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# Topological particles in spherically polarized Bessel-X pulses

S. Savitski[1], J. Beršky[1] and S. Orlov[1]

[1]*Department of Optoelectronics, State research institute Center for Physical Sciences and Technology, Sauletekio av. 3, Vilnius, Lithuania*
Email: stanislau.savitski@ftmc.lt

Bessel beams exhibit non-diffracting behavior, making them of considerable interest for short-pulse applications [1]. For small cone angles, they are typically described within the scalar approximation. However, when the cone angle becomes sufficiently large, scalar theory no longer provides an accurate description, and a vectorial treatment of the electromagnetic field is required [2].

Skyrmions are topologically stable quasiparticles that have been predicted and demonstrated in quantum fields, solid-state physics and magnetic materials, but have only recently been observed in electromagnetic fields. In optics, skyrmions and other topological quasiparticles can be constructed with various three-dimensional vector fields, such as the electric field, spin angular momentum, and polarization Stokes vector [3].

In this work, we investigate the topological structure of spherically polarized Bessel-X pulses in different domains, including the Poynting vector, Stokes vector, and spin angular momentum.

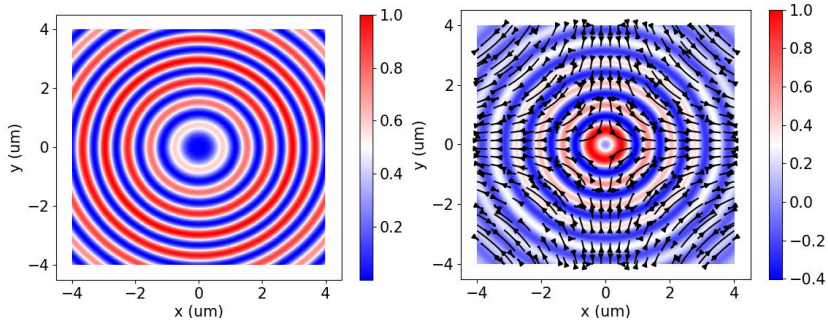


Fig. 1 Normalized total intensity of the transverse electric mode of the Bessel-X pulse (a) and the magnitude of the longitudinal component of the spin angular momentum (b), where the black streamlines with arrows show the orientation of the transverse field. The parameters of the simulation: the cone angle = 45 deg, the pulse duration α = 1.06e-14 s, frequency ω = 1.885e15 Hz, the topological charge m = 2, distance z = 0, time t = 0.

## REFERENCES

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[3] Shen, Y., Zhang, Q., Shi, P., Du, L., Yuan, X., & Zayats, A. V. (2024). Optical skyrmions and other topological quasiparticles of light. Nature Photonics, 18(1), 15-25.