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The dynamics soliton gasses: Fredholm determinants, asymptotics, and kinetic equations

I will describe a collection of collaborations with K. McLaughlin (Tulane U.), T. Grava (SISSA/Bristol), R. Jenkins (UCF) and A. Minakov (U. Karlova). We analyze the case of a regular, dense (modified) KdV soliton gas and its large time behaviour in the presence of a single trial soliton. We show that the solution can be decomposed as the sum of the background gas solution (a modulated elliptic wave), plus a soliton solution: the individual expressions are however quite convoluted due to the interaction dynamics. We are able to derive the local phase shift of the gas after the passage of the soliton, and we can trace the location of the soliton peak as the dynamics evolves; additionally, we show that the soliton peak, while interacting with the soliton gas, has an oscillatory velocity whose leading order average value satisfies the kinetic velocity equation analogous to the one posited by V. Zakharov and G. El.