Astronomers measure new distances to nearby stars

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Astronomers from the U.S. Naval Observatory (USNO), in collaboration with others from the REsearch Consortium On Nearby Stars (RECONS), have determined new distances to a group of faint young stars located within 25 parsecs (pc) of the sun. These measurements, based on parallax observations obtained over periods ranging from nine to twelve years, include new measures of the star known as TRAPPIST-1, which has been recently identified as having a system of up to seven Earth-sized planets orbiting around it.

The paper describing the measurements, whose lead author is Dr. Jennifer Bartlett of the USNO, has been published in the *Astronomical Journal*.

Measuring the distances to nearby stars is accomplished by a technique called "trigonometric parallax," in which the tiny apparent annual shift of a star's position is related to the diameter of the Earth's orbit around the sun. By measuring the tiny angle produced by this motion, astronomers can use trigonometry to determine the distance to the star.

The distances to these stars are measured in parsecs, short for "parallax second." One parsec is the distance at which a star would show an annual parallax shift of one second of arc on the plane of the sky; it is equivalent to 3.26 light-years.

Utilizing the 0.9-meter telescope at the Cerro Tololo

Inter-American

Observatory (CTIO) in Chile, Dr. Bartlett and her colleagues measured the parallaxes of 32 stellar systems, most of which are very cool faint red dwarf stars. Of these systems, 17 have never had previous parallax measurements, and out of those, 14 have been found to lie less than 25 pc from the Earth. One of these new, nearby stars, 2MASS 2351-2537AB, also shows evidence of actually being two new nearby stars, i.e., a binary.

In addition to these newly-measured star systems, the astronomers also obtained new parallax measurements for 15 other, previously-known nearby stars. Among these is the star known as "TRAPPIST-1," which has been recently shown to host a system of at least seven planets. Using over 12 years of observations made with the 0.9-meter telescope at CTIO, Dr. Bartlett presents a new parallax of 79.29 +/- 0.96 mas, yielding a distance of 12.61 pc, about 4 percent more distant than previous measurements.

The team also measured the brightness of each of these star systems in three regions of the optical and near infrared electromagnetic spectrum and analyzed how the brightness of each system varied over the course of their parallax observations. Although the team caught TRAPPIST-1 flaring during July 2009, they found the overall variability of this star to be low. In other words, its brightness varied enough to be detectable but not enough to be considered significant.

For many of these star systems, the team obtained optical spectra using the 1.5 m CTIO telescope. This study is the first to identify LP 991-84 as a M 4.5 V type star, confirming its cool, dim, red nature. As a graduate student, Dr. Bartlett discovered that this star is within 10 pc of the sun. This study measured its parallax more precisely to be 115.90 +/- 1.33 mas, or 8.63 pc.

From their assessment of the positions, motions, variability, and spectra of these 32 star systems, the astronomers concluded that 13 of them are young, probably less than 120 million years old. TRAPPIST-1 and 2MASS 2351-2537AB, however, do not appear to be particularly youthful.

On the other hand, LP 991-84 may be 1 billion years old, or more.

"I am amazed at what we can find in our backyard—well, if your backyard is 25 pc deep," Dr. Bartlett said. "We are still looking and identifying stars within the sun's immediate vicinity, its neighborhood so to speak. What will we find next?"

More information: Jennifer L. Bartlett et al. The Solar Neighborhood. XXXX. Parallax Results from the CTIOPI 0.9 m Program: New Young Stars Near the Sun, *The Astronomical Journal* (2017). DOI: 10.3847/1538-3881/aa8457

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