Once more on the dominance of nonlinear transfer for wind-driven seas

V. E. Zakharov[1,2,3], **Sergei I. Badulin**[3,4]

[1]Department of Mathematics, Arizona University, USA

[2]P. N. Lebedev Physical Institute of the Russian Academy of Science, Russia

[3]Novosibirsk State University, Novosibirsk, Russia

[4]P.P.Shirshov Institute of Oceanology, Moscow, Russia

e-mail: *(zakharov@math.arizona.edu)*

We show that in the energy balance in the wind-driven sea the process of four-wave nonlinear interactions plays the leading role. This process surpasses competing mechanisms – input energy from wind and dissipation of energy due to white capping at least in order of magnitude. Our argumentation is based on a milestone case of fully developed sea introduced by Komen et al. (1984). Even in this extreme case when competition of wind input S_{in} and wave dissipation S_{diss} is, evidently, responsible for appearance of a stationary state, the constituents of the nonlinear transfer term S_{nl} – nonlinear damping and nonlinear forcing exceed dramatically these quasi-linear terms and determine wave spectra shaping.

The effect of four-wave nonlinear interactions in wind wave spectra is shown to be related mainly with quadruplets comprising of two long and two essentially shorter wave harmonics. It explains fast relaxation of high-frequency tails of wind-wave spectra to the Kolmogorov-Zakharov solutions of the weak turbulence theory. In particular, it explains naturally the effect of anomalously fast suppression of wind waves by sea swell observed both experimentally and numerically.

The work was supported by the Russian government contract 11.G34.31.0035 (signed 25 November 2010) and Russian Foundation for Basic Research grant 11-05-01114-a.