

Contrats doctoraux 2026

Titre du projet de thèse : Manipulation of optical solitons and Generalised Hydrodynamics

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Résumé du projet de thèse (en 20 lignes maximum) :

Solitons are fundamental entities that are ubiquitous in nonlinear dispersive wave systems. In optical fibres, they manifest as shortpulses that propagate without deformation over very long distances. Solitons exhibit remarkable properties and can be described as particles interacting through elastic collisions. In recent years, the concept of soliton gases (large random ensembles of interacting solitons) has attracted increasing attention across various fields of nonlinear physics due to its ability to describe complex phenomena related to integrable turbulence. However, their large-scale emergent behaviors remain poorly understood. 'Generalised Hydrodynamics' (GHD) is a recently developed theoretical framework designed to describe these behaviors in out-of-equilibrium quantum systems. It provides access to the average values of local observables as well as their spatio-temporal correlations. The objective of this thesis is to conduct original nonlinear optics experiments on fiber-based platforms aimed at generating, manipulating, and observing large ensembles of solitons to confirm GHD predictions and potentially refine its models. This work relies on the unique expertise of the host team, which has developed recirculating fibre loop systems enabling spatio-temporal control of waves during their propagation. Specifically, various configurations where solitons interact within external potentials of different forms will be studied, along with the impact of effects that break the system's integrability. The proposed activities also include numerical simulations of wave propagation and the use of machine learning tools to experimentally generate complex optical fields.

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Remarques/commentaires supplémentaires :