# Unraveling Bessel Beams

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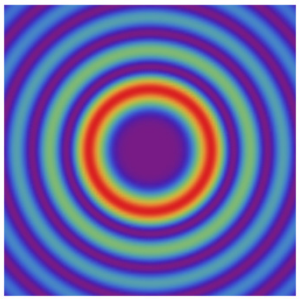
# Bessel beams

Bessel beams:1980s by J. Durnin

Theory

•Non-diffractive over an infinite region
•Infinite number of rings
• Carry infinite power



Practical (qausi-Bessel beams)

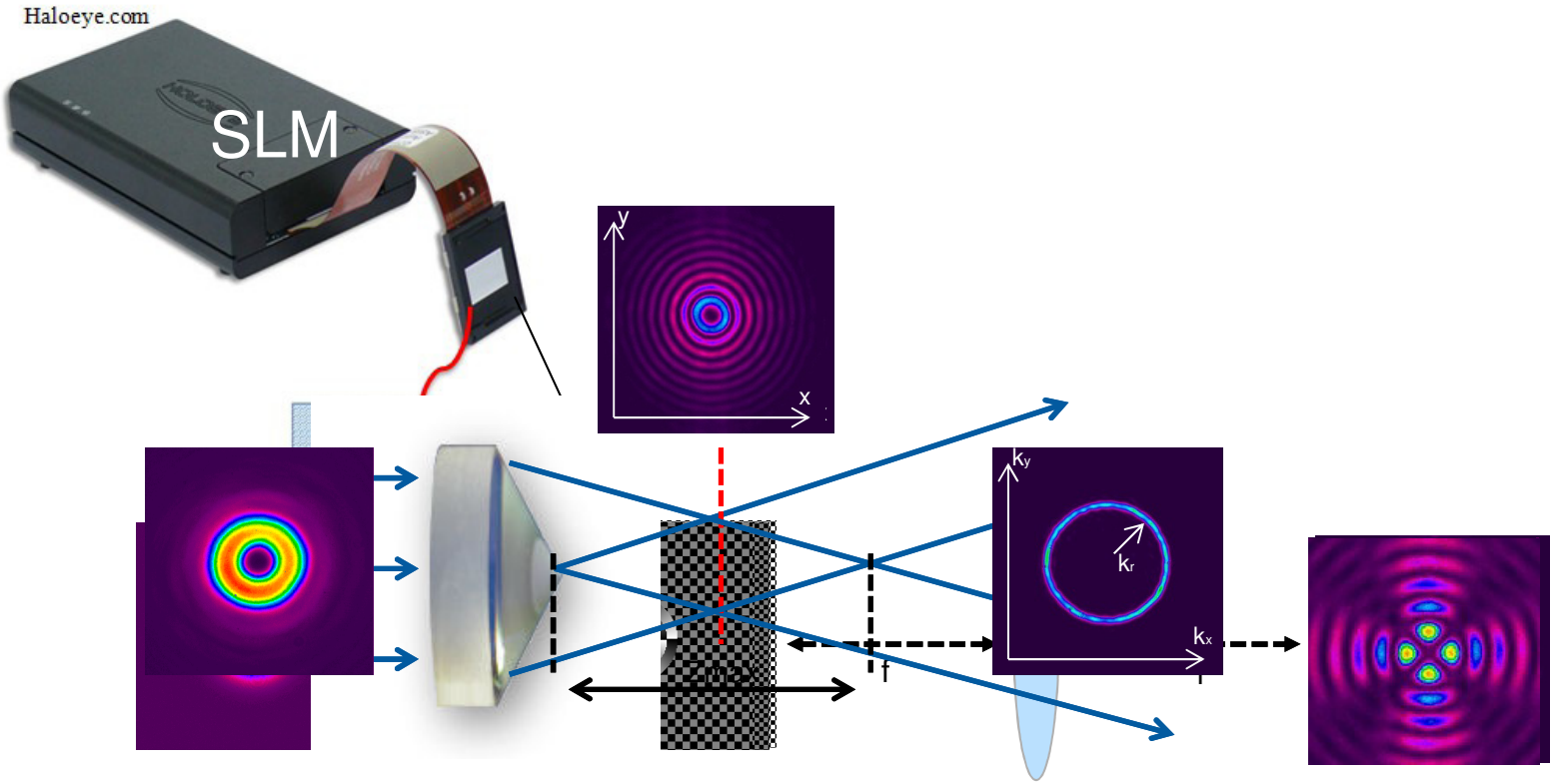
•Non-diffractive over a finite region
•Annular ring at far-fields
•Spiral wavefront, carry orbital angular momentum
•Information carriers

$$U(r,\theta,z=0) = J_l(k_r r)\exp(il\theta)$$

Spacing between rings

Azimuthal index

# Digital generation of Bessel beams with axicon



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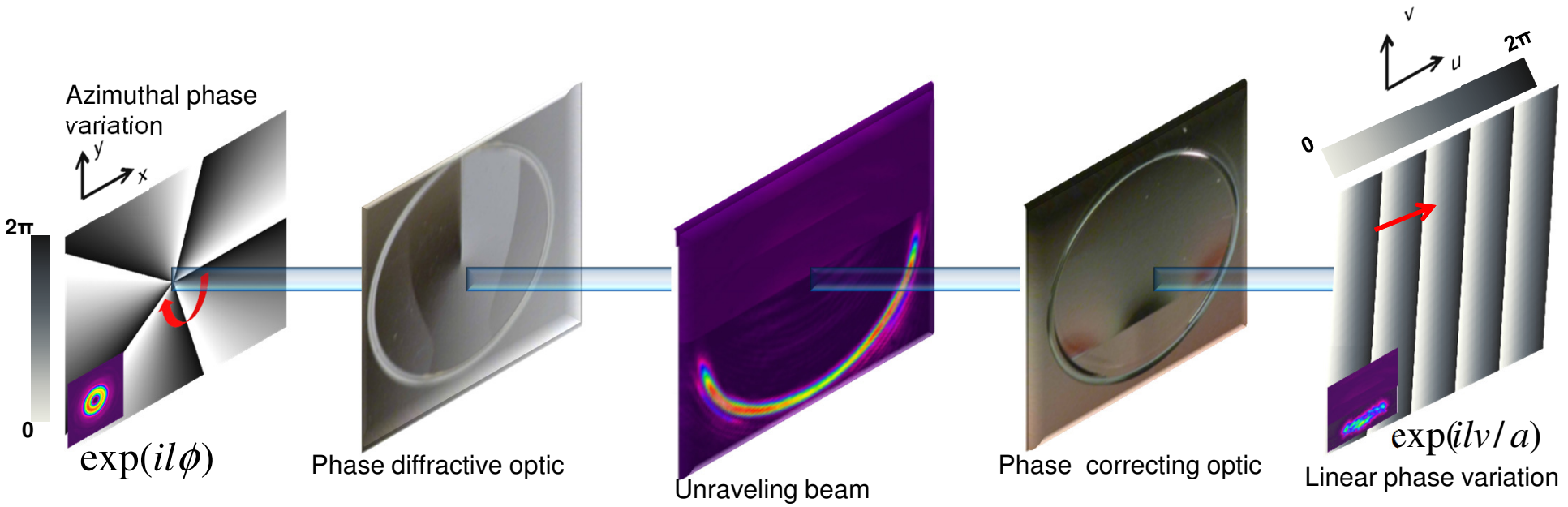
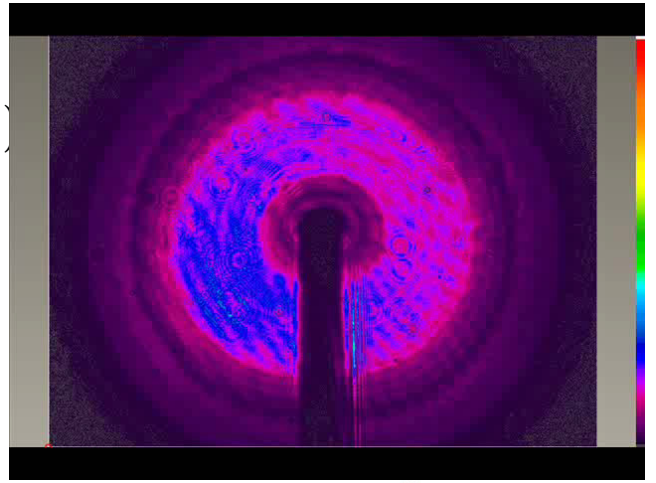
# Conformal mapping



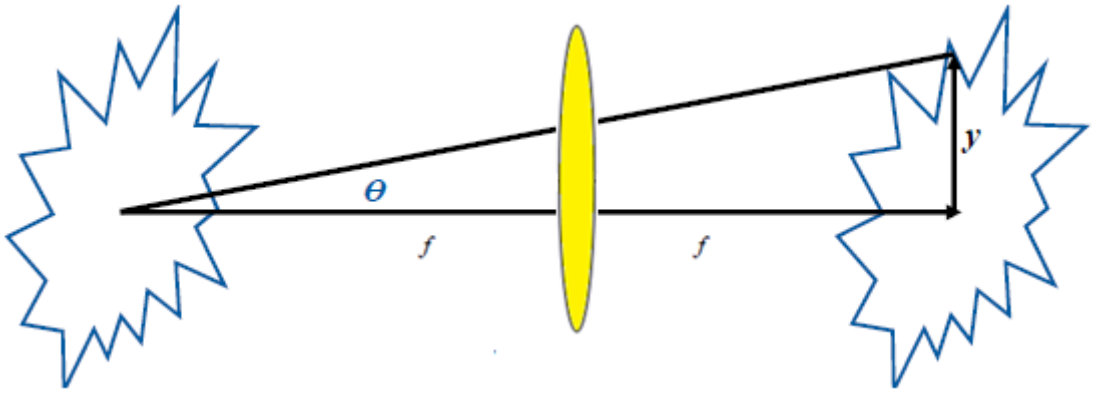

$$(x, y) \rightarrow (u, v)$$

$$u = -a(\ln \sqrt{x^2 + y^2}/b),\ v = a \tan^{-1}(y/x)$$

$$\phi(x, y) = \frac{a}{f(n-1)}\left[ y \arctan\left(\frac{y}{x}\right) - x \ln\left(\frac{\sqrt{x^2 + y^2}}{b}\right) + x - \frac{1}{a}\left(\frac{1}{2}(x^2 + y^2)\right)\right.$$



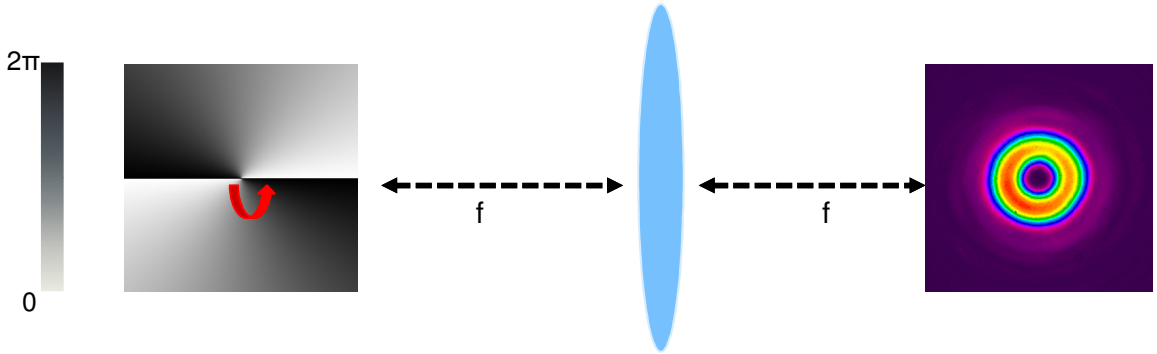
# Concept of the Fourier lens



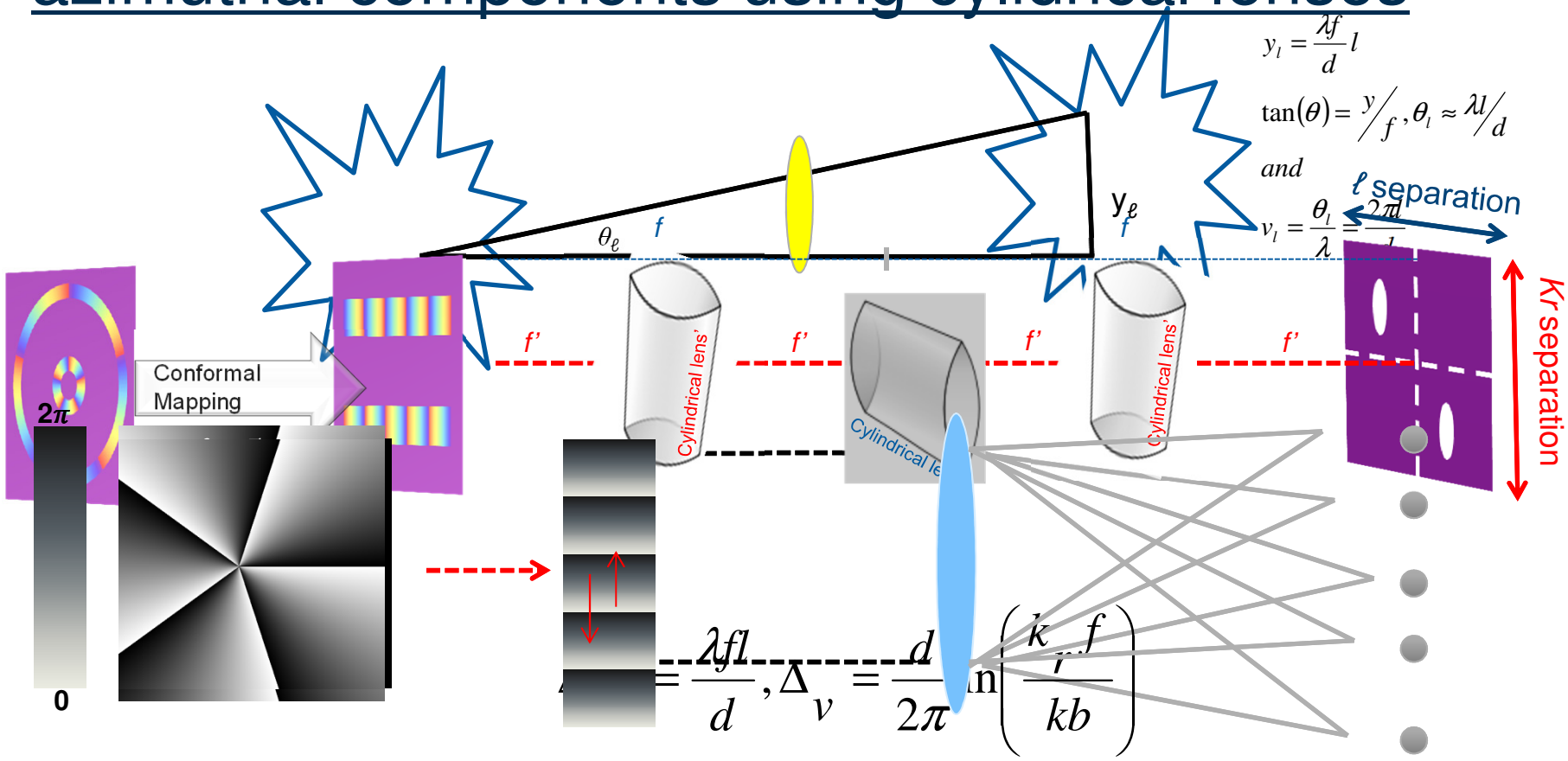

$$\tan(\theta) = {}^{y}\!/_{f}, \theta \approx {}^{y}\!/_{f}$$

*and*

$$v = \frac{y}{\lambda f} = \frac{\theta}{\lambda}$$



# Simultaneous separation of OAM states azimuthal components using cylidrical lenses



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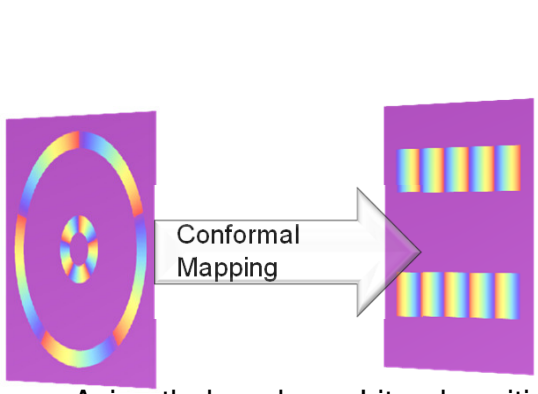
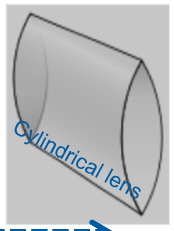
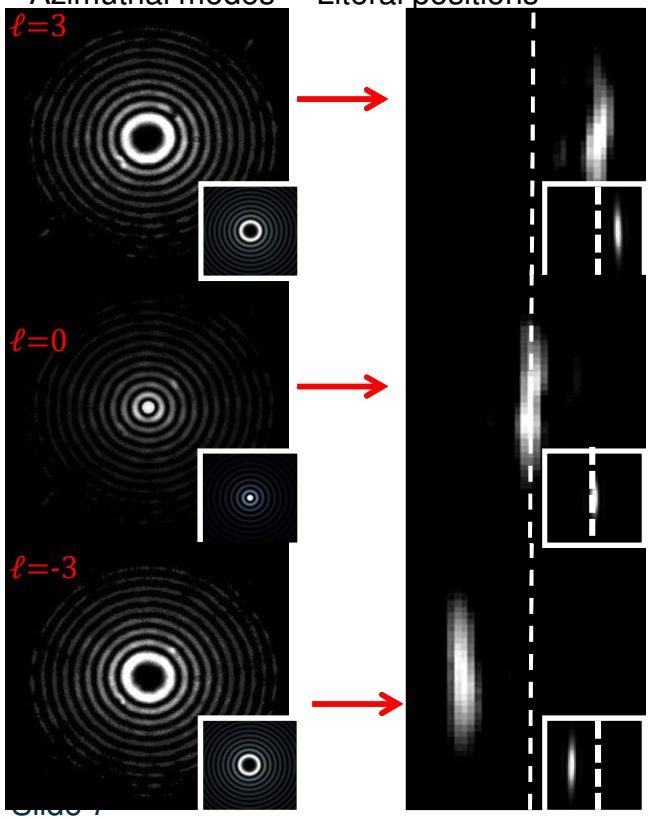
# Horizontal separation of the azimuthal component

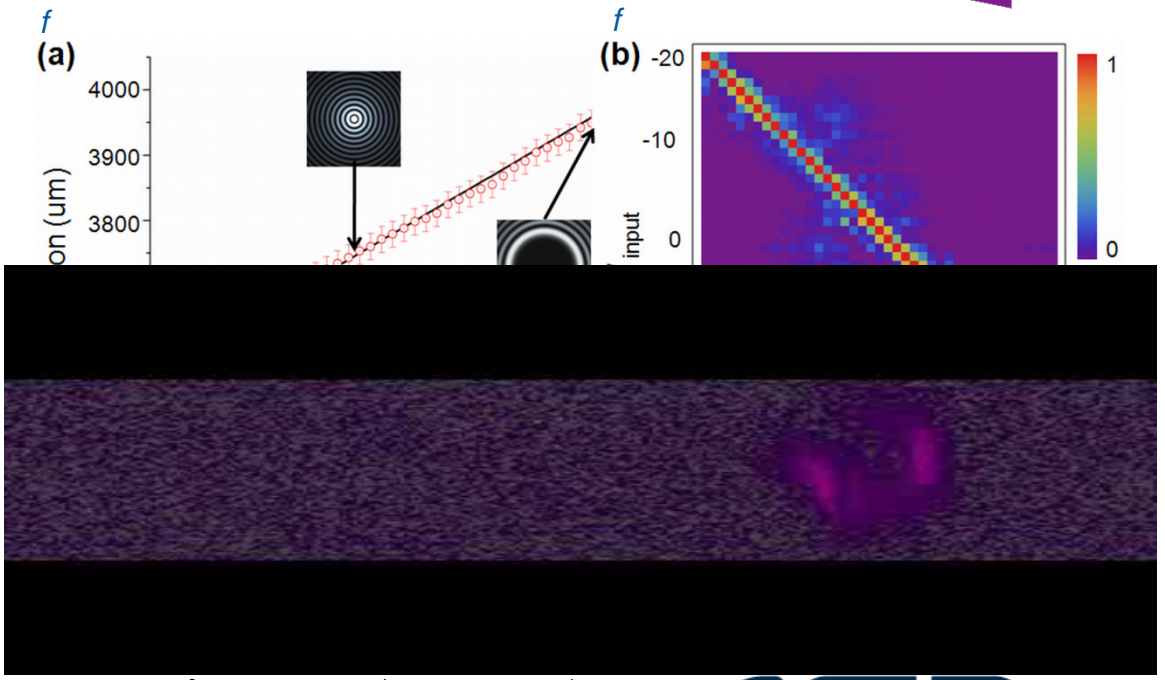



$$\Delta_H = \frac{\lambda f l}{d}$$


Azimuthal modes Literal positions

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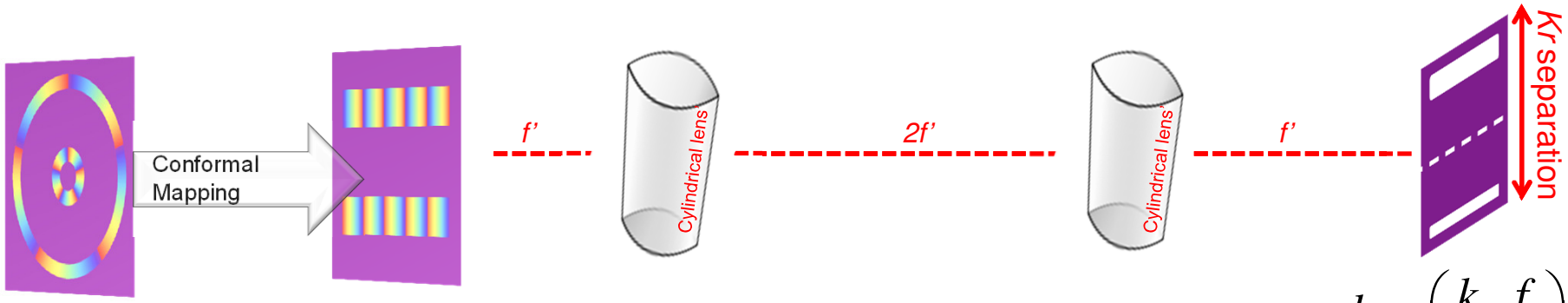
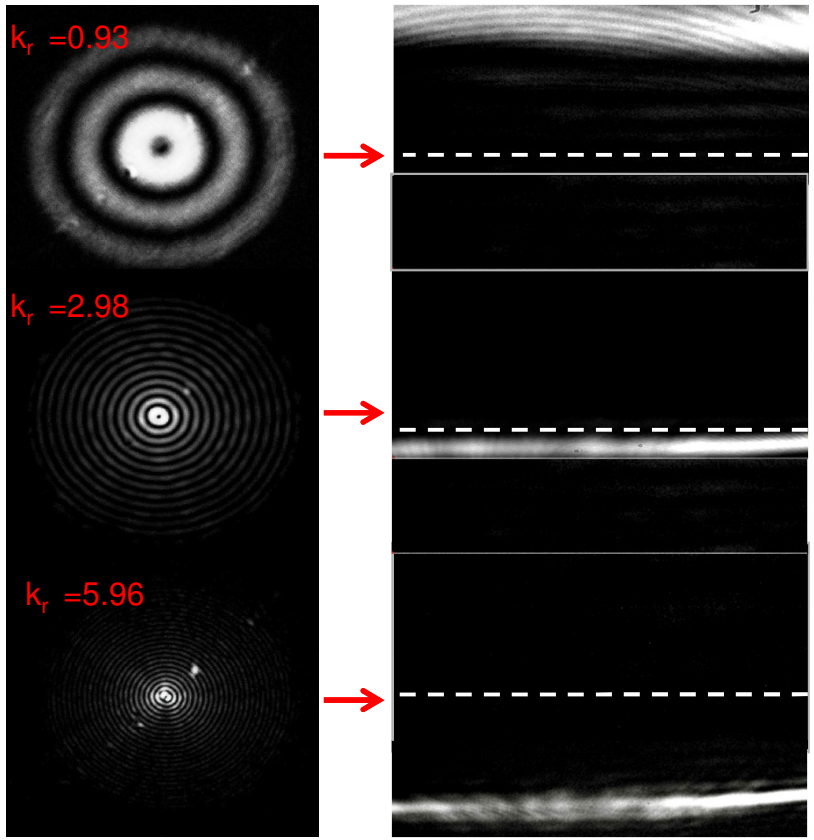
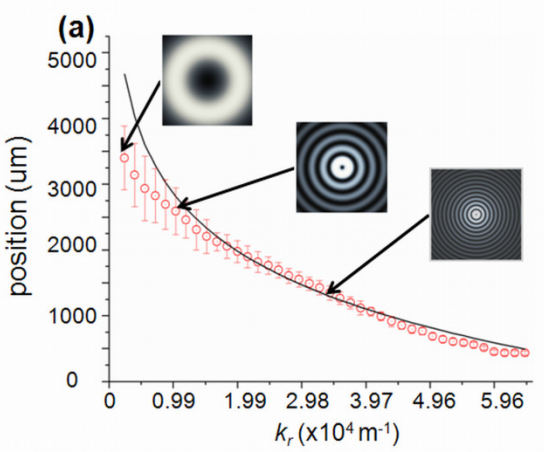
# Vertical separation of the radial component

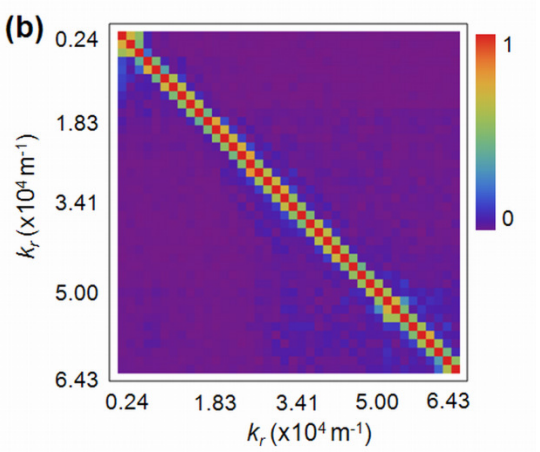



$$\Delta_v = \frac{d}{2\pi}\ln\left(\frac{k_r f}{kb}\right)$$

Radial component(x10$^4$m$^{-1}$) Literal positions




**Efficient Sorting of Bessel Beams**
**Angela Dudley,[1,*] Thandeka Mhlanga,[1] Martin Lavery,[2] Andre McDonald,[1] Filippus S. Roux,[1] Miles Padgett,[2] and Andrew Forbes[1]**
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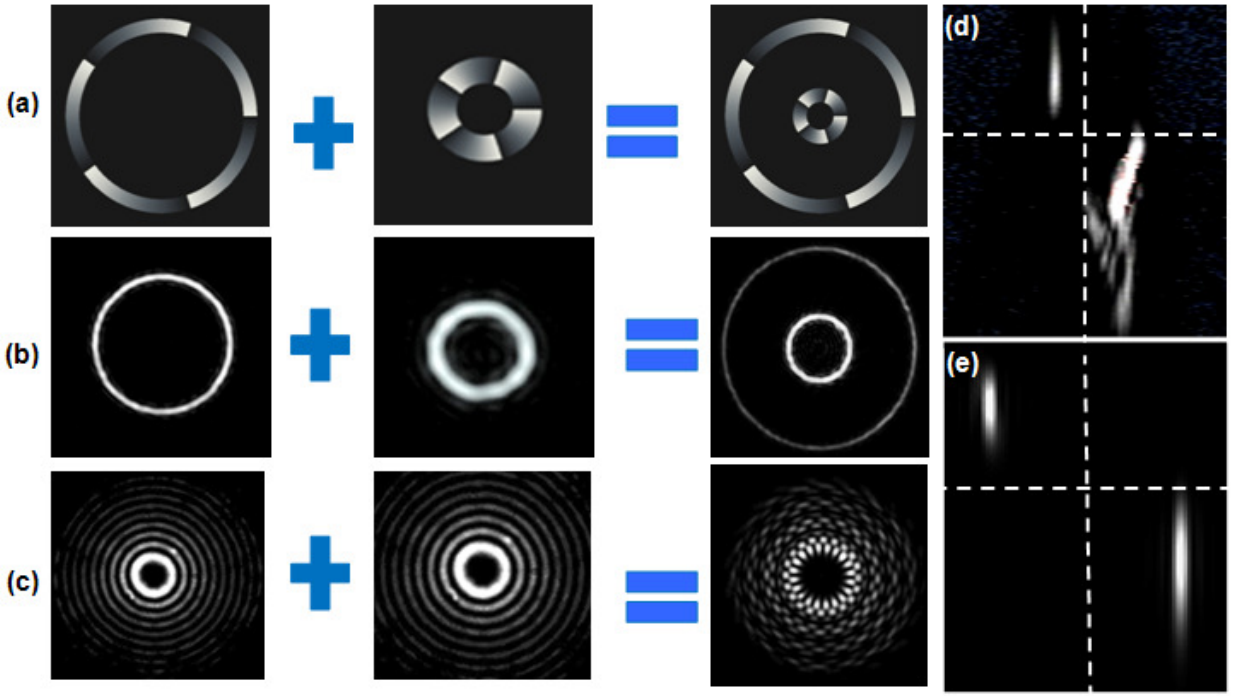
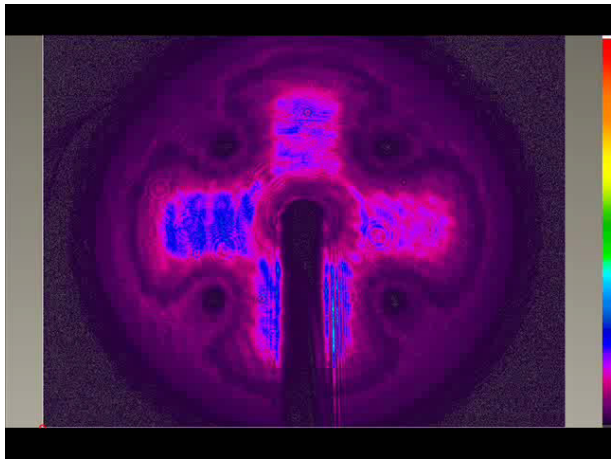
# Superposition of Bessel beams





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# For more information……


# Any questions?