Chirality is a geometric property of some molecules, which are non-superimposable on their mirror image. As an universal feature, chirality can be observed at various levels of life on our planet, from subatomic and molecular to supramolecular and macroscopic. For example, only D-sugars and L-amino acids occurs in nature. In turn, nucleic acids like DNA or proteins like albumin are vital supramolecular systems. Supramolecular chirality is produced by non-symmetric arrangement of molecules through a noncovalent interactions like hydrogen bonds, hydrophobic effects and van der Waals forces. Therefore, supramolecular chirality can be produced from chiral components, the combination of chiral and achiral ones, or exclusively only by achiral molecules. The study in this project is focused on optical properties of superstructures built from both: chiral and achiral elements, in which induce chirality is observed. Induced chirality refers to those system, where due to the strong interaction with chiral components, optical activity of achiral ones can be recorded.

In order to study natural optical activity of chiral materials, which is the differential interaction of a chiral molecule with left versus right circularly polarized light, chiroptical techniques like: Electronic Circular Dichroism (ECD) and Raman Optical Activity (ROA) are planned to use in this project.

ECD is a type of spectroscopy based on the on the differential absorption of left- and right-handed circularly polarised light in the UV-Vis range. In turn, ROA is a relatively young technique, related with the observation of a small difference in Raman scattering intensity for right minus left circularly polarized light. Together with UV-Vis and Raman spectroscopy, ECD and ROA create a set of sensitive spectroscopic tools to study structure, helicity, optical properties of supramolecular systems.

The project generally refers to the chiral superstructures exposing induced chirality, built from both: chiral and achiral species, with the higher content of achiral components. As a natural chiral system, carotene crystals, released from a carrot root will be used. In order to deeper investigation, as an artificial model system supramolecular aggregates of naturally occurring xantophylls will be prepared.

Deeper examination of the supramolecular chirality, as well as the aggregation and induced chirality processes will allow for broader understanding of this phenomenon in model natural systems like carotene crystals. The results will also have an impact on the development of Raman Optical Activity technique.