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Title: *"Resonance effects within LEO, MEO and GEO regions"*

Abstract. Due to the large number of debris, produced during the human space activity, the circumterrestrial space became unsafe. The impact of operative spacecraft or satellites with large enough space debris could result in a disastrous situation; the accumulation of debris in specific regions of the sky - where most of operative satellites are positioned - cannot be neglected anymore.

Space agencies have seriously considered the extent of the danger and started space situational awareness programs to investigate all sources of hazard both for Earth and its orbiting environments. Among these programs, monitoring and cataloguing the space debris population is now an ongoing activity with an ever enriching database.

On the theoretical side, it is of seminal importance to understand the global dynamics of this population in each specific region, LEO, MEO and GEO. The study of dynamics might provide practical solutions in the assessment of space debris mitigation measures and in the development of maintenance and control strategies.

In this talk, we describe several recent results describing the dynamics of resonances within LEO, MEO and GEO regions. Two types of resonance affect the motion of space debris, namely tesseral resonances, which occur when there is a commensurability between the Earth's rotation period and the orbital period of the space debris, and lunisolar resonances, which involve commensurabilities among the slow frequencies of orbital precession of the debris and the perturbing body. Tesseral resonances provoke variations of the semi-major axis on a time scale of the order of hundreds of days, while lunisolar resonances influence the evolution of the eccentricity and inclination on a much longer time scale, of the order of tens (or hundreds) of years.

By using both analytical and numerical tools, we provide a description of the main dynamical features of the two types of resonance, highlighting the phenomena occurring in each region of the sky. In particular, in the LEO region we discuss the interplay between the conservative and dissipative effects and we show that the orbital decay, caused by the air drag, can be balanced by resonant effects. In MEO and GEO, we show the existence of various dynamical phenomena such as splitting and overlapping of resonances, chaotic variations of the orbital elements, bifurcations, variations of the amplitude of resonances with respect to various parameters etc. We discuss the importance of these phenomena in the evaluation of the long-term evolution of the orbital elements, in particular the semi-major axis, eccentricity and inclination.

This talk refers to several works in collaboration with Alessandra Celletti.