Frequency Map and Global Dynamics in the Solar System : Short Period Dynamics of Massless Particles

Philippe Robutel[1], **Jacques Laskar**[2]

[1]*Astronomie et Systèmes Dynamiques, IMC, CNRS EP1825, 77 Av. Denfert-Rochereau, 75014 Paris, France. robutel@bdl.fr*
[2]*Astronomie et Systèmes Dynamiques, IMC, CNRS EP1825, 77 Av. Denfert-Rochereau, 75014 Paris, France. laskar@bdl.fr*

Frequency Map Analysis (FMA) is a refined numerical method based on Fourier techniques which provide a clear representation of the global dynamics of multi-dimensional systems, which is very effective for systems of 3 degrees of freedom and more, and was applied to a large class of dynamical systems (Solar System, galaxies, particle accelerators,...). FMA requires only a very short integration time to obtain a measure of the diffusion of the trajectories, and allows to identify easily the location of the main resonances. We have performed a complete analysis of massless particles in the Solar System, from Mercury (0.38 AU) to the outer parts of the Kuiper belt (90 AU), for all values of the eccentricities, and several values for the inclinations. This provides a complete dynamical map of the Solar System, which is, in this first step, restricted to mean motion resonances. The precise extend of the resonant islands in the phase space has been determined, and the vicinity of the phase space has been plotted for the 62 best known Kuiper belt objects. We have thus set up a system for the analysis of the numerous planetary systems which are expected to be discovered in the near future. As an example, we present the application of this method to the understanding of the dynamics of the newly discovered υ-Andromedae system.