Abstract for Dynamics Days Crete 2006
Topic: Dynamical Systems

Regular and Chaotic Dynamics of a Generalized Hamiltonian Associated with the Nonlinear Schrödinger Equation

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We formulate a Generalized Hamiltonian (GH), of N degrees of freedom, associated with the Nonlinear Schrödinger Equation (NLSE) using Fourier analysis in bounded space. We studied the regular and chaotic behaviors of the GH system for $2, 3$ and 4 $degrees - of - freedom$ using the energies of the systems as the bifurcation parameters. The *energy-momentum bifurcation diagrams (EMBD)* in the Poincaré section reveals the existence of elliptic, near elliptic and non-elliptic periodic orbits (for low energies); quasiperiodic orbits (for high energies); and chaotic orbits (for very high energies) - the higher energy behavior corresponding to very high perturbation in which the Kolmogorov-Arnod-Moser (KAM) surface is completely destroyed. The effect of an increase in N is a gradual transition from elliptic to non-elliptic orbits in the low energy region and while chaos is enhanced in the chaotic region, leading to increased unpredictabilty of the system behavior.