Sapphires and Rubies in the Sky

Researchers at the Universities of Zurich and Cambridge have discovered a new, exotic class of planets outside our solar system. These so-called super-Earths were formed at high temperatures close to their host star and contain high quantities of calcium, aluminium and their oxides - including sapphire and ruby.

Barbara Vonarburg

21 light years away from us in the constellation Cassiopeia, there is a planet five times more massive than Earth: HD219134 b. Unlike the Earth however, this “super-Earth” does most likely not have a massive core of iron, but is rich in calcium and aluminium. "Perhaps it shimmers red to blue like rubies and sapphires, because these gemstones are common on the exoplanet," says Caroline Dorn, astrophysicist at the Institute for Computational Science of the University of Zurich. HD219134 b is one of three candidates likely to belong to a new, exotic class of exoplanets, as Caroline Dorn and her colleagues at the Universities of Zurich and Cambridge now report in the British journal MNRAS.

The researchers study the formation of planets using theoretical models and compare their results with data from observations. It is known that during their formation, stars such as the Sun were surrounded by a disc of gas and dust in which planets were born. Rocky planets like the Earth were formed out of the solid bodies leftover of proto-planetary gas discs. "Normally, these planet building blocks form in regions where rock-forming elements such as iron, magnesium and silicon have condensed," explains Dorn who is associated to the NCCR PlanetS. The resulting planets have an Earth-like composition with an iron core, like most of the known super-Earths.

The composition of super-Earths is more diverse than expected

But there are also regions close to the star where it is much hotter. "There, many elements are still in the gas phase and the planetary building blocks have a completely different composition," says the astrophysicist. With their models, the research team calculated the resulting planet composition: calcium and aluminium are main constituents alongside magnesium and silicon, and there is hardly any iron. "This is why such planets cannot, for example, have a magnetic field like the Earth," says Dorn. And because the inner structure is so different, their cooling behavior and atmospheres will also differ from those of normal super-Earths. The team therefore speak of a new, exotic class of super-Earths formed from high-temperature condensates.

The authors identify three candidates that belong to this new class of super-Earths with an exotic composition. The researchers are also correcting an earlier image of super-Earth 55 Cancri e, which had made headlines in 2012 as the "diamond in the sky". Researchers had previously assumed that the planet consisted largely of carbon, but had to abandon this theory on the basis of subsequent observations. "We are turning the supposed diamond planet into a sapphire planet," laughs Dorn.

Reference:

Illustration of one of the exotic super-Earth candidates, 55 Cnc e, that are rich in sapphires and rubies and might shimmer in blue and red colors. Illustration: Thibaut Roger