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Kinematic theory of nonlinear resonances

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In classical statistical wave turbulence theory only *non-resonant* wave interactions are taken into account and many important physical phenomena originated *nonlinear resonant* interactions are left unexplained. We argue that kinematic theory of nonlinear resonances should be regarded as a distinct research area in the nonlinear physics. We give a compendious overview of specific features that can (or cannot) appear in the 2-dimensional dispersive systems due to nonlinear resonances. Mathematical background and specially developed computational methods are briefly discussed as well as a novel geometric presentation of the resonance sets in the spectral space - non-planar graphs (2007) instead of classical dispersion curves. This representation gives a clear and transparent way to predict various *dynamical* characteristics of a nonlinear wave system (2008), for instance, spectrum anisotropy, cluster formation, etc. Some specially developed software for kinematic studies will be demonstrated (2008).

Possible applications of kinematic theory to the deeper understanding of freak waves formation in the ocean are discussed. Relevant classical and recent results are put together, and new points are established. Some directions of further studies are pointed out at the end.