Guest Editorial Special Issue on Progress in Photonic Spin-Orbit Interaction (SOI)

WE ARE delighted to present to the *IEEE Photonics Journal* this special issue on "Progress in Photonic Spin-Orbit Interaction (SOI)," which is a topic that has become a focus of great interest in the last decade.

Spin and orbital angular momenta (SAM and OAM) are two distinct components of light beams. The SAM is associated with polarization of the light, whereas the OAM is related to a helical wave front, which has an azimuthal dependence of phase and can be described by a topological charge. These two different forms of AM are independent of each other within the boundaries of paraxial propagation in space. However, they become intertwined when the light beam is traveling through inhomogeneous and anisotropic media, or is tightly focused beyond the paraxial condition, leading to the photonic SOI. The photonic SOI underpins many optical processes, thus playing a significant role in the modern optics. The photonic SOI has led to such intriguing optical phenomena, as photonic spin Hall effect, orbit Hall effect, spin-orbit Hall effect, optical Skyrmion, and interconversions between the spin and the orbital terms, among others. Importantly, the photonic SOI also holds promise for potential applications in nanophotonic devices, quantum information processing, precise metrology, and optical (including quantum) sensing.

This special issue aims to provide a platform for researchers to present the most recent discoveries and developments in the related areas. We present a collection of diverse papers in this special issue covering a broad range of topics: photonic SOI in anisotropic ENZ metamaterials and graphene-wrapped nanoparticles, photonic pseudospin Skyrmion, photonic wheels and polarization Möbius strips, robust geometric phase of Bloch sphere, deep learning recognition of OAM modes, and photonic spin Hall effect in photonic crystal slabs.

We thank Prof. Gabriella Cincotti, the Editor-in-Chief of *IEEE Photonics Journal*, for offering us the opportunity to organize this special issue. We also thank the authors for their enthusiastic response to the call for this special issue, and the IEEE editorial teams for their hard work during the review and publishing process of this special issue.

We hope that the journal audience will not be disappointed in the result of our effort.

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APPENDIX: RELATED ARTICLES

[A1] V. Aita and A. V. Zayats, "Enhancement of optical spin-orbit coupling in anisotropic ENZ metamaterials," *IEEE Photon. J.*, vol. 15, no. 1, Feb. 2023, Art. no. 0600108, doi: 10.1109/JPHOT.2022.3232460.

[A2] W. Liu, Z. Chai, K. Shi, and Z. Zhang, "Configurable spin orbital interaction utilizing vector beam interference," *IEEE Photon. J.*, vol. 15, no. 1, Feb. 2023, Art. no. 2700106, doi: 10.1109/JPHOT.2022.3233071.

[A3] F. Zhao et al., "Robust geometric phase of Bloch sphere deformation in quasiphase matched structures," *IEEE Photon. J.*, vol. 14, no. 3, Jun. 2022, Art. no. 3032006, doi: 10.1109/JPHOT.2022.3177687.

[A4] X. Gu, Y. Sun, L. Gao, A. Novitsky, W. Yu, and D. Gao, "Nonlinearity-tuned optical spin-orbit interaction of graphene-wrapped nanoparticles," *IEEE Photon. J.*, vol. 14, no. 6, Dec. 2022, Art. no. 3058705, doi: 10.1109/JPHOT.2022.3218815.

[A5] M. Lin, L. Du, and X. Yuan, "Photonic pseudospin Skyrmion in momentum space," *IEEE Photon. J.*, vol. 15, no. 1, Feb. 2023, Art. no. 6500106, doi: 10.1109/JPHOT.2022.3224216.

[A6] W. Li, P. Liu, C. Lu, F. Peng, H. Gao, and Y. Yang, "Generation and manipulation of optical Ferris wheel by nested spiral-array plates," *IEEE*

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Photon. J., vol. 14, no. 3, Jun. 2022, Art. no. 6533405, doi: 10.1109/JPHOT.2022.3178079.

[A7] Z. Wang, C. Yan, Z. Dong, F. Wang, Y. Chen, and Y. Cai, "Effect of degree of polarization on localized spin density in tightly focusing of vortex beams," *IEEE Photon. J.*, vol. 14, no. 4, Aug. 2022, Art. no. 6540008, doi: 10.1109/JPHOT.2022.3189626.

[A8] X. Pang, M. Hu, W. Liu, and X. Zhao, "Photonic wheels and polarization Möbius strips in highly-confined trigonometric beams," *IEEE Photon. J.*, vol. 14, no. 5, Oct. 2022, Art. no. 6553708, doi: 10.1109/JPHOT.2022.3205640.

[A9] R. Zhang et al., "Giant photonic spin Hall effect by anisotropic band in photonic crystal slabs," *IEEE Photon. J.*, vol. 14, no. 6, Dec. 2022, Art. no. 6562704, doi: 10.1109/JPHOT.2022.3221823.

[A10] Y. Xiang, L. Zeng, M. Wu, Z. Luo, and Y. Ke, "Deep learning recognition of orbital angular momentum modes over atmospheric turbulence channels assisted by vortex phase modulation," *IEEE Photon. J.*, vol. 14, no. 5, Oct. 2022, Art. no. 8554909, doi: 10.1109/JPHOT.2022.3205947.