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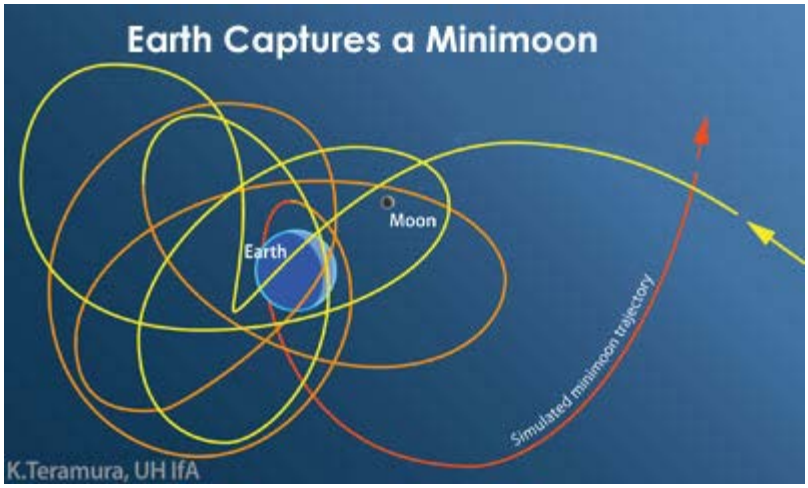
Quick Views of Big Advances

Earth's Temporary Minimoons

The Moon is not Earth's lone natural satellite. At any given time there are at least one or two meter-sized asteroids and about a thousand smaller centimeter-sized rocks also orbiting our planet. These are the findings from a supercomputer model designed to calculate the probability of small asteroids being captured by Earth's gravity into temporary orbits.



Colored line shows the path of a simulated minimoon while temporarily captured by Earth. The size of Earth and the Moon are not to scale but the size of the minimoon's path is to scale in the Earth-Moon system. Image courtesy of K. Teramura, of the Institute for Astronomy, University of Hawaii. Click for high-resolution options.

An international team from the US, Finland, and France created the steady-state model to determine minimoon motions and residence times taking into account the orbital and dynamical influence of all the massive bodies in our Solar System (but mainly the Sun, Earth, and Moon) on their test sampling of 10 million near-Earth objects. Mikael Granvik, Jeremie Vaubaillon, and Robert Jedicke found that minimoons are captured year-round but more frequently in January and July, peaking about one to two weeks after Earth's ***perihelion*** or ***aphelion***. But minimoons, it turns out, are only loosely captured by Earth's gravity. A typical minimoon stays less than a year and, on average, makes about three revolutions around Earth during its visit. According to the model, the trajectories of these temporary satellites are anything but simple, as shown in the figure. Most are captured and released, but the model predicts that about one in a thousand of these small rocks falls toward Earth joining the other meteors that streak our night sky. None of the minimoons in the model impacted the Moon.

The only verified minimoon known to date is a car-sized minor planet referred to as 2006 RH120, which was discovered in 2006 by the University of Arizona's Catalina Sky Survey. After its discovery 2006 RH120 orbited Earth for less than a year before escaping the Earth-Moon system and returning to a Sun-centered orbit. Telescope spectroscopic studies of, or possibly even future spacecraft missions to, a temporarily-captured natural Earth satellite would be a scientific boon. But finding these relatively small, faint, fast-moving rocks would be difficult. The successful Almahata Sitta meteorite campaign has already given us a taste of the excitement of tracking a meteor, then finding and studying the resulting meteorites (see ***Asteroid, Meteor, Meteorite*** and ***Asteroid Tracked—Meteorites Found!***). Granvik and coauthors' research tantalizes us with the unprecedented notion that if long-duration minimoons could someday be found and tracked reliably and frequently, these small asteroids could be sampled or even hauled back here for study or mining.

(pdf version)

Reference:

· Granvik, M., Vaubaillon, J., and Jedicke, R. (2012) The Population of Natural Earth Satellites, *Icarus,* v. 218, p. 262-277. [***abstract***]

· Listen to the National Public Radio news story "***Earth Has Just One Moon, Right? Think Again***" hosted by Joe Palca. ***www.npr.org/2012/04/03/149712082/earth-has-just-one-moon-right-think-again*** (3 April 2012)

· **ADDED in 2017:**
Fedorets, G., Granvik, M., and Jedicke, R. (2017) Orbit and Size Distributions for Asteroids Temporarily Captured by the Earth-Moon System, *Icarus,* v. 285, p. 83-94, doi: 10.1016/j.icarus.2016.12.022. [***abstract***]

· **ADDED in 2014:**
Bolin, B., Jedicke, R., Granvik, M., Brown, P., Howell, E., Nolan, M. C., Jenniskens, P. M., Chyba, M., Patterson, G., and Wainscoat, R. (2014) Detecting Earth's Temporarily-captured Natural Satellites—Minimoons, *Icarus,* v. 241, p. 280-297, doi: 10.1016/j.icarus.2014.05.026. [***abstract***]

Written by Linda Martel, Hawai'i Institute of Geophysics and Planetology, for ***PSRD***.

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http://www.psrd.hawaii.edu
psrd@higp.hawaii.edu