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Low energy transfers, weak stability boundaries and applications

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Low energy transfers for spacecraft are of intense interest due to their low fuel use. Low energy transfers to the Moon were discovered in 1986 (by this speaker) that utilized a new concept, at the time, of ballistic capture. This is where capture (temporary) about the Moon is automatically obtained. This results in substantial fuel savings. A new type of ballistic capture transfer to the Moon was found by this speaker, with James Miller, to rescue a failed Japanese lunar mission and get its spacecraft, Hiten, successfully to the Moon in 1991. This represented the first use of a ballistic capture transfer. The same type of transfer was used 20 years later in 2011 by NASA's GRAIL mission. The theory of ballistic capture transfers is based on a region about the Moon, and Earth, where this type of capture can occur, called a 'weak stability boundary' (WSB). Since their discovery in 1986, they have been extensively studied, and most recently, their structure has been revealed, by Garcia, Gomez (2007), Belbruno, Gidea, Topputo (2010, 1012). It turns out that they have an interesting complex invariant manifold structure, which can be studied by an algorithm, originally developed in 1986. Recently this algorithm has been substantially improved. WSB transfers, as they are also referred, have been used recently to find other low energy routes to the Moon and beyond. If there is time, applications are mentioned in astrophysics, on their use for the transfer of material between stars in open star clusters in new work on the Lithopanspermia Hypothesis by Belbruno, Moro-Martin, Malhotra (2012).

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