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Celestial 'surfing' offers hope of cheap and efficient space travel



(Cici Koenig/JPL/NASA)

Chris Smyth

Spacecraft could be built to surf “gravitational tubes” between planets and moons, allowing longer and cheaper journeys around the solar system, scientists believe.

A network of looping passageways created by the competing gravitational pull of celestial bodies is being mapped by researchers, who believe that they could allow spacecraft to move effortlessly between orbits.

“There are low-energy passageways winding between the planets and moons that would slash the amount of fuel needed to explore the solar system,” said Shane Ross, a professor of engineering science and mechanics at Virginia Tech university, in the United States. “You can think of them as natural conduits through the solar system.”

The tubes — constantly shifting with the motions of the planets and moons — would be a particularly helpful way of exploring the moons of Jupiter or Saturn, Professor Ross told the British Science Festival in Guildford yesterday.

The tubes are formed between the “balancing points” in the gravitational fields of two large bodies. These, known as Lagrange points, exist at the place where the forces of attraction from each of the two bodies are exactly equal. A spacecraft at such a point will remain in the same position relative to each of the large bodies.

Many Lagrange points have been found in the solar system, where the gravitational pull of different bodies interact. Between them exist tube-like areas where forces would allow spacecraft to “fall” between one point and another.

“When there’s more than one gravitational body in addition to the Earth, things get pulled in strange ways,” Professor Ross said. “There are freefall paths through space.”

He added: “I like to think of them as similar to ocean currents, except they are gravitational currents.” Just as ships could drift around the world on ocean currents, so spacecraft could coast the solar system. “You could do it essentially for free, just using a little bit of fuel for course corrections,” Professor Ross said.

As with reliance on ocean currents, though, “gravitational surfing” would be much slower than using a traditional propulsion system.

Professor Ross believes that wholly unpowered trips between the planets are impractical, and conventional fuel would still be needed. But he said that the technique would be an ideal way to travel around moon systems, and he hoped to see it used on a future mission to explore the moons of Jupiter. Because little fuel would be needed, exploration could go on almost indefinitely.

“Once you get to another planet, especially a planet that has its own moons, like Jupiter, you could start using these techniques to go between the different moons of Jupiter or Saturn,” he said. “The trade-off is it takes time. To go between two moons of Jupiter could take several months.”

The technique has already been used on the Nasa Genesis mission to explore solar wind, in which a small spacecraft surfed gravitational tubes on its way towards the Sun.

This allowed it to carry much less fuel than a traditional probe — only 4 per cent of its weight was fuel, compared with 40 per cent on a normal craft, Professor Ross said. “If you don’t have to use so much fuel, you have more room for equipment.”

The principles underlying the tubes have been known since Newton. But the calculations needed to map them were too complex until the arrival of modern computing.

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