SOFT MATTER PLATFORM FOR OPTICAL DEVICES VIA ENGINEERING OF NON-LINEAR TOPOLOGICAL STATES OF LIGHT (TopoLight)
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Liquid crystals (LC) are advanced materials known for their anisotropic optical properties allowing to control the polarisation of light and are used in various optical devices. Now the time has come to push the LC applications further by implementing them into novel polariton devices to control topological properties of light. TopoLight deals for the first time with non-linear effects in room temperature Bose-Einstein condensate (BEC) and topological states of light uncovering astonishing possibilities of external electrical control over spin-orbit interaction due to artificially engineered fields acting on photons. With a two main technological approaches: originating from solid-state physics and developing molecular control of LC devices, we aim to demonstrate novel systems of tunable topological emitters based on room temperature BEC substantial in topological photonics and information encoding.

We will design, fabricate and investigate photonic structures to start an innovative integrated hybrid organic/liquid-crystal system for room temperature BEC research and applications. Our disruptive innovation is based on the idea of external electrical control over spin-orbit coupling due to artificially engineered fields acting on photons, which has never been realised in photonics. We will create topologically protected states of light: unidirectional flow robust against backscattering and vortex states carrying quantised angular momentum. We will utilise the strong non-linearities observed in organic microcavities and SOC in liquid-crystal cavities to the demonstrate single photon polarisation switches capable for ternary logic. Our OLC microcavities (MCs) platform will combine a strong emissivity with the ease of fabrication, low costs, and scalability and room temperature operation.