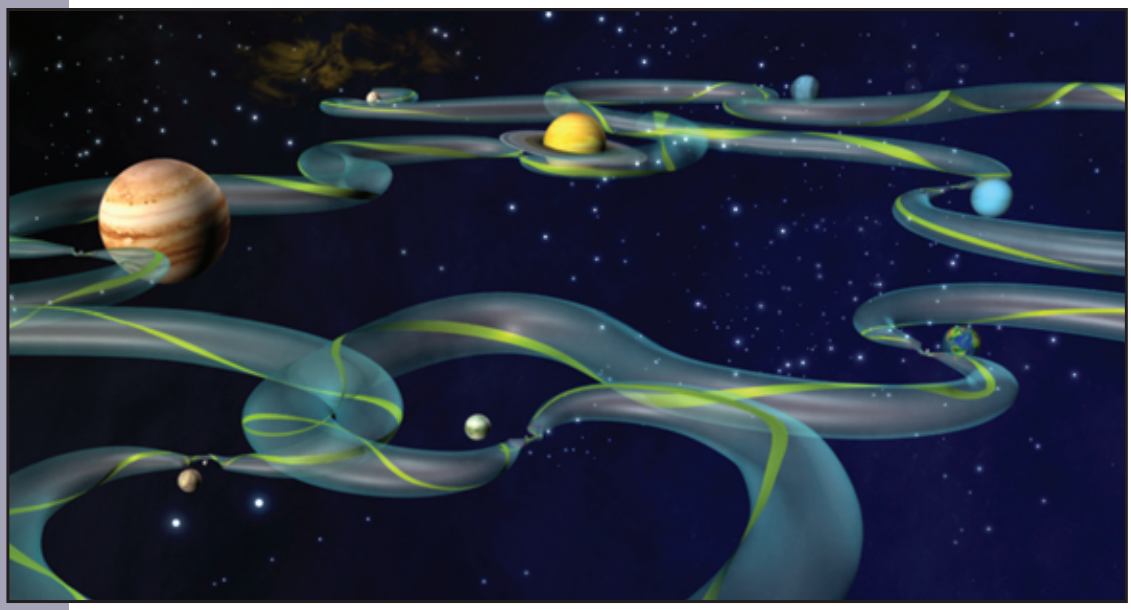
Boldly Going

The "tubes" below are illustrations of low-energy pathways along which space vehicles can travel using far less fuel. The recent discovery of these pathways has made previously impossible missions feasible. Much of space travel depends on calculus, trigonometry, and vector analysis, but the existence of these routes derives from an area of mathematics called dynamical systems applied to the mutual interaction of the gravities of the sun, nearby planets, and moons.

Calculations of forces between two celestial bodies and their orbits are fairly direct, but to understand orbits and trajectories when more than two bodies are involved, dynamical systems and chaos theory are necessary. Even the simplest extension beyond two bodies, the *three-body problem*, has been proven to have no explicit general solution. Some special cases, however, have been solved and applied not only to mission design, but also now to atomic physics to study the paths of certain excited electrons. Thus, mathematics is locating new routes for space travel and establishing connections between the atomic and the cosmic.

For More Information: "Ground Control to Niels Bohr: Exploring Outer Space with Atomic Physics," Mason A. Porter and Predrag Cvitanović, *Notices of the American Mathematical Society,* October, 2005.



Artist Concept of the Interplanetary Superhighway, courtesy of JPL, artist Cici Koenig.

AMS
American Mathematical Society

*The **Mathematical Moments** program promotes appreciation and understanding of the role mathematics plays in science, nature, technology, and human culture.*

www.ams.org/mathmoments