frontiers | Frontiers in Physics

TYPE Editorial
PUBLISHED 01 February 2023
DOI 10.3389/fphy.2023.1146288

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Optics and Photonics, a section of the journal Frontiers in Physics

RECEIVED 17 January 2023
ACCEPTED 20 January 2023
PUBLISHED 01 February 2023

CITATION
Fu S, Luo H and Rosales-Guzmán C (2023), Editorial: Laser field manipulation and its advanced applications.
Front. Phys. 11:1146288.
doi: 10.3389/fphy.2023.1146288

Editorial: Laser field manipulation and its advanced applications

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KEYWORDS

laser field manipulation, orbital angular momentum (OAM), vectorial vortex beam, beam array, particle trapping

Editorial on the Research Topic
Laser field manipulation and its advanced applications

Laser field manipulation intra or extra a laser cavity is currently one of hot Research Topic in the field of photonics. A wide variety of novel beams, for instance, vectorial vortex beams [1], orbital angular momentum (OAM) comb [2], toroidal vortices [3], and high-dimensional beam arrays [4], can be well generated by tailoring various spatial and temporal degrees of freedom (DoFs) such as the OAM, spin angular momentum (SAM), phase, time/frequency, amplitude, and wave vector. Such novel beams have inspired a myriad of advanced applications covering classical and quantum physics, such as large-capacity optical communications, lidar, optical tweezers, laser processing, high-dimensional quantum entanglement, and gravity wave detection [5]. Hence, to show the recent advances in laser field manipulation and their enabled applications, we have organized this Research Topic, which we expect will motivate more state-of-the-art research.

The seven published papers in this Research Topic include both fundamental and engineering research on complex laser field tailoring and applications. Zhang et al. demonstrate ghost diffraction in crystallography, overcoming the bottleneck of low coherent X-rays, which provides low-resolution diffraction patterns from a spatially periodic object structure. Lu et al. investigate controllable self-focusing behavior *via* tailoring of the polarization DoF, bringing new opportunities for multidimensional optical manipulation. Geometric phase origins from polarization transformation along a Poincare sphere, which are usually determined by the main axis orientation arrangement of anisotropic units. Based on the geometric phase, Liu et al. propose compact planar dielectric elements to achieve OAM and SAM manipulation. Li et al. show a dielectric metalens to produce focal fields with oscillating SAM to induce a chiral-sensitive lateral optical force, providing a new source for optical trapping. Coherent combination is a promising means to produce high-power structured beams. Chang et al. demonstrate a cascaded internal phase control scheme, which is actually cascaded active phase-locking, to construct a fiber laser array, enabling the generation of complex vectorial vortex fields.

In terms of applications, Li et al. propose unwound polygonal vortex beams transformed from Laguerre-Gauss beams, through which massive parallel sorting of particles is achieved. A challenge of OAM-based free-space optical communications is the disturbance from atmospheric turbulence. Such turbulence will distort the helical wavefronts and increase bit-error-rates. Toward a practical OAM data-transmission link, Li et al. demonstrate a hybrid

two-stage variational mode decomposition and autoregression model to forecast atmospheric turbulence, thus providing a new strategy for compensating OAM distortions.

In summary, this Research Topic presents seven representative works on state-of-the-art laser field manipulation and its advanced applications. We expect that this Research Topic will build a bridge among different research areas, further promoting the development of laser field manipulation.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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