Meriem Bahhi

A mathematical study of a quasi-linear Schrödinger type-equation

We explore a Quasi-linear Schrödinger-type equation that is related to the describtion of the behavior of particles within atomic nuclei. Under some assumption on the parameters of the model we establish the existence, the uniqueness, and the non-degeneracy of positive radial solutions. Moreover, we analyze the behavior of these solutions according to the parameters.

Rana Badreddine

The Calogero-Sutherland derivative NLS equation

We consider a type of nonlocal nonlinear derivative Schrödinger equation on the torus, called the Calogero-Sutherland DNLS equation.
We derive an explicit formula to the solution of this nonlinear PDE. Moreover, using the integrability tools, we establish the global well-posedness of this equation in all the Hardy-Sobolev spaces $H^s_+(\mathbb{T})$, $s\geq 0$, down to the critical regularity space, and under a mass assumption on the initial data for the focusing equation, and for arbitrary initial data for the defocusing equation. Finally, a sketch of the proof for extending the flow to the critical regularity $L^2_+(\mathbb{T})$ will be presented.

Louise Gassot

Zero-dispersion limit for the Benjamin-Ono Equation

We focus on the Benjamin-Ono equation on the line with a small dispersion parameter. The goal of this talk is to precisely describe the solution at all times when the dispersion parameter is small enough. This solution may exhibit locally rapid oscillations, which are a manifestation of a dispersive shock. The description involves the multivalued solution of the underlying Burgers equation, obtained by using the method of characteristics.
This work is in collaboration with Elliot Blackstone, Patrick Gérard, and Peter Miller.

Patrick Gerard

Explicit formulae for a class of integrable PDEs and applications.

I will review recent results establishing explicit formulae for solutions of a class of integrable partial differential equations, including the Benjamin-Ono equation. I will give examples of applications to global wellposedness and to various asymptotics.

Eddy Brandon de Leon

Ray tracing in stationary axisymmetric vacuum spacetimes

In this talk I will show a numerical study of some solutions to the stationary axisymmetric Einstein equation generated via solutions to the Ernst equation, which is an integrable system. These solutions are constructed on hyperelliptic curves of genus g and as a special case, black hole spacetimes can be constructed. However, these solutions have not been widely explored due to the complexity of computing the non-elementary functions that describe these spacetimes and thus the first task is implementing a routine to compute such functions efficiently. This allows to compute solutions to the geodesic equations efficiently, which are systems of ODEs describing the motion of light and particles, and combined with ray tracing techniques to generate the necessary initial conditions to perform image simulations, it is possible to visualize images in these spacetimes. With these methods we are able to reproduce phenomena observed in black hole spacetimes, but they are general enough to explore analogous phenomena in any stationary axisymmetric spacetime.

Jonas Lampart

The strong-coupling limit of the Dirac-Klein-Gordon system

I will discuss how the Dirac-Klein-Gordon system gives rise to the (cubic) nonlinear Dirac equation in the limit of strong coupling and large (field) mass.
Joint work with Loic Le Treust, Simona Rota Nodari and Julien Sabin.

Guopeng Li

Deep-water and shallow-water limits of statistical equilibria for the intermediate long wave equation

The Intermediate Long Wave equation (ILW) models the internal wave propagation of the interface in a stratified fluid of finite depth, establishing a natural connection between the deep-water regime (the Benjamin-Ono (BO) regime) and the shallow-water regime (the Korteweg-de Vries (KdV) regime). In this talk, I will address convergence issues for ILW from a statistical mechanics viewpoint at different energy levels. By exploiting both the Hamiltonian and completely integrable structure of ILW, BO, and KdV, I will delve into the convergence of Hamiltonian and higher-order conservation laws for ILW, along with their associated measures and dynamics. Two interesting phenomena arise: (i) the modes of convergence of the measures in the deep-water and shallow-water limits differ. (ii) KdV, appearing in the shallow-water limit, possesses half as many conservation laws as ILW and BO, leading to a 2-to-1 collapse phenomenon.

This talk is based on joint works with Tadahiro Oh, Andreia Chapouto (both Edinburgh) and Guangqu Zheng (Liverpool).