

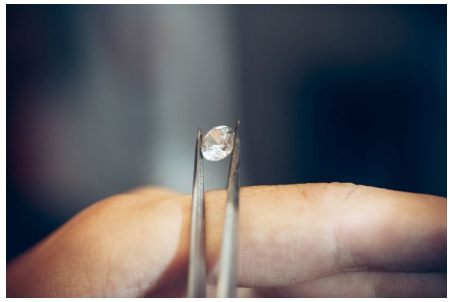
Dynamic higher-order Bessel-Gauss beam interference generation of rotating beams

Gabrielius Kontenis, Darius Gailevičius, Noé Jiménez, and Kęstutis Staliūnas

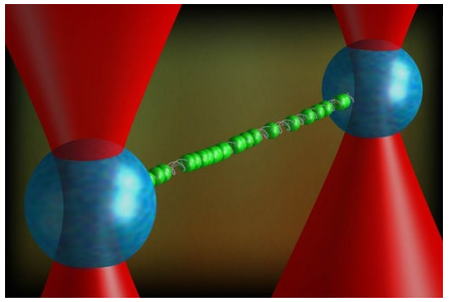
What has been done and importance

- Particle manipulation and translational motion,
- Stabilization of cold atoms,
- Ablated material ejection from the processing region.

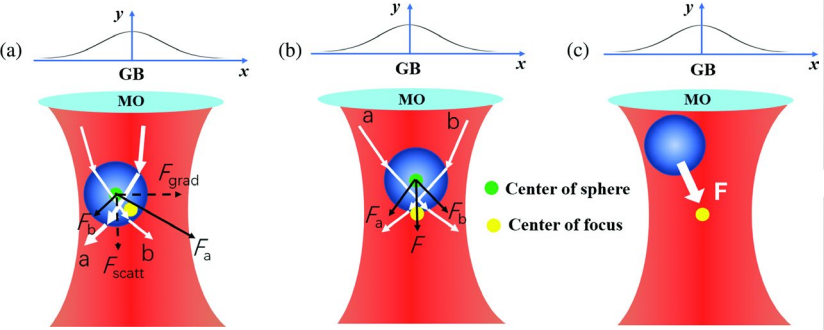
Mechanical



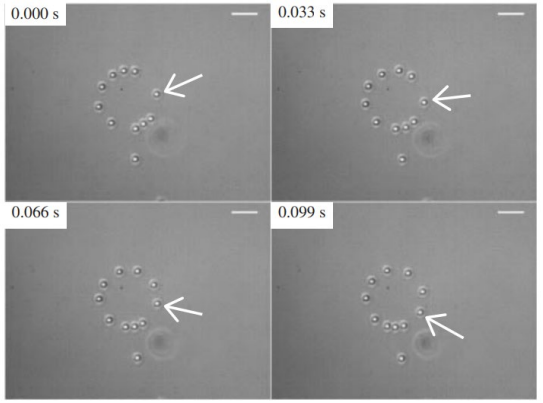
Optical



https://physics.aps.org/articles/v11/100

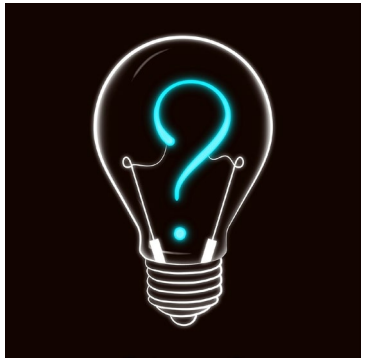


Yang et al.: Optical trapping with structured light: a review



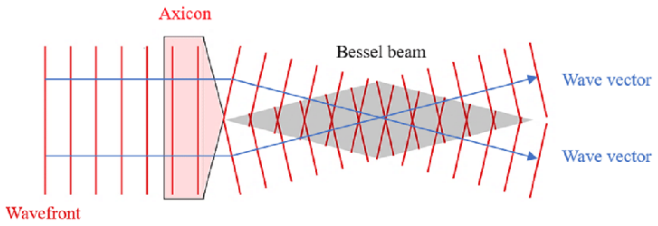
Jpn. J. Appl. Phys., Vol. 44, No. 7B (2005)



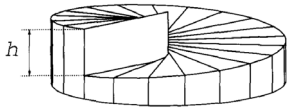


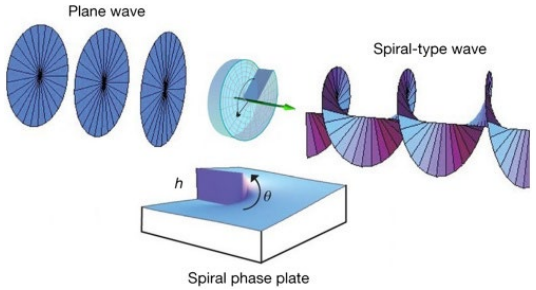
Generating a higher order Bessel





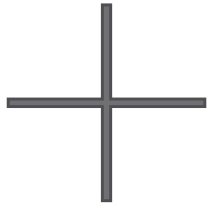
Rev. Sci. Instrum. 89, 093506 (2018)

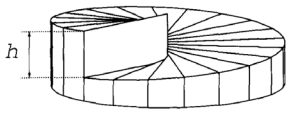


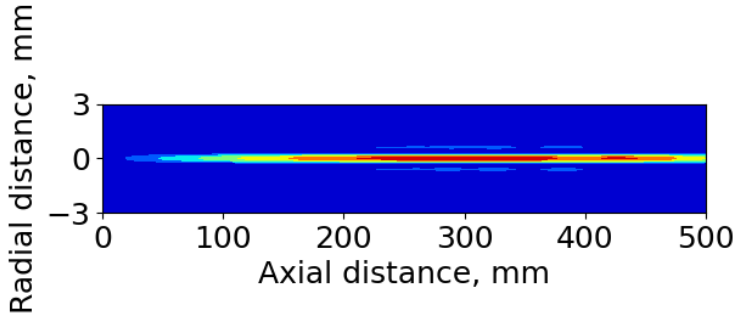


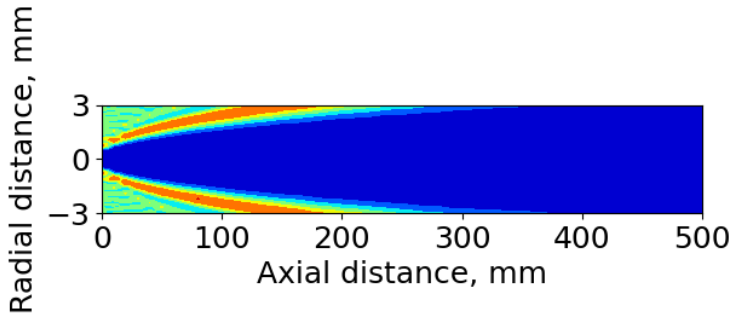
M. Massari et. al., Vol. 54, No. 13 / May 1 2015 / Applied Optics

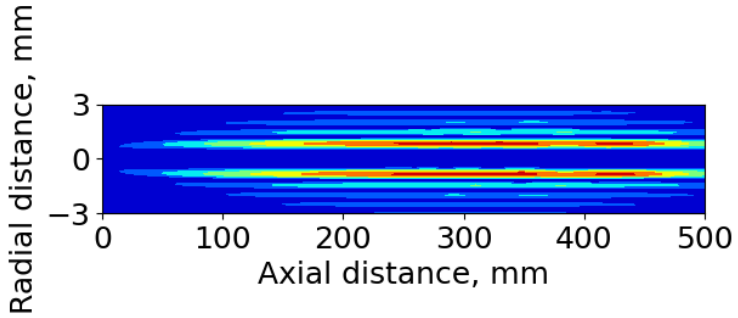






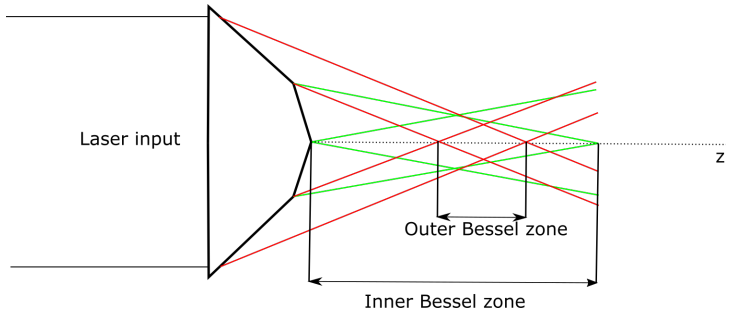


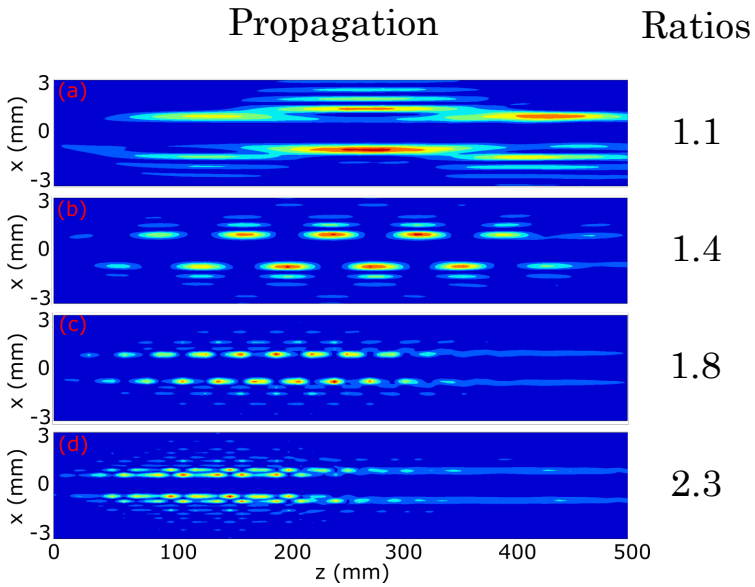


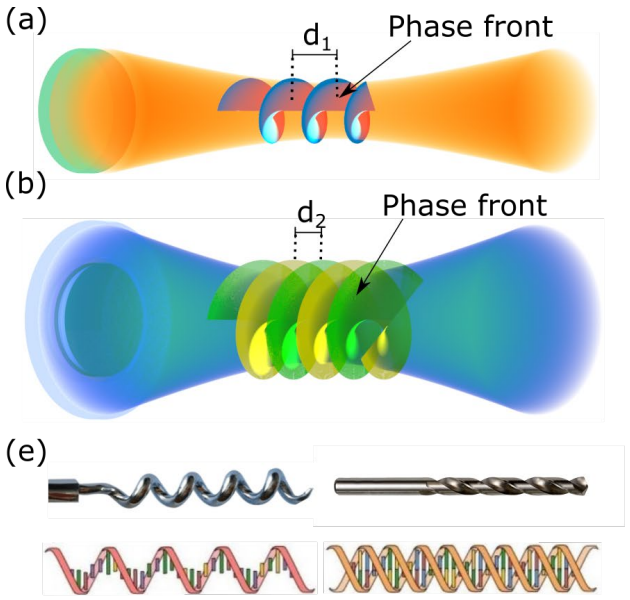


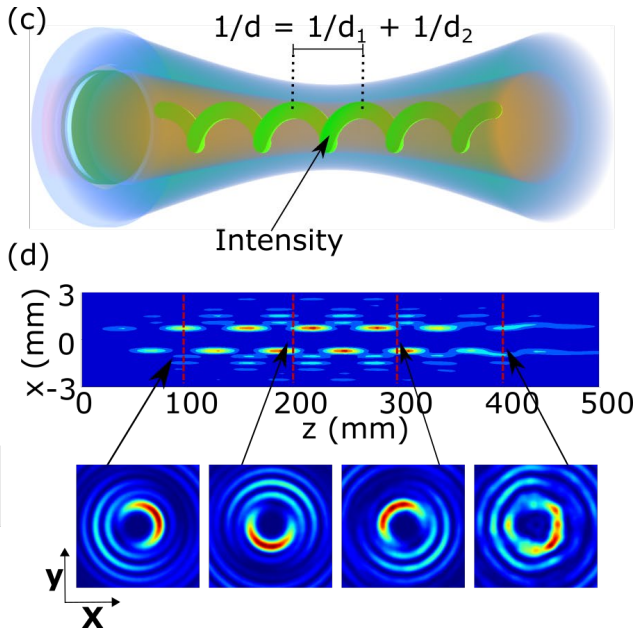
Different order Bessel spatial overlap

$$A_m(r,z) = J_m\left(k_{m,\perp} r\right) \exp\left(im\theta + ik_{m,\parallel} r\right)$$



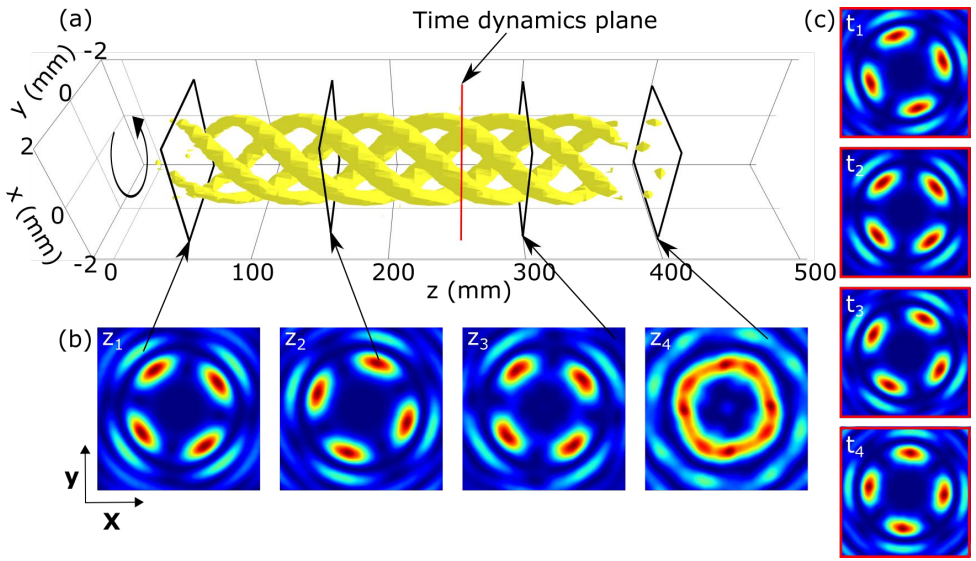




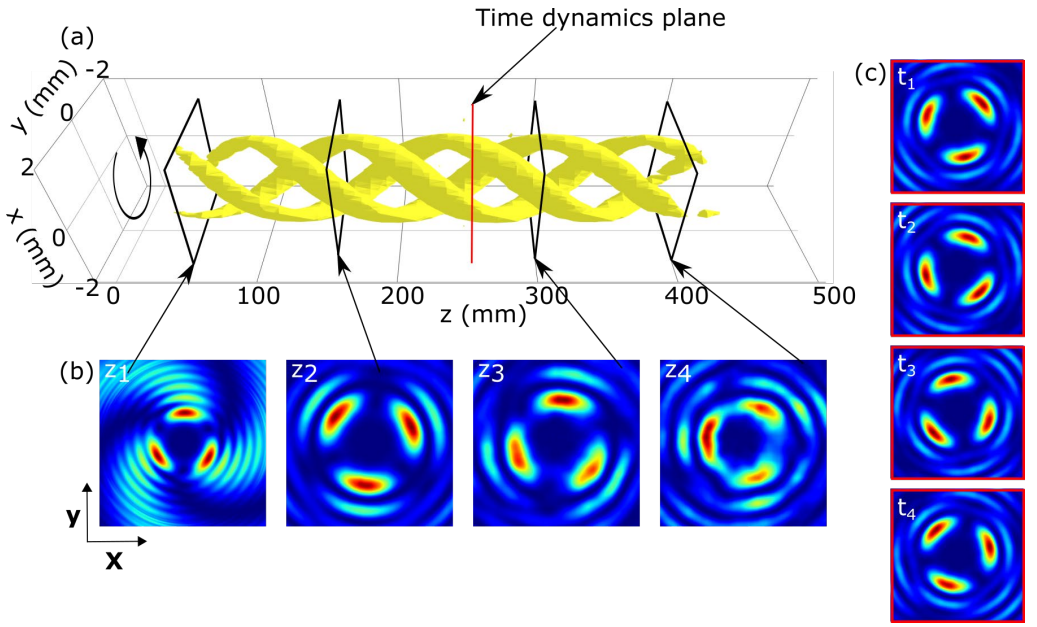


Numerical simulation

$\Delta m = 4$

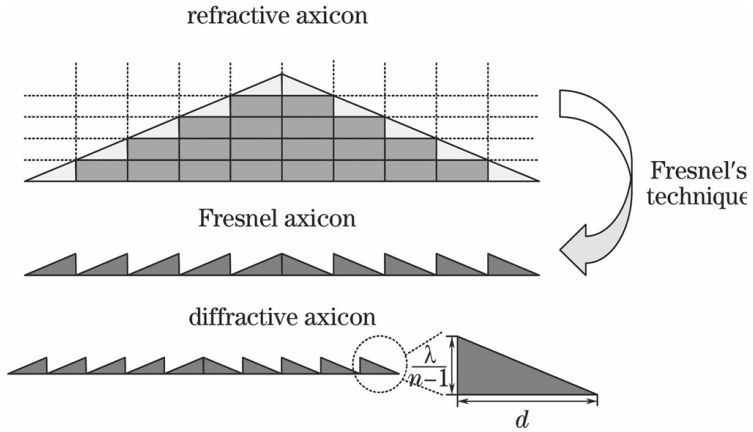


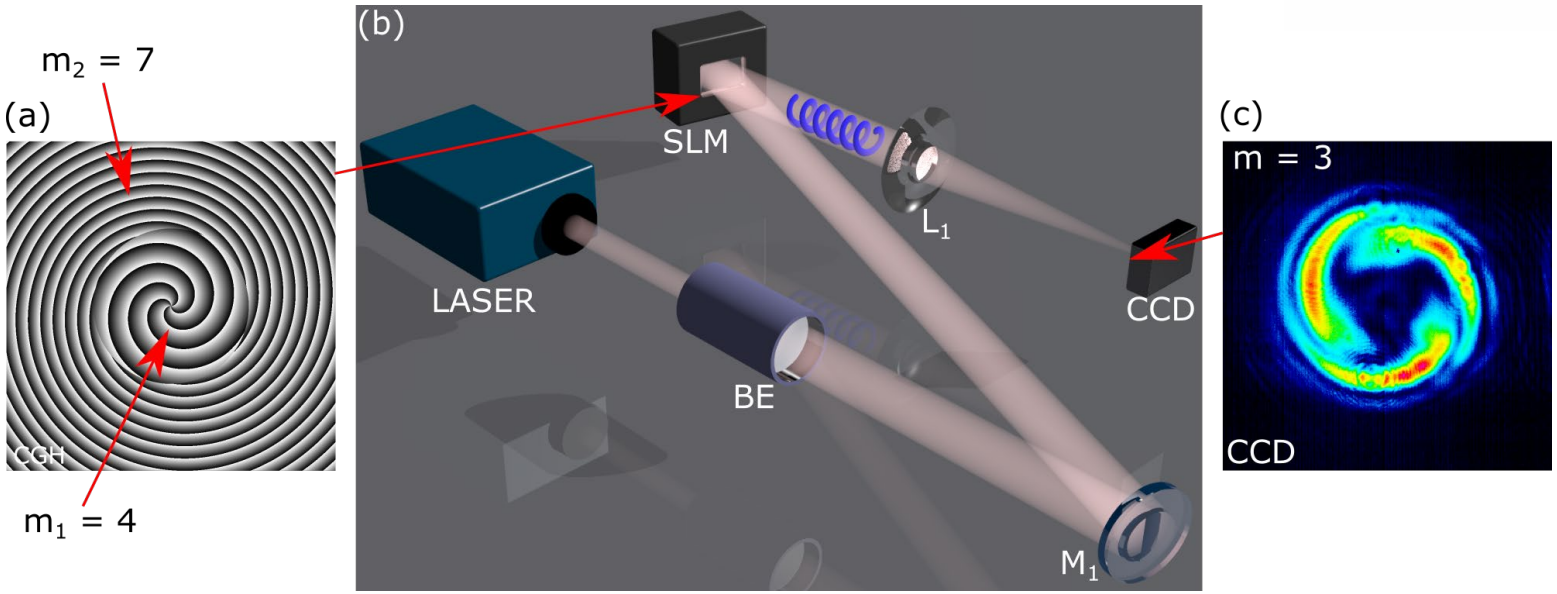
$\Delta m = 3$



Experimental scheme

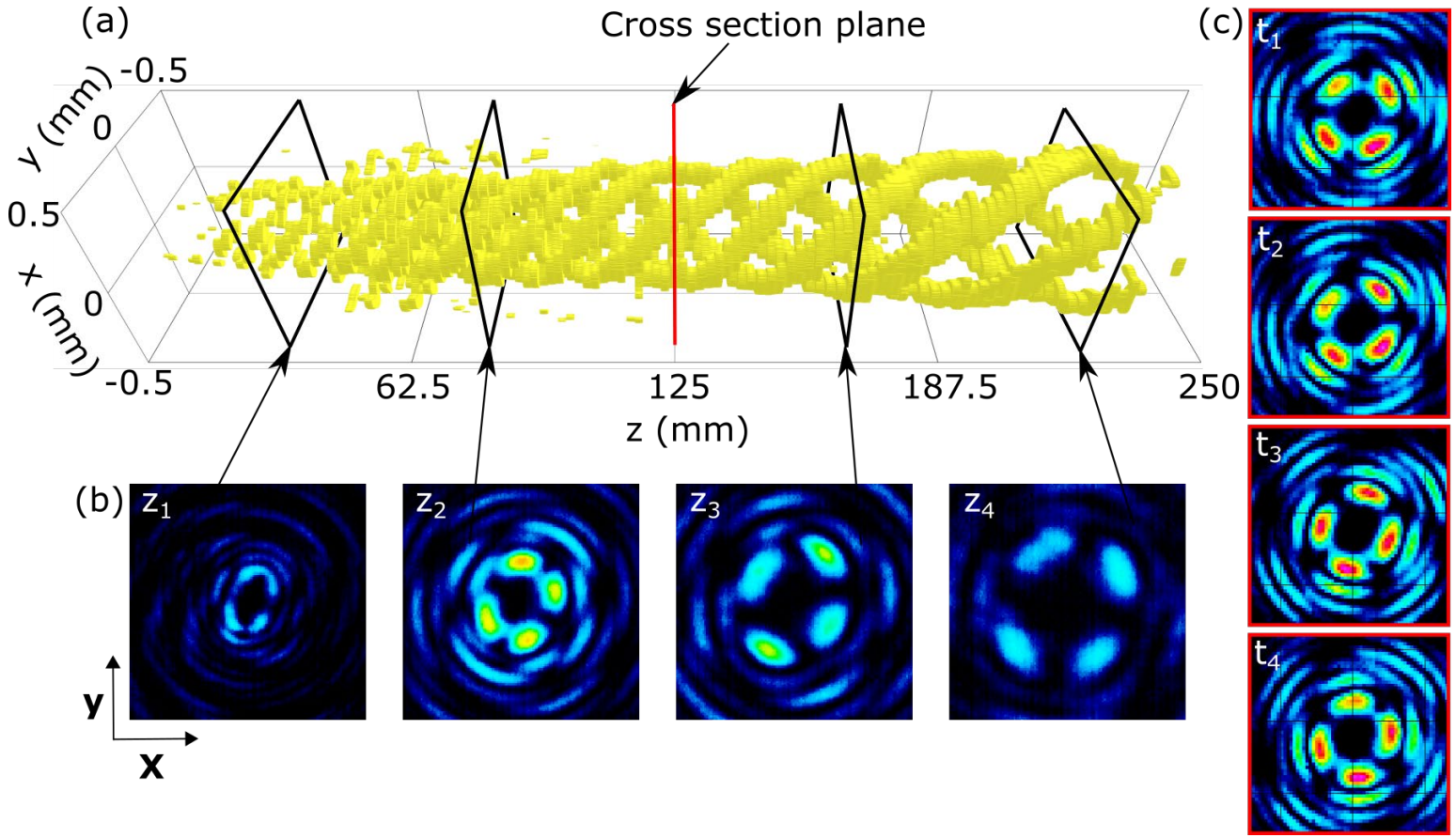
- Beam expander,
- Lambda/2 waveplate,
- Aperture/diff grating to separate 1st diffraction order,
- 4F system.





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Experimental reconstruction

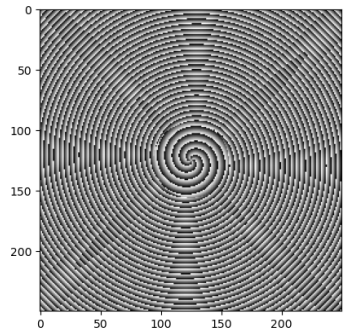


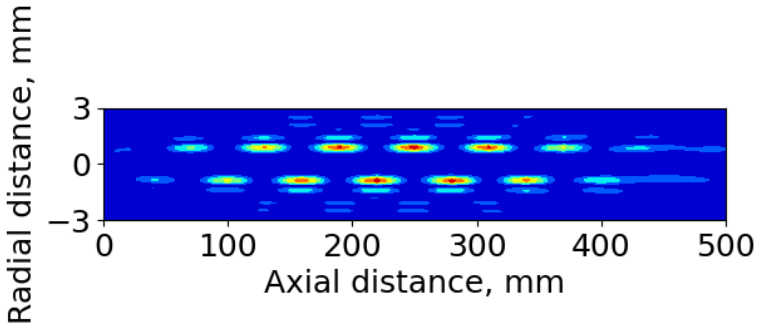
Dynamics of the optical drill

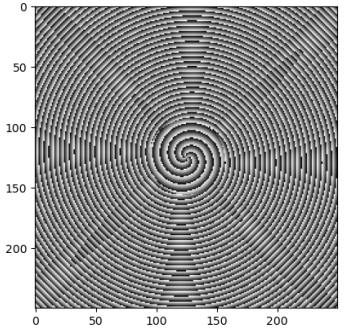
Phase hologram

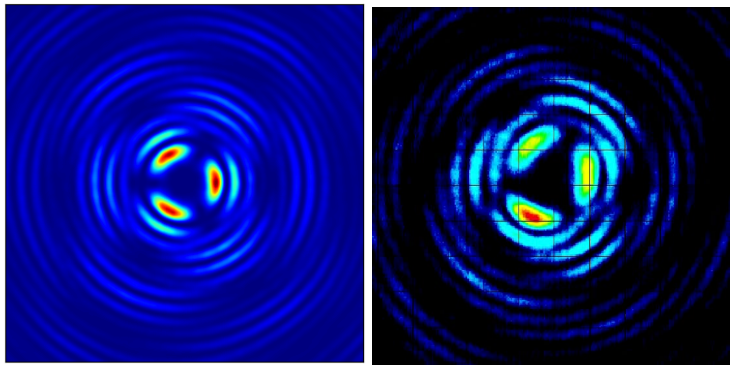
2D

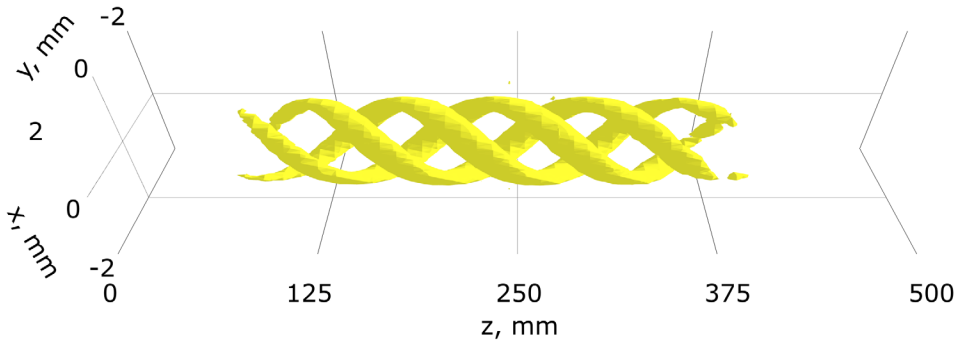
3D





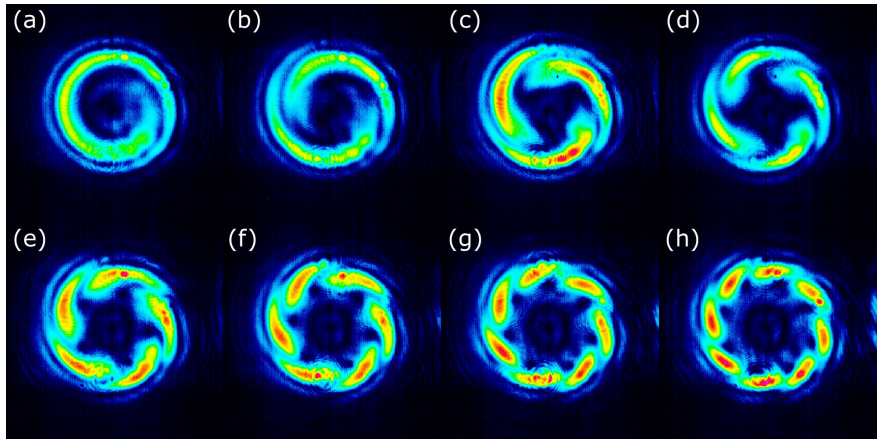




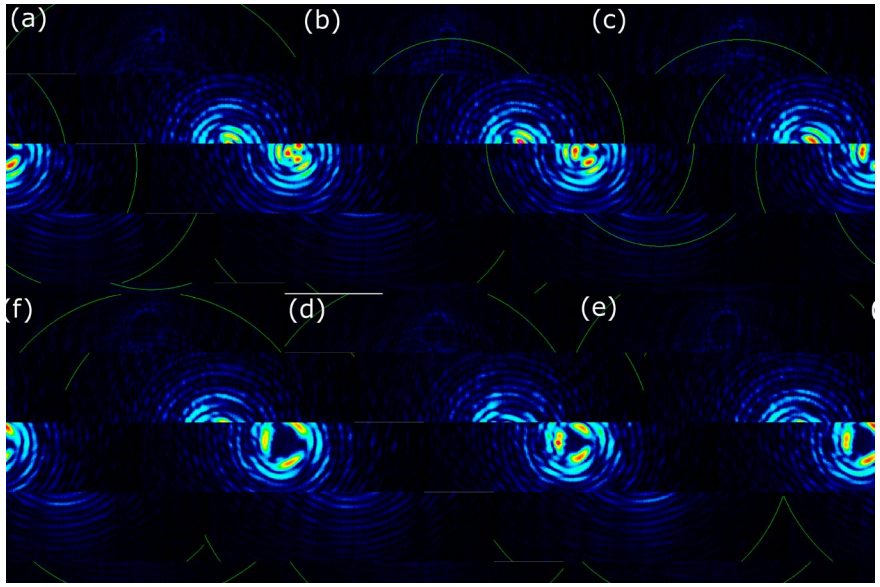


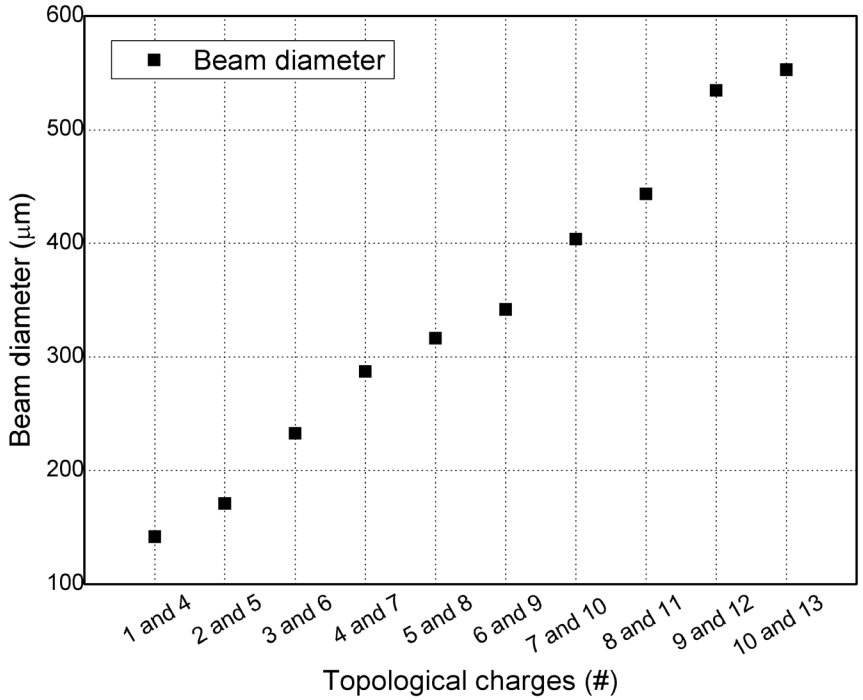
Change in topological charge pairs

$m_1 - const.$



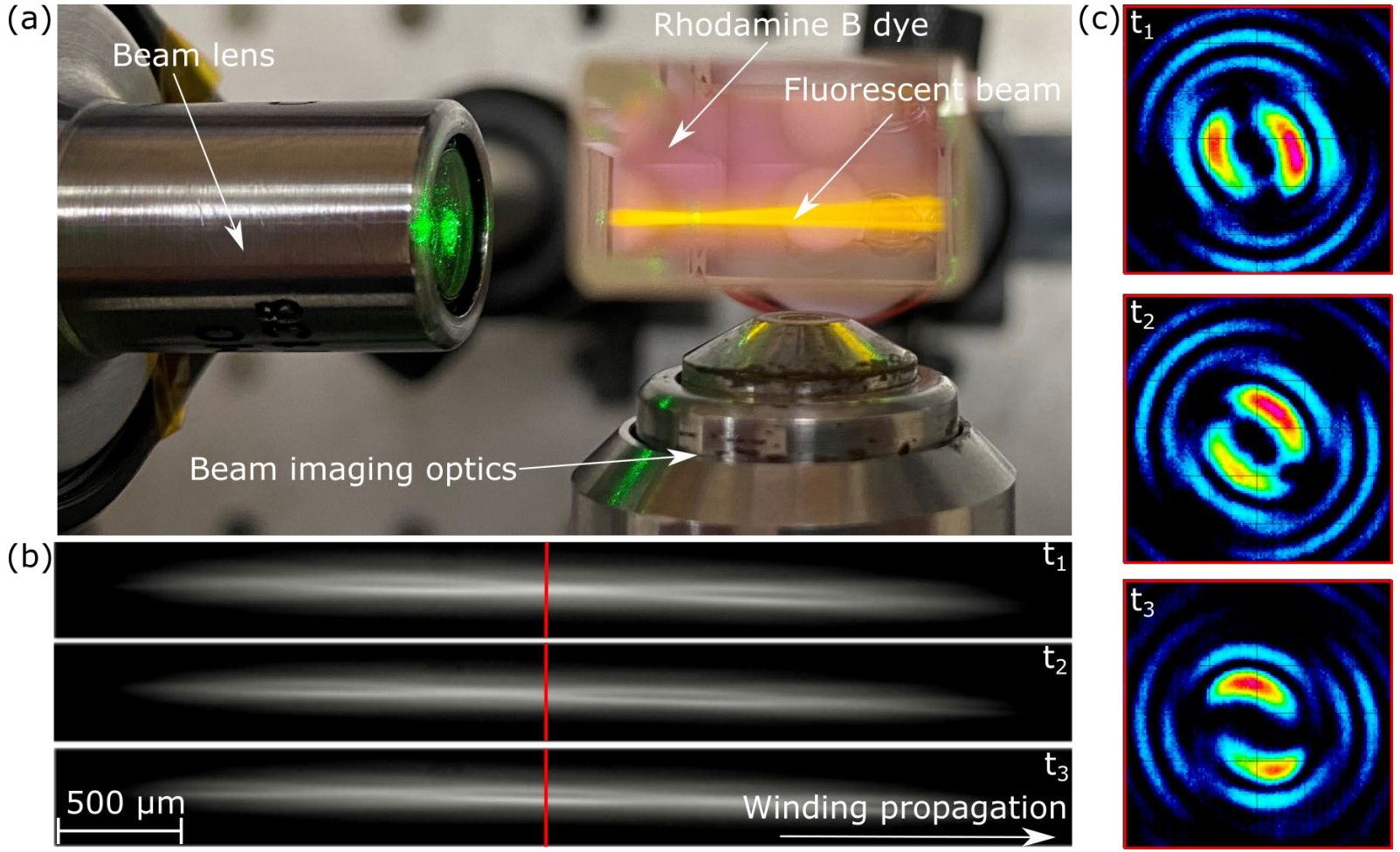
$\Delta m - const.$



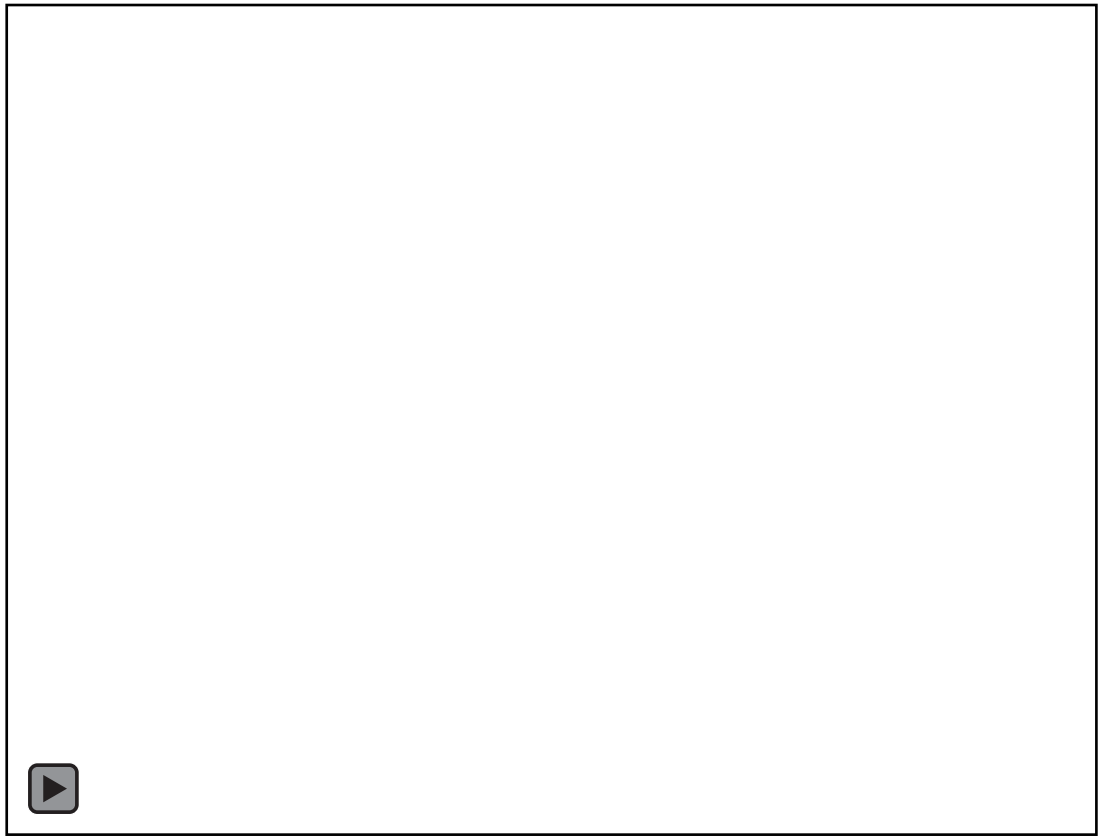


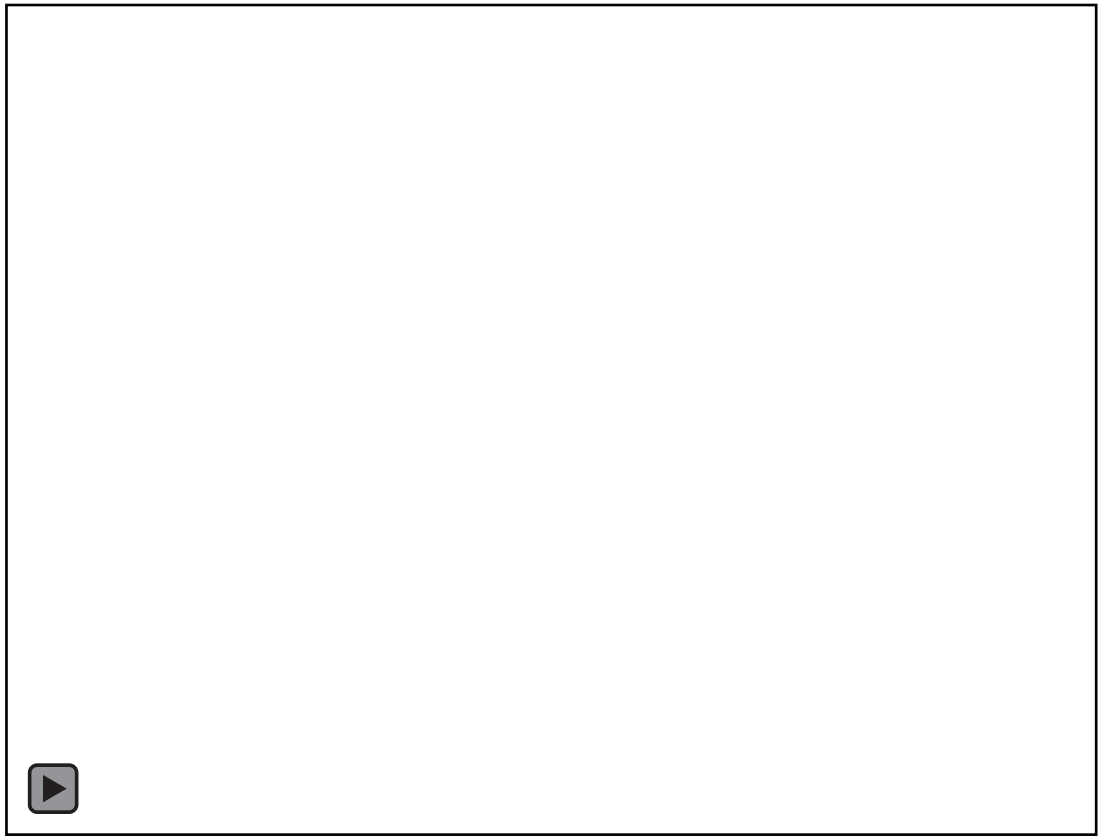
Fluorescence measurements (1)

- 4F system with 150 mm lens and 0.2 NA objective,
- Rhodamine B dyeas fluorescent material,
- Microscope of 0.65NA and 100 mm lens for visualization.



Fluorescence measurements (2)





Future outlook

1. Faster rotation
   a) Acoustic frequency shift induced rotation
   b) Different harmonic interference
2. Particle trapping
   a) Inducing orbital angular momentum
   b) Improved 3D particle trapping

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