28 new planets, 7 new brown dwarfs reported by California, Carnegie team

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The world's largest and most prolific team of planet hunters announced the discovery of 28 new planets outside our solar system, increasing to 236 the total number of known exoplanets.

University of California, Berkeley, post-doctoral fellow Jason T. Wright and newly minted Ph.D. John Asher Johnson reported the new exoplanets at a noon media briefing at the semi-annual meeting of the American Astronomical Society (AAS) in Honolulu. The findings are a result of the combined work of the California and Carnegie Planet Search team and the Anglo-Australian Planet Search team.

The planets are among 37 new objects – all of them orbiting a star, but smaller than a star –discovered by the teams within the past year. Seven of the 37 are confirmed brown dwarfs, which are failed stars that are nevertheless much more massive than the largest, Jupiter-sized planets. Two others are borderline and could be either large, gas giant planets or small brown dwarfs.

Wright said the research teams have become much more sophisticated in their analyses and are able to detect smaller planets as well as planets farther from their parent stars. In both cases, he said, these planets produce much smaller wobbles in the parent star, making them harder to detect.

"We've added 12 percent to the total in the last year, and we're very proud of that," said Wright of the 28 new exoplanets. "This provides new planetary systems so that we can study their properties as an ensemble."

The California and Carnegie Planet Search team is headed by Geoffrey Marcy, professor of astronomy at UC Berkeley; Paul Butler of the Carnegie Institution of Washington; Debra Fischer of San Francisco State University; and Steve Vogt, professor of astronomy at UC Santa Cruz. The Anglo-Australian Planet Search team is headed by Chris Tinney of the University of New South Wales and Hugh Jones of the University of Hertfordshire. They and colleagues Shannon Patel of UC Santa Cruz and Simon O'Toole of the Anglo-Australian Observatory have published their exoplanet results in papers over the past year, but the AAS meeting is the first time the teams have presented their findings together.

In addition to reporting 37 new substellar objects, Wright singled out an exoplanet discovered by their teams two years ago as "extraordinarily rich." Circling the star Gliese 436 (GJ 436), a red M dwarf only 30 light years from Earth, was an ice-giant planet the teams calculated to be at least 22 Earth masses, slightly larger than the mass of Neptune (17 Earth masses). After the discovery in 2004 and publication of the exoplanet's orbit earlier this year, a Belgian astronomer, Michael Gillon at Liege University, observed the planet crossing in front of the star – the first Neptune-sized planet observed to transit a star. Gillon and colleagues reported two weeks ago how this transiting planet allowed them to precisely pin down the mass, 22.4 Earth masses, and to calculate the planet's radius and density, which turns out to be similar to Neptune's.

"From the density of two grams per cubic centimeter – twice that of water – it must be 50 percent rock and about 50 percent water, with perhaps small amounts of hydrogen and helium," Marcy said. "So this planet has the interior structure of a hybrid super-Earth/Neptune, with a rocky core surrounded by a significant amount of water compressed into solid form at high pressures and temperatures."

Its short, 2.6-day orbit around Gliese 436 means the exoplanet is very close to the star – only 3 percent of the sun-Earth distance – making it a hot Neptune, Wright said. It also has an eccentric orbit, not a circular orbit like most giant planets found orbiting close to their parent stars. This orbit, in fact, suggests that the star may have another planetary companion in a more distant orbit.

"I'm sure people will immediately follow up and try to measure the atmospheric composition of this planet." Wright predicted.

Also among the 28 new exoplanets are at least four new multiple-planet systems, plus three stars that probably contain a brown dwarf as well as a planet. Wright said that at least 30 percent of all stars known to have planets have more than one. Because smaller planets and outer planets of a star are harder to detect, he predicts that the percentage will continue to rise as detection methods improve.

"We're just now getting to the point where, if we were observing our own solar system from afar, we would be seeing Jupiter," he said, pointing out that the teams' Doppler technique is now sensitive to stellar wobbles of a meter per second, much less than the 10-meter per second limit they started out with 15 years ago.

Wright keeps track of all known exoplanets for the California and Carnegie Planet Search team's Web site, exoplanets.org, which hosts the only peer-reviewed catalog of exoplanets within 200 parsecs (652 light years) of Earth. This includes "everything that is close enough to study and possibly follow up with imaging," he said.

Three of the newly reported planets are around large stars between 1.6 and 1.9 times the mass of our sun. Johnson has focused on exoplanets around massive stars, known as A and F stars, with masses between 1.5 and 2.5 solar masses. Planets around these massive stars are normally very hard to detect because they typically rotate fast and have pulsating atmospheres, effects that can hide or mimic the signal from an orbiting planet. He discovered, however, that cooler "retired" A stars – "subgiant" stars that have nearly completed hydrogen burning and have stabilized for a short period of time – are more stable, making planet-caused wobbles detectable.

So far, Johnson has tracked down six previously discovered exoplanets around retired A stars, and by combining this set with the three newly discovered exoplanets, has been able to draw preliminary conclusions. For one, planets around more massive stars seem to be farther from their host stars, Johnson said.

"Only one of the 9 planets is within 1 AU (astronomical unit, or 93 million miles), and none of them is within 0.8 AU, of their host stars, which is very different than the distribution around sun-like stars," he said, noting that many sun-like stars harbor hot gas giants that whip around their host stars in two to 100 days. Even though such planets are easier to detect, no such planets have been detected orbiting retired A stars, whose typical planets have an orbital distance about equal to Earth's orbit or greater, with an orbital period of a few years.

Based on the results of his search for planets around retired A stars, Johnson has discovered that massive stars are more likely to harbor Jupiter-sized planets than are lower-mass stars. The chance of having a Jupiter-like, giant planet orbiting within 2 AU is 8.7 percent for stars between 1.3 and 2 solar masses, versus 4 percent for sun-like stars with masses ranging from 0.7 solar masses to 1.3 solar masses, and 1.2 percent for M stars with less than 0.7 solar masses. As would be expected from the core accretion model of planet formation, large planets are more often observed around massive stars, probably because these stars start out with more material in their disks during the early formation period.

Johnson will continue to focus on the retired A stars, 450 of which have been added to the teams' target list. As more planets are discovered around subgiants, it should become clearer whether larger orbits are "a result of different formation and migration mechanisms in the disks of A–type stars, or simply a consequence of the small number of massive subgiants currently surveyed," he and colleagues wrote in a paper submitted in April to the Astrophysical Journal.

Source: University of California - Berkeley

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