TOPOLOGICAL LASERS GENERATING AND MULTIPLEXING UNBOUNDED ORBITAL ANGULAR MOMENTA

Tech ID: 32034 / UC Case 2019-B18-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,191,633	01/07/2025	2019-B18

BRIEF DESCRIPTION

Optical vortices are specialized swirls of light energy that carry orbital angular momentum, a property highly prized for advanced optical applications. Historically, generating these vortices required passing standard laser beams through bulky external diffractive optics or custom-fabricated optical components. To streamline this process, UC Berkeley researchers have developed integrated, room-temperature lasers capable of directly generating and combining coherent light beams that carry arbitrarily large orbital angular momenta. The system achieves this by utilizing two-dimensional topological rings created at the circular boundaries between topologically distinct photonic materials, which naturally emit light vortices into the third dimension. Furthermore, the technology enables the planar multiplexing of these distinct beams on a single chip using a series of concentric lasers. This integration provides a direct bridge between topological matter and topological light, creating new opportunities for high-capacity data transmission and advanced optical manipulation.

SUGGESTED USES

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High-Capacity Communications: Multiplexing multiple independent channels of orbital angular momentum light onto a single optical path to dramatically increase data bandwidth in fiber-optic and free-space communication networks.

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Advanced Microscopy and Optical Tweezers: Using the structured force of the light vortices to trap, rotate, and manipulate microscopic biological cells or nanoparticles with high precision.

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Metrology and High-Precision Sensing: Employing the stable phase singularities of topological light to perform ultra-sensitive distance, rotation, and surface-mapping measurements.

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Quantum Information Processing: Generating high-dimensional quantum states to encode information for secure quantum cryptography and advanced quantum computing protocols.

ADVANTAGES

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INVENTORS

» Kanté, Boubacar

OTHER INFORMATION

CATEGORIZED AS

» **Optics and Photonics**

» All Optics and Photonics

» **Engineering**

» Engineering

RELATED CASES

2019-B18-0

Direct Laser Generation: Eliminates the need for external, lossy, and bulky beam-shaping optics by emitting the structured light vortices directly from the laser source.

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Unbounded Scalability: Capable of producing arbitrarily large orbital angular momenta, offering a theoretically unlimited number of distinct modes for data encoding.

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On-Chip Multiplexing: The concentric laser design allows multiple complex light beams to be combined and manipulated within a compact, planar device footprint.

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Ambient Operation: Operates efficiently at room temperature, making the technology highly practical for integration into existing commercial electronic and optical systems.

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Topological Protection: Capitalizes on the inherent stability of topological boundaries, ensuring that the generated laser modes remain robust against material defects or manufacturing imperfections.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Ultra-Broadband, High Efficiency, And Polarization Independent Achromatic Metalens

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