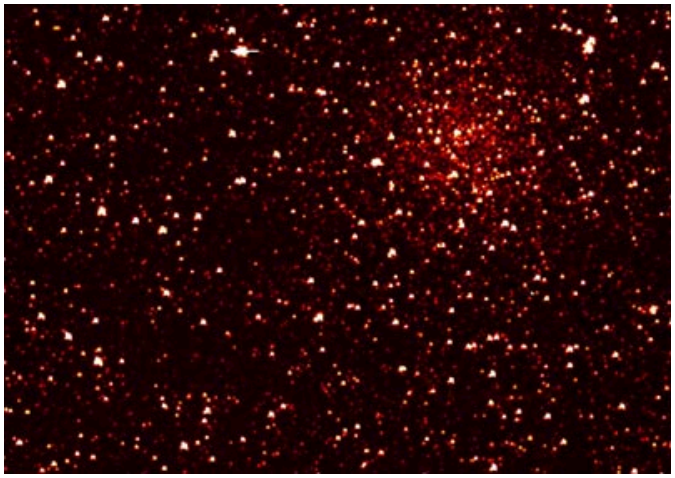
News archive

- 2010
  - December 2010
  - November 2010
  - October 2010
  - September 2010
  - August 2010
  - July 2010
  - June 2010
  - May 2010
  - April 2010
  - March 2010
  - February 2010
  - January 2010
- 2009
- 2008
- 2007
- 2006
- 2005
- 2004
- 2003
- 2002
- 2001
- 2000
- 1999
- 1998
- 1997

Earth-sized planets may be more common than we thought

Oct 28, 2010



Star cluster NGC 6791 from Kepler

Almost one in four stars like the Sun could harbour an Earth-mass planet, according to US researchers. Their finding questions conventional models of planetary formation, which suggest that it is rare to find low-mass planets close to their parent stars, implying that solar systems like ours could be more common than we thought. The result also suggests that NASA's Kepler mission, currently hunting for Earth-like planets, could discover more than 250 "plausibly terrestrial worlds".

The population of known alien worlds, a total of almost 500 discovered since the mid-1990s, is currently skewed towards the more easily detectable Jupiter-mass planets that orbit close to their host stars. It is only recent advances in technology that have allowed the search for planets with similar masses to the Earth. Yet existing models of solar-system formation predict a "planetary desert" close to the star: a lack of planets with 1–30 times the mass of Earth and an orbital period of less than 50 days. Now, a team of astronomers, including Geoff Marcy at the University of California at Berkeley, is challenging this received wisdom.

"This is the first time anyone has measured the fraction of stars that have smaller planets," Marcy, often credited as the most prolific planet hunter of all time, told *physicsworld.com*. His team used data from the Keck telescope in Hawaii relating to 166 stars between 0.54 and 1.28 solar masses, all within 80 light-years of Earth. Doppler shifts in the starlight, the result of the star wobbling under the gravitational influence of an orbiting exo-planet, revealed a total of 33 planets around 22 of the stars.

Don't forget the missed planets

Marcy's team also made an attempt to account for any planets that might have been missed due to limitations in the sensitivity of their equipment. "We asked what would be the maximum planet mass that could hide in our data. If there were a more massive planet than that we would have seen it," Marcy explained. This statistical sampling analysis enabled them to infer the "missed" planets that sit alongside the confirmed planets.

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This information, from both the confirmed and inferred cases, was used to model the likelihood of close-by planets as a function of a planet's mass. It turned out that a power law was the best fit to the data, one that implied that the smaller the mass of the planet, the more likely it was to exist. This suggests the "planetary desert" is far from the desolate wasteland previously envisioned. "Our observations don't agree with theoretical predictions. We now know that the universe has more Earth-mass planets than Jupiter-mass planets," said Marcy. His power law predicts the chances of a Sun-like star having a one Earth-mass planet to be 23% – almost one in four. The findings are published in *Science*.

However, the research was limited, by current technology, to only modelling planets orbiting at less than one quarter of the Sun–Earth distance. So Marcy's finding could still be promising in the hunt for Earth's "twin": a one Earth-mass planet orbiting at an Earth–Sun distance. "Current models suggest most planets form far away from their stars; you should find more planets at longer orbital periods," Coel Hellier, an exo-planet researcher at Keele University, told *physicsworld.com*. "This research predicts a 23% chance of finding short period Earth-mass planets, so there should be even more further out; perhaps then nearly all solar-type stars have an Earth-mass planet," he added.

Searching for a second Earth

However, just because a planet has near Earth-mass, doesn't necessarily mean it is Earth-like. "Planets with a few Earth masses may be qualitatively different from one Earth-mass planets. They might be much larger, more like mini-Neptunes, with a lot more water and a lot less rock," Marcy warned.

But early results from NASA's Kepler space telescope, which measures a planet's radius rather than its mass, are promising. "Many of Kepler's planet candidates appear to have small radii, which is consistent with our research; they could be Earth-like after all," said Marcy. The team predicts that Kepler could find 120–260 "plausibly terrestrial worlds". "We are starting to see suspicious signs that Earths are out there in large numbers," he added.

Meanwhile, a pair of researchers based in the US and Switzerland has begun to study a contender Earth in more detail. Kevin Heng at ETH Zurich and Steven Vogt at the University of California have simulated atmospheric circulation on Gliese 581g, a "super Earth" discovered in 2009. Publishing their findings in a paper submitted to the *arXiv* preprint server, the researchers argue that the specific locations for habitability depend on whether the planet is tidally locked and how fast radiative cooling occurs on a global scale.

About the author

Colin Stuart is a science writer and astronomer based in London