Efim Pelinovsky, J Astrophys Aerospace Technol 2017, 5:3 (Suppl)
DOI: 10.4172/2329-6542-C1-010

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Solitons gas and turbulence in the long wave hydrodynamic systems, described by the Korteweg-de Vries-type equations

Solitons are an important part of the modern nonlinear physics providing the wave propagation over long distances. In integrable systems like KdV and NLS equations, there are a lot of approaches (inverse scattering method, Darboux and Backlund transformations, bilinear Hirota method) allowing obtaining rigorous solutions for description of Solitons interaction. Solitons turbulence is specific in the theory of wave (weak) turbulence, and kinetic equations are derived here for parameters of the associated spectral problem (AKNS scheme), and not for spectral characteristics of the wave field. Vladimir Zakharov was the first who has shown it in 1971 the important role of pair collisions of Solitons within the Korteweg-de Vries equation. Then, a kinetic equation for the Solitons parameters has been developed by Gennady El with his coauthors to describe various properties of solitonic gas taking into account two Solitons elastic interaction. In our paper, we study the solitonic gas in the integrable systems described by the Korteweg-de Vries (KdV) and modified KdV equations. First of all, we investigated the features of two Solitons interaction which can influence on the statistical characteristics of a solitonic gas. Then, we compute analytically the statistical moments of solitonic gas of low density in periodic domain for the times when Solitons interaction can be ignored (for instance, if Solitons are isolated at initial time). Then, dynamics of a solitonic gas is studied numerically with use of pseudo-spectral method in periodic domain. Initially, a wave field is presented by the set of isolated Solitons with random amplitudes located on the same distance between neighbor Solitons. We studied the process of the freak wave formation in the solitonic gas described by the mKdV equation. Typical shape of freak wave in the solitonic gas is shown in Figure

Biography

Efim Pelinovsky is a PhD, and Dr. Sc. Holder. He is a Professor of Chief Scientist at the Institute of Applied Physics and State Technical University, and also Professor at Higher School of Economics. He works in the theory of nonlinear waves in hydrodynamics, ocean physics and plasma physics. He is an author of more 1o books and 500 papers. His h-index is 30 (WoS) and 32 (Scopus). His main results are: Asymptotic method for non-sinusoidal waves in dispersive media, adiabatic theory of soliton evolution in inhomogeneous medium, nonlinear sea wave run up on a coast, evaluation of coastal wave hazards, mechanisms of the freak wave phenomenon. He is a Laureate of the Russian State Prize (1997), Soloviev Medal from European Geoscience Union (2006) and award from Int. Tsunami Society (2012).

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