Four new giant planets detected around giant stars

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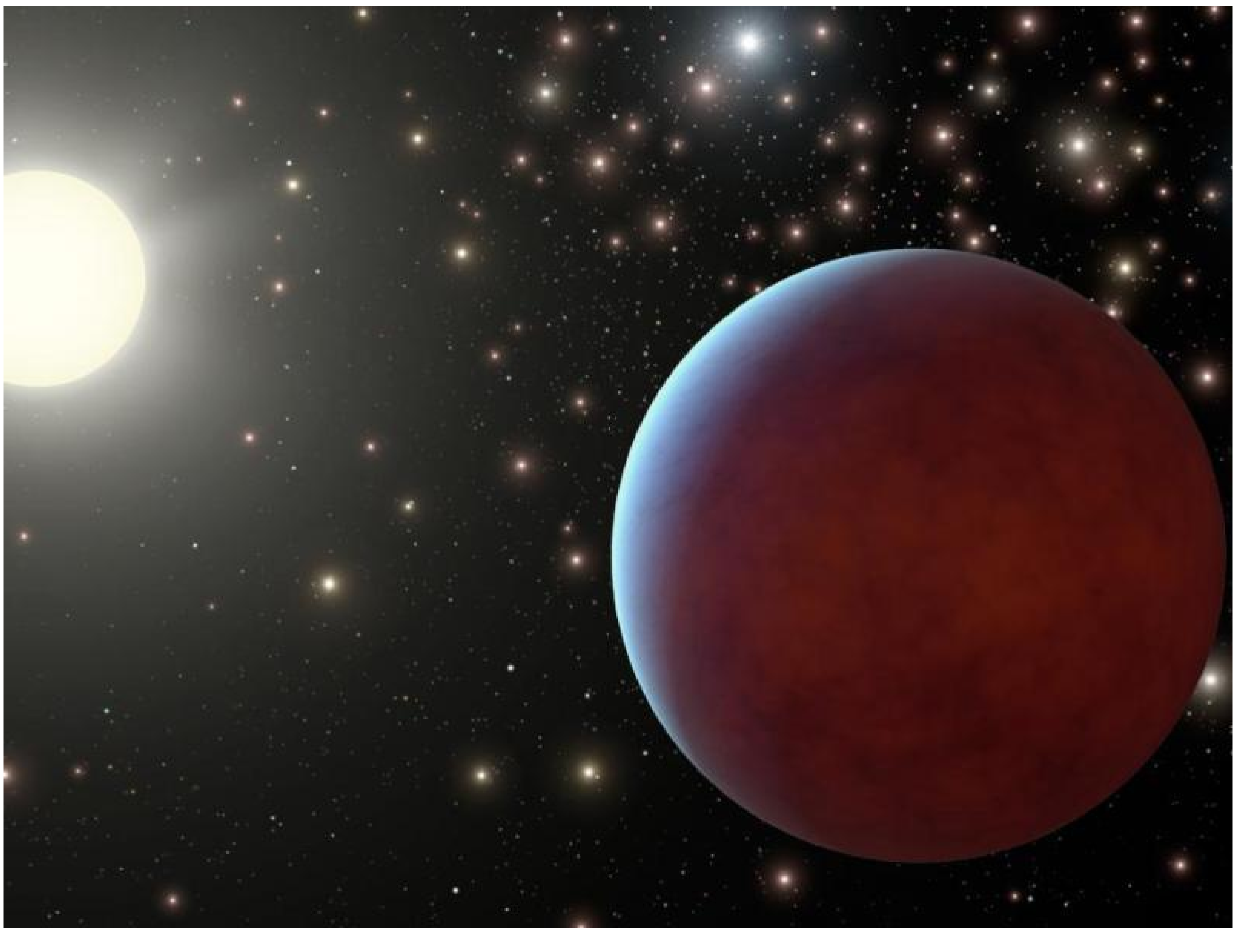

Artist's concept of a giant extrasolar planet. Credit: NASA/JPL-Caltech.

(Phys.org)—An international team of astronomers reports the discovery of four new giant exoplanets orbiting stars much bigger than our sun. The newly detected alien worlds are enormous, with masses from 2.4 to 5.5 the mass of Jupiter and have very long orbital periods ranging from nearly two to slightly more than four Earth years. The findings were published on Mar. 11 in a research paper available online at *arXiv.org*.

The team, led by Matias Jones of the Pontifical Catholic University of Chile, made the discovery during observations under the EXPRESS (EXoPlanets aRound Evolved StarS) radial velocity program. They used two telescopes located in the Atacama desert in Chile: the 1.5 m telescope at the Cerro Tololo Inter-American Observatory and the 2.2 m telescope at La Silla observatory. Complementary observations were conducted at the 3.9 m Anglo-Australian telescope in Australia.

Using spectrographs mounted on these telescopes, the researchers were monitoring a sample of 166 bright giant stars that are observable from the southern hemisphere. They took several spectra for each of the stars in the sample thanks to these instruments. The observation campaign lasted from 2009 to 2015.

The astronomers have computed a series of precision radial velocities of four giant stars: HIP8541, HIP74890, HIP84056 and HIP95124. According to them, these velocities show periodic signal variations. The team concluded that the most probable explanation of the periodic radial velocity signals observed in these stars must be the presence of planetary companions.

"These velocities show periodic signals, with semi-amplitudes between approximately 50 to 100 ms^{-1}, which are likely caused by the doppler shift induced by orbiting companions. We performed standard tests (chromospheric emission, line bisector analysis and photometric variability) aimed at studying whether these radial velocity signals have an intrinsic stellar origin. We found no correlation between the stellar intrinsic indicator with the observed velocities," the paper reads.

HIP8541b is the most massive of the newly found quartet of planets. With a mass of about 5.5 Jupiter masses, this exoplanet also has a much longer orbital period than the other three worlds, equal to 1,560 days. Its parent star is slightly more massive than the sun and has a radius of nearly eight solar radii.

HIP74890b and HIP84056b are very similar in terms of mass and orbital period. The mass of HIP74890b is estimated to be 2.4 Jupiter masses, what is about 92 percent of the mass of HIP84056b. The more massive planet of this comparable duo has an orbital period lasting nearly 819 days – about three fewer days than the other planet. Their host stars are also of similar mass and size, about 1.7 the mass of the sun, with a radius of 5.03 (HIP 84056) and 5.77 (HIP 74890) solar radii.

Among the exoplanets described in the paper, the one with the shortest orbital period (562 days), is designated HIP95124b. It has a mass of 2.9 Jupiter masses and orbits a star nearly two times more massive than the sun, with a radius of 5.12 solar radii.

The discovery of these planets also yielded interesting results about correlations between the stellar properties and the occurrence rate of planets. The researchers have found that giant planets are preferentially detected around metal-rich stars.

"We also present a statistical analysis of the mass-metallicity correlations of the planet-hosting stars in our sample. (…) We show that the fraction of giant planets increases with the stellar mass in the range between 1 to 2.1 solar masses, despite the fact that planets are more easily detected around less massive stars," the scientists noted.

The team concluded that the high fraction of multiple systems observed in giant stars is a natural consequence of the planet formation mechanism around intermediate-mass stars.

More information: Four new planets around giant stars and the mass-metallicity correlation of planet-hosting stars, arXiv:1603.03738 [astro-ph.EP] arxiv.org/abs/1603.03738

Abstract
CONTEXT. Exoplanet searches have demonstrated that giant planets are preferentially found around metal-rich stars and that their fraction increases with the stellar mass. AIMS. During the past six years, we have conducted a radial velocity follow-up program of 166 giant stars, to detect substellar companions, and characterizing their orbital properties. Using this information, we aim to study the role of the stellar evolution in the orbital parameters of the companions, and to unveil possible correlations between the stellar properties and the occurrence rate of giant planets. METHODS. Using FEROS and CHIRON spectra, we have computed precision radial velocities and we have derived atmospheric and physical parameters for all of our targets. Additionally, velocities computed from UCLES spectra are presented here. By studying the periodic radial velocity signals, we have detected the presence of several substellar companions. RESULTS. We present four new planetary systems around the giant stars HIP8541, HIP74890, HIP84056 and HIP95124. Additionally, we find that giant planets are more frequent around metal-rich stars, reaching a peak in the detection of f = 16.7+15.5−5.9% around stars with [Fe/H] ~ 0.35 dex. Similarly, we observe a positive correlation of the planet occurrence rate with the stellar mass, between $M_\star$ ~ 1.0 -2.1 M⊙, with a maximum of f = 13.0+10.1−4.2%, at $M_\star$ = 2.1 M⊙. CONCLUSIONS. We conclude that giant planets are preferentially formed around metal-rich stars. Also, we conclude that they are more efficiently formed around more massive stars, in the mass range of $M_\star$ ~ 1.0 - 2.1 M⊙. These observational results confirm previous findings for solar-type and post-MS hosting

stars, and provide further support to the core-accretion formation model.