Researchers propose ballistic capture as cheaper path to Mars

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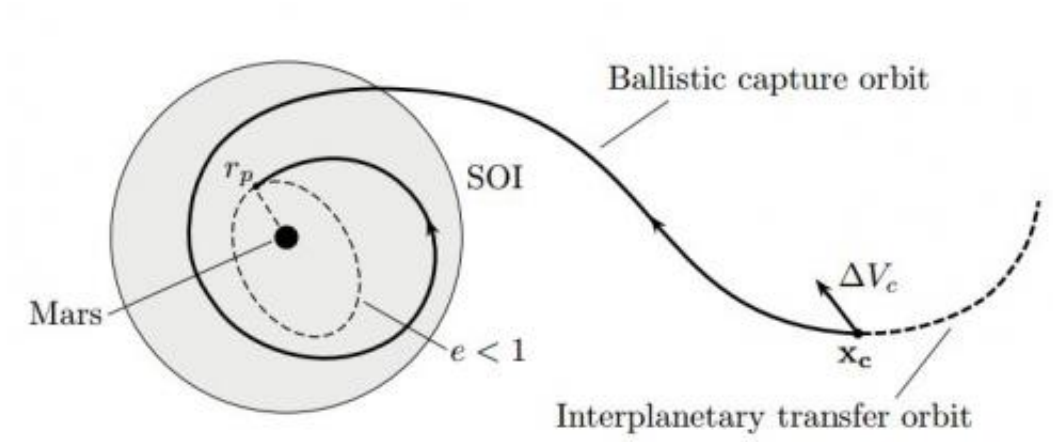

Structure of the ballistic capture transfers to Mars. Credit: arXiv:1410.8856 [astro-ph.EP]

(Phys.org)—Space scientists Francesco Topputo and Edward Belbruno are proposing in a paper they have written and uploaded to the preprint server *arXiv*, the idea of using ballistic capture as a means of getting to Mars, rather than the traditional Hohmann transfer approach. They suggest such an approach would be much cheaper and would allow for sidestepping the need for scheduling launch windows.

The traditional way to get to Mars is to calculate where the planet is going to be at a certain point in time and then launching a rocket to get there at the same time—this is known as the Hohmann transfer approach

and it involves using retrorockets upon arrival to slow down as the rocket is sent as quickly as possible during its trip. Those retrorockets use up a lot of fuel which makes travel to the Red planet bulky and expensive. The Hohmann transfer approach also involves scheduling during optimal launch windows—when the Earth and Mars are closet together, which can also cause problems if there is a delay for any reason—having to wait for another launch window can mean waiting up to two years. In their paper, Topputo and Belbruno suggest taking another approach altogether—instead of aiming for the planet directly, they suggest aiming for a spot ahead of the planet in its orbit around the sun and waiting for the planet to catch up—an approach known as ballistic capture.

Ballistic capture would eliminate the need for retrorockets, making a mission to Mars much cheaper—but it would also add months to the trip, which could be a problem for manned missions. For that reason, the researchers suggest it might best be used to send unmanned vehicles to the planet, some for observation and scientific purposes, others to send gear for use by humans once they arrive. Because such missions would not be time critical, they could be launched anytime, avoiding the necessity of launching during launch windows.

One drawback of the ballistic capture approach is that it does not lead to low orbit around the target planet—some sort of propulsion would still be needed to move into an orbit low enough for scientific study, or to get down to the surface itself. Such vehicles could carry some fuel for that purpose, the researchers suggest but it wouldn't take nearly as much as retrorockets used in the Hohmann transfer. The two are working with NASA contractor Boeing Corporation to further develop the idea to see if it might be feasible.

More information: Earth—Mars Transfers with Ballistic Capture, arXiv:1410.8856 [astro-ph.EP] arxiv.org/abs/1410.8856

Abstract

We construct a new type of transfer from the Earth to Mars, which ends in ballistic capture. This results in a substantial savings in capture Δv from that of a classical Hohmann transfer under certain conditions. This is accomplished by first becoming captured at Mars, very distant from the planet, and then from there, following a ballistic capture transfer to a desired altitude within a ballistic capture set. This is achieved by manipulating the stable sets, or sets of initial conditions whose orbits satisfy a simple definition of stability. This transfer type may be of interest for Mars missions because of lower capture Δv, moderate flight time, and flexibility of launch period from the Earth.

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