FerroTWIST | Light-Driven Molecular Motion with Ferroelectric Twist

Most of us have likely used an electronic device equipped with an LCD screen. The acronym stands for *Liquid Crystal Display*, a liquid crystal-based display technology. The first LCD screen was developed in 1964 by George H. Heilmeier, working at RCA. His groundbreaking discovery is considered one of the most significant milestones in electronic engineering. Since then, demand for LCDs has grown steadily, with nearly all electronic devices featuring them - from television screens to smartphones and household appliances. This widespread adoption stems from the unique properties of **liquid crystals** (LCs). LCs are a state of matter that combines the fluidity of liquids with the ordered structure characteristic of solids. This rare combination allows for the control of the alignment of mesogens, the building blocks of LCs, using an external electric field.

In 2017, researchers identified and synthesised a specialised type of LC with **ferroelectric** properties. Unlike regular LCs, ferroelectric LCs show spontaneous polarisation, which allows them to keep their alignment even without an external electric field. That property promises numerous future applications. However, ferroelectric liquid crystals, aside from the electric field, do not respond to external stimuli, which significantly limits their potential.

The project aims to advance ferroelectric LCs through the development of light-responsive ferroelectric liquid crystals (Fig. 1). Light is an ideal stimulus because it allows for remote manipulation over matter with the highest precision and in a non-invasive manner. The project aims to achieve precise control over the properties of ferroelectric LCs by exploiting the motion of artificial molecular machines and switches. These synthetic molecules, like biological proteins in muscles, can change shape and function in response to external stimuli.

The research will focus on two main objectives: (**i**) using light to control the helicity of ferroelectric crystals, i.e., the so-called twist observed in their order; (**ii**) switching between polarised and non-polarised states (Fig. 1). In the next phase of the project, potential applications of newly developed photoresponsive liquid crystalline materials will be explored. Particular attention will be given to their use in adaptive light-responsive displays and reconfigurable data storage systems. This project will pave the way for a new generation of dynamic and multifunctional materials that could drive technological innovations in the future.

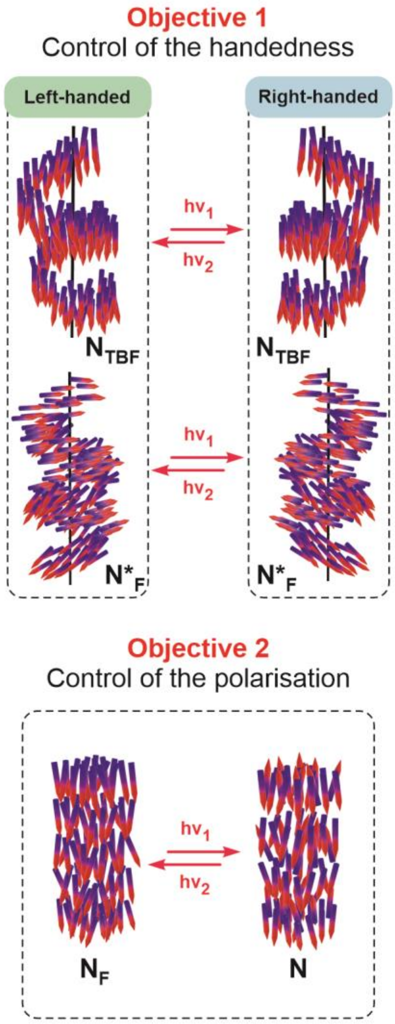

Fig. 1 | Schematic overview of goals of the project.