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Nonlinear PDEs with potentials and the stability of Solitons and Kinks

Solitons are coherent structure that emerge from the balance of linear restoring forces and nonlinear focusing interactions in many physical models. They play a key role in our understanding of complex nonlinear systems and their time evolution. While the literature on classical (spatially localized) Solitons is very extensive, much less is known about Topological Solitons, which are typically non-localized structures. The simplest example of a Topological Soliton is a 1 dimensional 'Kink', a stationary solution which connects two different trivial states at plus and minus infinity.

The starting point for the analysis of all these coherent structures is the linearization of the equations in their vicinity. This naturally leads to study nonlinear evolution equations of wave/dispersive-type with large potentials. In this talk we will give an introduction to this class of problems, and present some recent results with applications to the stability of kinks and Solitons, and to the phenomenon of "Radiation Damping". Our general approach is based on the use of the distorted Fourier transform, that is, the Fourier transform adapted to a Schrödinger operator, and the development of multilinear Harmonic Analysis in this setting.

This talk is based on joint works with P. Germain (Imperial), F. Rousset (Paris-Saclay Orsay), A. Soffer (Rutgers), G. Chen (Georgia Tech), T. Léger (Princeton), Z. Zhang (NYU), A. Kairzhan (U of Toronto).