# Orbital stability and instability of fractional KdV solitary waves

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## Abstract

Consider nonlinear dispersive PDEs of the form

$$\partial_t u = \partial_x(|\partial_x|^\alpha u - u^p), \tag{1}$$

where $u = u(t,x) : \mathbb{R} \times \mathbb{R} \to \mathbb{R}$ is the unknown, $\alpha \in (1/3, 2]$ describes the strength of the dispersion, and $p > 1$ represents a "generic" power law nonlinearity. This family of problems encapsulates a number of important hydrodynamical models, including the famous Korteweg–de Vries ($\alpha = 2$, $p = 2$) and Benjamin–Ono equations ($\alpha = 1$, $p = 2$).

It is well-known that (1) has solitary wave solutions, and there is an extensive literature devoted to studying their stability properties. Notably, Bona, Souganidis, and Strauss obtained a general stability/instability criteria that applied for $\alpha \in [1, 2]$. In this talk, we will present a new, more direct proof of this seminal result. Our argument relies on a relaxed version of the Grillakis, Shatah, and Strauss method that can treat Hamiltonian systems like (1) for which the Poisson map is not surjective but has dense range. In fact, we are able to extend the theorem to the fractional regime $\alpha \in (1/3, 1)$. This is joint work with Kristoffer Varholm (NTNU) and Erik Wahlén (Lund).