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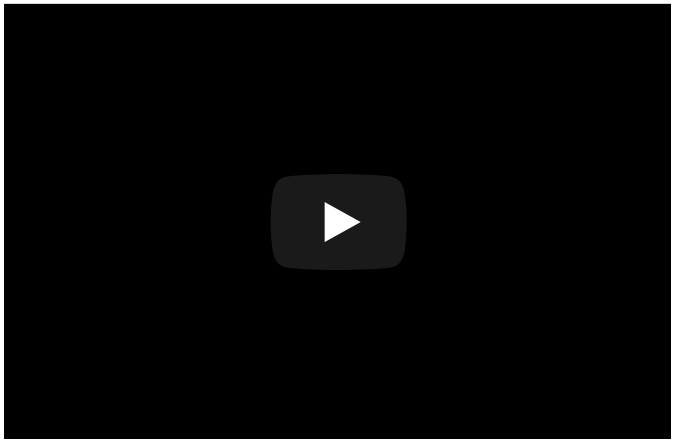
Researchers discover a new superhighway system in the Solar System



Researchers have discovered a new superhighway network to travel through the Solar System much faster than was previously possible. Such routes can drive comets and asteroids near Jupiter to Neptuneâ€™s distanceÂ in under a decade and to 100 astronomical units in less than a century. They could be used to send spacecraft to the far reaches of our planetary system relatively fast, and to monitor and understand near-Earth objects that might collide with our planet.

In their paper, published in the Nov. 25 issue of Science Advances, the researchers observed the dynamical structure of these routes, forming a connected series of arches inside what's known as space manifolds that extend from the asteroid belt to Uranus and beyond. This newly discovered "œcelestial autobahn," or œcelestial highway, acts over several decades, as opposed to the hundreds of thousands or millions of years that usually characterize Solar System dynamics.

"Simply put, these highways are entirely produced by the planets," said Aaron Rosengren, a professor in the Department of Mechanical and Aerospace Engineering at UC San Diego, and one of the paper's authors. "Asteroids, comets, etc., are candidates to travel along them, but do not produce their own 'fast routes'. Jupiter, being the most massive body in our planetary system, is responsible for most of the structures we've discovered, but each planet generates similar 'arches' and all of these structures can interact to produce quite complicated routes for transport."

The most conspicuous arch structures are linked to Jupiter and the strong gravitational forces it exerts. The population of Jupiter-family comets (comets having orbital periods of 20 years) as well as small-size solar system bodies known as Centaurs, are controlled by such manifolds on unprecedented time scales. Some of these bodies will end up colliding with Jupiter or being ejected from the Solar System.

The planets ‘carry’ their highways with them during their orbital motion about the Sun, and each planet has its own ‘network of celestial autobahns’. Routes originating from the different planets can cross mutually, which was previously known. Such complexities are almost impossible to describe mathematically, but the great power and scope of modern computers and numerical methods do allow researchers to at least visualize them in two- and three-dimensions.

The structures were resolved by gathering numerical data about millions of orbits in our Solar System and computing how these orbits fit within already-known space manifolds. The results need to be studied further, both to determine how they could be used by spacecraft, or how such manifolds behave in the vicinity of the Earth, controlling the asteroid and meteorite encounters, as well as the growing population of artificial man-made objects in the Earth-Moon system.

The Arches of Chaos in the Solar System
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