

Orbital evolution of giant planet satellite systems: from the Solar System to exoplanets

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The present-day orbital configurations of satellite systems around giant planets result from long-term evolution processes dominated by tidal dissipation and by the capture, crossing, and disruption of orbital resonances. Reconstructing realistic evolutionary scenarios is essential to robustly link the present states of these systems to their formation and subsequent history, and to interpret constraints from interior modelling and observations.

We will provide an overview of the main mechanisms governing the orbital evolution of large moons around giant planets, with particular emphasis on the Galilean satellites and the major moons of Saturn which offer complementary archetypes. On one hand, the Galilean system is dominated by the long-lived Laplace resonance, offering the perfect example of a stable resonant chain. On the other hand, observational constraints indicate that the Saturnian system is undergoing comparatively a rapid orbital evolution that possibly results from a disruption of past resonances.

This review will be organised along the following axes:

- **The role of orbital resonances (capture, stability, and disruption):** in the Jovian system, present configuration of the Laplace resonance and proposed scenarios for its formation and evolution; in the Saturnian system, constraints from present-day orbits on past resonant configurations, and implications for the moons' evolution
- **Dynamical evolution of satellite systems under tidal dissipation:** orbital migration, eccentricity and inclination evolution, orbit-rotation couplings, respective roles of dissipation within the planet and within the moons
- **Opening to exoplanet systems,** beginning with an overview on the characterization of compact resonance systems. We will discuss the challenges posed by observational constraints and theoretical aspects, drawing from both statistical studies of exoplanet populations and well-characterized systems such as TRAPPIST-1. We will raise a question on possible connection between exoplanets, and Solar System studies.