Hamiltonian Dynamical Systems and Applications
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4 lectures on the N-body problem

Alain Chenciner
Observatoire de Paris-CNRS
61 avenue de lobservatoire
Paris, 75014
France
chenciner@imcce.fr

Abstract

In the first two lectures, Hamiltonian techniques are applied to avatars of the N-body problem of interest to astronomers: *the first one* introduces one of the simplest non integrable equations, the planar circular restricted problem in the lunar case, where most degeneracies of the general (non restricted) problem are not present: *the second one* is a quick introduction to Arnold's theorem on the stability of the planetary problem where degeneracies are dealt with thanks to Herman's normal form theorem. The last two lectures address the general (non perturbative) N-body problem: *in the third one*, a sketch of proof is given of Marchal's theorem on the absence of collisions in paths of N-body configurations with given endpoints which are local action minimizers: *in the last one*, this theorem is used to prove the existence of various families of periodic and quasi-periodic solutions with prescribed symmetries and in particular to extend globally Liapunov families bifurcating from polygonal relative equilibria. Celestial mechanics is famous for demanding extensive computations which hardly appear here : these notes only describe the skeleton on which these computations live.

References

[1] A. Chenciner, *Various papers, surveys,...* can be downloaded from: http://www.imcce.fr/Equipes/ASD/ person/ chenciner/chenciner.html.

[2] C. Conley, *On some new long periodic solutions of the plane restricted three-body problem*, CPAM **XVI** (1963), 449–467.

[3] J. Féjoz, *Démonstration du "Théorème d'Arnold" sur la stabilité du système planétaire (d'après Herman)*, Michael Herman Memorial Issue, Ergodic Theory and Dynam.Systems **24** (2004), no. 5, 1521-1582. Updated version at: `http://www.institut.math.jussieu.fr/~fejoz/`.