Hints of planets circling nearby stars

Detecting a planet the size of Jupiter orbiting a nearby star similar to the sun is like trying to see light reflected from a speck of dust sitting next to a 1,000-watt light bulb when the observer is miles away. Astronomers have to rely on indirect measurements, with their associated uncertainties, to find stars with such low-mass companions. Two separate groups of astronomers now have accumulated the best evidence yet that nearby stars are likely to have planet-sized companions. The two groups announced their findings last week in Baltimore at a meeting of the International Astronomical Union.

One discovery was the result of a serendipitous accident. David W. Latham of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., and his colleagues were carefully measuring the radial velocity – how fast the star moves toward or away from an Earth-based observer – of a faint star known as HD 114762, a star similar to the sun about 90 light-years away. It had been proposed as a "standard" star astronomers could monitor to calibrate their instruments. Analyzing observations his team had accumulated over seven years, Latham was surprised to find the star had a tiny wobble, presumably the effect of an invisible companion. That wobble made HD 114762 unsuitable as a standard but a promising candidate as a star with a planetary companion.

Latham's calculations, based on observations of 30 cycles, indicate the invisible companion circles the star every 84 days in an orbit as close to the star as Mercury's orbit is to the sun. A group of astronomers in Geneva, Switzerland, making independent observations on HD 114762, has confirmed Latham's measurements.

Latham estimates the object has a mass roughly 10 times that of Jupiter. However, uncertainties in how much the orbit is inclined – whether Earth-based observers are seeing the orbit face on or edge on – allow the possibility that the object's mass may be substantially larger, meaning that it could be more like a star than a planet.

"This is certainly the most convincing evidence so far for a low-mass companion around another star," Latham says. "This discovery encourages speculation that there are planets around other stars, but it's a long extrapolation from what we're beginning to see now and what we could call true [Earth-like] planets, where you could start thinking about the evolution of life."

Bruce Campbell of the University of Victoria in British Columbia and his colleagues have developed a particularly sensitive technique for precisely measuring radial velocities (SN: 6/27/87, p.405). The technique should allow the detection of Jupiter-sized companions in orbit around bright, nearby stars. "This opens the possibility of detecting companions to solar-type stars at a lower level than previously detectable," says Campbell.

Out of 18 stars monitored so far for seven years, all within 100 light-years of Earth, nine show velocity trends suggesting a possible companion. However, the companions appear to be far enough from their central stars that only one has yet completed a full orbit.

The exception, Gamma Cephei, is particularly complicated and interesting because it involves the observation of a wobble on top of a wobble in the central star's motion. Campbell's analysis suggests the Gamma Cephei system probably consists of two widely separated stars and a planet about 1.6 times the mass of Jupiter orbiting the more massive, brighter star every 3.1 years.

"There is as yet no confirmed detection of a planetary companion, but we are close," Campbell says. Based on the results so far, "something like half or more of the stars in our galaxy may have planetary systems." Campbell's technique is not sensitive enough to detect Earth-sized planets.

Objects that are more than 10 times but less than 100 times the mass of Jupiter are generally considered to be more like stars than like planets and are known as brown dwarfs. These "failed stars" have too little mass to ignite but may still radiate some heat. Although several astronomical teams have reported brown dwarf candidates in the past, none has been definitely confirmed (SN: 11/1/86, p.282). In one case, new observations show that the companion of Gleise 569B, once proposed as a brown dwarf, is actually a normal star (SN: 7/9/88, p.23).

Recent observations of white dwarf stars are turning up a surprising number of companion objects that may well be brown dwarfs. Benjamin M. Zuckerman of the University of California, Los Angeles, and Eric E. Becklin of the University of Hawaii in Honolulu have studied infrared light coming from the direction of more than 120 white dwarf stars and found at least 10 cases in which the white dwarf shows a separate, warm companion or a greater output of infrared energy than expected.

In observations only a few weeks old, Zuckerman reports detection of two of the lowest-luminosity objects ever seen. "There's no chance these are dust clouds," Zuckerman says. "The objects are definitely in the brown dwarf range."

Still unresolved is Zuckerman's earlier suggestion that a star known as Giclas 29-38 has a brown dwarf companion (SN: 11/21/87, p.327). It's possible the anomalous infrared readings from Giclas 29-38 may be caused by a "bizarre dust cloud," Zuckerman says. That star has just returned to the night sky and will be studied in more detail to see if the question can be settled.

The rate at which Zuckerman is now finding brown dwarf candidates surprises him. "The inescapable conclusion is that there must be a lot of objects in the field in the one-tenth solar mass range on down to brown dwarfs," Zuckerman says. "They're out there in great abundance."

Campbell's survey shows that none of his nine possible companions is large enough to fall into the brown dwarf category. However, his observations are restricted to companions in orbits closer to the star than those studied by Zuckerman. "What's significant here is that brown dwarfs are apparently rare as close companions of solar-type stars," Campbell says. That observation may give theorists something new to consider while the search for both planetary and brown dwarf companions continues.

– I. Peterson

Farthest known galaxy

An international group of astronomers has discovered a galaxy they believe is the most distant yet seen, located more than 90 percent of the way to the visible limits of the universe. Emissions from the object, designated 4C41.17, traveled farther to reach Earth than those of any other galaxy ever studied, suggesting they may have left their source as little as a billion years after the Big Bang.

Discovery of a galaxy apparently formed so early in the universe's evolution raises the question of whether such objects are extremely rare or whether present models of galaxy formation must be revised.

Astronomers spotted 4C41.17 in measurements made by the Very Large Array radiotelescope complex in Socorro, N.M. These showed it to be a powerful source and one with a strikingly steep radio spectrum, suggesting it was very distant. They then observed the galaxy optically from Kitt Peak National Observatory in Arizona. Those observations indicated a redshift – the key to its distance – of 3.8. Uncertainties preclude setting too exact a distance from a given redshift, but the researchers who reported the finding Aug. 8 at the meeting of the International Astronomical Union in Baltimore estimate the galaxy could be as much as 15 billion light-years away.

The discovery was announced by graduate student Ken Chambers of Johns Hopkins University in Baltimore and astronomer George Miley of Leiden University in the Netherlands. They worked with astronomer Wil van Breugel of the University of California, Berkeley.

– J. Eberhart