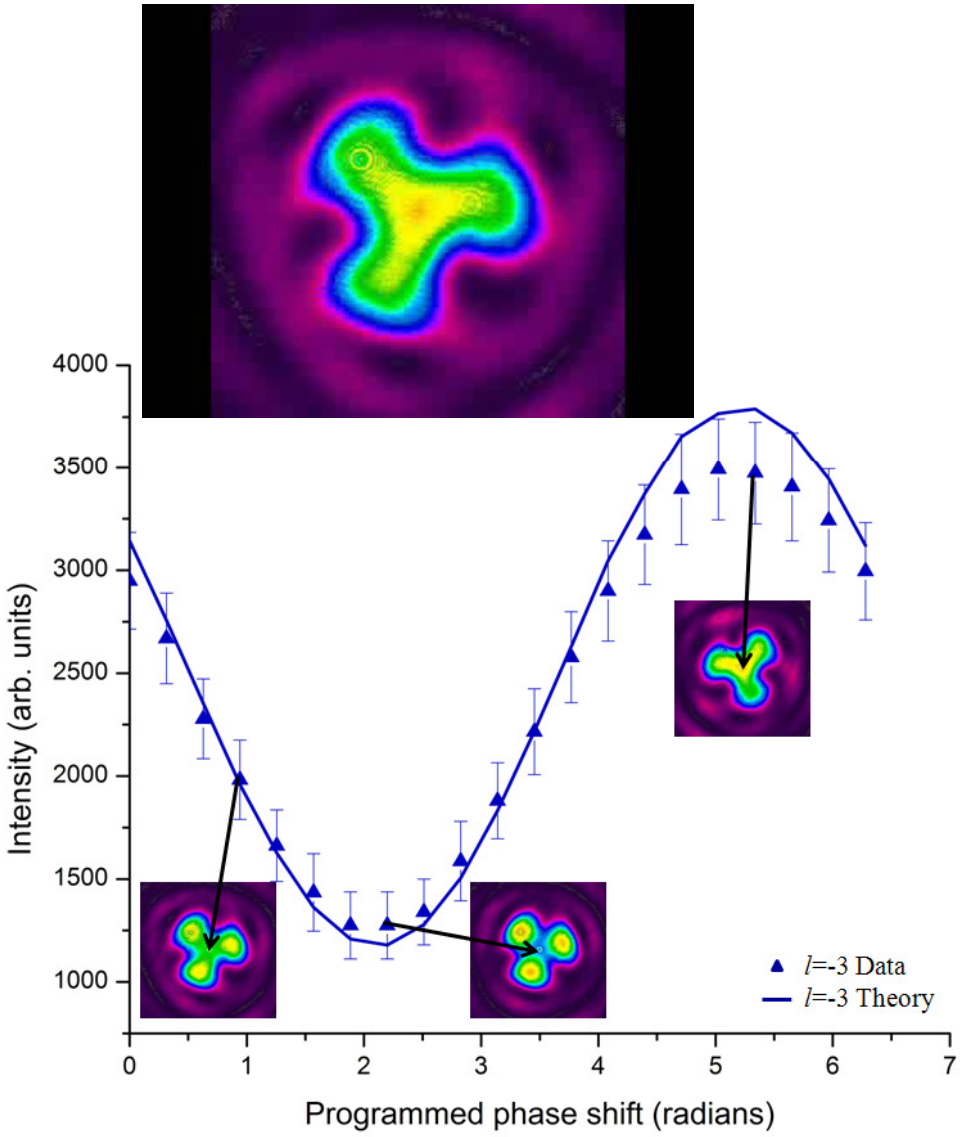
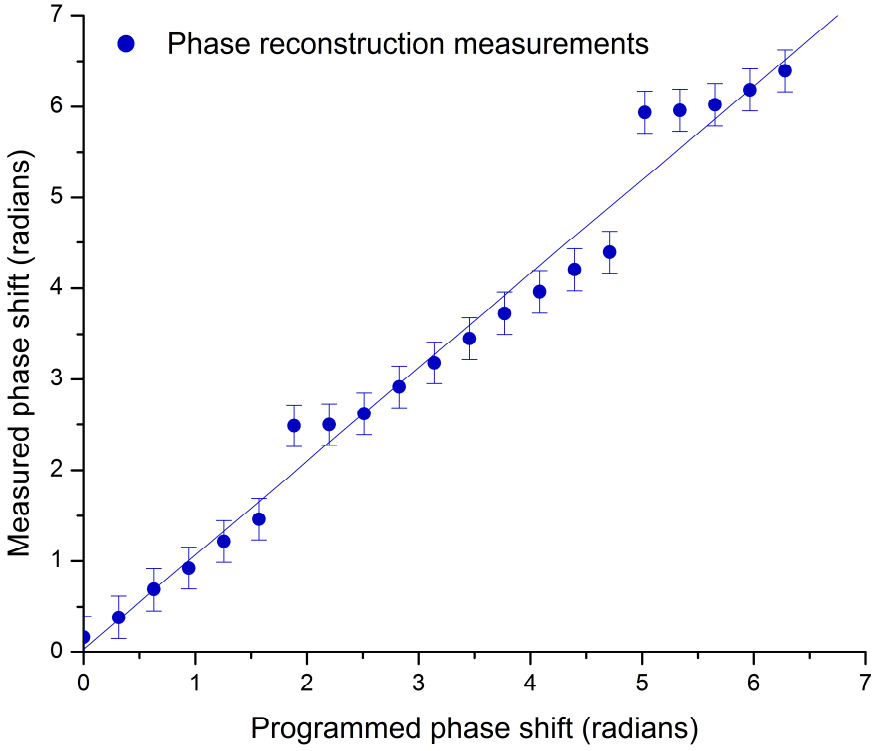
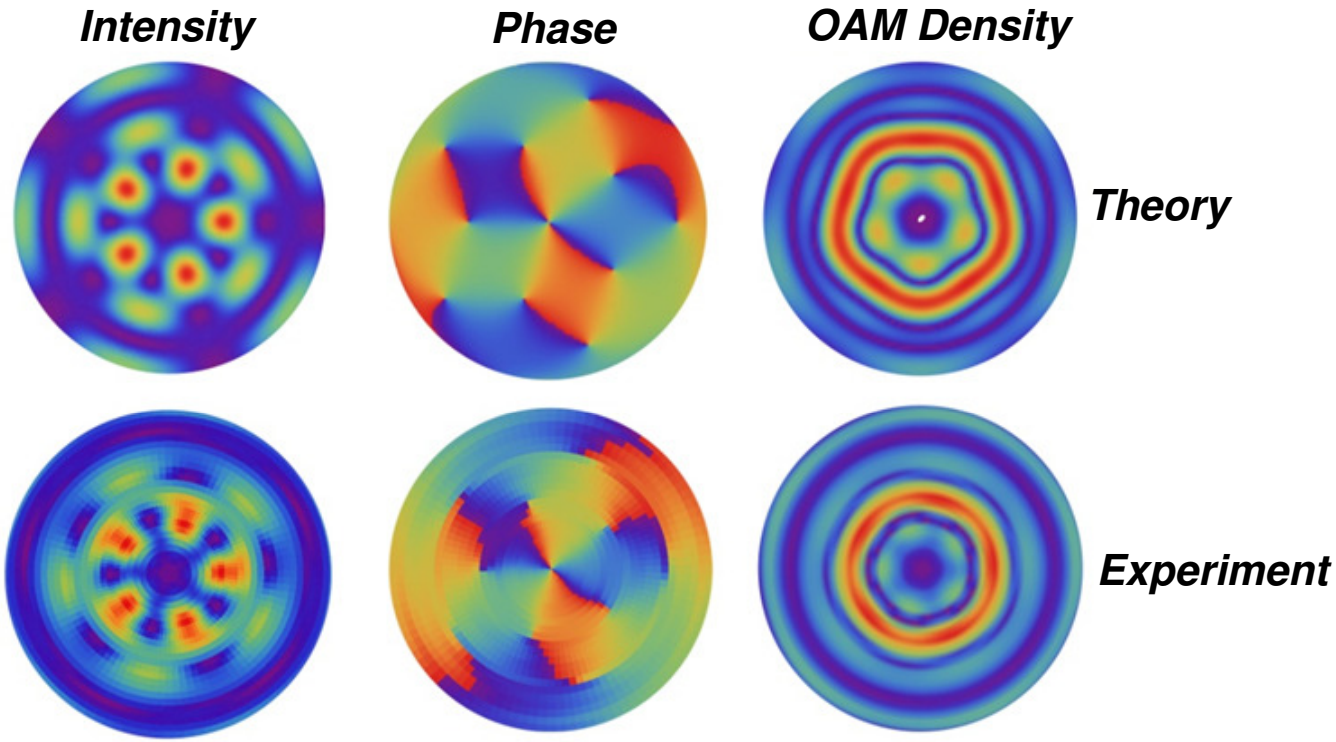
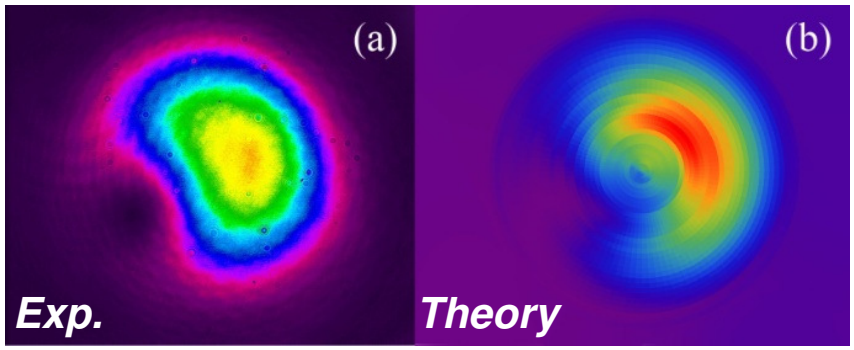


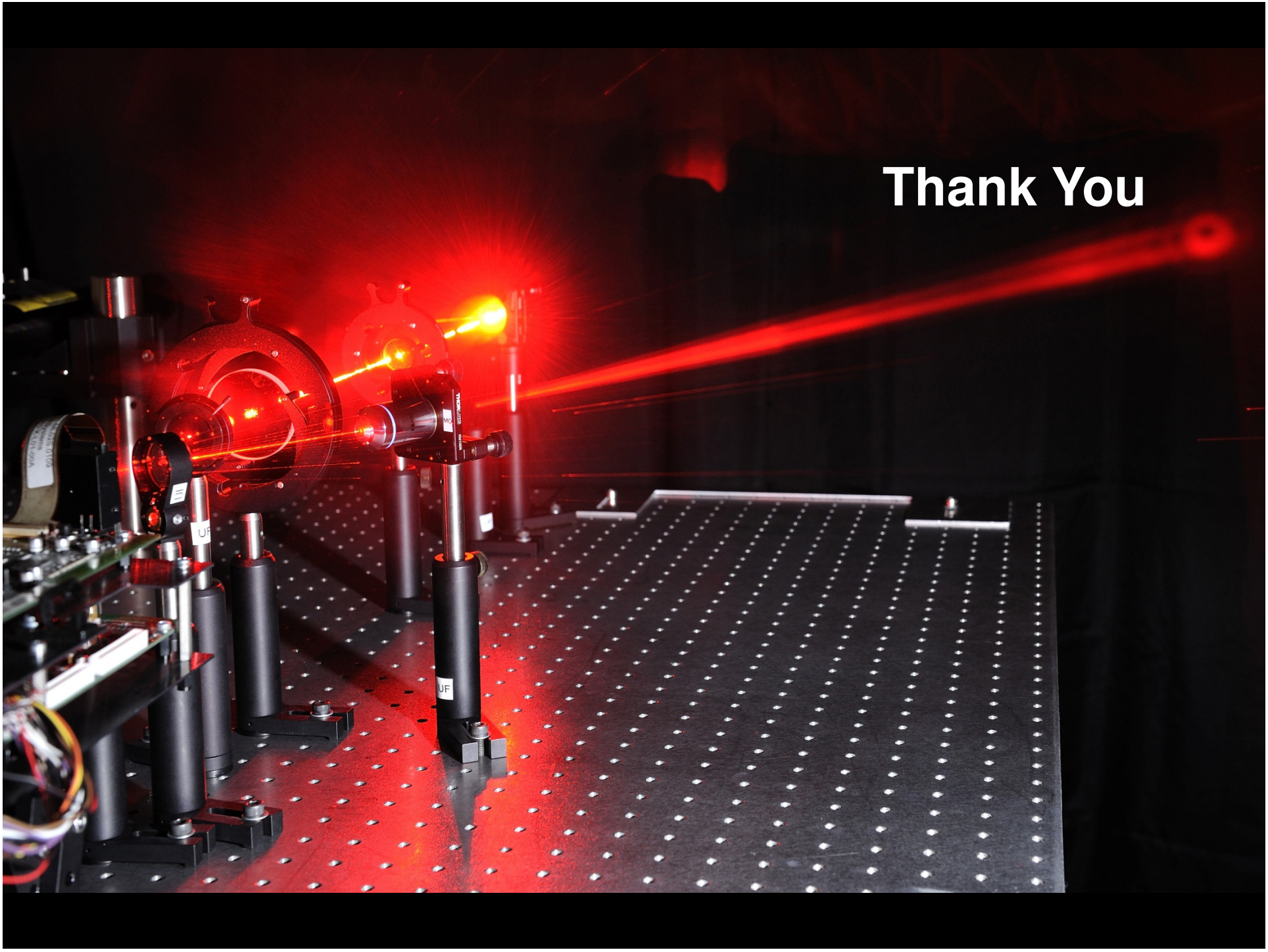


We can construct the spatial distribution, phase and OAM density of the initial mode





Opt. Express **20**(10), 10996-11004 (2012)


Thank You

IONS SOUTH AFRICA 2012

31/08 - 02/09

Dates	31 August – 2 September 2012
Venue	Cathedral Peak Hotel, Drakensberg, South Africa
Topics	Fibre optics and quantum optics

IMPORTANT DATES

28 May 2012	Abstract submission opens
15 June 2012	Abstract submission closes
30 June 2012	Notification for abstracts
1 July 2012	Registration opens
31 July 2012	Registration closes

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