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**Title:** *"Stability dreams (with a symplectic friend) in Celestial Mechanics"*

**Abstract.** Is the solar system stable? This is one of the oldest open question in dynamical systems. It is still a lively and very active research field, even if many famous scientists like Newton, Lagrange, Maxwell, Poincaré and Birkhoff proved many astonishing results in this direction.

A lot of useful techniques are developed so far to tackle this problem: KAM theory, symplectic and contact methods, blow-up techniques, computer-assisted proofs, etc. One more (variationally oriented piece) we add to this arsenal: the index theory!

In this talk we try to shed some lights on the ideas behind some very recent results on this topic and we discuss some new perspectives and challenges in Celestial Mechanics. We show some amazing classes of equivariant periodic orbits and we prove very recent (in)stability results for a plethora of periodic motions via symplectic techniques.

Joint work with: V. Barutello, X. Hu and S. Terracini.