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Press Release

Rich exoplanet harvest for CoRoT

Today, the CoRoT team announces the discovery of 6 new planets with diverse characteristics and one brown dwarf.

CoRoT[1], a space telescope operated by the French space agency CNES[2], discovers exoplanets when they pass in front of their stars, via the so-called transit method. Once CoRoT detects a transit, additional observations are made from the ground, using a number of facilities all over the world. Although astronomers cannot see the planets directly, they can use space- and ground-based data to measure indirectly the sizes, masses, and orbits of these new planets very precisely. This is is only possible for transiting planets, which is why, among all known exoplanets, these yield the most complete information about planetary structure, and also the formation and evolution of these new worlds.

« *Every discovery of an extrasolar planetary system is a new piece in the puzzle of how these systems form and evolve. The more systems we uncover, the better we can hope to understand the processes at play* », says Magali Deleuil, researcher at the Laboratoire d'Astrophysique de Marseille (LAM) and head of the CoRoT exoplanet program.

The six newly discovered extrasolar planets discovered vary in size, mass, orbit shape and various other properties:

CoRoT-8b: the smallest in this batch

At about 70% of the size and mass of Saturn, CoRoT-8b is moderately small among the previously known transiting exoplanets. Its internal structure should be similar to that of icy giant planets, like Uranus and Neptune in the Solar System. It is the second smallest exoplanet discovered by the CoRoT team so far after CoRoT-7b, the first transiting Super-Earth.

CoRoT-10b[3]: the eccentric giant

CoRoT-10b is one of the very few transiting planets with a substantially elongated orbit that brings the planet very close to its host star. The large variation in the orbital distance results in a tenfold increase in the amount of stellar radiation received by the planet. Scientists estimate that the surface temperature of the planet may increase from 250 to 600°C, in a mere 13 days (the length of the year on CoRoT-10b).

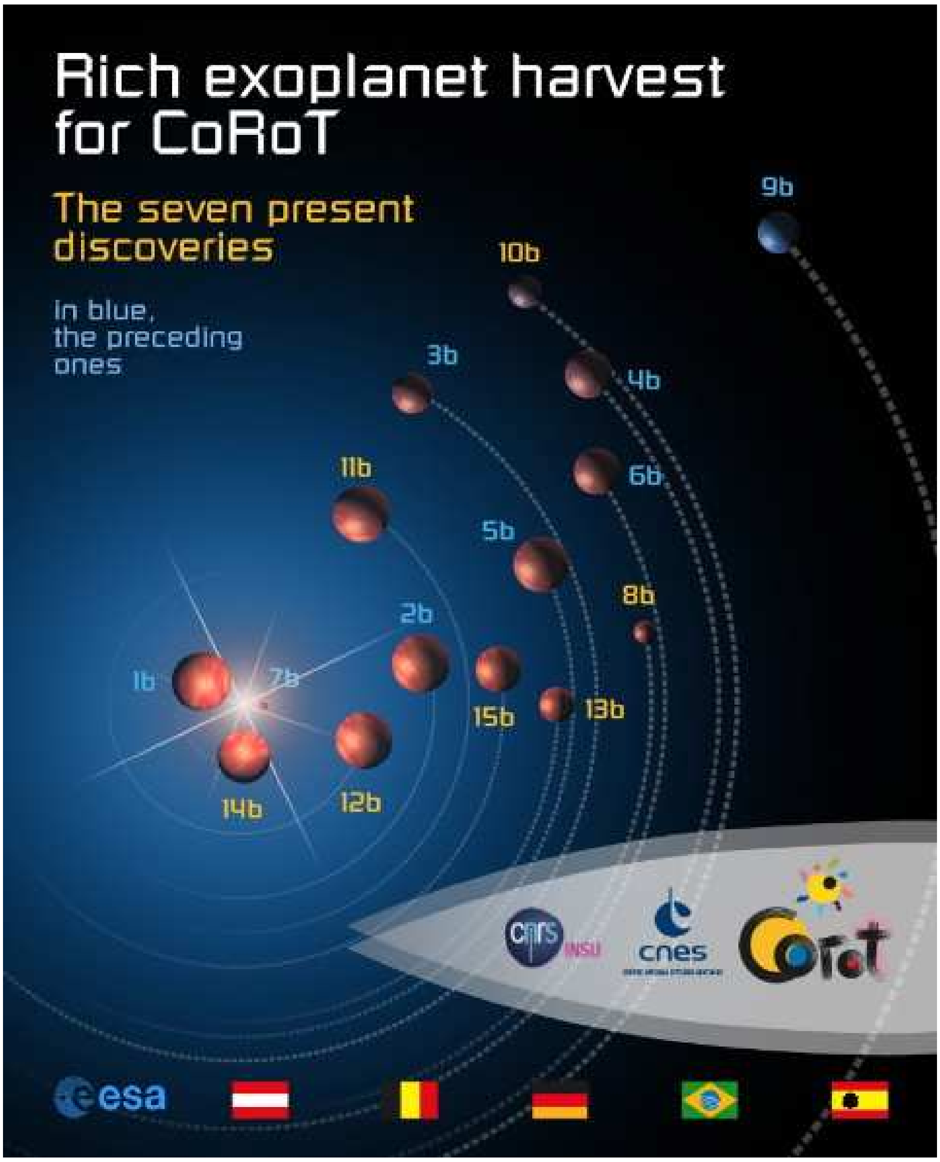
[1] The CoRoT satellite has been developed and is exploited by CNES with a significant participation from Austria, Belgium, the European Space Agency (ESA), Germany, Spain, and Brazil.
[2] CNES stands for Centre National d'Etudes Spatiales.
[3] CoRoT-9b, a giant planet with an orbital period of 95 days, is not included in this press release as its discovery was announced earlier this year and published in the Journal Nature.

CoRoT-11b: the planet whose star does the twist
CoRoT-11, the host star of CoRoT-11b, rotates rapidly around its axis, completing one rotation every 40 hours. By comparison, the Sun's rotation period is 26 days. It is particularly difficult to confirm planets around rapidly rotating stars, so this detection marks a significant achievement for the CoRoT team.

CoRoT-12b, 13b and 14b: a trio of giants
These three planets, all orbit close to their host star, but have very different properties. CoRoT-13b is smaller in size than Jupiter, and therefore twice as dense. This suggests the presence of a massive rocky core inside the planet. With a radius that is 16 times larger than the Earth, CoRoT-12b belongs to the family of `bloated hot Jupiters', whose anomalously large sizes are probably due to intense stellar radiation they receive. Amazingly, CoRoT-14b, which is even closer to its parent star, has a size similar to Jupiter's. Its mass, however, is 7.5 times the mass of Jupiter making the planet 6 times denser. Such a combination, very massive and very hot, is rare and CoRoT-14b is only the second planet of this type discovered so far.

CoRoT-15b: the brown dwarf
CoRoT-15b's mass is about 60 times that of Jupiter. This makes it incredibly dense, about 40 times more than that of Jupiter. For that reason, it is classified as a brown dwarf Intermediate in nature between planets and stars, brown dwarfs are much rarer than planets, which makes this discovery all the more exciting. This discovery will help astronomers understand the nature of brown dwarfs and their relationship to planets.

CoRoT detects planets by searching for transits **(see box 1 below)**, minute periodic dimming of a star which occur when a planet in orbit around it crosses the stellar disk. This is a complex and time-consuming endeavour, which requires follow-up observations from the ground **(see box 2)**, but it has the unique advantage of yielding both the size and the mass of the planet, and thus its mean density. This gives astronomers information about the type of planet – whether it is a gaseous giant like Jupiter, a terrestrial planet like Earth, or something in between like Neptune. Together with the orbital characteristics, which can be particularly well determined for transiting planets, these provide key parameters for understanding how different kinds of planets form and evolve. In the last fifteen years, astronomers have discovered over 450 exoplanets, of which only 82 transit across their host star. CoRoT has spotted 15 in three full years of operation



Family portrait of the first 15 CoRoT planets – credit: Patrice Amoyel

(1) Detecting planets with CoRoT: a meticulous analysis

Since February 2007, the CoRoT space telescope observes about 80,000 stars per year. The brightness of each star as a function of time, or its « light curve » in astronomical jargon, is recorded for 20 to 150 days. An international team of scientists from 9 European institutions searches these light curves for periodic micro-eclipses (or transits) which may be cause by the passage of planets in front of their stars: « We have chosen to work in parallel, analyzing the full data set independently. By using different methods at the same time, we increase the number of discoveries. », says Pascal Bordé of the Institut d'Astrophysique Spatiale (IAS) in Orsay. Every year, the team identifies about a thousand light curves featuring transit-like events, of which about a hundred fulfil all the conditions for being good planetary candidates. But this far from the end of the story...

(2) Key support from ground-based telescopes

Many configurations, in particular combinations of two or more stars (as illustrated below), can mimic the transit of a planet. The CoRoT team can only claim a detection of a planet when all other scenarios have been rejected: « People usually don't realize that between the detection of a transit by CoRoT and the official announcement of a new planet there is an intense campaign of follow-up observations that may take as long as two full years! » explains Claire Moutou, also from LAM, who is in charge of coordinating the follow-up program. CoRoT planet hunters must thus scrutinize from the ground about a hundred potential planet-bearing stars per year. About fifteen telescopes all over the world are used for this task. First, the team must check which star is being eclipsed, as more than one star usually contributes to a single brightness measurement by CoRoT, by re-observing the transit from the ground with larger telescope than CoRoT. Then, they must demonstrate that the transiting body is a genuine planet and not a star, by measuring the mass of the unseen object. Finally, they must determine precisely what kind of star the planet is orbiting, which is done by obtaining a high-quality stellar spectrum.

The various configurations that produce a transit event. The target can be transited by a planet but also by another star. More tricky is the case where the transits are produced by a nearby eclipsing binary - credit: Claire Moutou / Magali Deleuil

Number of ground-based telescopes support CoRoT observations and contribute to the characterization of planets: the Canada France Hawaii Telescope (INSU-CNRS, CNRC, U. Hawaii), the IAC80 and the ESA-OGS of Teide Observatory, Spain, the 1,2m telescope at Observatoire Haute Provence, France. the Swiss Euler 1.2m telescope in Chile, the 0.46 and 1m Wise Observatory, Israel, the TEST telescope of the Thuringia State Observatory, Germany, the BEST and BEST2 telescopes of the Deutsche Luft und Raumfahrt Gesellschaft (DLR), the HARPS spectrograph on the 3.6 m telescope (ESO/Chile), the ESO's 8.2-m Very Large Telescopes at Paranal Observatory in Chile, the HIRES spectrograph (under NASA Keck time) on the 10m KECK telescope at Hawaii, USA and the SOPHIE spectrograph, on the 1.93m telescope at Haute Provence Observatory in France

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