Arnold Web in the 3D LiCN Hamiltonian System

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Abstract

The dynamical structure of phase space can be revealed by the construction of composite Poincar surface of section. Unfortunately, this method is only feasible for two degrees of freedom (dof) Hamiltonian systems. Therefore as soon as a third mode is considered a new way of visualizing the dynamics is required. A good method for the characterization of invariant tori should provide accurate descriptions of invariant tori, and at the same time measure local diffusion strength, in order to distinguish regular from chaotic regions. For this purpose we use the frequency analysis(FA) method. Although these frequencies are, strictly speaking, only defined and fixed on these tori, the algorithm will compute a frequency vector over a finite time span for any initial condition. On the KAM tori, this vector is a very accurate approximation to the true frequencies, whereas at resonances and in chaotic regions it provides a natural interpolation between these fixed frequencies.

In this contribution we use the FA method to characterize the phase space of a 3 dof Hamiltonian model for the LiNC/LiCN system. In particular, we have located the main resonances of the system, the areas of quasiperiodic motion and the regions where Arnold diffusion is important, thus producing a picture of the global dynamics of the system.

For the trajectories that are chaotic, and invariant tori do not exist, the local frequency analysis, performed by following the time evolution of the frequency ratios, provides very useful information on the way in which they evolve in phase space.