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Caltech-led team of astronomers finds 18 new planets

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The twin telescopes at Keck Observatory in Hawaii. The astronomers used Keck to discover 18 new Jupiter-like planets orbiting massive stars. Credit: Rick Peterson/ W.M. Keck Observatory

Discoveries of new planets just keep coming and coming. Take, for instance, the 18 recently found by a team of astronomers led by scientists at the California Institute of Technology (Caltech).

"It's the largest single announcement of planets aside from the discoveries made by the Kepler mission," says John Johnson, assistant professor of astronomy at Caltech and the first author on the team's paper, which was published in the December issue of The Astrophysical Journal Supplement Series. The Kepler mission is a space telescope that has so far identified more than 1,200 possible planets, though the majority of those have not yet been confirmed.

Using the Keck Observatory in Hawaii—with follow-up observations using the McDonald and Fairborn Observatories in Texas and Arizona, respectively—the researchers surveyed about 300 stars. They focused on those dubbed "retired" A-type stars that are more than one and a half times more massive than the sun. These stars are just past the main stage of their life—hence, "retired"—and are now puffing up into what's called a subgiant star.

To look for planets, the astronomers searched for stars of this type that wobble, which could be caused by the gravitational tug of an orbiting planet. By searching the wobbly stars' spectra for Doppler shifts—the lengthening and contracting of wavelengths due to motion away from and toward the observer—the team found 18 planets with masses similar to Jupiter's.

This new bounty marks a 50 percent increase in the number of known planets orbiting massive stars and, according to Johnson, provides an invaluable population of planetary systems for understanding how planets—and our own solar system—might form. The researchers say that the findings also lend further support to the theory that planets grow from seed particles that accumulate gas and dust in a disk surrounding a newborn star.

According to this theory, tiny particles start to clump together, eventually snowballing into a planet. If this is the true sequence of events, the characteristics of the resulting planetary system—such as the number and size of the planets, or their orbital shapes—will depend on the mass of the star. For instance, a more massive star would mean a bigger disk, which in turn would mean more material to produce a greater number of giant planets.

In another theory, planets form when large amounts of gas and dust in the disk spontaneously collapse into big, dense clumps that then become planets. But in this picture, it turns out that the mass of the star doesn't affect the kinds of planets that are produced.

So far, as the number of discovered planets has grown, astronomers are finding that stellar mass does seem to be important in determining the prevalence of giant planets. The newly discovered planets further support this pattern—and are therefore consistent with the first theory, the one stating that planets are born from seed particles.

"It's nice to see all these converging lines of evidence pointing toward one class of formation mechanisms," Johnson says.

There's another interesting twist, he adds: "Not only do we find Jupiter-like planets more frequently around massive stars, but we find them in wider orbits." If you took a sample of 18 planets around sunlike stars, he explains, half of them would orbit close to their stars. But in the cases of the new planets, all are farther away, at least 0.7 astronomical units from their stars. (One astronomical unit, or AU, is the distance from Earth to the sun.)

In systems with sunlike stars, gas giants like Jupiter acquire close orbits when they migrate toward their stars. According to theories of planet formation, gas giants could only have formed far from their stars, where it's cold enough for their constituent gases and ices to exist. So for gas giants to orbit nearer to their stars, certain gravitational interactions have to take place to pull these planets in. Then, some other mechanism—perhaps the star's magnetic field—has to kick in to stop them from spiraling into a fiery death.

The question, Johnson says, is why this doesn't seem to happen with so-called hot Jupiters orbiting massive stars, and whether that dearth is due to nature or nurture. In the nature explanation, Jupiter-like planets that orbit massive stars just wouldn't ever migrate inward. In the nurture interpretation, the planets would move in, but there would be nothing to prevent them from plunging into their stars. Or perhaps the stars evolve and swell up, consuming their planets. Which is the case? According to Johnson, subgiants like the A stars they were looking at in this paper simply don't expand enough to gobble up hot Jupiters. So unless A stars have some unique characteristic that would prevent them from stopping migrating planets—such as a lack of a magnetic field early in their lives—it looks like the nature explanation is the more plausible one.

The new batch of planets have yet another interesting pattern: their orbits are mainly circular, while planets around sunlike stars span a wide range of circular to elliptical paths. Johnson says he's now trying to find an explanation.

For Johnson, these discoveries have been a long time coming. This latest find, for instance, comes from an astronomical survey that he started while a graduate student; because these planets have wide orbits, they can take a couple of years to make a single revolution, meaning that it can also take quite a few years before their stars' periodic wobbles become apparent to an observer. Now, the discoveries are finally coming in. "I liken it to a garden—you plant the seeds and put a lot of work into it," he says. "Then, a decade in, your garden is big and flourishing. That's where I am right now. My garden is full of these big, bright, juicy tomatoes—these Jupiter-sized planets."

Provided by California Institute of Technology

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