Master 2 Internship

Title: Spin-orbit optomechanics of dielectric metasurfaces

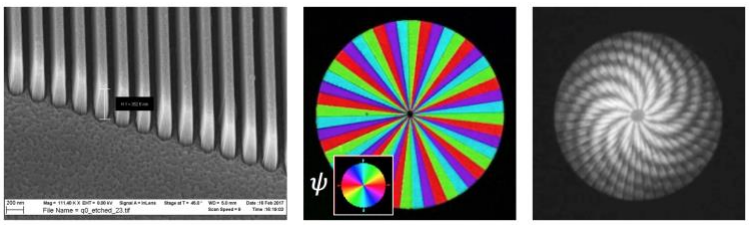
Supervisor: Etienne BRASSELET

Email: etienne.brasselet@u-bordeaux.fr

PhD funding : possible opportunities for interested candidates.

Project

Light can carry both spin and orbital angular momentum, which related to the polarization state of light and its spatial degrees of freedom, respectively. When optically anisotropic media are endowed with local spatial rotations, spin-orbit interaction takes place for the photons [1]. Dielectric metasurfaces—subwavelength-thick space inhomogeneous media endowed with subwavelength structuring—nowadays offer a routine pathway to shape light in arbitrarily structured manners. In particular, it is possible to tailor both the spin and orbit angular momentum transfer from light to matter (or inversely) when light passes through suitably structured media, which has been experimentally assessed in our group via optomechanical indirect [2] and direct [3] experiments. Very recently, this has been extended to free-to-move micro-metasurfaces [4], though restricted to the emergence of optical forces and optical spin torque. Here, in the framework of a collaboration collaborators from Switzerland and Australia with whom we developed free-standing micro-metasurfaces (see figure), we propose to address experimentally the challenging direct mechanical detection and quantitative measurement of the spin-orbit optical torques.



Structural and optical characterization of a disk-shaped diamond metasurface operating at maximal efficiency at 532nm, with 50µm diameter, 350nm thickness and 200nm local periodicity. Left: SEM image; Middle: color-coded experimental image of the in-plane orientation angle of the space-variant nanograting wavevector obtained by optical polariscopy. Right: optical vortex interference pattern with topological charge 12 recorded in bright field.

References

[1] K.Y. Bliokh, F.J. Rodriguez-Fortuno, F. Nori, and A.V. Zayats, *Spin-orbit interactions of light*, Nature Photonics 9, 796–808 (2015).

[2] D. Hakobyan and E. Brasselet, *Left-handed optical radiation torque*, Nature Photonics 8, 610-614 (2014).

[3] H. Magallanes and E. Brasselet, *Macroscopic direct observation of optical spin-dependent lateral forces and left-handed torques*, Nature Photonics 12, 461–464 (2018).

[4] D. Andrén, D.G. Baranov, S. Jones, G. Volpe, R. Verre and M. Käll, *Microscopic metavehicles powered and steered by embedded optical metasurfaces*, Nature Photonics 16, 970-974 (2021).

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