

A diamond planet?

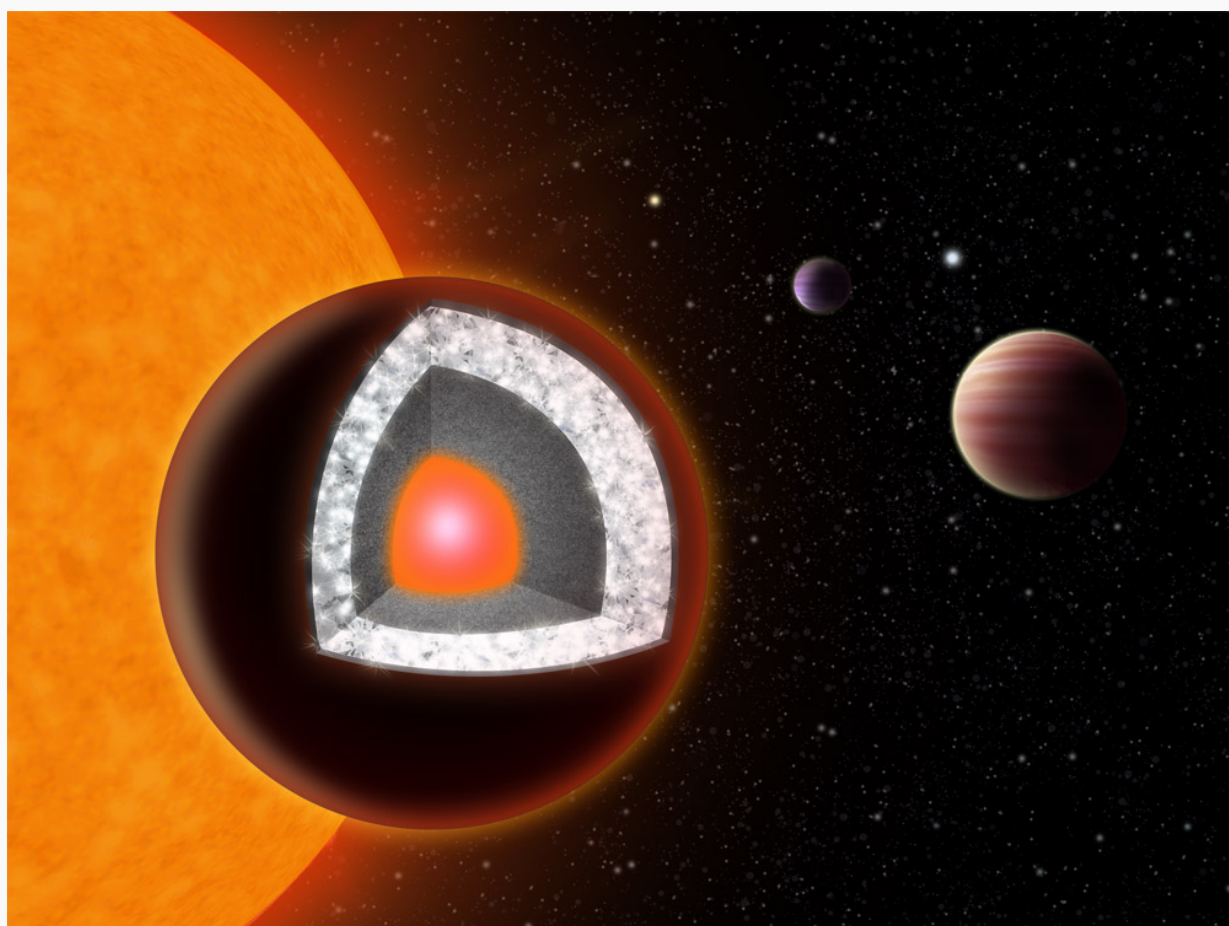
By Sid Perkins / November 30, 2012

A planet orbiting a distant star is probably unlike any of the hundreds yet discovered. Scientists say that about one-third of this incredibly hot, barren world — larger than Earth — could be made from diamonds.

The planet, known as 55 Cancri e, is one of five circling the star 55 Cancri. This star lies about 40 light-years from Earth. A light-year is the distance that light travels in one year, about 9.5 trillion kilometers. The distant solar system lies within the constellation Cancer. 55 Cancri can be seen from Earth, but only in dark skies far from cities.

(The yellow star is slightly smaller and slightly less massive than the sun, so overall the star is cooler and a little bit dimmer than the sun.)

Although planets orbiting 55 Cancri remain completely invisible to



A drawing of the planet 55 Cancri e, orbiting its parent star with some of its companions. As much as one-third of the planet may be diamond, a new study suggests. Credit: Haven Giguere

astronomers, the scientists know that they are there: The planets are so big that their gravitational pull tugs on their parent star, causing it to wobble back and forth in ways that can be seen from Earth.

The innermost of these planets, 55 Cancri e, passes across the face of the star during each orbit, says Nikku Madhusudhan. He's an astrophysicist at Yale University. During each pass, the planet blocks a small fraction of the starlight streaming toward Earth. Using very sensitive instruments, including some that detect changes in starlight, Madhusudhan and his colleagues learned a lot about 55 Cancri e.

For one thing, this planet passes in front of its parent star, as seen from Earth, once every 18 hours. (Just

imagine if a year on Earth, or the time it takes us to circle the sun once, was less than a day long!) Using that figure, the researchers estimate that 55 Cancri e orbits just 2.2 million kilometers (1.4 million miles) away from its star. That would give the planet a blazing hot surface temperature of about 2,150° Celsius. (Earth, by comparison, orbits about 150 million kilometers, or 93 million miles, from the sun.)

Based on the amount of light that 55 Cancri e blocks when it passes in front of its parent star, the planet must be just over twice the diameter of Earth. That's what Madhusudhan and his team report in a recent issue of *Astrophysical Journal Letters*. Additional information, some gathered previously by other scientists, suggests that the planet has about 8.4 times the mass of Earth. This makes it a "super-Earth," meaning its mass is between 1 and 10 times that of Earth's. Using the size and mass of the planet, the researchers can estimate what sort of materials 55 Cancri e is made from.

Other scientists had previously suggested that 55 Cancri e, discovered in 2004, was covered with a light material, such as water. But that's not likely, concludes Madhusudhan. That's because analyses of light from the parent star suggest that its chemical composition, as well as that of the planet, is carbon-rich and oxygen-poor. Instead of accumulating water (a substance whose molecules contain one atom of oxygen and two atoms of hydrogen) when it formed, this planet probably accumulated other light materials, such as carbon and silicon.

The core of 55 Cancri e might be made of iron, the same substance at Earth's core. But the faraway planet's outer layers could be a mixture of carbon, silicates (minerals that contain silicon and oxygen) and silicon carbide (an extremely hard mineral with a very high melting point). At the very high pressures inside this planet — and maybe even near its surface — much of the carbon could be diamond. In fact, diamond could account for up to one-third of the entire planet's weight.

Of the hundreds of planets recently discovered circling distant stars, 55 Cancri e is the first that might be made largely of carbon, concludes Madhusudhan. "Our study shows that planets can be extremely diverse," he notes.

Because there are several uncertainties about the new study, "we can't say that we've found a carbon planet yet," says Marc Kuchner. He's an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Md., who did not take part in the planet's analysis. However, he adds, if there are diamond planets, "55 Cancri e is a very strong candidate."

For one thing, Kuchner notes, the planet's surface is a very hot, harsh environment. That means that light molecules such as water vapor, oxygen and other gases found in Earth's atmosphere would probably be rare or absent altogether on 55 Cancri e. But under such conditions, many forms of carbon — such as diamond and graphite (the same substance found in pencil lead) — would be stable.

"Carbon can exist in many forms on Earth, and there are likely even more types on a carbon planet," says Kuchner. "Diamond might be just one of the types of carbon that you'd see." So, thinking of 55 Cancri e only as a "diamond planet" doesn't show a lot of imagination, Kuchner suggests.

"It's unfair to compare the beauty of a planet in all of its diversity to a single jewel," says Kuchner. After all, if aliens were to consider all of Earth to be as boring as its most common rock, they'd miss, for example, the colorful mineral formations found in the hot springs of Yellowstone National Park.

Power Words

astrophysicist A scientist who studies the nature of energy and matter within the universe, including stars and planets, as well as how they behave and interact.

Cancri The Greek name for the constellation also known as Cancer.

constellation Patterns formed by prominent stars that lie close to each other in the night sky. Modern astronomers divide the sky into 88 constellations, 12 of which (known as the zodiac) lie along the sun's path through the sky over the course of a year. Cancri, the original Greek name for the constellation Cancer, is one of those 12 zodiac constellations.

diamond One of the hardest known substances and rarest gems on Earth. Diamonds form deep within the planet when carbon is compressed under incredibly strong pressure.

graphite Like diamond, graphite — the substance found in pencil lead — is a form of pure carbon. Unlike diamond, graphite is very soft. The main difference between these two forms of carbon is the number and type of chemical bonds between carbon atoms in each substance.

gravity The force that attracts any body with mass, or bulk, toward any other body with mass. The more mass there is, the more gravity there is.

mineral A chemical compound that is solid and stable at room temperatures and has a specific chemical recipe (with atoms occurring in certain proportions) and a particular crystal structure (with atoms organized in certain three-dimensional patterns).

silicate A mineral containing silicon atoms and usually oxygen atoms. The majority of Earth's crust is made of silicate minerals.

super-Earth A planet (in a distant solar system) with between one and 10 times the mass of Earth. Our solar system contains no super-Earths: All of the other rocky planets (Mercury, Venus, Mars) are smaller and less massive than Earth, and the gas giants (Jupiter, Saturn, Neptune and Uranus) are all larger, containing at least 14 times the mass of Earth.