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Title: *"Analytical treatment of long-term evolution of extrasolar systems: an extension of the classical Laplace-Lagrange secular theory"*

Abstract. One of the most remarkable properties of extrasolar planets is their possibly high orbital eccentricities, in contrast to the quasi-circular planetary orbits of the Solar System. The classical Laplace-Lagrange secular theory uses the circular approximation as a reference, thus its applicability to extrasolar systems can be doubtful.

We aim to show here that perturbation theory reveals very efficient for describing the long-term evolution of extrasolar systems. More precisely, we study the long-term evolution of two-planet extrasolar systems by extending the Laplace-Lagrange theory. We identify three categories of systems: (i) secular systems, whose long-term evolution is accurately described by an extension of the classical Laplace-Lagrange theory to a high order in eccentricities; (ii) systems that are near a mean-motion resonance, for which an extension of the Laplace-Lagrange secular theory to order two in the masses is required; (iii) systems that are really close to or in a mean-motion resonance, for which a resonant model has to be used.

In the first two cases, we determine the fundamental frequencies of the motion and compute precisely the long-term evolution of the Keplerian elements with a totally analytical method, based on Lie series. Coming to the resonant systems, we show how the long-term evolution can be accurately reproduced by including appropriate resonant combinations of the fast angles via a resonant normal form. This result extends the Laplace-Lagrange secular approximation to resonant systems.

Joint work with A.-S. Libert.