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Theory of Orbits Volume 1: Integrable Systems and Non-Perturbative Methods

D. BOCCALETTI and G. PUCACCO *(Astronomy and Astrophysics Library)*
(Springer, 1996) 412 pp., hardcover, ISBN: 3-540-58963-5, US $69

This volume is meant for students in astronomy and physics, but the reading is recommended to anyone interested in the field of celestial mechanics and stellar dynamics. The intent of the authors is to present the foundations of celestial mechanics and stellar dynamics in the common framework of orbital theory for integrable systems.

Considering the enormous literature on the subject (well sampled by the extensive references given) the authors' efforts have resulted in a well-written book, which can be read with pleasure not only by students but also by researchers active in the field.

In Chapter 1 a concise but exhaustive review of the basic principles and methods of Newtonian, Lagrangian, and Hamiltonian dynamics is presented. Chapter 2 deals with the two-body problem. The problem is examined and discussed thoroughly, and also such very interesting issues as the problem of regularization and the topologic properties are discussed.

In Chapter 3 the general results on the N-body problem are described and elucidated: existence theorems, singularities, and integrals of motions are treated. A particularly interesting section is that in which homographic solutions are discussed. In Chapter 4 the three body problem, "the most important problem of celestial mechanics", is finally approached. This chapter starts with the exposition of the celebrated Lagrangian solutions. After that, the Sundman and Levi-Civita regularization methods are carefully presented, and the restricted problem exhaustively discussed.

Finally, in Chapter 5 the basic properties of orbits in a given potential are summarized, moving from the simplest case (a spherically symmetric potential, with an extensive treatment of the isochrone potential), to the axisymmetric and to the triaxial potentials. In this last case the Stackel Theorem is proved. Finally, the problem of the motion in the field of two fixed points is discussed. This chapter is undoubtedly the nearest to the methods of stellar dynamics, and reading it is really a pleasure.

A second volume (*Theory of Orbits – 2: Perturbative and Geometrical Method*), dealing with the complementary subjects of the classical perturbation theory, KAM theory, Lie transform, adiabatic invariants, resonances and chaos, is due by mid 1997.

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