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PRESS RELEASE

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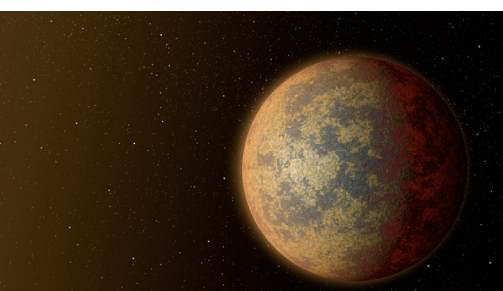
AN EXCEPTIONAL PLANETARY SYSTEM DISCOVERED IN CASSIOPEIA BY ASTRONOMERS OF UNIGE

THE CLOSEST TRANSITING ROCKY PLANET

Astronomers from the University of Geneva (UNIGE) and members of the NCCR PlanetS have teased out a secret planetary system hiding in the arms of Cassiopeia, just 21 light years away from us. The remarkable system, named HD219134, hosts one outer giant planet and three inner super-Earths, one of which transits in front of the star. The transiting super-Earth has a density similar to the Earth's. It is by far the closest transiting planet known today. It provides the ideal candidate for follow-up studies and a deeper understanding of planetary formation, internal composition, and atmospheres. The system is so close that astronomers already dream about taking pictures of the new "Stars".

HARPS-N, the northern twin sister of the famous planet hunter HARPS, designed and built by an international consortium led by researchers at the Geneva University and installed at the *Telescopio Nazionale Galileo* on the La Palma island, just unveiled an exceptional planetary system around HD219134. The star, a 5th magnitude K dwarf, slightly colder and less massive than our Sun, is so bright that we can follow her with a naked eye with a naked eye from dark skies, next to one leg of the W-shape Cassiopeia constellation, all year round in our boreal hemisphere. The cortege of planets is composed of three mostly rocky super-Earths and an outer giant planet, a configuration reminiscent of our own Solar System.

A super-Earth with terrestrial density revealed by Spitzer observations
"When the first HARPS-N radial-velocity measurements indicated the presence of a 3-day planet around HD219134, we immediately asked NASA for Spitzer space telescope time" explains a smiling Ati Motalebi, astronomer at UNIGE and first author of the paper describing the discovery to appear in one of the coming issues of the *Astronomy & Astrophysics* journal. "The idea was to check for a potential transit of the planet in front of the star, a mini eclipse, that would allow us to measure the size of the planet," she continues, "to do this, we needed to go to space to reach the required precision". Fortune favours the brave; HD219134b does indeed transit the star. It is by far the closest transiting planet known, and likely to remain one of the closest ever. The mass of the planet obtained from the ground-based radial velocities, combined with the planet radius derived from space observations with Spitzer, yield the mean density of the planet. HD219134b is a 4.5 times more massive than the Earth and 1.6 times larger, what planet hunters call a super-Earth. Its mean density is close to the density of the Earth, suggesting a possibly similar composition as well.



Hot, Rocky World

This artist's rendition shows one possible appearance for the planet HD 219134b, the nearest rocky exoplanet found to date outside our solar system. The planet is 1.6 times the size of Earth, and whips around its star in just three days. Scientists predict that the scorching-hot planet -- known to be rocky through measurements of its mass and size -- would have a rocky, partially molten surface with geological activity, including possibly volcanoes.

Image credit: NASA/JPL-Caltech

Two additional super-Earths and a giant planet

But, there is more! The team discovered three additional longer-period planets in the system from the HARPS-N radial velocities. In the inner regions, a planet weighing 2.7 times the Earth orbits HD219134 in 6.8 days,

and a planet of 8.7 times the mass of the Earth resides on a 46.8-day orbit. If, by chance, these 2 planets would be in a coplanar configuration with their 3rd inner sister, as often observed for compact systems, the whole family might be transiting. Motivated by this exciting perspective, future observations to capture the potential transits have already been organized. “In particular, the future CHEOPS satellite of the European Space Agency (ESA), developed under Swiss leadership with a strong involvement of UNIGE and of the University of Bern, will provide the perfect tool for such observations” comments with enthusiasm Prof Stéphane Udry from the Geneva University, who is further adding that “being able to characterise three transiting super-Earths in a single bright and close system would provide incomparable constraints for planet formation and composition models, in particular for super-Earths”. The story does not stop here, yet. The system includes as well a giant planet (of small-Saturn type) at 2.1 astronomical units, orbiting the star in a bit more than 3 years.

This system, reminiscent of our own Solar System with the inner “small” planets and the outer gaseous one, will without doubt encounter a growing interest from the astronomical community. Indeed, the proximity and brightness of the star makes the system the most favourable one for an in-depth characterisation of the planet physical properties. For atmospheric studies, astronomers are already planning observations with ground-based high-resolution spectrographs and the future NASA-ESA James Webb Space telescope (JWST) using transmission spectroscopy techniques; during the transit the light of the star crosses the atmosphere of the planet on its way to the observer, carrying over the spectral signature of the chemical species present in the atmosphere. They even dream about direct imaging of the outer planet in the system with the new generation of giant telescopes on the ground, the Extremely Large Telescopes, planned for the next decade.

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