

Evidence discovered for two distinct giant planet populations

July 6 2017



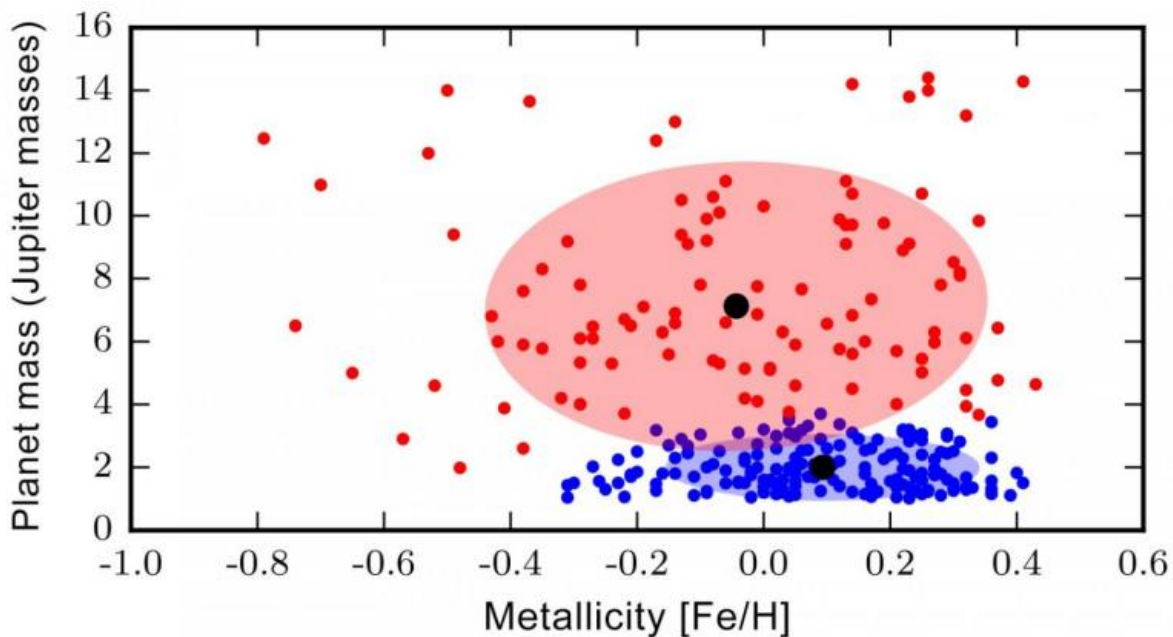
Artistic impression that shows the formation of a gas giant planet in the ring of dust around a young star. Credit: ESO/L. CalÁada

In a paper published in *Astronomy & Astrophysics*, a team of researchers from the Instituto de Astrofísica e Ciências do Espaço (IA3) discovered observational evidence for the existence of two distinct populations of giant planets.

So far, more than 3500 [planets](#) have been detected orbiting solar-type [stars](#). Although recent results suggest that most planets in the galaxy are rocky like Earth, a large population of [giant planets](#), with masses up to 10 or 20 times the mass of Jupiter (itself 320 times the mass of the Earth), was also discovered.

A large amount of the information about how these planets form is coming from the analysis of the connection between the planets and their host star. Initial findings have shown, for example, that there is a tight connection between the metallicity of the star and the planet occurrence or frequency. Stellar mass has also been suggested to influence planet formation efficiency.

State-of-the-art models of planet formation suggest that two main avenues exist for the formation of gas giants. The so called core-accretion process holds that first, a rocky/icy core forms, which draws gas around it, eventually resulting in a giant planet. The other suggests that instabilities in the protoplanetary disk⁵ can lead to the formation of gas clumps, which then contract to form a giant planet.



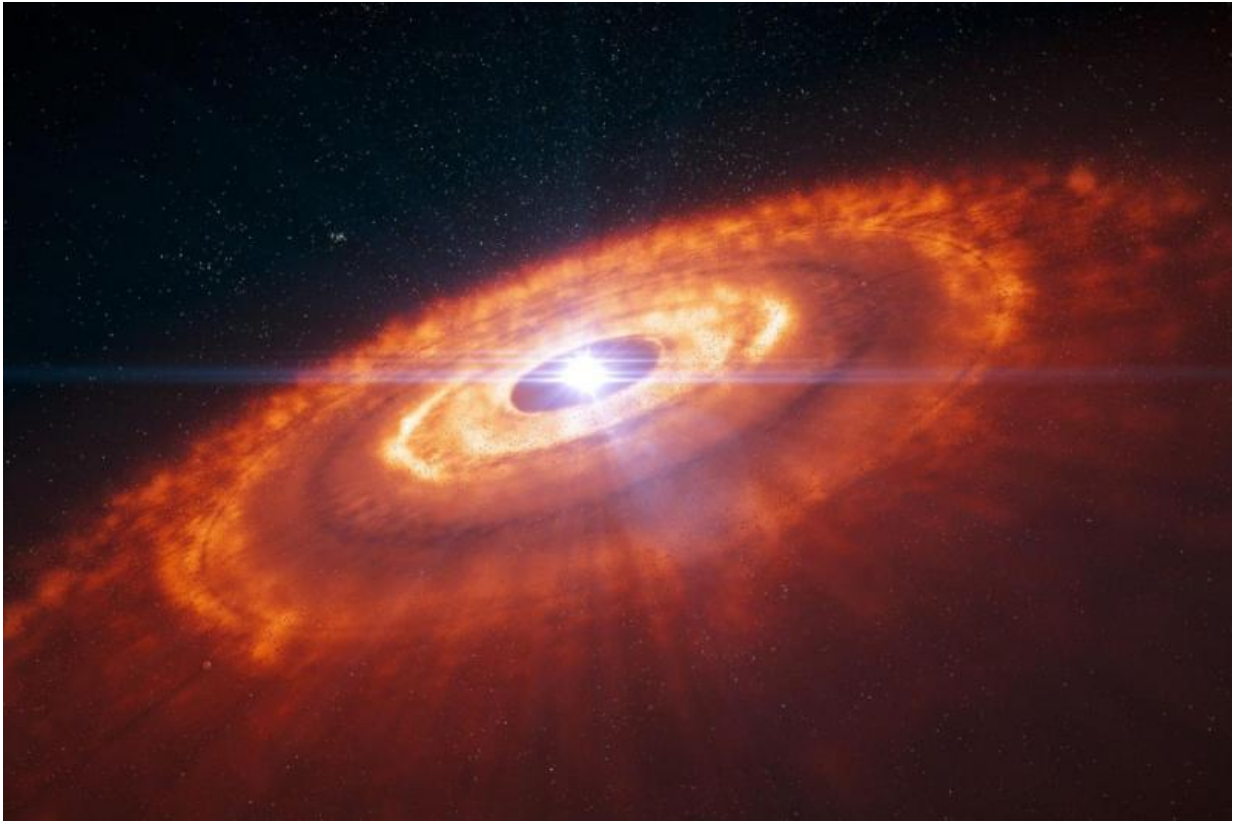
Planet mass vs metallicity for the analysed stars. In the plot one can see the position of the two populations of giant planets. Credit: Santos et al. 2017

Vardan Adibekyan (IA & Universidade do Porto) says, "Our team, using public exoplanet data, obtained interesting observational evidence that giant planets such as Jupiter and its larger-mass cousins, several thousand times more massive than the Earth (of which we do not have an example in the solar system) form in different environments, and make two distinct populations."

While objects smaller than about four Jupiter masses show a strong preference for metal-rich stars, in the four to 20 Jupiter-mass range, host stars tend to be more metal poor and more massive, suggesting that these massive giant planets form with a different mechanism than their lower-mass contemporaries. Nuno Cardoso Santos (IA & Faculdade de Ciências da Universidade do Porto) says, "The result now published suggests that both mechanisms may be at play, the first forming the lower-mass planets, and the other one responsible for the formation of the higher-mass ones."

The lower-mass giant planets seem to be formed by the core accretion process around more metal-rich stars, while more [massive planets](#) seem to be formed mainly through gravitational instability. Adibekyan says, "Although this discovery was a large and important step toward a complete understanding of planet formation, it is not the last and final one. Our team will enthusiastically continue addressing many open questions."

Observations with GAIA (ESA) may shed some light into this. In the near future, missions like ESA's CHEOPS and PLATO, or NASA's TESS, which will allow for the study of mass-radius relation, along with studies of their atmospheric composition using instruments such as ESO's ESPRESSO at the VLT and HIRES at the ELT, or the James Webb Space Telescope (JWST), may also bring new constraints about the processes of [planet formation](#).



Artistic impression of a young star surrounded by a protoplanetary disc. Concentric rings of gas, with gaps indicating where planets are forming, are visible. Credit: ESO/L.Caláada

More information: N. C. Santos et al. Observational evidence for two distinct giant planet populations, *Astronomy & Astrophysics* (2017). [DOI: 10.1051/0004-6361/201730761](https://doi.org/10.1051/0004-6361/201730761)

Provided by Instituto de Astrofísica e Ciências do Espaço

Citation: Evidence discovered for two distinct giant planet populations (2017, July 6) retrieved 10 April 2024 from

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