

PhD GRANTS 2024

PhD project title: Studies of optical shock waves generated during propagation in liquid crystals

PhD Supervisor: E. Louvergneaux

PhD project summary (max. 20 lines):

Everyone has heard of shock waves. One of its consequences is this "boom" that we hear when an airplane exceeds the speed of sound. It is also the case of tidal bores, these mini water walls that come round the rivers. They result from the sudden elevation of water at the entrance of rivers or estuaries. These "mini-tsunamis" are accompanied by waves in their wake, called dispersive shock waves.

Generally speaking, shock waves (or "shocks") are created when an abrupt change occurs in a system (abrupt rise in water in the case of a tidal bore). We are here concerned with the generation of shock waves in optics; and more particularly, the shocks resulting from the injection of a laser beam exhibiting an intensity profile discontinuity through a non-linear medium.

The goal is to study shock waves during optical propagation through a medium whose non-linearity has a non-local response and which is stochastic - a liquid crystal. We aim at exploring if the generic structure of such a shock wave (jump) is always composed on one side (upstream) of solitary waves and on the other end (downstream) of dispersive linear waves. Another aim pursued is the control and manipulation of the light trajectory of this shock. The idea here is to take advantage of the non-linear effect and the characteristics of the medium to control and manipulate the trajectory of the light in order to carry out "routing" of light.

The goal is to explore the nonlinear effects obtained during optical propagation, understanding the underlying mechanisms as well as the influence of the parameters of the system (in particular the non-local response of the nonlinearity). The thesis will mainly include aspects of setups and realizations of optical experiments, as well as numerical simulations to understand and explain the experimentally observed phenomena.