Nekhoroshev theory and its applications: exponential estimates, chaos indicators and diffusion

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Abstract: In these lectures I will show how the Nekhoroshev theorem provides an important framework to study the dynamics of quasi-integrable Hamiltonian systems. In fact, on the one hand it provides the celebrated exponential estimates about the stability of the actions; on the other hand it supplies a set of techniques, constituting its proof, which are used to inspect numerically the instability of the action variables also on times longer than the Nekhoroshev stability time. In particular, the separation of the motions in a superposition of quasi-periodic oscillations, possibly chaotic (but bounded) fast drift oscillations, and an extremely slow chaotic diffusion along the resonances, has been observed in several numerical experiments.