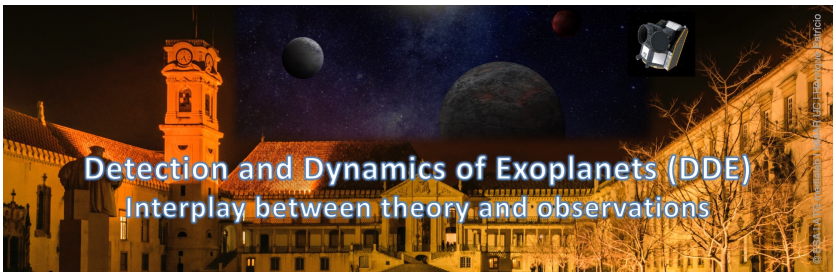

Contribution ID: **72** Type: **not specified**

Convergence of tori of maximal dimension towards tori of lower dimension in Hamiltonian systems close to integrable. Application to extrasolar planetary systems

Tuesday 8 July 2025 16:30 (15 minutes)

In nearly integrable Hamiltonian systems with n degrees of freedom, KAM theory guarantees, under suitable conditions, the existence of invariant tori of maximal dimension n , foliated by quasiperiodic orbits. In addition to these maximal tori, resonant tori of lower dimension p < n may also exist. These lower-dimensional tori play an important role in the study of extrasolar planetary systems. For example, in (Couetdic et al., 2010), we designed an algorithm based on frequency analysis (FA) to locate the center of libration of a 5:1 resonance in the HD202206 system. This involved the search for a 3-torus in a 4-degree-of-freedom system. Such an orbit is of interest because, during the formation of the planetary system, dissipative effects might have driven the system toward the center of libration of the resonance. Due to observational uncertainties, the best-fit orbit may not lie exactly at this center, yet an orbit located there could potentially provide a more physically relevant configuration for the system. While the FA algorithm proved very effective in locating lower-dimensional tori, it lacked some theoretical justification. In this work, we show how the FA algorithm enables convergence to such lower-dimensional tori starting from orbits lying on a full-dimensional torus. For a specific class of Hamiltonians, we derive an analytical estimate of the convergence rate of the algorithm. These theoretical estimates are found to be in good agreement with numerical results obtained in several examples. We also provide an improved robust algorithm for this search. This is a joint work with L. Guillot.

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Session Classification: Stability and dynamics of planetary systems