Chaotic Dynamics in N-body systems

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Ever since Isaac Newton in 1687 posed the N-body problem, astronomers have been looking for its solutions in order to understand the evolution of dynamical systems, such as our own solar system, star clusters and galaxies.The main difficulty is that small errors grow exponentially, so that numerical solutions diverge easily from the mathematical solution.

This thesis presents two new state of the art N-body algorithms, one of which is designed for high precision (Brutus) and the other for speed (Sakura). The assumption that N-body results are accurate in a statistical sense, is put to the test for three-body configurations. Finally, a new mathematical model is constructed that describes the origin of chaos in a dynamical system, and explains the short Liapounov time of Comet Halley's orbit.

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