

## Master 2 Internship

**Title: Light-triggered director bullets in nematic liquid crystals**

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### Project:

Topological defects (Nobel prize 2016) appear in all the branches of physics. Topological defects in liquid crystal director\*[1] have potential application for information encoding and storage, inclusions localization, or even tuning global properties (like in metamaterials) etc. Incorporating motion to these defects opens many novel applications: targeted delivery and communications in driven systems, auto-organization and collective phenomena in self-propelled systems.

Recently intriguing active topological defects were reported to appear in nematic liquid crystals driven by low-frequency AC electric field. These localized in space nematic director distortions were called “director bullets”[2]. One can tune their speed and direction (left or right in Fig.1) via frequency and amplitude of AC electric field. After three years of thorough studies by several leading research groups, “bullets” are described only in particular cases and still lack fundamental understanding.

In this M2 internship we suggest to master the “director bullets” in terms of (i) location of their generation and extinction, (ii) number of generated bullets and (iii) direction of their propagation. You will use the light for “triggering” the “bullets” and characterize their propagation using polarization microscopy.

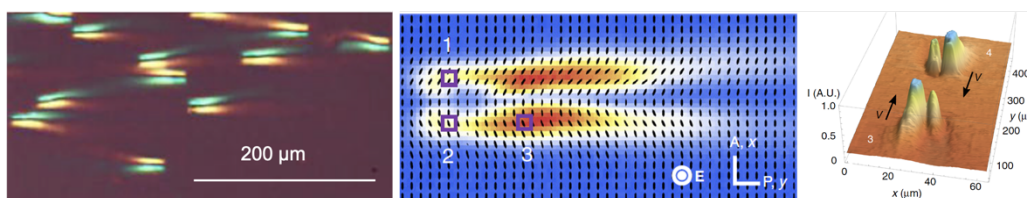


Figure1. Polarization microscope image (left), a sketch of individual internal structure (middle) and a 3D intensity plot (right) of director bullets (adapted from [2]).

[1] Kralj, M., Kralj, M. and Kralj, S. *Topological Defects in Nematic Liquid Crystals: Laboratory of Fundamental Physics*. Phys. Status Solidi A, 218: 2000752, (2021).

[2] B.-X. Li, V. Borshch, R.-L. Xiao, S. Paladugu, T. Turiv, S. V. Shiyankovskii and O. D. Lavrentovich, *Electrically driven three-dimensional solitary waves as director bullets in nematic liquid crystals*, Nature Communications, vol. 9, no. 2912, (2018).

\* director is a headless unit vector indication local averaged orientation of molecules of liquid crystal.