

The Development of the InterPlanetary Superhighway
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Abstract

Our Solar System is interconnected by the "InterPlanetary Superhighway". This is a vast system of tunnels and passageways connecting the entire Solar System from the Kuiper Belt beyond Pluto, all the way to the Sun. Roughly speaking these channels are generated by the Lagrange Points of all of the planets and moons within the Solar System. Mathematically speaking, these are the invariant manifolds of unstable periodic and quasiperiodic orbits throughout the entire Solar System viewed as a series of coupled three body problems. This simple change of the model of the Solar System from a series of heliocentric conic orbits to a series of coupled three body problems significantly alters our understanding of the Solar System. In addition to the scientific implications of this paradigm shift, the InterPlanetary Superhighway is a space technology which has significant implications for the future of the development of space. In the year 2001, two NASA missions, Genesis and MAP were launched into halo orbits around L_1 and L_2 respectively, using the InterPlanetary Superhighway. The NASA Exploration Team is currently studying future plans for the coming decade on placing a lunar gateway module in halo orbit around the Lunar L_1 for astronauts to service space observatories currently being planned for Earth halo orbits such as the Terrestrial Planet Finder. The vast distances between the Earth's halo orbit and the Moon's halo orbit (1 to 2 million km) requires almost no energy for transport due to the existence of low-energy invariant manifolds. Similar structures in the Jovian and Saturn satellite systems may be exploited to provide innovative low energy missions in the near future. Like any other natural resource, the InterPlanetary Superhighway is a space technology that must be developed. Although we now possess a general theory of the dynamics of this complex system, we are only at the beginning of a long road to a systematic understanding of the dynamics and implications for transport within the Solar System, from the motions of natural bodies to that of artificial satellites. Whether the future development of space will be dominated by robotic missions or human missions, we will all need a road map of the low-energy pathways within the Solar System which can be provided by a systematic exploration and development of the InterPlanetary Superhighway.