Purely Geometric Spin-Orbit Laguerre-Gauss Waveplates

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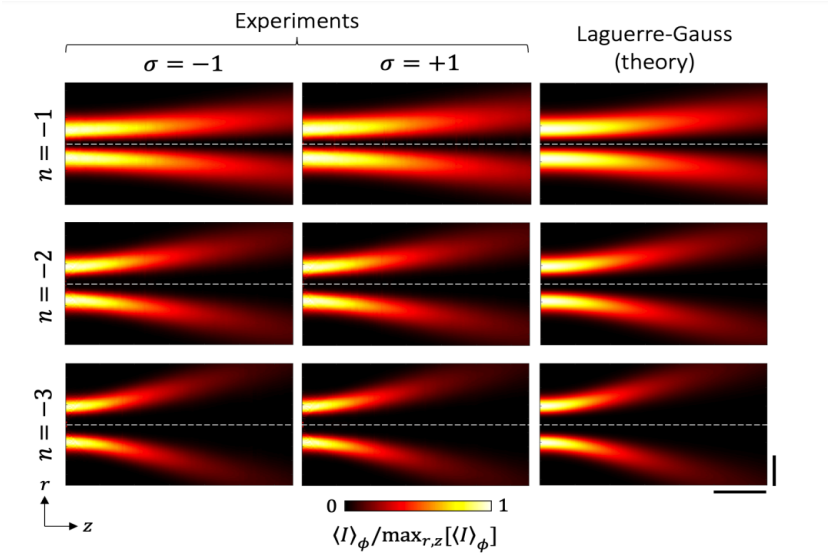
During my first year of PhD, I completed a work on spin-orbit modal beam shaping of light [1], where we experimentally demonstrate the possible generation of pure Laguerre-Gauss modes from a circularly polarized fundamental Gaussian beam by using properly designed optically anisotropic waveplates. This offers a novel class of optical elements to prepare structured light beams in a robust and compact manner.
The idea relies on the use of a 3D structured optically anisotropic retarder consisting of a space-variant half-wave plate sandwiched between two identical space-variant quarter-wave plates—a concept theoretically proposed a few years ago for designing doubly inhomogeneous effective waveplates, drawing inspiration from Pancharatnam's work in the 1950s. This approach eliminates unwanted dynamic phase spatial modulation that was a serious drawback of previously reported attempts towards the realization of perfect spin-orbit modal plates. Moreover, it can be implemented with any 2D optical axis patterning technology, such as photopatterned liquid crystals, laser-structured glass (which has been used here), or metasurfaces. In addition, although the resulting modal waveplates are designed to operate for predetermined values of incident beam size and wavelength, we experimentally and theoretically show that the modal behavior survives up to marginal deviations when the operating conditions do not match from the nominal specifications, which allows us reporting on polychromatic modal beam shaping.



Experimental and simulated normalized azimuthal average intensity distribution in the (z, r) plane for right-handed ($\sigma = -1$) and left-handed ($\sigma = +1$) circularly polarized incident Gaussian beams with beam waist radius w_0 and wavelength λ_0. Vertical scale bar: 1 mm. Horizontal scale bar: 30 cm[1].

[1] **Mufeeduzaman Chavilkkadan**, Sergei Shevtsov**, Peter Kazansky**, and Etienne Brasselet (Supervisor)*. *Purely Geometric Spin-Orbit Laguerre-Gauss Waveplates from 3D Laser-Nanostructured Silica Glass.* submitted to APL Photonics (presently under review).

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