Potential Landscaping for Ultracold Atoms using Holographic Optical Traps

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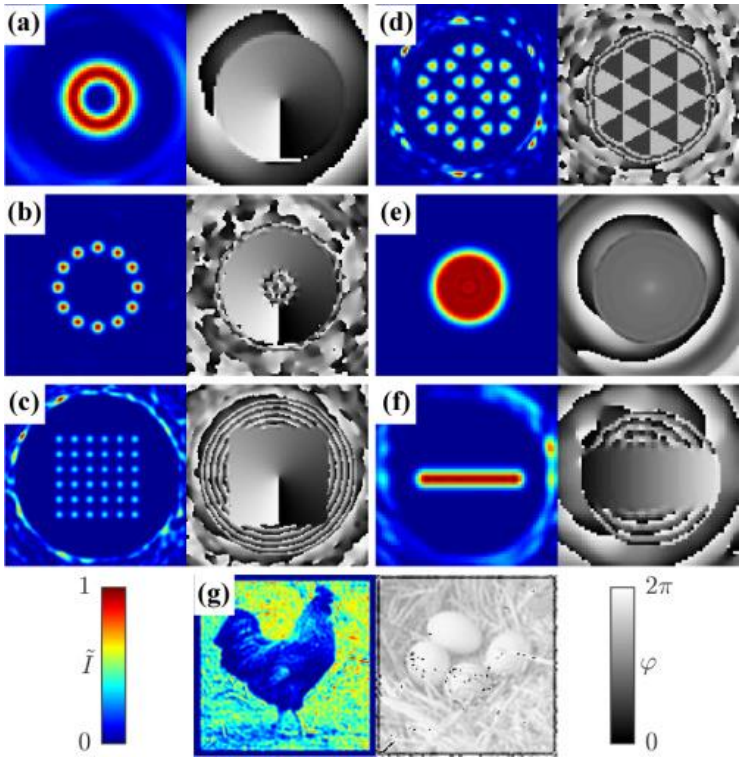
The development of new laser beam shaping methods is important in a variety of fields within optics, atomic physics and biophotonics. Spatial light modulators offer a highly versatile method of time-dependent beam shaping, based on imprinting a phase profile onto an incident laser beam that determines the intensity in the trapping plane laser field. The calculation of the required phase is a well-known inverse problem, which can be tackled with different approaches. Our method based on conjugate gradient minimisation [1] not only allows the calculation of smooth and accurate intensity profiles suitable for trapping cold atoms, but can also be used to generate multi-wavelength traps [2] and for simultaneous control over both the intensity and the phase of the light [3], with exceptionally high reconstruction fidelity.



Simultaneous control over the amplitude (colour) and phase (gray) of holographic optical traps [3]

References:

[1] T Harte, et al., "Conjugate gradient minimisation approach to generating holographic traps for ultracold atoms" Opt. Express **22**, 26548 (2014)

[2] D Bowman, et al., "Multi-wavelength holography with a single spatial light modulator for ultracold atom experiments" Opt. Express **23**, 8365 (2015)

[3] D Bowman, et al., "High-fidelity phase and amplitude control of phase-only computer generated holograms using conjugate gradient minimisation" Opt. Express **25**, 11692 (2017)