**Editorial Overview: Preface to the special issue on “Twisted Light with Orbital Angular Momentum”**

In the 1600s, Kepler proposed that the momentum of sunlight was the reason that the visible tails of comets pointed away from the sun. Beyond this optical linear momentum, in the early 1900s, Poynting reasoned how circularly polarized light also carries spin angular momentum (SAM) of ±*ħ* per photon (*ħ*: reduced Plank’s constant). In the 1930s, Darwin went beyond spin to consider how rare high-order atomic transitions required an additional angular momentum exchange between light and atoms corresponding to integer multiples of *ħ*. However, rather than being rare, in 1992, Allen, Woerdmann and co-workers recognized that every photon of a light beam having helical phasefronts carried this orbital angular momentum (OAM). These helically phased light beams (i.e., twisted light) have an OAM of 𝓵*ħ* per photon, where 𝓵 describes the azimuthal phase variation of exp(*i*𝓵𝜃) (𝜃: azimuthal angle). Since that time, the study of OAM and other more-general structured light beams with spatially variant amplitude/phase/polarization has grown into a significant field, giving rise to many developments in astronomy, optical manipulation and trapping, microscopy, imaging, sensing, nonlinear interactions, quantum science and optical communications.

This special issue aims to explore the fundamental properties of OAM-carrying twisted light and expanded structured light. It includes 1 invited review article and 2 contributed papers, focusing on the recent advances and future challenges in twisted light with OAM, structured light and their wide applications in various fields.

In the invited review article, Erhard, Fickler, Krenn and Zeilinger provide a comprehensive overview of new quantum perspectives regarding OAM-carrying twisted photons in high dimensions [1]. OAM states of twisted photons form discrete high-dimensional quantum systems, also called qudits. After a brief introduction of quantum information science and technology and OAM of photons, the advantages of high-dimensional quantum systems are addressed. Some recent developments and notable experiments in high-dimensional quantum information with OAM are presented, including the creation of high-dimensional entanglement, unitary transformations, optimal quantum cloning, long-distance high-dimensional quantum key distribution (QKD), quantum walk, quantum teleportation of multiple degrees of freedom of a single photon, and experimental creation of a Greenberger-Horne-Zeilinger state in three dimensions. Challenges of OAM-carrying twisted photons in high-dimensional quantum systems and several important open questions of general interest are finally discussed.

In the 2 contributed papers, Huang et al. report spiniform phase-encoded metagratings entangling arbitrary rational-order OAM [2]. A single metadevice comprising a bilaterally symmetric grating with an aperture is presented. The metadevice can create optical beams with controllable OAM values that continuously vary over a rational range. The feasibility of realizing quantum coincidence based on rational-order OAM-superposition states is demonstrated. Future applications in quantum communication and optical micromanipulation are also discussed. Liu et al. propose and demonstrate direct fiber vector eigenmode multiplexing transmission seeded by integrated optical vortex emitters [3]. Beyond OAM-carrying twisted light, there is more general interest in structured light, such as vector light with spatially variant polarization. Using radially and azimuthally polarized vector vortex modes generated from angularly etched silicon microring resonators, low-crosstalk km-scale data-carrying fiber vector eigenmode multiplexing transmission is demonstrated, which opens up added capacity scaling opportunities by accessing vector eigenmodes in the fiber and provides compact solutions to replace bulky diffractive optical elements for generating vector light.

The 3 papers selected in this special issue are a mere sample of the research works in this emerging field. It is expected to see more developments in twisted light with OAM and its expanded structured light.

Finally, we thank all authors who contribute their works and all reviewers who devote their evaluation efforts.

[1] [Erhard et al. Twisted photons: new quantum perspectives in high dimensions](http://www.nature.com/articles/lsa2017146) (Invited Review).

[2] [Huang K et al. Spiniform phase-encoded metagratings entangling arbitrary rational-order orbital angular momentum](http://www.nature.com/articles/lsa2017156).

[3] [Liu J et al. Direct fiber vector eigenmode multiplexing transmission seeded by integrated optical vortex emitters](http://www.nature.com/articles/lsa2017148).

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