

# Manipulating structure lights by using nonlinear processes

Bao-Sen Shi<sup>1,2</sup>, Zhi-Yuan Zhou<sup>1,2</sup>

<sup>1</sup>University of Science and Technology of China, Hefei 230026, China;

<sup>2</sup>Synergetic Innovation Center of Quantum Information & Quantum Physics, University of Science and Technology of China, Hefei 230026, China

**Abstract:** Structure light, as light carrying orbital angular momentum (OAM), has exciting applications in many fields, including the studies of fundamental quantum physics, optical manipulation, and trapping of particles, astrophysics, high-precision optical measurements and optical communication, etc. Besides, in the quantum information field, a photon encoded with information in its OAM degrees of freedom enables networks to carry significantly more information and increase their capacity greatly due to the inherent infinite degrees of freedom for OAM. The frequency conversion of light carrying OAM gives rise to new physics and applications such as up-conversion detection of images and high dimensional OAM entanglements. We achieved a series of experimental progress on the control of light carrying OAM by using nonlinear processes. Our works will also have potential applications in many other fields, such as biology, astrophysics, night-vision technology, and chemical sensing.

## References

- [1] S. -L. Liu, et.al. Coherent frequency bridge between visible and telecommunications band for vortex light, *Opt. Express*, 25, 24290 (2017).
- [2] Z.-Y. Zhou et al, Superresolving Phase Measurement with Short-Wavelength NOON States by Quantum Frequency Up-Conversion, *Phys. Rev. Appl.* 7, 064025 (2017).
- [3] Z.-Y. Zhou et al, Orbital angular momentum-entanglement frequency transducer, *Phys. Rev. Lett.* 117,103601 (2016).
- [4] Z.-Y. Zhou et al, Orbital angular photonic quantum interface, *Light*, 5, e16019 (2016).
- [5] Z.-Y. Zhou et al, Orbital angular momentum light frequency conversion and interference with quasi-phase matching crystals, *Opt. Express*, 22, 20298 (2014)
- [6] Y. Li et al, Sum frequency generation with two orbital angular momentum carrying laser beams, *J. Opt. Soc. Am. B.*, 32, 407 (2015).
- [7] Z. -Y. Zhou, et al. Highly efficient second harmonic generation of a light carrying orbital angular momentum in an external cavity. *Opt. Express*, 22: 23673-23678, (2014)
- [8] Z.-Y. Zhou, et.al., Classical to quantum optical network link for orbital angular momentum carrying light, *Opt. Express* 23, 18435 (2015)
- [9] S Shi, et.al., Transcoder for the spatial and temporal modes of a photon, *Optics Express* 24, 13800-13811 (2016)