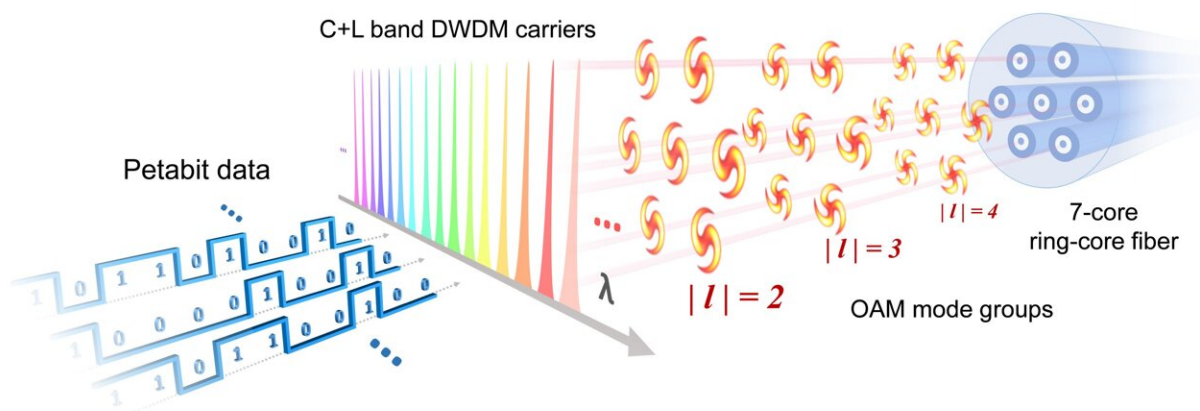


# Demonstrating a 1-Pbps orbital angular momentum fiber-optic transmission

August 26 2022



Credit: Junyi Liu et al

Space-division multiplexing (SDM) technology has a promising role in overcoming the so-called "capacity crunch" of existing single mode fiber (SMF). Now, researchers in China experimentally demonstrated an orbital-angular-momentum (OAM) mode based SDM transmission system with a total capacity over 1-Pb/s. The result has significant potential for further up-scaling communication capacity by exploiting the OAM modes in optical fibers while keeping multi-input multi-output (MIMO) processing to an ultra-low level of complexity.

With [internet traffic](#) approaching the capacity limit of SMF in the foreseeable future, optical communication technologies with larger transmission capacity is becoming ever more desired. However, in reported solutions that add more cores and/or modes per core into a fiber to increase the total capacity, there stands a fundamental bottleneck in that the MIMO processing complexity required for signal equalization can increase in square law with the channel counts (number of modes  $\times$  cores) due to the inter-channel crosstalk (XT).

Simply inserting many sufficiently separated cores in a fiber to ensure low inter-core XT will enlarge the fiber diameter, and diameters of more than 200 microns seriously degrade the performance of fiber fabrication, splicing, and reliability. Hence, new solutions are needed to balance the spatial channel counts, fiber cladding diameters and the MIMO complexity.

In a new paper published in *Light: Science & Applications*, a team of researchers led by Dr. Jie Liu and Professor Siyuan Yu from the State Key Laboratory of Optoelectronic Materials and Technologies, School of Electronics and Information Technology, Sun Yat-Sen University, China, have proposed and demonstrated a fiber-optic transmission system based on OAM modes.

The system integrates SDM, polarization division multiplexing (PDM) and C+L band dense wavelength division multiplexing (DWDM) over a 34-km long 7-core ring core fiber (RCF) of 180  $\mu\text{m}$  diameter, allowing a raw (net) capacity of 1.223 (1.02) Pb/s and a spectral efficiency of 156.8 (130.7) bit/s/Hz. In this system, they utilized three non-degenerate OAM mode groups (MGs) per core, each MG containing 4 near-degenerate OAM modes (12 modes in all).

Every mode is loaded with 312 wavelengths which are all modulated by 24.5-GBaud QPSK signals. By exploring the fixed OAM mode number

in each MG, the low coupling between MGs and cores, and the relative ease in OAM mode multiplexing, the researchers achieved simultaneous weak coupling among the seven fiber cores and amongst the three OAM MGs within each core, so that only a modular  $4 \times 4$  MIMO processing scheme is needed to equalize the coupling among the 4 near-degenerate modes in each MG.

The reported method demonstrates the promise of SDM fiber-optic systems with high scalability in the spatial channel count and the transmission capacity while maintaining low and fixed MIMO equalization complexity within a reasonable fiber cladding diameter. The researchers emphasize the key role of OAM modes in achieving the petabit per second transmission:

"These results take the capacity of OAM-based fiber-optic communications links over the 1-Pb/s milestone for the first time."

"They also simultaneously represent the lowest MIMO complexity and the 2<sup>nd</sup> smallest fiber cladding diameter amongst reported few-mode multicore-fiber (FM-MCF) SDM systems of >1-Pb/s capacity," they added.

"Therefore, the scheme demonstrates significant potentials for up-scaling of transmission capacity per optical fiber while keeping ultra-low MIMO complexity, and consequently, low cost and [low power consumption](#), by exploiting the uniquely excellent characteristics of OAM modes in ring core optical fibers over distances of tens of kilometers (e.g. the metro, or inter-data center links, etc.)," the researchers claimed.

**More information:** Junyi Liu et al, 1-Pbps orbital angular momentum fibre-optic transmission, *Light: Science & Applications* (2022). [DOI: 10.1038/s41377-022-00889-3](https://doi.org/10.1038/s41377-022-00889-3)

Provided by Chinese Academy of Sciences

Citation: Demonstrating a 1-Pbps orbital angular momentum fiber-optic transmission (2022, August 26) retrieved 19 April 2024 from <https://phys.org/news/2022-08-pbps-orbital-angular-momentum-fiber-optic.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.